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# IMPLICATION OF BIOFUELS PRODUCTION ON FOOD SECURITY IN TANZANIA







**actionaid**

# **IMPLICATION OF BIOFUELS PRODUCTION ON FOOD SECURITY IN TANZANIA**

Research Report

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**ABBREVIATIONS**

BRELA	Business Registration and Licensing Agency
BSC	Biofuels Steering Committee
CAMARTEC	Centre for Agricultural Mechanization and Rural Technology
CFC	Common Fund for Commodities
CPR	Common Pool Resource
DAEE	Department of Agricultural Education and Extension
DALDO	District Agricultural and Development Officer
DANIDA	Danish International Development Agency
DED	District Executive Director
DSI	Development Studies Institute
EIA	Environmental Impact Assessment
EU	European Union
EWURA	Energy and Water Utilities Regulation Authority
EZCORE	Eastern Zone Client Oriented Research and Extension
FAO	Food and Agriculture Organization
FGD	Focus Group Discussion
GBEP	Global Bioenergy Partnership
GDP	Gross Domestic Product
GHG	Greenhouse gas
IEA	International Energy Agency
IIED	International Institute of Environment and Development
ILO	International Labour Organization
KAKUTE	Kampuni ya Kusambaza Teknolojia
LGA	Local Government Authority
MAFC	Ministry of Agriculture, Food Security and Cooperatives
MEM	Ministry of Energy and Mining
MITM	Ministry of Industries, Trade and Marketing
MJCA	Ministry of Justice and Constitutional Affairs
MLHHS	Ministry of Lands, Housing and Human Settlement Development
MNRT	Ministry of Natural Resources and Tourism
MoFEA	Ministry of Finance and Economic Affairs
MoWI	Ministry of Water and Irrigation
NAEP	National Agricultural Extension Programme
NALERP	National Agricultural and Livestock Extension and Research Programme
NBTF	National Biofuels Task Force
NEMC	National Environment Management Council

NGO	Non-Governmental Organization
OECD	Organization for Economic Co-operation and Development
PMO-RALG	Prime Ministers' Office Regional Administration and Local Government
R&D	Research and Development
SBT	Sugar Board of Tanzania
SEKAB	Svensk Etanol kemi AB
SPFS	Special Programme for Food Support
SUA	Sokoine University of Agriculture
TANESCO	Tanzania Electric Supply Company Ltd.
TaTEDO	Tanzania Traditional Energy Development and Environment Organization
TAOMC	Tanzania Association of Oil Marketing Companies
TARP II	Tanzania Agriculture Research Programme II
TBS	Tanzania Bureau of Standards
TIC	Tanzania Investment Centre
TIRDO	Tanzania Industrial Research Development Organization
TPDC	Tanzania Petroleum Development Corporation
TRA	Tanzania Revenue Authority
Tshs.	Tanzanian Shilling
UK	United Kingdom
UN	United Nations
UNDP	United Nations Development Programme
UNEP	United Nations Environmental Programme
UNICEF	United Nations Children's and Education Funds
URT	United Republic of Tanzania
USA	United States of America
USDA	United States Department of Agriculture
VAT	Value Added Tax
WWF	World Wildlife Foundation

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## EXECUTIVE SUMMARY

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This study examines the impact of production of biofuels on food security, socio-economy and the environment in six districts of Tanzania namely Rufiji, Kisarawe, Bagamoyo, Lindi, Kilwa and Arusha. The findings are later considered in the context of the whole country. Specifically, this study identifies companies or investors engaged in the production of biofuels in Tanzania; presents a critical review of the national guidelines for sustainable development of liquid biofuels and co-generation in Tanzania; identifies policies through which the government is pushing the production of biofuels in the country; and finally draws some policy recommendations for a sustainable production of biofuels in Tanzania.

To address these objectives, the study conducted extensive desk research aimed at understanding the global and national context of production of biofuels, followed by field research that involved holding focus group discussions with the smallholder farmers, key informants interviews with the District Agricultural and Livestock Development Officers (DALDO), District Community Development Officers, District Natural Resource Officers, District Land Officers in six district councils namely Rufiji, Kisarawe, Bagamoyo, Lindi rural, Kilwa, Arusha Municipal and Meru. Furthermore, executive interviews were also held with the District Executive Directors in the mentioned districts, Coordinator for Biofuels Crops in the Ministry of Agriculture Food Security and Cooperatives, and Management in the following companies: BioShape Tanzania Ltd., Diligent Tanzania Ltd. and Kampuni ya Kusambaza Tekinolojia (KAKUTE).

The findings indicate that the biofuels industry in Tanzania is still at infancy stage. Most biofuels projects started in 2006, a year after the study on liquid biofuels for transportation in Tanzania had been done, a study funded by the GTZ. This study opened up doors for investors to invest in the sector. The government of Tanzania is on the forefront encouraging the production of biofuels. However, there is no policy and regulatory framework to guide investment decisions on such production in the country. Only recently the government has formed the National Biofuels Task Force (NBTF) chaired by the Ministry of Energy and Minerals, to steer a process of formulating biofuels guidelines as a short-term solution while waiting for the process to formulate a national policy for the same. The NBTF in November 2008 released draft guidelines for sustainable development of liquid biofuels and co-generation in Tanzania, which are still subject to discussion to solicit more inputs from various stakeholders.

In the absence of a biofuels policy, the government borrowed some clauses from various national policies to make decisions on biofuels investments. The identified policies includes: National Energy Policy (2003), National Environmental Policy (1997), Agricultural Policy (1997), Forestry Policy (1998), Wildlife Policy (1998) and Land Policy (1999). Examining these policies it is evident that there are some clauses promoting utilization of sustainable or renewable energy but they are not specific to biofuels. In addition, these policies contain

some general statements without any action plan or explicit priorities pointing towards national energy priorities. These policies do not specify any institution or agency to be charged with the responsibility to coordinate biofuels development activities. Lack of specific policy, priorities, institutional and regulatory framework for implementation has contributed to the *ad hoc* investment processes in the biofuels sector, in the country.

In view of the above, it was necessary to critically examine the draft guidelines for sustainable development of liquid biofuels and co-generation in Tanzania to ascertain the extent to which food crop production is ensured and not jeopardized as a result of the production of biofuels. The focus of the review was on institutional framework and sustainability criteria. Regarding the institutional framework, the findings show that the guidelines propose several actors such as sector ministries (i.e. MoFEA, MAFC, MJCA, MNRT, MITM, MLHSD, MoWI, PMO-RALG), supporting government agencies and bodies (i.e. TIC and BSC), biofuels investors/developers, farmers/processor associations, regulatory institutions (i.e. EWURA, BRELA, NEMC, TBS, TRA, and SBT), outgrowers, small scale producers of biofuels, energy related institutions (Universities, TANESCO, TPDC, TAOMC) and consumers. These actors are expected to facilitate the implementation of the proposed guidelines once approved. Looking at the composition of the team it is apparently reflecting the diverse nature of the biofuels industry but mainly with two categories of stakeholders namely government and business institutions. The government has its own interests in the sector and the business institutions are likely to be driven by the profit gains rather than sustainability issues. In this regard, it would be wise to include civil society organizations engaged in issues directly related to the production of biofuels, to play a watch dog role. This will act like a control mechanism for interested parties, to avoid conflicts of interest when making investment decisions.

The land acquisition process was examined and it was noted that most investors, both foreign and local, follow a formal procedure to acquire land. However, there are evident challenges and controversies surrounding the whole process especially when foreign investors are involved directly to negotiate land acquisition with the local communities. In view of this, the local communities have no capacity to negotiate land issues in the absence of land experts or professional assistance. But looking at the guidelines they address this problem by giving mandate to the biofuel one-stop-centre to guide village authorities in the whole process once the Biofuel Steering Committee has approved the land in a given area. The draft guidelines further recognize the importance of small-scale farmers and direct clearly the land acquisition procedure for this category, which is through the National Land Act of 1999 and Village Land Act of 1999. In view of the legal framework for the land allocation and recognition of property rights in Tanzania, smallholder farmers, both females and males, have equal rights to access and own land, which is a prime production resource. This procedure gives opportunity for women farmers to access and own land especially from communities where women are disadvantaged with regard to land ownership.

It was further noted that the government is in the forefront in promoting the production of biofuels as a strategy to reduce greenhouse gas emissions in the light of climate change, diversification of energy sources, creation of employment, improvement of energy security, saving of foreign exchange equal to the value of import substitution, creation of market for agricultural energy crops and enhancing rural development. Cognizant of the envisaged benefits, it is unlikely that these benefits would be realized if the existing pattern of investments in the biofuels sector remains the same. The diversification of energy sources, improvement of energy security and saving of foreign exchange equal to the value of import substitution will only be possible if the biofuels produced and generated in the country are used for local consumption and the surplus exported to generate foreign currency. This is possible if there is good supporting infrastructure for smallholder farmers to grow agro-energy crops and process them using local processing plants something that is still missing in the country. Thus, if smallholder farmers were well organized and supported by the market facilities, such facilities would likely create more employment opportunities in the chain of production, improve income and enhance rural development. The support for smallholder farmers should be in terms of accessibility to soft loans, tax incentives, and subsidies to make them competitive and support them with the processing plants in few rural centres in potential areas. It is worth noting that, reliance on foreign companies will never help Tanzania to meet these objectives, because all foreign companies visited during the research indicated that their biofuels are set for export to meet their national targets, and worse still other companies for example BioShape Tanzania Ltd. are planning to export raw biofuels feedstock (jatropha seeds) without any value addition. Consequently, these undertakings would limit employment opportunities along the chain of value addition. In so doing, the government would also be denied of higher export gains and untapped technical skills and technology transfer.

## **Main observations**

### **Employment created by companies**

The drivers for the production of biofuels in Tanzania include the need to create new employment opportunities in rural areas, thus leading to increased incomes for enhanced rural development. According to the Integrated Labour Force Survey of 2006, the unemployment rate stands at 11 percent of which 1 million are males and 1.3 million are females. Based on the current level of investment in the pipeline, the biofuels industry has the potential to create 58,359 new jobs in different parts of the country, which is about 2.5 percent of the total unemployment rate. While biofuels companies were seen to create high expectation for job creation, in reality they create more jobs for casual/seasonal workers who are not covered by social security and medical assistance. The proportion of projected jobs coupled with the nature of employment (seasonal labour) meant for the majority, the loss of land and other common pool resources foregone by the communities may not be

justifiable. Additionally, this study revealed that although the companies' management is aware of health and safety regulations, some companies do not provide full protective gear to workers especially those who work with agrochemicals. This is contravening occupational safety and health regulations, which require employers to safeguard the health and welfare of their employees.

Looking at the advancement of technology and the level of agro-mechanization that is taking place in the study area, it is likely that most biofuels activities will be mechanized in the near future and it is unlikely that more jobs will be created by the companies even if these industries are to expand beyond their current level; moreover, most employment targets by these companies may not be attained. If this happens, it is going to be very disappointing to the communities who will have offered their land in anticipation of gaining employment opportunities.

## Impact on land

The study found that biofuels initiatives in Tanzania are largely characterized by acquisition of large tracts of land by the investors. More than 40 foreign companies showed interest in acquiring land for biofuel feedstock cultivation in Tanzania. Currently, about 435,839.6 hectares of land have been earmarked for biofuels, mainly along the coastal regions of Tanzania. Rufiji basin is one of the potential areas for the production of food crops in the country, with 60 percent of the land suitable for irrigation. According to a feasibility study done by NORAD in 1980's, if the entire basin was used for Agriculture then, it had a potential to produce enough food crops to feed Tanzania and the rest of Africa. With the advancement of agro-technology since 1980's to date, this statistics is still valid today. Therefore, the current move to allocate such prime land for the production of biofuels has negative implications on food security. Nevertheless, it was established that the earmarked hectares of land are currently covered by dense natural vegetation or biomass that will soon be cleared for biofuels plantations. Examples of such areas include virgin natural forests in Rujiji, Kisarawe, Bagamoyo and Kilwa Districts that have already been identified for biofuels plantations and where several foreign and local companies have started initial trials on production of biofuels. Removal of dense natural vegetation cover would in turn expose the land to agents of erosion and makes it more vulnerable to degradation. Land degradation is also associated with direct loss of biodiversity. Although investments in biofuels are claimed to create new employments, it is unlikely that the benefits to be accrued from these investments will outweigh the associated negative impacts.

Another pertinent finding is that while it is being politically advocated that feedstock will be grown on marginal lands, in reality this is not reflected on the ground because most prime arable areas along the coastal regions are being targeted for the production of biofuels. For instance, Rufiji Basin is in the process of being offered to SEKAB Tanzania Ltd. for

sugarcane production. In Kisarawe District, SunBiofuel Tanzania Ltd. has acquired 9,000 hectares of land from six surrounding villages which is virtually arable land, while BioShape Tanzania Ltd. is waiting for approval of 34,000 hectares of land from four villages in Kilwa District. The latter is basically virgin miombo woodland that could otherwise be converted to arable land. It is further estimated that about 100,000 hectares of land will be developed for biofuel feedstocks production by 2015 in Kilwa District alone, by the same company. All the targeted land is potential for food crop production. Therefore, it all boils to the fact that although the interested companies in biofuels investment claim to make use of what would have otherwise been large 'idle' or 'marginal' and 'underutilized' lands, in practice such lands do not exist. The truth is such areas are being targeted because they are endowed with adequate and reliable rainfall, fertile soils, and relatively well developed infrastructure such as roads, railways and port facilities in favour of export as opposed to the arid and semi-arid areas in the country.

The study also found that the land acquiring process for biofuels investment has already displaced 152 villagers in Kisarawe District, 13 in Kilwa Districts at Mavuji Village and 10 in Lindi District at Nyengedi village. Compensation for the lost land and crops has been effected by the SunBiofuel and BioShape companies to all affected people. In Lindi District only four people have accepted compensation from BioMassive Tanzania Ltd. while the other six have declined the offer for the reason that the amount is uneconomical. The land use changes associated with the establishment of biofuels plantations especially in Kilwa District have negatively affected the surrounding communities in various ways such as loss of building poles, areas for charcoal making, timber, traditional medicines and biodiversity, due to massive land clearing. Similar effects can be predicted in other districts where cultivation has not started. For instance, firewood and charcoal are dominant energy sources by most Tanzanian rural communities, accounting for more than 98 percent of the household energy consumption because people lack alternative energy sources such as electricity. In view of this, the expected massive land clearing will put the livelihood of the rural communities at stake. Thus, the irresistible dependency of rural communities on common pool resources coupled with massive clearing of vegetation is expected to greatly contribute to severe land degradation. The study revealed that the communities are benefiting in many ways from such lands, e.g. grazing, charcoal, timber, traditional medicines and building poles. Given the current demand of biofuels, all these ecologically important plant communities are to be cleared to give way to biofuels plantations, a situation which will limit the availability and accessibility of communities to these common pool resources, including land itself.

### **Impact on water resources**

Large scale production of biofuels and processing will increase withdrawal of large volumes of water from both surface and underground water resources. Likewise, although jatropha

is claimed to grow on marginal lands with little rainfall requirements, the experience in Mavuji Village in Kilwa District tells that large plantations (economies of scale) will compel investors to seek to grow jatropha on fertile land and even apply irrigation. Establishing biofuel crops in the earmarked areas would create pressure on water resources. It has been pointed out in this report that jatropha and sugarcane are major crops being promoted for liquid production of biofuels in the country. While it is claimed that jatropha is being promoted as a crop of marginal areas due to its ability to withstand drought, the study revealed that the area requested for jatropha plantations represent the most fertile lands suitable for food crop production in the country. It is unimaginable that most land in the coastal regions is favoured by biofuels investors on the pretext that they are marginal lands. Furthermore, sugarcane is known for its enormous water requirements. Hence, its introduction in the earmarked areas, in large scale, would significantly increase pressure on the available water sources and threaten their future ability to supply water sustainably. Massive clearing of vegetation is likely to expose these water resources (both surface and underground), which will eventually dry up. This is due to the fact that, water sources are better conserved in situ. The scarcity of water would impact more on the lives of people, most so, on women and children who are drawers of water in the rural settings.

### **Impact on food security**

Tanzania like many other countries with potential to produce biofuels, is food insecure. Unplanned increase of the production of biofuels will result into negative implications on food security since vital food crops will be diverted to the biofuels sector. Crops like sugarcane, palm oil, sweet sorghum and sunflower, which are currently earmarked for biofuels feedstock in Tanzania, are directly linked to food security. According to the Ministry of Agriculture, companies like Tanzania BioDiesel Ltd., African Green Oil Ltd. and Clean Power Tanzania Ltd. are targeting palm oil. Other companies and their targeted feedstock in brackets are CMC Agric-Bioenergy Tanzania (white sorghum), Abengoa Bioenergy Company (sweet sorghum), SEKAB Tanzania Ltd. (sugarcane) and SAVANA Biofuels Ltd. (sunflower), all intended for the production of biofuels. Promoting such crops for biofuels poses a great threat to food security not only in terms of use but also in terms of land (space), agricultural inputs, water and labour resources involved in production process, etc. While supporters of biofuels have been pushing for non-food feedstocks such as jatropha to be grown for biofuels feedstock and grown on marginal land, in reality this has not been the case. During the study, it was discovered that jatropha and sugarcane had been allocated to prime lands in Kisarawe, Rufiji, and Kilwa Districts where companies such as SunBiofuels, SEKAB and BioShape, are operating. The competing use of biofuels feedstocks and food is likely to increase food prices and consequently impact on women who are responsible for food security issues at the household level.

## Social impact of biofuel production

Currently, there are large and small-scale investors of biofuel production in Tanzania. During the discussion with different stakeholders it was felt that small-scale investors in the production of biofuels offer greater opportunities for employment generation and poverty alleviation if well supported than large-scale investors who are involved in production and processing of biofuels. This is due to the long production chain involved in the production and processing of the products. The large-scale plantation of biofuels involves conversion of large areas into energy crop plantations as revealed in the study area, especially in Rufiji (SEKAB), Kisarawe (SunBiofuel) and Kilwa (BioShape). The idea of acquiring land for biofuel crops, especially for large scale plantations, leads to landlessness, deprivation and social disruption for displaced small scale farmers. As far as outgrowers schemes are concerned, it was also felt that the majority of people may shift from cultivating food crops to producing biofuel crops, whose markets are readily available. Although during the study it may not have been considered such a big problem, in the near future this problem will become reality because the majority of small scale farmers indicated they would be willing to engage in the production of biofuels if they were paid well. If this happens, it will create food shortage which is likely to affect mainly the poor, who are net importers of food.

## LESSONS LEARNED

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- The bulk of global production of biofuels is still consumed domestically in developed countries like EU, Japan and USA. However, with mandatory blending, these countries expect to increase consumption of biofuels that will not match geographically with the scaling up of production. The expected mismatch between demand and supply presents export opportunities for low cost producers.
- Tanzania has a huge potential of the production of biofuels if well managed especially if it involves smallholder farmers. This may contribute to create new employment and sustainable source of income in rural areas and enhance energy security. These benefits all together address concerns of rural women in Tanzania who are the majority, and who are involved in collecting firewood as a major source of energy, and practising subsistence farming that has not helped much for decades to improve their livelihoods.
- The foreign large scale plantations of biofuels in Tanzania may not be a suitable mode of production under existing policy environment, since it involves taking up a large piece of land that may create big pressure on land in the near future that lead into social conflicts as the population grows. Similarly, these companies may not be able to address the problem of energy security and foreign currency saving since most of these are foreign and export- oriented.
- While there are many reasons for Tanzania to engage in the production of biofuels, the conceptual initiatives, technological base and investment capital are externally driven. At present the biofuel industry is dominated by the developed countries that may not necessarily be motivated by consideration of compassion but driven by self-interest and profit gains. In the absence of a policy and regulatory framework, Tanzania may not be able to benefit from the sub-sector as expected.
- The guidelines are not enforceable by law and therefore will not address the need to bind investors to conditions that will ensure smallholder farmers and the nation as a whole benefit from the biofuel industry. In light of this, the government should see the urgent need to formulate a policy and regulatory framework before the nation loses its bargain during the interim period.

## Conclusion

The global policy goals that have driven the production of biofuels in the world can be used to explain the current shift to the production of biofuels in Tanzania. Primarily, Tanzania has been motivated by concerns over an unprecedented increase in price of fossil fuel and

hence the need to reduce import bills, save foreign currency equal to the value of imports substituted, mitigate the problem of climate change through reduction of greenhouse gases, create employment, ensure markets for agricultural energy crops and diversify rural economy. In this regard, the government is in the forefront promoting investment in biofuels and over forty companies have indicated interest and are in different stages of the investment process. While this is happening, there is no policy governing investment decisions, a situation that has contributed to *ad hoc* investment.

In the absence of a biofuel policy, the government was caught in a situation where it had to borrow some clauses from other policies to guide investment decisions. However, these policies were formulated for other purposes, and so for this reason they are not adequate to stand for biofuels due to its complexity. The government has realized this fact and formed a National Biofuel Task Force mandated to formulate a regulatory and institutional framework to regulate and provide incentives for development and growth of the biofuel industry in Tanzania. The NBTf has released a draft of the guidelines for sustainable development of liquid biofuels and co-generation in Tanzania, which is open for discussion by various stakeholders. In view of the draft guidelines, this study is in the opinion that it is not enforceable by law and therefore will not address the need to bind investors to conditions that ensure smallholder farmers and the national as whole to benefit from the biofuel industry. This calls for urgent action from government to formulate a biofuel policy before investors take advantage of the situation.

Despite the absence of a regulatory and institutional framework to govern investment in biofuels, Tanzania has huge potential for biofuel production. It is endowed with diverse climatic conditions that can support growth of various biofuels feedstocks, adequate marginal land of about 39 million hectares that can be converted to biofuel production with minimal competition with food crops, abundant labour force and a gateway for export through its three harbours (i.e. Dar es Salaam, Tanga and Mtwara) along Indian Ocean. While these potentials are there, the sustainability of the biofuel sub-sector will depend much on the selection of feedstock adaptable to marginal land and the mode of production fit to address national objectives such as to guarantee energy security, reduce import bills and foreign currency savings, create employment, diversify rural economy and mitigate climate change. However, mismanagement of the sub-sector may cause several unforeseen social, environmental and food security impacts.

Regarding the types of biofuel feedstocks in Tanzania, companies have chosen various types, i.e. palm oil, sunflower, sugarcane, white sorghum, and jatropha. While jatropha is reported to perform well on marginal land and one would expect it to be grown on such land, in practice this study found that investors are targeting arable land. This poses serious competition to food crops in terms of production resources such as land, labour, water and agro-inputs. Similarly, palm oil, sunflower, sugarcane and white sorghum, adopted

by other companies are used for food; changing use of these crops to energy sources will push prices up for these crops and have similar implication on food security. The problem is expected to be even more serious for poor resourced women who take care of their households.

With regard to the mode of production, this study identifies two dominant modes of production namely large scale plantations and smallholder farmers or contract farmers who supply their feedstock to developers at low price, which does not benefit such farmers much to improve their livelihood. A similar trend is expected as the biofuel industry expands. Large scale plantations will expand into areas rich in biodiversity and fertile lands; this will create pressure on food security and significant loss of biodiversity. Another registered concern is that large scale plantations may not address the national objectives of biofuel production since most of them are foreign companies motivated by self-interest and profit gains. If Tanzania is to achieve its objectives there is a need to promote and support local small-scale farmers to produce biofuels feedstocks and process them to add value so that they can fetch better market prices. The focus should be to select biofuel feedstocks suited to marginal lands (i.e. jatropha), and which will not compete directly with food crops. By supporting local small-scale farmers there are several advantages:

- Land conflicts are going to be reduced because smallholder farmers will be growing such crops on their own land.
- By adopting jatropha as a biofuels feedstock does not compete directly with food crops because it is a non-edible oil seed and grows well on marginal land that is not suitable for food crops.
- Energy security is going to be ensured because it is more likely for local companies to produce biofuels for local consumption than foreign companies which are export-oriented.
- By using biofuels locally, there will be an enhancement of foreign currency saving equivalent to the amount of import of the fossil fuels foregone as a result of using biofuels.
- The production chain of jatropha is likely to create sustainable employment at all stages of production, processing and selling. It will increase income of the rural poor and move them out of poverty.

However, promoting small scale farmers does not mean there should be no large scale investment in the biofuels industry. Since this is new technology, the government should allow a limited number of foreign large scale investors who will be used as role models where small scale farmers can learn and apply production techniques in their small enterprises. But the focus should be to encourage a hybrid mode of production whenever large scale firms are to be established to involve contractual farmers who will be able to sell their feedstocks.

## Recommendations

1. Large scale plantations of biofuels involve taking up large tracts of land, and this leads to several social impacts to the community in that particular area intended for biofuel investment. Such impacts involve displacement of people, loss of property and creation of pressure on land resource and other social tensions. To safeguard land rights of smallholder farmers, foreign investors should only be assigned to value addition processing investments while production of biofuel feedstocks should be restricted to smallholder farmers who will be contracted by processors / developers.
2. Experience from successful stories from other countries like Brazil indicates that biofuels production is costly and requires government interventions during the initial stages of investment. This implies that the Government of Tanzania should invest heavily on Research and Development from production of biofuel feedstocks to the processing of finished products (bioethanol/biodiesel), at the same time should offer attractive credit guarantees and low interest loans to local companies interested to venture into the energy sub-sector.
3. Unrestricted transfer of funds on free convertible currency from the country to abroad by investors is likely to weaken foreign currency reserves, which is a threat to the sustainability of the economy. To address this problem the government should restrict transfer of funds to capital goods and set a maximum amount of proceeds/profit that can be transferred on free convertible currency.
4. The local government authorities are responsible to facilitate development in their areas of jurisdiction. Since the development process requires resources which are limited to most local government authorities, partnerships in biofuel investment between local government authorities and investors will open up more avenues for financial resources which will improve the ability of the Local Government Authorities to spear development in their localities. Investment in biofuels should be allowed with a minimum of 25 percent ownership by local government, to ensure sustainable benefits go to the communities through local government authorities.
5. The process of land acquisition and use has brought some challenges and controversies especially when it directly involves foreign investors to negotiate for land with communities. In view of this, it is strongly proposed that investors should not be involved in the process of negotiating for land with the local communities. Instead TIC should acquire land from various communities through LGA's and hold the land through land bank that will be made available to investors through derivative right.

6. To avoid disputes on land and contractual issues, and to safeguard the income and quality of employment of poor people residing in these areas, communities should be educated on legal issues relating to contracts and land rights so that they are aware of the impacts of decisions they might be required to make.
7. Export of raw biofuel feedstocks leads to denial of employment opportunities in the chain of value addition, loss of export gains, untapped technical skills and technology transfer. The government should restrict export of raw materials to maximize the potential benefits that could be realized from investment in biofuels.
8. The current government compensation rates should be revised to accommodate the realistic value of land and associated properties and this should apply especially when land is taken for commercial purposes like investment in biofuels.
9. Land use planning governs land use decision and avoids land use conflicts that may result into social conflicts. Proper land use planning allocates adequate land for common pool resources (CPR) to the communities and other uses, takes care of the growing demand/needs as a result of population growth and other factors. Based on this fact, proper land use planning should be a prerequisite for investment in biofuels and should be done in all potential areas earmarked for such investment. An investor intending to invest in a respective area should fit in the available land identified for that specific use.
10. To reduce dependency on fossil fuels, enhance energy security and reduce import bills, the government should set mandatory biofuels blending targets to promote development and local consumption of biofuels in Tanzania and restrict export of biofuels to 40% and balance of 60% be retained for local consumption.
11. The government should offer greater support to local investors in the biofuels sector, who are predominantly small-scale farmers to enhance value addition of biofuels and create sustainable income and employment in the value addition chain.

## 1.0 INTRODUCTION

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Increased concern on climate change, rising costs of fossil fuels and progressive depletion of fossil fuels base have created great challenges to the world. In response to the three challenges the production and use of biofuels is rising as countries try to reduce their dependence on fossil fuels while curbing emissions of greenhouse gases (GHG). The global energy supply is predominantly based on fossil fuels like petroleum, natural gas and coal. The imported petroleum products are consumed in all sectors of the economy, including transport, industry, household, mining and agriculture. The use of petroleum products in diverse sectors of the economy is linked to the emission of pollutants such as lead (Pb), Sulphur dioxide (SO<sub>2</sub>), and Carbon dioxide (CO<sub>2</sub>), which in turn raise environmental concerns. In addition, the unpredicted rising price of fossil fuels at the world market has created not only political and social problems but also insecurity and uncertainty in all sectors that entirely depend on them. In view of this, production and use of biofuels is considered to be the best option to address these challenges.

While the production of biofuels is rapidly increasing in developing countries, mostly because of the establishment of large-scale biofuels feedstock plantations, it is likely to impact food security and socio-economic aspects. Drukkerij and Bennekon (2007) argue that large-scale production of biofuels will have complex effects on economic development, with both positive and negative social outcomes in rural areas. Furthermore, the likely potentials like job creation, improved energy security and risks associated with production of biofuels such as food insecurity, particularly in developing countries, have been explored in several studies (Dufey, 2006; Ejigu, 2008; CFC, 2007; FAO, 2007). At present, much of the development of biofuel feedstocks in developing countries is arising from the expectations that, there will be greater possibilities for exporting high-value commodities (bioethanol and biodiesel), make use of productive large areas of uncultivated land, create technical solutions to energy problems, reduce import bills from fossil fuels, create jobs and expand livelihood opportunities (Ejigu, 2008).

On the other hand, other scholars view it differently and argue that the shift to production of biofuels will not be a solution to any of the current global crises, but rather may contribute to other crises such as food insecurity, displacement of communities, degradation of natural resources such as land, forestry, water and biodiversity (Oxfam, 2008). These problems have already been experienced in other countries like Ghana, Benin, Ethiopia and Senegal. In Ghana for example, it is reported that a corporation illegally seized 38,000 hectares of land for production of biofuels, a situation that created social tension within community members. Similarly, in Ethiopia 10,000 hectares of land were cleared, out of which 86 percent of land was part of elephant haven (UNCTAD XII, 2008). All these incidences have implication on the socio-economy, food security and natural resources. While this is happening in other countries, in Tanzania it is not clear to what extent biofuels have impacted food security, socio-economy and the environment to the localities where they are grown.

Despite the ongoing disagreements, production and use of biofuels is on the increase. The rapid increase in the demand for both land and food crops for biofuels feedstocks has turned the issue of food security into the debate of the day. In recent years, food prices have hiked, indicating some degree of food shortage and placing poor people in either an untenable situation or accessing food of low nutrition value. According to the World Bank (2008), the food crisis has already pushed over 100 million people into poverty. Several other authors have registered a similar concern of production of biofuels contributing in one way or another to the current global food crisis due to the conversion of food crops to biofuels feedstocks (IEA, 2007; UNEP, 2007; Dufey, 2007). The anticipated threat of production of biofuels to food security may be disastrous if proper measures are not put in place. The effects of food shortage on women and children are severe during famine as they are the most vulnerable groups in rural communities. In addition, the potential loss of both biodiversity and agro-biodiversity as a result of production of biofuels presents risks to food producing communities, thereby posing a serious threat to rural livelihoods and sustainability of food security (UNEP, 2007).

In light of the above, given the socio-economic and environmental implications associated with production of biofuels in other countries and the paucity of the similar information on the same in Tanzania that is still at infancy stage of production of biofuels, this study is timely designed to explore the impact of production of biofuels in the Tanzanian context, gives an overview of production of biofuels in the country and its implication on food security, socio-economy and the environment. The study also gives policy recommendations which will input into the ongoing process of formulating a regulatory framework which will guide the development of a sustainable biofuels sector in Tanzania.

## 1.1 Objective of the research

The main objective of this study was to examine the impact of production of biofuels on the socio-economic welfare of smallholder farmers, environment and food security in the study area.

## 1.2 Specific objectives

Specifically, this study intended to achieve the following objectives:

- a) Get a clear understanding of the companies or investors engaged in the production of biofuels in Tanzania.
- b) Gain deeper understanding of the anticipated impact of production of biofuels on food security.
- c) Gain a deeper understanding of the anticipated socio-economic and environmental impact of production of biofuels.

- d) Critically review guidelines and/or policies pushing the production of biofuels and gain deeper understanding of the ongoing policy formulation process for production of biofuels in Tanzania.
- e) Develop policy recommendations on production of biofuels to protect the livelihoods of smallholder farmers in Tanzania.

### **1.3 Limitations of the study**

The Terms of Reference (ToRs) required the research team to examine the impact of production of biofuels on socio-economic welfare of smallholder farmers, environment and food security in the study area. However, this study faced some constraints that deserve mentioning. The main limitation of this study is that the biofuel sub-sector is still at an infancy stage in Tanzania, data are scarce considering that few companies have started operating. Despite this limitation, the study presents a fair overview of the potential impact of production of biofuels on food security, environment and social welfare of smallholder farmers in Tanzania, based on the assumption that the existing investors' requests are fully exploited.

### **1.4 Organization of the report**

The rest of the report is organized as follows. The following section describes the methodology employed during the study. Section three provides a review of the global and national contexts of production of biofuels and critically examines the draft guidelines for sustainable development of liquid biofuels and co-generation in Tanzania. Section four maps the companies engaged in production of biofuels in Tanzania and section five presents the potential impacts of production of biofuels. The lessons drawn from the study are presented in section six. The report concludes with a summary of the main findings and draws some policy recommendations for the way forward in section seven.

## 2.0 RESEARCH METHODOLOGY

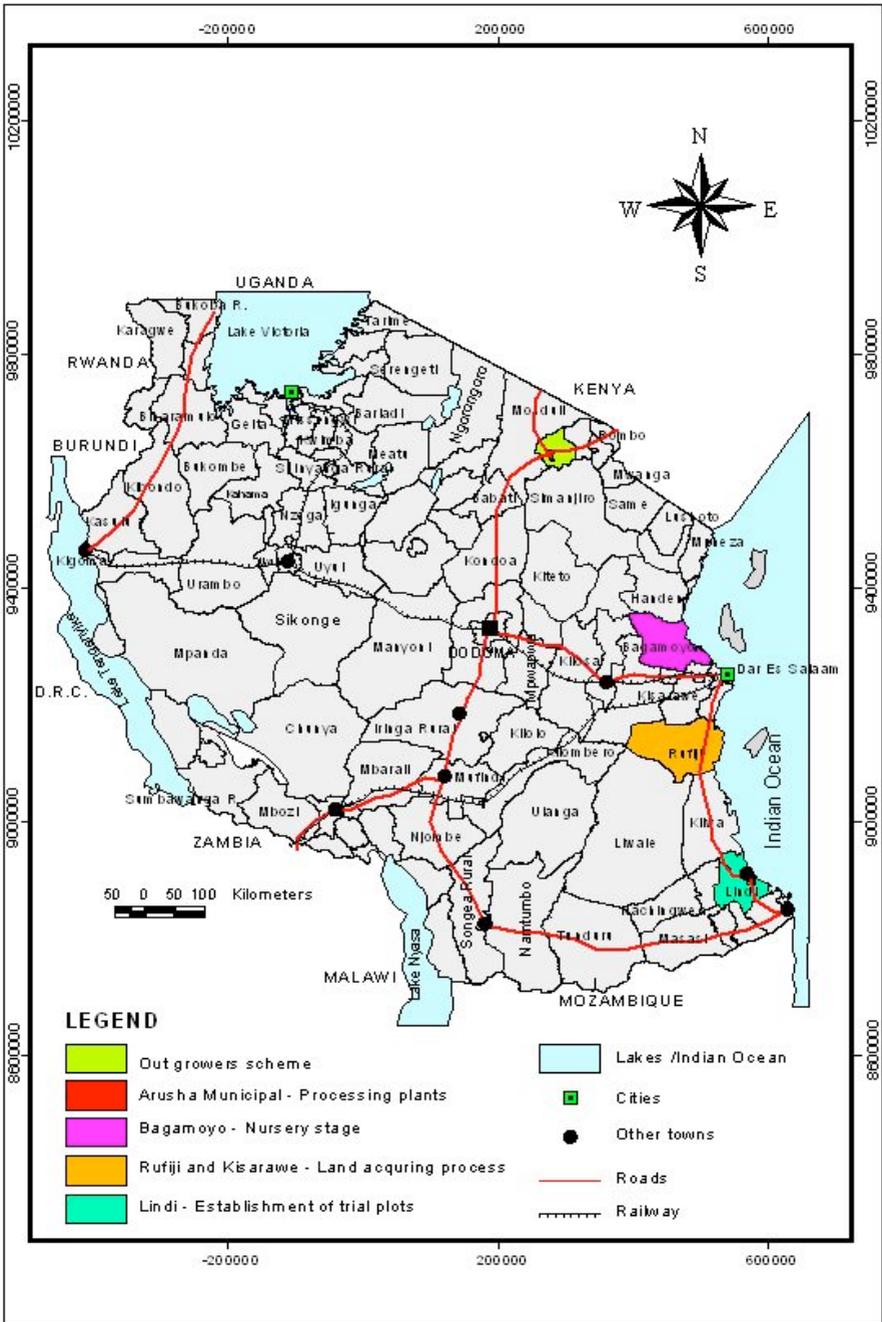
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This section briefly describes the methodology of the study that involved both desk and field research. A combination of participatory research methodologies such as focus group discussions, executive interviews, key informants interviews, and direct observation were used to collect qualitative data.

### 2.1 Scope of the research

The purpose of this study was to investigate and understand the implications of production of biofuels on food security, environment and socio-economic welfare of smallholder farmers in the study area. Based on the ToRs this study focused on areas where land is earmarked or already in use for production of biofuels in Tanzania for both large and small scale firms. Guided by the ToRs, the researchers selected the following six locations with names of companies in brackets operating in these localities: Rufiji (SEKAB), Kisarawe (SunBiofuels), Bagamoyo (SEKAB), Lindi (BioMassive), Kilwa (BioShape), and Arusha (Diligent and KAKUTE). Figure 2.1 presents the six locations visited during the study. During the field research, the study covered both local and foreign companies engaged in production of biofuels with the intention to draw lessons which would lay the basis for policy recommendations in Tanzania.

Figure 2.1 Map of Tanzania indicating study area



## 2.2 Desk research

The desk research aimed at understanding the global and national context of production of biofuels, identified and reviewed the national policies through which the government is pushing production of biofuels and the reasons behind, reviewed a draft of guidelines for sustainable development of liquid biofuels and co-generation in Tanzania, and other documents related to food security, environment, and biofuels.

## 2.3 Field research

The field research was intended to collect data or information useful in meeting the objectives of the study, coupled with the physical observation of what was happening on ground. It involved conducting Focus Group Discussions (FGDs) with small-scale farmers in the study area, executive interviews to Districts Executive Directors (DED), Management of Companies, and Ministry officials. Interviews with key informants were also carried out for the District Agricultural and Livestock Development Officers (DALDO), District Land Officers, District Community Development Officers and District Natural Resource Officers in eight Local Government Authorities, i.e. Rufiji, Kisarawe, Bagamoyo, Lindi, Kilwa, Arusha Municipality, Arusha District Council, and Meru. The field researchers visited both local and foreign companies engaged in production of biofuels in the research area. The visited sites with operating companies in brackets were Rufiji and Bagamoyo (SEKAB Tanzania Ltd.), Kisarawe (SunBiofuels Tanzania Ltd.), Lindi (BioMassive Tanzania Ltd.), Kilwa (BioShape Tanzania Ltd.), Arusha (Diligent Tanzania Ltd. and KAKUTE). However, the study went further to map all the companies engaged in, or interested in engaging in production of biofuels in Tanzania.

### 2.3.1 Sampling and sample size

Sampling for primary data collection adopted a number of steps and procedures to ensure a representative sample was obtained. Purposive sampling was used to select respondents in the identified local government authorities, key government ministries and agencies such as the Ministry of Agriculture Food Security and Cooperatives and companies involved in production of biofuels in Tanzania. The purposive sampling was adopted to generate specialized information from the targeted respondents. However, simple random sampling for small-scale farmers was employed for Focus Group Discussions to solicit information. A total of 315 respondents were covered during data collection. Of these, 11 respondents were for executive interviews, 36 respondents for key informants interviews, and 268 respondents were for focus group discussions. In all cases, except for key informants and executive interviews where respondents were drawn by their position and professions, FGDs strived to involve as many women as possible.

### 2.3.2 Data collection

Combination of methodologies were used to collect qualitative data. Such methodologies include FGDs that were managed with small-scale farmers in all villages covered by the study, key informants interviews conducted for local government officers at local government levels, executive interviews for key Ministries officials, District Executive Directors, and biofuels companies. The purpose of covering a wide range of stakeholders was to create a sense of ownership of the research results among respondents who took part in the survey. The ownership of findings is important because they form a basis for policy recommendations which will subsequently improve the ongoing process of formulating the regulatory framework for national guidelines, for sustainable development of liquid biofuels and co-generation in Tanzania.

Focus Group Discussions were guided by a checklist and throughout the researchers were able to collect information on land tenure systems, status of food security, process which investors follow to acquire land; examine the labour migration patterns, main food and cash crops, major sources of energy, land use, sources of livelihoods; and identify the most pressing demands for women, local farmers and consumers in the study area.

The key informant interviews with the local government officials were meant to find out the role the local government played to facilitate land-acquiring process for investors in the biofuels sector, and identify benefits they reap from biofuels investments in their areas of jurisdiction and other specialized information. Similarly, the executive interviews with the management from different companies were intended to determine the number of jobs generated, nature of companies ownership, size of land taken for production of biofuels, mode of production, type of bio-energy crops intended or grown, types of products planned or produced, potential markets for their products and corporate social responsibilities to proximate communities. As for the central government officials, the aim was to find out the key drivers of production of biofuels in Tanzania, identify companies investing in production of biofuels, and identify total national energy demand and foreign currency spending for importation of the fossil fuels.

### 2.3.3 Data analysis

Qualitative data were processed, analyzed and presented in different formats; the detailed findings and their interpretation are presented in detail in section three, four and five, which all together present the global and national context of production of biofuels, map companies engaged in, or interested in engaging in production of biofuels in Tanzania and finally shows the impact of production of biofuels on the social welfare of the small-scale farmers, environment and food security.

### 3.0 GLOBAL AND NATIONAL CONTEXT OF PRODUCTION OF BIOFUELS

The following section reviews the global and national context of production of biofuels. It also critically examines the draft guidelines for sustainable development of liquid biofuels and co-generation in Tanzania and or policies through which the government is pushing production of biofuels.

#### 3.1 Global context of production of biofuels

The interest in biofuels can be traced back to late 1970s when OPEC reduced crude oil supply in the world market, an attempt which led to a substantial increase in the price of fossil fuels. At present, fossil energy accounts for about 80% of the worldwide total primary energy supply with variations on per-capita consumption between countries (Zeller and Gras, 2007). According to IEA estimates in 2006, residents in United States of America (USA) consume more than double the energy consumed by European residents and the Europeans use ten times more energy than Africans. In addition, economic growth in countries like China and India result in significant increase in energy demand. All these create pressure on fossil fuel base and call for alternative sources of energy.

In light of the above, one could see why the USA and Brazil, in late 1970's, launched ethanol programmes from cereals, oil seeds and sugar beet. However, the processing of agricultural crops to biofuels still uses first generation technologies, which are relatively expensive (CFC, 2007). For example, International Energy Agency (IEA) reports that in IEA countries including the US, Canada, several European countries, Australia and Japan, the production cost of ethanol and biodiesel is three times higher than that of gasoline and diesel. Among other reasons, this explains why production of biofuels was not expanded in late 1970's. In view of this, advanced conversion technologies are needed for the second generation of biofuels that will use a wider range of biomass resources originating from agriculture and waste resource materials. According to FAO (2009) second generation biofuels promise to achieve higher reductions in greenhouse gas emissions, cost of production, and less competition of biofuel feedstocks to food.

The recent rise of the oil prices in combination with environmental concerns has led to the current interest in production and use of biofuels. According to Banse *et al.* (2007) the drivers for biofuel production in the EU, USA and Canada are mainly tax exemptions, investment subsidies and obligatory blending of biofuels. While the need to reduce oil import bills has encouraged production of biofuels and consumption in other countries, several studies have also argued that the policies for promoting biofuels are inclined to the need to reduce greenhouse gas emissions in the light of climate change, diversification of energy sources, decrease on dependency on fossil fuels, improvement of energy security and enhancement of rural development (CFC 2007; Hoogwijk *et al.*, 2005; Meijle *et al.*, 2005; MEM, 2008).

### 3.1.1 Trends of global production of biofuels

Global production of ethanol has tripled from 20 billion litres to 50 billion litres and world biodiesel production was reported to grow from 200 million gallons to about 1000 million gallons from 2001 to 2005 (Bansel *et al.*, 2007). The author added that the growth rate during the years 2002 to 2004 was 27 % and 70 % for bioethanol and biodiesel, respectively. Nowicki *et al.* (2007) projects that, meeting 10 % of EU energy blending targets for transport in 2020 could take up 43 % of the current land use for cereals, oil seeds and other crops, land that will not be available in Europe. Referring to a scenario developed for US and EU, they indicate that a near term blending target of up to 6% displacement of petroleum fuels with biofuels appears feasible using conversional biofuels, given available crop land. Beyond 6% displacement level of gasoline and diesel fuels, production of biofuels using current technologies and crop types may begin to draw substantial amounts of land away from other purposes such as production of crops for food, animal feed and fibre (IEA, undated). This scenario has an implication on EU 10% blending target set to be realized by year 2020 and open up an export opportunity of biofuels to EU for advantaged countries like sub-Saharan Africa with vast land, suitable climatic conditions and relatively lower production costs.

Consistently, other findings indicate that the EU short-term blending target of 5.75% for 2010 will require 15.03 million tonnes of biofuels, which will require 12.02 million hectares of land or 9.4 % of the EU agricultural land demand. Further projections indicate that in 2010 there will be about 6.98 million hectares of agricultural land for biofuels feedstocks, which will yield 8.74 million tonnes of biofuels (Banse *et al.*, 2007). This implies that if EU relies on internal sources of biofuels, there will be a deficit of 6.29million tones of biofuels and 5.04 million hectares which cannot be sourced within EU land without seriously conflicting with other land use types. Similarly, the USDA (2007) estimates that more than 30% of corn produced in the US will be used to produce ethanol by 2009/2010. Despite this increase in ethanol production, the US cannot fulfil its target goal of greatly reducing the US dependency on crude oil imports. In 2006, US ethanol production (5 billion gallons) could only substitute 1.5% of US crude oil imports. Similarly, in 2004, the European Union (EU) for instance, used about 0.4 % and 0.8 % of its cereals and sugar beet, respectively, for bioethanol production and more than 20 % of its oilseeds to process biodiesel but could not satisfy the requirements of local demand (Banse *et al.*, 2007). In view of this, USA and EU may need to increase quantities of imports of ethanol and biodiesel most likely from Latin American countries and Africa especially sub-Saharan Africa including Tanzania. It is therefore expected that the trade in biodiesel and bioethanol will increase substantially during the next few years.

### 3.1.2 Experience from Brazil

Brazil is frequently cited a success story for sugarcane-based bioethanol and a model for increasing energy security. The productivity and efficiency of Brazilian sugarcane ethanol production are virtually unmatched by any other country. The United States, where most ethanol is produced from corn, is the second largest biofuel market. However, ethanol production is more economical in Brazil than in the United States. This is due to several factors such as the superiority of sugarcane to corn as an ethanol feedstock, Brazil's large unskilled labour force, and climate suited to grow sugarcane. Table 3.1 presents physical productivity comparisons between two feedstocks (i.e. sugarcane and corn). The findings clearly indicate that sugarcane is superior in terms of yield per hectare which is 85,000 Kg / ha, compared to corn which stands at 10,000 Kg/ ha. Similarly, the quantity of ethanol from sugarcane is 7,080 litres per hectare compared to corn which is 3,570 litres per hectare, this difference is twice as much.

**Table 3.1 Physical Productivity Comparison of biofuel feedstocks**

Raw Material	Production / ha (Kg)	Quantity of product (litre of ethanol)	Quantity of ethanol /ha
Sugarcane	85,000	12	7,080 litre
Corn	10,000	2.8	3,570 litre

Source: Ministry of Agriculture Brazil as cited by Xavier (2007)

According to UNICA (2002), the raw material accounts roughly 60 \$ of production cost, and production cost for ethanol in Brazil is reported to be the world's lowest estimated at USD 0.75 per gallon. While the US and Brazil make about the same volume of ethanol, the US uses almost twice as much land to cultivate corn for ethanol as Brazil does to cultivate sugarcane for the same purpose. Xavier (2007) contends that corn-based ethanol produced in quantities large enough to displace a significant percent of US petroleum consumption, could have significant environmental impacts. According to the World Watch Institute, ethanol may damage the environment when it is produced on a large scale from low yielding crops such as corn. In this case it may generate as much or more greenhouse gas emissions than do petroleum fuels. Also, corn-based ethanol production processing consumes more non-renewable fuels compared to the production of sugarcane ethanol.

Brazil ethanol infrastructure model did not arise from free market competition – it required huge taxpayer subsidies over decades before it could become viable. This sends signals to countries like Tanzania intending to venture in this sub-sector. This implies that government intervention is necessary at the initial stages of investment to support producers of biofuels feedstocks, processors and to establish distribution channels. For the case of Brazil, the

government launched the Brazil National Alcohol Programme, PROALCOOL in 1975 as a policy to reduce the country's dependence on oil imports and agricultural price support programme. At the time, Brazil was importing 80% of its oil and the 1973 OPEC oil embargo and production cutback had raised concerns that oil dependency would endanger national security. The PROALCOOL aimed at increasing production of sugarcane alcohol for use as a gasoline substitute, but it also sought to guarantee the profitability of the sugar industry after the sharp fall in sugar prices in 1974. The programme allowed the excess production to be converted into alcohol (ethanol) in special distilleries close to sugar mills. The ethanol thus produced was blended with gasoline in a proportion of up to 24 %.

### 3.1.3 Implications of biofuels consumption targets

Ambitious biofuels targets set by many countries in recent years reflect the new optimism about this new potential of biofuels. For instance, the EU biofuels directive, which was presented in 2003, set indicative targets for member states to attain. The EU commission has also adopted an EU strategy for biofuels. The European Union Biofuel Strategy and the Renewable Energy Road Map propose an overall binding target of 20 % renewable energy by 2020 and a 10 % biofuels target by 2020 (European Commission, 2006a and European Commission 2006b). These ambitious targets require significant expansion of production of biofuels. The current aggressive policy decisions and strategies with regard to the expansion of biofuels, using first generation feedstock such as cereals, sugars and oil seeds certainly will drive up the prices of food crops because the energy market is much larger than the market for food. Zeller and Gras (2007) assert that the resulting impact on food prices is outstanding from the perspective of poor consumers, using first generation feedstock it is expected that the rise of food prices by 2020 will be in the range of 25% to 135% depending on the crop. Even under rapid technological development (second generation feedstock) prices are estimated to rise in the range of 10% to 50%. Increasing food prices would impair the living of the poorest people especially women and children in rural areas who are the most vulnerable. Increased land use due to biofuels will also lead to loss of biodiversity, which the poor people depend on for their livelihoods.

Cognizant of this rising importance of biofuels, it is important that the countries that wish to engage in the production of biofuels formulate or adopt clear policy frameworks for rational decision making on entry into production and/or use of biofuels. The multidimensional nature of production of biofuels raises critical issues including policy dilemma on food security, environment and sustainability of natural resources. Biofuels are associated with many forms of challenges including production, disruption of established production systems as well as the overall possible cost and benefits of intensified production of biofuels.

### 3.1.4 Global policy goals for biofuels development

Bioethanol and biodiesel are considered to be the modern alternative forms of bioenergy and more efficient to use as opposed to the traditional biomass (i.e. wood, charcoal, cow

dung etc). Apart from being efficient, these forms of bioenergy derived from plants and agricultural crops/ residues offer tremendous opportunities to meet the growing energy demands, increase income, reduce poverty and mitigate environmental degradation. Similarly, the IEA in 2006 reports four global policy goals, which are associated with the current move by different countries to promote development of biofuels industries, e.g. energy security, rural development, export development and climate change mitigation.

### 3.1.5 Risks associated with the production of biofuels

The rising demand and supply of biofuels bears some risks on food security and the environment as it has already been experienced on the rising prices of cereals and other food crops (FAO, 2007). Biofuels have also posed several environmental challenges partly due to increased bad practices like mono-cropping, application of high fertilizer and pesticides rates, which subsequently pollute soils and underground water. The issues of concern are changes in land use and risk of converting large areas currently occupied by natural forestry and grasslands into production of biofuels. The threat is not only on the existing biodiversity and other ecosystem, but also in the emissions of greenhouse gasses. In Brazil, for instance, the increase in the area under cultivation for bioethanol crops is jeopardizing entire eco-regions, including the Cerrado, one of the world's biodiversity hot spots (UNEP, 2007). Similarly, other scholars argue that the significant quantities of soil carbon released when grasslands are converted to crop production might negate any potential carbon benefits associated with production of biofuels (Guo and Gifford, 2002).

The scale of the biofuels industry and the number of countries involved in its production are rapidly expanding. According to FAO (2008) global production of liquid biofuels amounted to 0.8 EJ in 2005 USA, Brazil and the EU who are still the main biofuel producers. However, production of biofuels is also growing quickly in several developing countries such as Indonesia and Malaysia (FAO, 2009). In 2005 there were 12 million hectares under oil production worldwide of which 5.4 million ha were in Malaysia and 5.3 million ha were in Indonesia and the two countries together aimed to supply 20 % of the EU demand for biofuels (Tauli-Corpus and Tanang, 2007). It has been reported that the rapid expansion of palm oil plantation in Malaysia and Indonesia has been accompanied by violation of rights of smallholder farmers and indigenous people and in some cases the displacement of the local people (UNDP, 2007). Tanzania has a lot to learn from this experience, as it seeks to embark on production of biofuels.

Despite all these global experiences, and the ambitious targets to meet the growing global demand for biofuels, the questions of sustainability of biofuels activities remain unclear. In this respect, sustainability remains a key objective and therefore important for the countries to formulate policies to ensure sustainable management of the entire production chain starting from feedstock production processing and use of biofuels. In such undertakings, the government policies play a critical role in influencing investment in the biofuels sector.

Thus, if they are carefully formulated to take into account food security, environment and socio-economic concerns, they can determine the long-term viability of this important emerging opportunity.

### 3.2 National context of production of biofuels

Before examining the national context of biofuel production, it is desirable to review briefly the country profile, highlighting the potential of agriculture and status of food security, which are directly related to production of biofuels in the country.

#### 3.2.1 Country profile

Tanzania is located in Eastern Africa and borders Indian Ocean to the East; Uganda and Kenya to the North; Burundi, Rwanda, and Congo to the West; and Mozambique, Zambia and Malawi to the South (Figure 3.1). The country has a total area of 945,087 square kilometres of which 59,050 square kilometres are covered with water and the rest 886,037 square kilometres are dry land. In 2008, the country was estimated to have a total population of 40,213,160 at a population growth rate of 2.072 percent (World Fact Book, 2009). The population distribution in Tanzania is extremely uneven. Population density varies from 1 person per square kilometre in arid regions to 51 people per square kilometre in the mainland’s well-watered highlands and 134 people per square kilometre in Zanzibar (<http://www.state.gov/r/pa/ei/bgn/2843.htm>).

Figure 3.1: Map of Tanzania showing boundaries



Source: World Fact Book 2009

Tanzania is blessed with diverse water sources; for example, it contains three of Africa's best known lakes – Victoria in the North, Tanganyika in the West, and Nyasa in the South. The climatic conditions of the country vary from tropical along the coast to temperate in the highlands, which favours the growth of various cash and food crops. The economy of the country is therefore heavily dependent on agriculture which is the main source of livelihood to the majority of rural folks.

### 3.2.2 Agriculture in Tanzania

Agriculture is the predominant sector of the Tanzanian economy. The economic survey of 2007 report that the agriculture sector accounted for about 25.8 % of Gross Domestic Product (GDP). According to Sicilima (2005), agriculture contributes about 66 percent of foreign exchange earnings. It is also a source of food and provides jobs to about 80 percent of Tanzanians who reside in rural areas (URT, 2001). In spite of being the main sector in the country, it is dominated by small-scale farmers who cultivate average farm sizes of between 0.9 hectare and 3.0 hectares each (Sokoine Memorial Lecture, 2008). The majority of players in the agriculture sector in rural areas are women who constitute the main part of the agricultural labour force. It is established by Shimba (2000) that around 60 percent of the rural population are women, who play a central role in food production. According to URT (1994), approximately 98 percent of rural women classified as economically active are engaged in agriculture and their activities determine the amount of food available for consumption in the household and for export. This implies that any project that has some impact on agriculture will touch directly on rural women and household food security.

The main cash crops grown include coffee, sisal, cashew, cotton, tobacco, tea, cloves, flowers and oil seeds (i.e. sunflower, simsim, cotton seeds, palm oil, ground nuts and macadamia nuts) while the main food crops include maize, sorghum, millet, rice, wheat, pulses mainly beans, bananas and potatoes. Maize is considered the main food crop and coffee is regarded as the main cash crop. Food crop production dominates the agriculture economy. For instance, 44.4 million hectares are suitable for agriculture; of these 10.8 million hectares are cultivated annually for food crops (GTZ 2005). To sustain and expand production at the farm level, yields of food crops need to be increased and expanded to meet the rising domestic, regional and global demands. The expansion of agriculture for food crops is limited to the remaining 33.6 million hectares currently not in use.

The current growth of the biofuel industry in Tanzania is putting much pressure on arable land since it is competing on the same land that could otherwise be expanded for food crop production. For instance for a period of two years, that is between 2006 and 2008, the country has witnessed an influx of investors interested in biofuel and about 435,839.6 hectares have already been earmarked for growing various types of biofuel feedstocks. Although currently the land already earmarked for biofuel production seems small in relation

to the available arable land with the expansion of biofuel markets in EU, US, Japan, China and India will offer more and more export opportunities, which will push more investors to acquire more land for biofuel production. This trend is likely to pose great pressure on land and food security.

Although agriculture forms the backbone of the country's economy, over a number of years it has experienced poor performance and has rendered the country to record low crop production and food insecurity at both household and national levels. For example, an average maize yield is about 1.2 tonnes per hectare, instead of 3.5 – 4.0 tonnes per hectare expected under good management (Sokoine Memorial Lecture, 2008). The major constraint facing the agriculture sector is that agriculture has not changed much to take into account a number of problems that face the sector. For years, the area utilized for agriculture has not expanded, the area under irrigation has remained very small, use of agricultural inputs has continued to be small and use of agricultural implements has remained a stumbling block to the development of the sector. Generally, the falling labour and land productivity due to application of poor technology, dependence on unreliable and irregular weather conditions have been common features to the sector.

### **3.2.3 Status of food security in Tanzania**

In its simplest form, food security is defined as the condition in which everyone has access to sufficient and affordable food; it can relate to a single household or to the global population. Maxwell (1996) cited by Sanga (2008) defined food security to imply access by all people at all times to sufficient food for an active and healthy life. Also it encompasses the three dimensions of food security, i.e. availability of sufficient quantities of food of appropriate quality, access by household and individuals to adequate resource to acquire appropriate foods for a nutritious diet, and stability level of aggregation at the global, national, household and individual levels. Therefore food security exists when all people at all times have physical and nutritional food to meet their dietary needs and preferences for an active and healthy life. On the other hand, food insecurity occurs when there is no or poor availability, accessibility and stability of food in the household or community, that leads to lack of enough food for people to live a healthy and active life. There is direct relationship between food insecurity and poverty, in that food insecurity contributes to the perpetuation of poverty, and similarly poverty can hinder people's ability to access food.

As in other developing countries, food insecurity has been one of the main problems that has been threatening Tanzania. About 60 percent of Tanzanians face the challenge of food insecurity in rural areas (Cooksey, 1994 as cited by Barashishwa, 2007) and 36 percent live below the poverty line. This has direct implication on food accessibility. In 1994 the United Republic of Tanzania revealed that about 28.7 percent of the population were chronically food insecure as land holdings were too small to provide sufficient food for subsistence.

More than 25 percent of the population suffered from protein energy malnutrition, 32 percent from nutritional anaemia, 6.1 percent from vitamin A deficiency and 25 percent from iodine deficiency. This problem of food insecurity could partly be resolved by expanding the area under crop production and facilitating smallholder farmers to access credit facilities and be able to afford agricultural inputs such as improved seeds, fertilizers and pesticides. The current trend of expanding biofuel investment will limit possibilities of expanding food crop production. To resolve this conflict, selection of biofuel feedstocks should capitalize on feedstocks that are adaptable to marginal lands and which will not compete directly with food in terms of land and use, and other production resources such as land, labour, water and agricultural inputs.

Despite this problem of food insecurity, the productivity of food crops in Tanzania has not been encouraging. For example, TARP II, 2003 as quoted by Barashishwa, (2007) indicates that from 1995 up to 2001 the productivity of major cereals was below 2 tones/ha. The same trend was observed with other food crops like sweet potatoes that showed a decline to 1.8 tone/ha in 2000/2001. Productivity of bananas was highest in 1998/99 (3 tones/ha) but it dropped to 2.8 tones/ha in 2000/01. According to the preliminary crop production forecast by the Ministry of Agriculture, Food Security and Cooperatives in 2003, there was acute food shortage in different parts of the country with the worse affected regions being Dodoma, Singida and Shinyanga. The problem of food insecurity increased in 2004 where 4.1 million people including 1.09 million in the three worst affected regions were severely hit by hunger (Information Bulletin, 2004). The situation is expected to worsen in year 2009 where by about 16 million people in 65 districts out 120 in the country are expected to face severe food shortages. The mentioned districts are distributed in twelve regions namely Arusha, Lindi, Mtwara, Kilimanjaro, Mara, Mwanza, Shinyanga, Singida, Dodoma, Tabora, Morogoro and Tanga. It was reported further that in February, 2009 food prices had increased by about 25 percent compared to February, 2008 (Sauti ya Watu Tanzania, 2009).

Several factors have contributed to food insecurity in the country. Among others are low production exacerbated by small farm holdings, poor implements, drought, floods, and pre- and post-harvest food losses, just to mention a few. For a long period, the government of Tanzania has been making efforts to improve agriculture in order to increase its productivity and hence increase household and national food security. For example, after independence in 1961, the government adopted a number of approaches towards agricultural development. These approaches include the Transformation Approach (1962 -1966), the Improvement Approach (1963-1966), the Commodity Approach (1978-1983); while various projects were initiated such as the Sasakawa Global 2000 (1989-1998), the National Agricultural and Livestock Extension and Research Programme (NALERP-1989-1996), the Southern Highlands Extension and Rural Finance Project (1994-2001), the National Agricultural Extension Project Phase II (NAEP-1996-2001), and the FAO Special Programme for Food

Security (1995 to date) (Sicilima and Rwenyagira, 2001). Others include Eastern Zone Client Oriented Research and Extension (EZCORE), Special Programme for Food Support (SPFS), Danish International Development Agency (DANIDA), Food and Agriculture Organization (FAO), United Nations Children's and Education Fund (UNICEF) and other Non-Governmental Organizations (NGOs) like ActionAid International Tanzania and PLAN Tanzania. Despite all the efforts that have been employed in the country, the situation of food security has continued to be a common problem in most of the households and nation at large, something that is unimaginable and needs special attention due to the fact that Tanzania is one of the countries blessed with good potentials for agriculture as explained in Section 3.2.4.

### 3.2.4 Opportunities of agriculture in Tanzania

Although there are constrains that challenge the agricultural sector and accelerate the problem of food insecurity, Tanzania is endowed with diverse opportunities for agricultural development. It is estimated to have a total of 94.4 million hectares of land; of these 44.4 hectares are fertile and suitable for agriculture, 10.8 million hectares are in use for crop production and 39 million hectares are marginal lands with no agricultural potential. The country is also endowed with good climatic conditions suitable for cultivation of diverse crops – both food and cash crops. In addition, there are plenty of water sources like lakes, rivers, seas, wells and springs all over the country. According to URT (2004), a total number of 29.4 million hectares of land (or 31 % of Tanzania's area) is suitable for irrigation development. Of this area, 2.3 million hectares (8 %) are of high development potential, 4.8 million hectares (16 percent) fall under medium potential and 22.3 million hectares (76 %) are of low irrigation potential. Similarly, Huggins (undated) contends that 60 % of lands of high potential for agriculture fall in Rufiji basin; that implies Tanzania could be a major food producer and exporter if these opportunities were efficiently and effectively exploited.

Due to its potentialities, for many years Tanzania has been attracting many investors from outside the country to invest in both food and cash crops. In recent years there has been a concern of many local and international investors showing their interest to invest in biofuel crops which were not produced before or were produced for food purposes in the country. Studies show that Tanzania is endowed with a variety of farming systems with climatic variations and agro-ecological conditions of which the targeted biofuels crops like jatropha, palm oil, cotton, sunflower and sugarcane can be grown (GTZ, 2005). However, the idea of growing energy crops has been received with mixed feelings. There are people who believe growing energy crops will transform agriculture in Tanzania, provide alternative source of income among smallholder farmers especially women, improve energy security and create new jobs and enhance rural development (MEM, 2008; GTZ, 2005). On the other hand, there are those who believe that a shift to energy crops is a threat to food security to countries like Tanzania which have never attained sustainable levels of food sufficiency (Oxfam, 2008; FAO, 2009). It is from these opposing views that this study was

commissioned to examine the impact of the production of biofuels on food security. The subsequent sections will explain in detail the status of production of biofuels in Tanzania, the motivation behind production of biofuels, biofuels feedstocks and the policy environment.

### **3.2.5 Bio-fuels production in Tanzania**

Tanzania is still new in the biofuels industry. Production of biofuels has just started to be established in the country following a recent study on liquid biofuels for transportation in Tanzania commissioned by GTz in 2005. The government of Tanzania is on the forefront encouraging production of biofuels. Recently, several companies, both foreign and local, have showed interest to invest in biofuels in Tanzania. Some companies have already acquired land for growing biofuel feedstocks and others are in the preliminary stages of acquiring land or seeking for government approval to start producing biofuels.

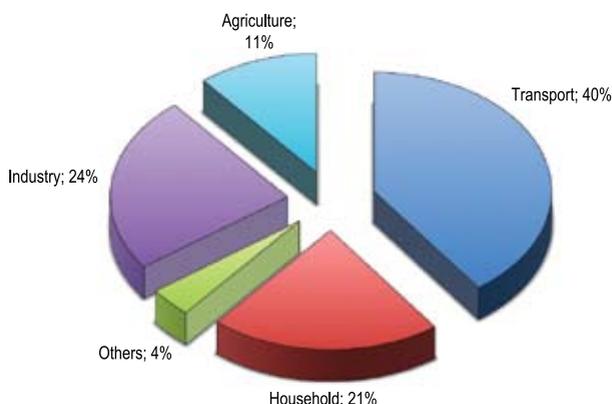
Jatropha, sunflower, palm oil and sugarcane are some of the crops to be grown on both large-scale (plantations) and small-scale by smallholder farmers as biofuel feedstocks. For instance, it is reported that thousands of Tanzanian rice and maize growing farmers have already been displaced from fertile lands with good access to water for sugarcane and jatropha plantations on newly privatized land (Oxfam, 2008). Villagers are being displaced with minimum compensation for the loss of land and other properties. This has already taken place in Kisarawe District and the Usungu plains and tens of thousands of hectares in Bagamoyo, Rufiji and Kilwa Districts are either being given to foreign investors or are in the process of being given to foreign investors for the same purpose. The government has identified more hectares in at least 10 other districts for the same purpose. Unfortunately, all this is happening when the government is yet to put in place any policy guiding the production and use of biofuels in the country.

Tanzania has been criticized by law makers and environmental groups for awarding licenses for the production of biofuels without regulating the industry or carrying out assessment on the possible consequences. One of the concerns is possible competition for space and water between biofuel and food crops. In many places, the rush to produce biofuels takes place where local land rights are insecure, which results in poor people losing out land. An Oxfam report (2008) on production of biofuels in Tanzania warns that food supply to the nation could be in jeopardy with the environment endangered if the government continues to support haphazard production of biofuels. Thus, in order for developing countries like Tanzania to be able to benefit from the biofuel sector without putting at risk social, environmental, and political stability, more knowledge is needed on the same. In line with this, an institutional and regulatory framework ought to be in place to enable thorough cost-benefit analysis, to minimize the associated negative impacts.

While there are many reasons why Tanzania should promote the production of biofuels, the conceptual initiatives, technological base and investment capital are externally driven. At present, the biofuels industry in Tanzania is dominated by the developed countries that may not necessarily be motivated by compassion, but driven by self-interests and profit gains. This is dangerous for a country like Tanzania that is promoting the production of biofuels without a legal and regulatory framework. However, in April 2006, Tanzania made a step forward by establishing the National Biofuels Task Force (NBTF) with the mandate of developing the biofuels guidelines and the national biofuels policy, legislations and regulations. So far, the draft guideline has been developed, but still requires some inputs from various stakeholders for improvement. It is expected that the findings and recommendations from this study will contribute to its improvement. However, guidelines are not legally binding and therefore may not safeguard the interests of vulnerable groups such as resource poor smallholder farmers and women in particular, hence a need to have a concrete policy as a basis for solid regulatory framework enforced by law.

### **3.2.6 Motivation for production of biofuels in Tanzania**

The global policy goals that have driven production of biofuels in the world can also be used to explain the current shift to production of biofuels in Tanzania. Primarily, Tanzania has been motivated by concerns over an unprecedented increase in cost of fossil fuels and hence the need to reduce its import bill. Tanzania's economy is completely dependent on the importation of petroleum-based products whose cost has increased substantially. The country's importation of petroleum products accounts for about 40 % of all the imports of which the transport sector is consuming more than 40 % of the imported petroleum products, 24 % for manufacturing industry, 11 % for agriculture and 21 % household consumption and 4 % for other uses (Figure 3.2). The country's spending on petroleum accounts for 25 % of its foreign earnings (Tanzania Economic Surveys, 2007). The country's annual petroleum products consumption for year 2004 was 1,295,852 metric tonnes, worthy about US\$ 1.2 billion (Tanzania Economic Surveys, 2005). The report further estimates the country's annual petroleum at 1,736,566 metric tonnes in the year 2010, which translate into 34 % increase for a period of six years. The increased trends in petroleum consumption in the country, gradual depletion of fossil fuel base coupled with the ever increasing cost of fossil fuels prompts a need to diversify energy sources and ensure energy security for sustainable economic growth (MEM, 2008).

**Figure 3.2: Consumption of petroleum by sector**


As already alluded to, potential opportunities are envisaged in biofuels, and Tanzania has seen the need to promote biofuels to include: creation of employment and diversification of rural economy, creation of markets for agricultural energy crops, saving of foreign exchange equal to the value of imports substituted, contribution to cleaner environment through reduction of greenhouse gases and potential to halt deforestation and desertification, through use of drought resistant crops like *Jatropha curcas*, sisal, cassava and sweet sorghum. Other reasons include replacing fossil fuels in vehicles, facilitating technology transfer, and food security (MEM, 2008). Other factors that have given the country an incentive for biofuels development include, but not limited to: the availability of suitable land for energy crops, possibility to export liquid biofuels and co-generated electricity, existence of some local experience in co-generating especially at sugar processing factories, and appropriate weather and soil conditions for growing biofuel feedstocks (MEM, 2008).

### 3.2.7 Biofuels feedstock in Tanzania

The biomass necessary for the production of biofuels is derived from agricultural crops and residues, forests residues, or other kinds of plant-based biomass feedstocks. For example, biodiesel is derived from oil seed crops and fuel ethanol is produced from easily fermented sugars and starchy crops, and food processing wastes. Some of the crops that are being harnessed for ethanol production include sugarcane, sugar beets, sorghum, maize, wheat and cassava. As for biodiesel the prominent oil seed crops earmarked for biofuels are all types of vegetable oils (i.e. sunflower, palm oil, coconut) *jatropha*, and castor oil to mention few.

Tanzania is not unique in terms of types of crops targeted for production of biofuels. The most common crops grown that provide a potential source of biofuel feedstocks include palm oil, coconuts, cashew nuts, sunflower, *Jatropha*, sugarcane, wheat, and cassava.

However, most of the biofuels activities have been directed towards the use of *Jatropha curcas L.* for biodiesel, an indigenous plant whose seeds can be pressed to obtain non-edible oil. The water and nutrient requirements for *Jatropha curcas L.* are modest, while its oil yield is relatively high. Other crops such as sugarcane are earmarked for the same purpose to extract bioethanol. Contrary to *Jatropha*, sugarcane is a heavy feeder in terms of water and nutrients, which is unlikely to be grown on marginal lands. It is reported for example in India that sugarcane consumes an average of 3,500 litres of water to produce the amount of feedstocks required to produce 1 litre of bioethanol (De Frature *et al.*, 2007). This implies that an EIA should be done to analyze the impact on water resources in areas of existing water scarcity.

### 3.3 Policy environment for production of biofuels in Tanzania

Despite the growing trend of investment in biofuels sector in the country, the government doesn't have a policy to guide investment decisions. This is very dangerous once land is given to investors on contract that cannot easily be reverted in case of non-compliance to social and environmental sustainability criteria. Recently, in April 2006, the government formed a National Biofuels Task Force to steer a process of formulating the national guidelines for sustainable development of liquid biofuels and co-generation in Tanzania. However, the guidelines are not enforceable by law and therefore will not address the need to bind investors to conditions that will ensure smallholder farmers and the nation as whole benefit from biofuel industry. In light of this, the government needs to formulate a policy and regulatory framework immediately before the national loses its bargain during the interim period.

In the absence of a biofuels policy, the government was in a situation where it had to borrow patches of clauses from various policies in the country to facilitate investment decisions. Such policies include the National Energy Policy of 2003, National Environmental Policy of 1997, Agricultural Policy of 1997, Forestry Policy of 1998, Wildlife Policy of 1998, and Land Policy of 1999. While these policies have some clauses promoting utilization of sustainable or renewable energy sources they are not specific to biofuels. In addition, these policies contain general statements without any action plan or explicit priorities to direct the national energy priorities. The policies do not specify any institution or agency to be charged with the responsibility of coordinating biofuels research and development activities. Lack of priorities and institutional framework for implementation has contributed to the *ad hoc* investment process in the biofuel sector in Tanzania.

What should be clear is that those policies were prepared to serve other sectors and for this reason they are not adequate to guide decisions for biofuels investments, which is normally a complex undertaking. The use of these policies to guide decisions on the investment of biofuels is unrealistic and misleading regarding the whole issue of sustainability. It is important to note further that those biofuel feedstocks are sourced from agro-energy crops

the majority of which are food crops. Changing use of these crops from food to sources of energy creates pressure on food security which contravenes the main objectives of the same agricultural policy cited to promote biofuels.

### 3.3.1 Review of the draft guidelines for production of biofuels in Tanzania

The sustainable development of a viable biofuels industry requires a strong, supportive policy and firm regulatory and institutional framework to ensure that measures are put in place to harness the contribution of the sector to rural livelihood. This section examines the draft guidelines proposed by the National Biofuels Task Force for the development of the biofuels sector in Tanzania. In April 2006, as mentioned earlier, the government formed a National Biofuels Task Force (NBTF) mandated to formulate a regulatory and institutional framework to regulate and provide incentives for development and growth of the biofuel industry in Tanzania.

The NBTF released draft guidelines for sustainable development of liquid biofuels and co-generation in Tanzania, which were open for discussion by various stakeholders. It is from this context that reviewing of the draft guidelines seems necessary. The focus of the review is to examine adequacy of the draft guidelines and ascertain the extent to which food security is not compromised at the expense of production of biofuels, identify gaps if any and draw up recommendations for improvement. To attain these objectives, the study examined the roles of the National Biofuels Task Force, the institutional framework and the sustainability guidelines for biofuels development in Tanzania as detailed below.

### 3.3.2 Roles of the National Biofuels Task Force

The National Biofuels Task Force (NBTF) is composed of the Ministry of Energy and Mining (MEM) as a chair of the task force, Ministry of Agriculture Food Security and Cooperatives (MAFSC), Ministry of Finance and Economic Affairs (MoFEA), Ministry of Industry and Trade (MIT), Ministry of Justice and Constitutional Affairs (MJCA), Tanzania Petroleum Development Corporation (TPDC), Tanzania Electric Supply Company (TANESCO), NEMC, Sugar Board of Tanzania, Tanzania Investment Centre (TIC), TaTEDO, TIRDO and CAMARTEC. The Task Force is charged with the role to establish a regulatory and institutional framework to regulate and provide incentives for development and growth of the sustainable biofuel industry in Tanzania. However, the National Biofuels Task Force was guided by the following terms of reference:

- Facilitate the ongoing and potential biofuel initiatives in Tanzania,
- Review and develop a policy and regulatory framework,
- Develop guidelines for dealing with biofuels as an interim arrangement in Tanzania,
- Prepare a coordinated and integrated programme for the development of biofuels in Tanzania, and

- Identify and map-out zones of suitable areas/land for biofuels development in Tanzania.

The National Biofuels Task Force so far has accomplished the following;

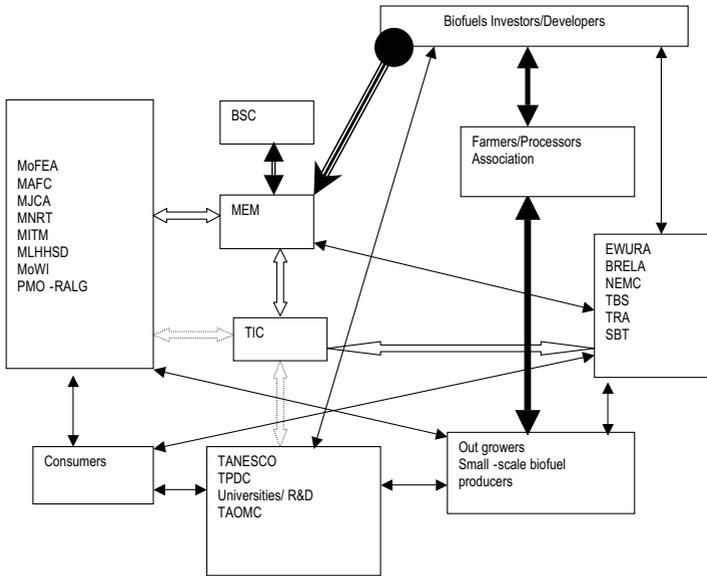
- Carried out a situational analysis for production of biofuels in Tanzania,
- Reviewed relevant policies and legal framework to support production of biofuels in Tanzania,
- Proposed the institutional and regulatory framework to support biofuels development in Tanzania, and
- Developed draft guidelines for sustainable development of liquid biofuels and co-generation in Tanzania.

In view of the diverse nature of the biofuels sector, one would expect a multidisciplinary team of expatriates to compose the National Biofuels Task Force, which is the case. The quality of the tasks already accomplished reflects the good mix of the NBTF team.

### **3.3.3 Institutional framework**

The diverse nature of the biofuel industry requires stakeholders to adhere to principles of sustainability. The draft guidelines propose several actors who will facilitate the implementation of the proposed guidelines once approved. Figure 3.3 gives a summary of stakeholders, i.e. sector ministries (i.e. MoFEA, MAFC, MJCA, MNRT, MITM, MLHSD, MoWI, PMO-RALG), supporting government agencies and bodies (i.e. TIC and BSC), biofuels investors/developers, associations of farmers/processors, regulatory institutions (i.e. EWURA, BRELA, NEMC, TBS, TRA, and SBT), outgrowers, small-scale biofuel producers, research and energy related institutions (i.e. Universities, TANESCO, TPDC, TAOMC), and consumers.

Figure 3.3 Institutional framework for implementation of guidelines.



Source: MEM, 2008

The proposed institutional framework covers a wide range of stakeholders and provides good representation of sectors involved directly or indirectly in the production of biofuels. However, production of biofuels has raised several controversies surrounding the impact on food security, environment, land and water use. For this reason the implementation team needs to be carefully formed to avoid conflict of interest among implementing institutions, if sustainability of the industry is to be attained. Examining the composition of the institutions it is clear that the formed team is composed mainly of two categories of the institutions: government institutions and agencies that include sector ministries, supporting government agencies and bodies, regulatory institutions, and research and energy related institutions. All these institutions are government affiliates that can easily be influenced by the government to meet its interests, which is a threat to the sustainability of the biofuels sector especially if government machinery is weak. Another category is that of business institutions that include developers, outgrowers, smallholder farmers, and associations of farmers/developers who are likely to be driven by profit gains rather than sustainability issues such as food security, environment, land and water. In this regard, it would be healthy to involve civil society organizations engaged in issues touched on directly by the production of biofuels such as the environment, land, water and food security. Such societies would play the role of a watch dog and raise alarm whenever implementation seems to veer from expectations. This will help to foster sustainability of the production of biofuels in Tanzania.

According to the draft guideline there will be a biofuel one-stop-center responsible for coordination, endorsement, monitoring biofuels investments and development, and a source of information on biofuels development in the country. The long-term institutional arrangement will be guided by the biofuels regulatory framework, once in place or as may be directed by the government. For the interim period the Ministry of Energy and Mining is serving this purpose. In view of the diverse nature of biofuels development, there is a Biofuels Steering Committee (BSC) chaired by the biofuels one-stop-center and composed of Permanent Secretaries from ministries that are directly involved in biofuels development. According to the biofuel draft guidelines, the responsible ministries are Energy, Agriculture, Food Security, Land, Water, Forestry, Environment, Local Governments, and Industry and Trade. While employment and community development are not mentioned as directly involved in production of biofuels and the responsible ministries are not included in the BSC, it is important to note that production of biofuels has long been linked to creation of new jobs, enhancement of rural development and improvement of rural livelihood. However, several scholars have argued that quite a big number of workers in several developing countries are working under difficult conditions as far as safety and health risks are concerned. There are also cases of child and forced labour (Dufey, 2006; IIED, 2003). There is therefore a need to assess working conditions, health and safety risks associated with agricultural jobs created by establishing a biofuels industry. If the monitoring system is to be effective one would expect ministries mandated to implement the employment policy and community development policy to be part of the Biofuels Steering Committee and not to be represented as an advisory group of experts as indicated in the biofuels draft guidelines. If they are made part of the BSC, this will give them more power in decision making especially on matters relating directly to their mandate such as employment, gender and community development.

### 3.3.4 Taxation and incentives

The draft guidelines indicate that the taxation arrangements shall be in accordance with the Tanzania taxation regime until a biofuel policy is in place or instructed otherwise by the government. According to the existing tax system, investors are obliged to comply with the following taxes: VAT 18%, Corporate tax 35% for foreign companies, and 30% for local companies, cess or produce levy 0.3% of profit, and industrial levy 6% of payroll turn over. As far as the law is concerned, VAT and corporate tax are payable to Tanzania Revenue Authority and the cess levy and industrial levy are payable to the local government authorities. Currently, the biofuels are taxed as vegetable oils, attract VAT 18% percent if consumed locally, in case of export they attract zero tariff because the investment policy exempts all agricultural products to promote exports. The corporate tax is charged once the company has recovered the investment costs, of which during the survey none of the company had started paying it. Similarly, the investment policy gives exemption to custom duty and defers VAT on capital goods such as agricultural implements and agro inputs (i.e. fertilizers and pesticides) for investment in agriculture. Since most companies involved in

export are foreign, exempting export and import taxes present unimaginable loss to the government proceeds.

While the export exemption was intended to promote export for agricultural products to foreign markets and generate foreign currency, this is unlikely to be realized because the government regulations permit a foreign investor unconditional transfer of funds through any authorized bank in freely convertible currency of net profits, repayment of foreign loans, royalties, fees charged for foreign technology and remittance of proceeds from an investment. The only official limit on transfers of foreign currency is on cash carried by individuals travelling abroad, which cannot exceed US\$ 10,000 over a period of forty days. In such an environment it is very likely that foreign firms would be able to transfer all proceeds (foreign currency) abroad and keep only operating capital in Tanzania which will not add much to our foreign currency reserve.

Again, exemption of export tax and imposing VAT for local biofuels consumption will not solve the problem of energy insecurity and saving of foreign currency reserve as a consequence of relying on import of fossil fuels foreseen as drivers of production of biofuels in Tanzania. Due to concerns on the environment and energy security, EU and USA who are the potential markets for biofuels from Tanzania and the rest of Africa are waiving tax for import of the biofuels and imposing tariff barriers for fossil fuels (Banse *et al.*, 2007). This strategy intends to promote biofuels importation in EU member states so that they can meet their ambitious targets of green energy. This trend poses severe threat to weak economies like Tanzania, because it will be more attractive for investors to export rather than sell locally. This again sends strong signals to the way we formulate our policies, unless measures are taken through tariff or non-tariff barriers to discourage export and promote local consumption, otherwise biofuels will not add value to our economy.

### 3.3.5 Land acquisition and use

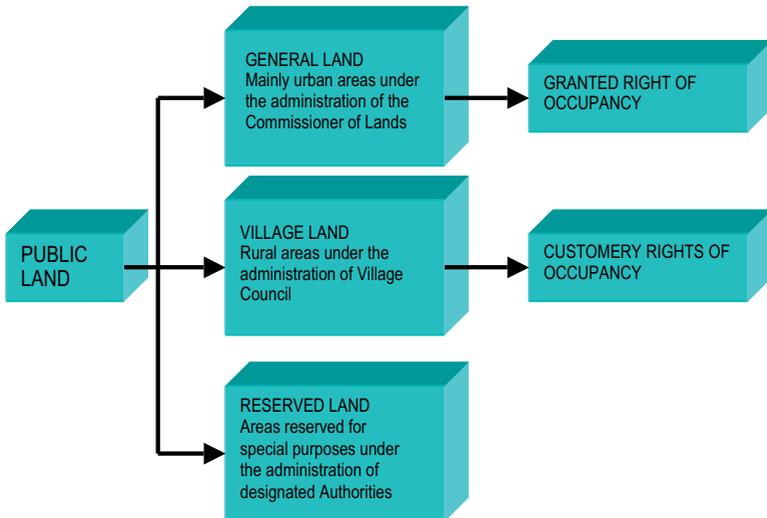
As the procedure is at present, land is reviewed and endorsed by the TIC, as the draft guidelines give this role to the Biofuels Steering Committee to ensure all sustainability criteria are met. The investment land will continue to be allocated by TIC through a procedure of land bank, and investors will apply and be given a derivative right for a specified period. The guidelines further give two more options through which investment land can be acquired. The first option is through conveyance where an investor can acquire land through buying it from another company or individual but an investor will still have to follow normal application procedures for biofuels investment. The second option is for an investor to acquire land through Village Land Act of 1999.

However, due to the challenges and controversies surrounding biofuels investment, the guidelines clearly state that village authorities will be guided by the biofuels one-stop-centre once the Biofuel Steering Committee approves the biofuel project in their area. While

guiding village authorities to grant land to investors is a good idea, it should be clear that this process is complex in itself and it involves land valuation, legal issues and compensation to the affected community members as stipulated in the Land Policy of 1999. In this respect, the one-stop-centre also should be composed of expatriates matching the requirements of the service to be offered. The draft guidelines however are silent on the composition of expatriates who should form the centre; the guidelines only state that the Ministry of Energy and Minerals is serving as the biofuels one-stop-centre. What should be clear is that the role of the Ministry is to formulate policy and regulations, and to monitor the sector performance for review to enhance effectiveness of the policy. In this case, there should be an independent regulatory authority like EWURA for licensing the production of biofuels, based on laws that will be enacted and policy to be promulgated by the government.

The draft guidelines further recognize the importance of small outgrowers and direct clearly the land acquisition procedure for this category, which is through the National Land Act of 1999 and Village Land Act of 1999. According to the Land Act of 1999 all land is public, vested in the President of the Republic as a trustee on behalf of all citizens. Figure 3.4 presents the legal framework for land allocation and recognition of property rights in Tanzania. In view of this framework, there are three categories of land, i.e. general land, village land and reserved land. General land is mainly urban areas which are under the administration of the commissioner of lands, while village land involves rural areas under the administration of the village councils. Reserved land includes areas reserved for special purposes under the administration of designated authorities.

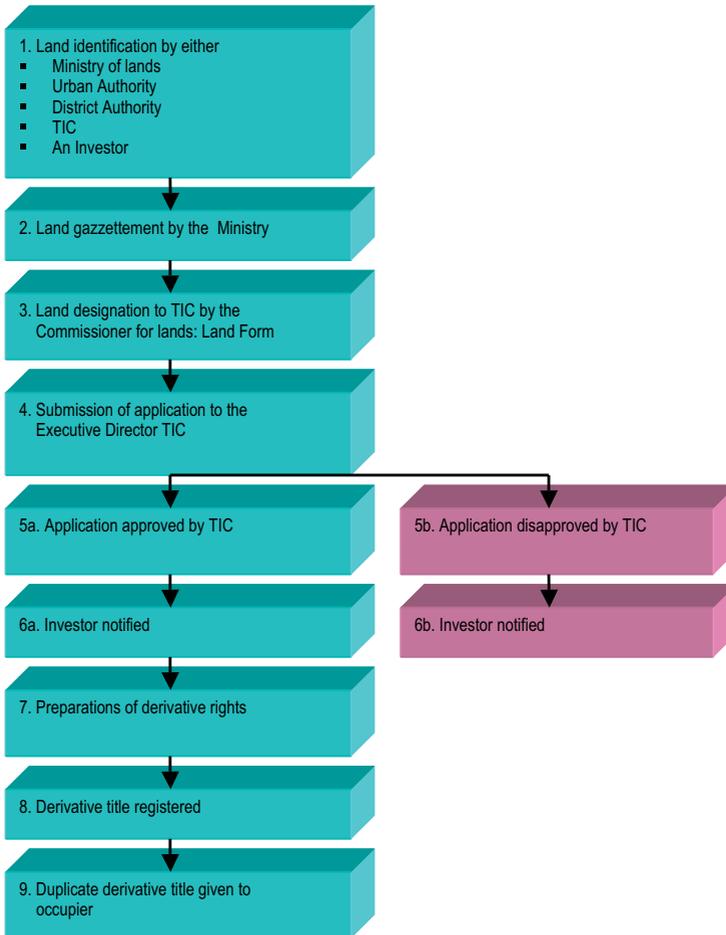
**Figure 3.4: Legal framework for the allocation and recognition of land right**



For the case of biofuels investment, most land targeted for this purpose is village land but due to legal restrictions imposed by the Village Land Act of 1999, village authorities are not allowed to offer more than 50 hectares. In case an investor requires more than 50 hectares, then the Village Council has to seek approval from the Local Government Authority, which is mandated to offer up to 500 hectares. In case the requirement goes beyond 500 hectares, the Local Government Authority seeks approval of the Commissioner for Lands, but the land must be transferred from 'village land' to 'general land' before it is granted to an investor. This process requires the Presidents' approval and according to the draft guidelines for biofuels investment, the right of occupancy is granted to TIC and TIC grants derivative right to an investor for a specified period.

However, under the law in Tanzania, occupation of land by non-citizens is restricted to lands for investment purposes under the Tanzania Investment Act 1997 and the revised new National Land Act 1999. Land in Tanzania is government property and citizens or non-citizens only lease the land from the government for 33, 66, or 99 years depending on the nature of the investment. The law does not allow individual Tanzanians to sell land to foreigners; foreigners can only lease land in Tanzania through the Tanzania Investment Centre (TIC). Figure 3.5 presents procedure to acquire derivative right through TIC.

**Figure 3.5: Procedure to acquire derivative right through TIC**



Note: Variable fees payable under 7  
Source: TIC

Examining the procedure for granting land through TIC seems to be good but the problem is still on who is responsible to identify the land for investment. If one examines Figure 3.5, there are several institutions currently involved in land identification, i.e. Ministry of Land, Urban Authority, District Authority, TIC and Investors. While there is no problem to involve the first four institutions, involving foreign investors directly to identify and negotiate land with the rural communities has had several problems. Foreign investors should acquire land through the land bank from TIC, to avoid inconveniencing both investors and local communities.

There are cases where investors have used tips to solicit consent of communities to support the idea of granting land to them, but the National Land Act and Village Land Act of 1999 requires maximum participation of citizens in decision making on matters connected with their occupation or use of land. The legal requirement is that at least 75 percent of the total community in a given village should pass the resolution to release land for investment, otherwise no land should be granted. For example, at Nyandakatundu village in Rufiji District investors in their first meeting paid each villager Tshs. 5,000/= equivalence of USD 4.00 (exchange rate USD1 = Tshs. 1,250/=) who had attended the village general assembly. Here, money was used as an inducement to push people to sign the proceedings of the meeting, which is one of the requirements for application of land acquisition. In view of this, another system should be put in place to engage investors in the process of land acquisition rather than exposing them directly to negotiate with the communities. The investors should negotiate with the government entrusted to safeguard the interest of its people because it is a democratically elected government. Communities have no capacity to negotiate land issues with investors who are advantaged with all sophisticated technologies and information compared to the villagers.

### **3.3.6 Resettlement and contract farming**

Land acquisition involves several social impacts to the community residing in a particular area intended for investment. This may involve displacement of people, loss of property and might create pressure on land resources and other social tensions; that is why the biofuels draft guidelines prohibit displacement of people for biofuels development and encourages the use of outgrowers' schemes or hybrid of outgrowers and plantation schemes. This is an important point in policy formulation to safeguard land rights of smallholder farmers, and avoid unnecessary inconveniences of having to push smallholder farmers to marginal land. Investors should be required to value addition processing investments, while production of biofuel feedstocks should be restricted to smallholder farmers that will be contracted out by processors to produce raw materials. This will not only prevent social tension as a result of land conflicts in future, but also will create a sustainable source of income to rural community, create jobs and enhance rural development.

It was further noted that the objective of all foreign biofuel companies identified during the study was to produce biofuels for export. During the field survey it was reported that Diligent Tanzania Ltd. had already been exporting bio-diesel but none of the product was sold on the local market except for a few litres reserved for company vehicles. Similarly, Bioshape Tanzania Ltd. expressed their intention to export raw jatropha seeds to Europe for further processing. This threatens the government's objective of attaining energy security as one of the drivers to promote production of biofuels. The government should impose either tariff or non-tariff barriers and set mandatory blending targets to enhance local consumption. Through this approach it will create a market locally and it will be possible to save foreign currency that would otherwise be used to import fossil fuels. Failure to set mandatory

blending targets, tariff and or non-tariff barriers, it is likely that all biofuels will be set for export and the government may not realize the objectives of energy security and foreign currency savings.

The study revealed some cases of displacement of people especially in Kisarawe, Lindi and Kilwa districts where 152, 10, and 13 people had been displaced, respectively. In Kisarawe and Kilwa districts farmers had already received compensation from SunBiofuels and BioShape, respectively. In Lindi there were some conflicts between the investor and smallholder farmers. Out of ten farmers only four had accepted compensation while six had refused compensation because the offer was very low.

While the Land Policy of 1999 clearly insist to pay full, fair and prompt compensation to any person whose right of occupancy or recognized long standing occupation or customary use of land is detrimentally affected by revocation or interference by the state, the compensation process is full of fundamental flaws, including lack of transparency, and unfairness. This was evident in Kisarawe District where 152 people had been compensated by the SunBiofuel Tanzania Ltd. The land valuation process was not allocated adequate time to effectively and fairly complete the exercise. Each village had been allocated only two days regardless of the number of people involved in the land valuation exercise, so as a result the valuation process was done in a rush, physical inventory of property in each farm was not done properly but estimated, also owners were not informed which properties were recorded for compensation. Secondly, the farm owners who were the poor smallholder farmers had not been informed about the size of their land liable for compensation, only that a few months later they received a letter from the Ministry of Lands Housing and Human Settlements Development informing them to file claims for compensation of damages and loss of land and property as a consequence of land taken for investment. The letter required claimants to file claims to the Ministry of Lands Housing and Human Settlements Development through their village councils and and that such claims should reach the Ministry within sixty days from the day the letter was served. According to the villagers, the problem was how to fill the claim forms, as they could not estimate the size of the land and value of property due for compensation because they had not been warned during the valuation process.

The rates used to pay compensation for property loss were also not reflecting the commercial value of specific properties. It is unimaginable that the total compensation for 9,000 hectares taken from 152 people in Kisarawe District attracted only a total of Tshs. 338,477,400 (Kisarawe District Compensation register, 2008). In Kilwa District about Tshs. 200 million were paid as compensation to the Kilwa District Council and the Mavuji Village Council received 40 percent (80 million) of the total compensation for offering 400 hectares of land to BioShape Tanzania Ltd. The 60 % was retained by the Kilwa District Council, and part was spent to purchase 19 power tillers which were distributed to 19 villages in the district (Key informants interview - DED's office in Kilwa District Council, 2009).

Examining the compensation, there seems to be a wide variation between locations. For example, the compensation for Kisarawe District is an average of Tshs. 37,608 per hectare, while in Kilwa District the average is Tshs. 500,000 per hectare. This variation is too big and unjustifiable. Also the value of this land per unit area (hectare) as given above is not comparable, even to the short term benefits that could be realized by smallholder farmers if they use it for food crop production. If we assume the same land for Kisarawe and Kilwa Districts is converted to grow maize under good management, farmers are assured of getting yields of between 3 and 4 tonnes of maize per hectare. If this crop is sold at peak market price of Tshs 500,000/= per tonne, it implies that the farmer would be assured of earning between Tshs. 1.5 and 2 million per hectare. This amount could be gained yearly with appreciation value over time. Converting this amount to the total land area sold to investors in Kisarawe and Kilwa Districts, that is 9,000 hectares and 400 hectares, respectively, it means that the land has a potential to generate Tshs. 13.5 billion and Tshs. 18 billion respectively, as gross income under good management practices. It is obvious from this analysis that the amount received by the communities as a once pay off compensation is a fraction (1.9%) of the projected annual income of what they could be receiving if they retained the land and grew maize for food.

The biofuels draft guidelines also insist on a number of pertinent issues which investors/developers in biofuels industry must observe; for example, the use of outgrowers schemes or contract farmers to avoid displacement of people, to enter into a contract with farmers associations on behalf of outgrowers to ensure fair prices for biofuels feedstocks/biofuels products and incorporating land owners in project land being used as partnership capital. This strategy is welcome since it will minimize incidences of displacement of smallholder farmers to marginal lands, reduce chances of over exploitation of smallholder farmers and outgrowers who will sell biofuel feedstocks to the developers and create long-term benefits to small-scale farmers by becoming shareholders in biofuel projects through use of their land.

The study found out that the prevailing price of jatropha seeds per kilogramme varied between Tshs. 100/= for contractual farmers and Tshs. 500/= for non-contractual farmers. It is interesting to note that contractual farmers received the lowest price per kilogramme and were bound by contract to sell only to a single customer. However, non-contractual farmers were free to sell jatropha seeds to any customer and the price was 500% higher than that of contract farmers as driven by market forces. The incidence of low price to contractual farmers occurred because smallholder farmers operate in isolation, not organized in cooperatives or associations where they can have bargaining power for good prices from companies, before filling in the contracts. In all cases, smallholder farmers were approached in isolation by companies and were asked to fill in the contracts documents without legal assistance to interpret them; as a result, they signed contracts without realizing the implications of the contracts. For example Diligent Tanzania Ltd. offered a

ten-year contract to farmers; the contract indicates that it will pay a minimum price of Tshs. 100/= per kilogramme of jatropha seeds. While the contract indicates that the price will change based on the prevailing market conditions, in practice farmers continued to receive a minimum price of Tshs. 100/= per kilogramme while the market price is Tshs. 500/=. This implies that if contractual farmers schemes are to be beneficial, farmers associations proposed in the biofuels draft guidelines should go to work aware these disparities and stand to negotiate prices with developers, otherwise farmers will still be losers even under contractual farming.

There are two options by which smallholder farmers can be assisted to move out of poverty. The first option, as already mentioned, is to use farmers associations to negotiate for better prices with investors on behalf of the small-scale farmers. The second option is to empower and build processing capacity among farmers associations so that they can process jatropha seeds, extract oil and add value to the products. To determine which path is more beneficial, it would be worthwhile to examine the two scenarios.

### Scenario 1: Use of contract farmers

Assumptions	
<ul style="list-style-type: none"> <li>Area under cultivation is the total land offered or in a process of being offered to investors</li> </ul>	435, 839.6 ha
<ul style="list-style-type: none"> <li>Prevailing price of jatropha per kilogramme</li> </ul>	Tshs. 100/=
<ul style="list-style-type: none"> <li>Potential yield of jatropha seeds per hectare</li> </ul>	6 tonnes
<ul style="list-style-type: none"> <li>Total potential yield from the prospective investment land (435, 839.6 ha x 6 tonnes per hectare)</li> </ul>	2,615,037.6 tonnes
<ul style="list-style-type: none"> <li>Total revenue received by selling (2,615,037.6 tonnes x Tshs. 100,000/= per tonne)</li> </ul>	261.5 billion

### Scenario 2: Value addition

Assumptions	
<ul style="list-style-type: none"> <li>Area under cultivation is the total land offered or in a process of being offered to investors</li> </ul>	435, 839.6 ha
<ul style="list-style-type: none"> <li>Prevailing price of jatropha oil</li> </ul>	Tshs. 2,000/=
<ul style="list-style-type: none"> <li>Potential yield of jatropha per hectare</li> </ul>	1,590 litres
<ul style="list-style-type: none"> <li>Total potential yield from the prospective investment land (435, 839.6ha x 1,590 litres per hectare)</li> </ul>	692,984.964 tonnes
<ul style="list-style-type: none"> <li>Total revenue received by selling (692,984.964tones x 2,000,000/= price per tonne)</li> </ul>	1.39 trillion

In view of the cost benefit analysis above, it is clear that selling processed products reaps higher prices than selling unprocessed seeds to investors, because of value addition. This implies that if the government is to help farmers move out of poverty, it should create conducive environment to support farmers associations to own processing plants so that farmers can process jatropha seeds and add value to them. The jatropha oil can still be used in different beneficial ways for example, making medicated soap, fuel for cooking stoves and oil lamps. The by products such as seed cake can be used locally to generate biogas, fertilizer, and briquettes which can be used for heating purposes. By supporting small scale farmers there are several advantages, as follows:

- Land conflicts will be reduced, because then smallholder farmers will grow such crops on their own land.
- Adopting jatropha as a biofuels feedstock does not compete directly with food crops because it is a non-edible oil seed and grows well on marginal land that is not suitable for food crops.
- Energy security will be enhanced, because it is more likely that local companies are going to produce biofuels for local consumption as opposed to foreign companies which are export-oriented, as noted earlier.
- Using biofuels locally will enhance foreign currency saving, equivalent to the amount of import of the fossil fuels foregone as a result of using biofuels.
- Exporting surplus of biofuels will generate foreign currency and improve foreign currency reserve.
- The production chain of jatropha is likely to create sustainable employment at all stages from production, processing and selling. It will increase income of the rural poor and enable them get out of poverty.

However, promoting small scale farmers does not mean there should be no large scale investment in the biofuels industry. Since this is a new technology, the government should encourage a limited number of foreign large-scale investments to serve as role models where small-scale farmers can learn and apply production techniques in their farms. But the focus should be to involve contractual farmers as well whenever large-scale firms are to be established.

### **3.3.7 Sustainability guidelines for biofuels development**

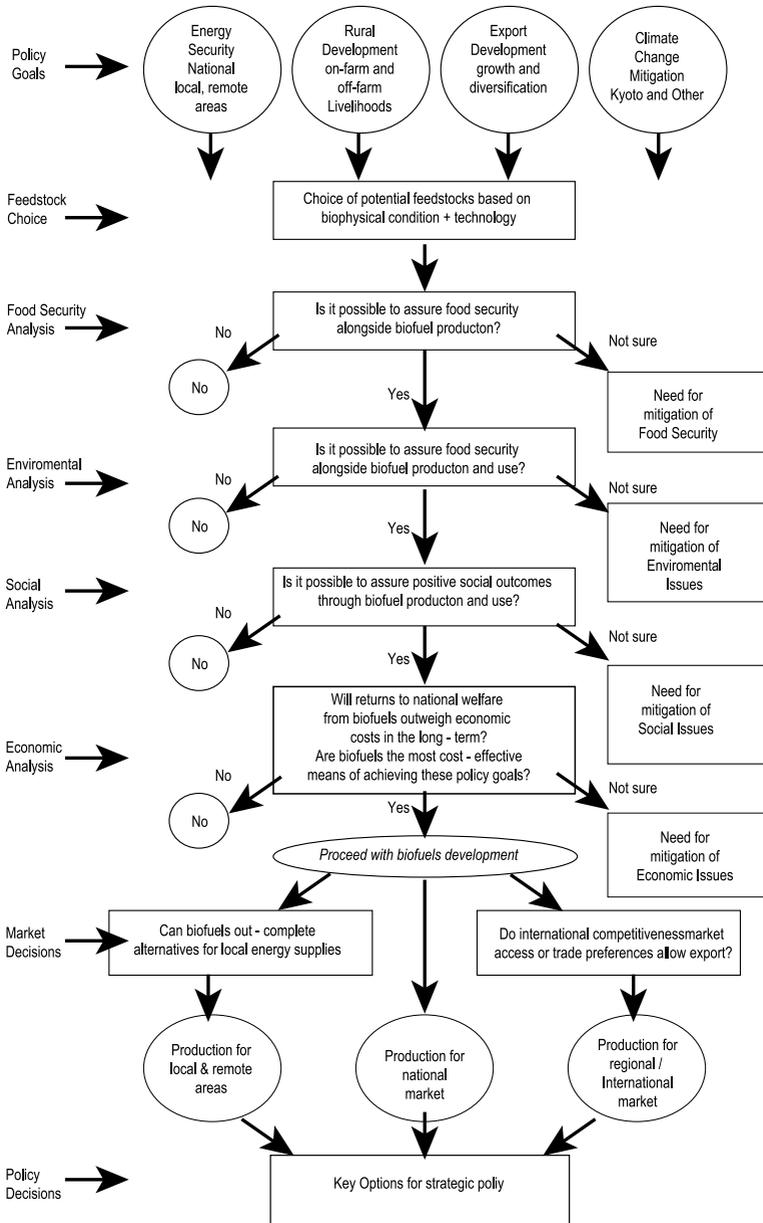
Several authors have written about the threat the production of biofuels might have on food security, environment, land and water (UNEP, 2007; UN-energy, 2007). The establishment of large energy crop plantations might compete for land with food crops, by expanding into areas rich in biodiversity and this could result into food insecurity and significant loss of biodiversity. Large scale plantations for production of biofuels may also be associated with increasing soils and water pollution (from fertilizer and pesticide use), soil erosion and water run off, with subsequent loss of biodiversity. There is also evidence that production

of bioethanol requires considerable amounts of water. In China, for example it takes an average of 2,400 litres of irrigation water to support corn enough to produce one litre of ethanol, while in the US 400 litres of water are needed especially because they mainly grow rain-fed corn. In India where sugarcane yields and conversion efficiency are lower, 3,500 litres of water are required (De Fraiture *et al.*, 2007). Although in Tanzania the amount of water for the same purpose has not yet been established, these findings from other countries are signalling red light for countries like Tanzania where the problem of water shortage is quite pronounced.

The draft guidelines for biofuel production recognize the negative impacts that may arise as a result of expanding production of biofuels in Tanzania. Some of the foreseen negative impacts include unavailability of food, rise in food prices, and all sorts of conflicts involving land, ecosystems, environment, society, water, water quality etc. Aware of all these, the guidelines have set strategies to enhance sustainable production of biofuels in Tanzania. For example, they insist on sustainable use of water for production of biofuels and all biofuels investments should contribute to the social wellbeing of the communities. To ensure food security, the guidelines require all investors in biofuels to use a portion of the land acquired for production of biofuels to grow relevant food crops, by applying the state of the art agricultural techniques which will subsequently assist to transfer technology to neighbouring farmers. While this is a good idea it is not certain how practical the idea will be in the absence of policy and appropriate laws that require investors to comply.

Furthermore, the guidelines restrict conversion of potential land for crop production to production of biofuels and prohibit forestry clearing without approval of the Biofuel Steering Committee. While this seems to reflect concerns of the impact of production of biofuels, it is not adequate to stand alone as a criterion for sustainability because the Biofuels Steering Committee that is charged with the responsibility to decide whether certain arable land should be converted to biofuel production or not, and whether certain forest land should be cleared for biofuels investment or not, is not provided with the guidelines to consult when making decision. This is likely to lead into subjective judgement in the course of implementation. To avoid subjectivity in decision making there should be standard procedures stipulated in the biofuels guidelines which the BSC will rely on when making decisions to approve or disapprove a certain project. There are several decision models for sustainability criteria developed by different scholars, and this study proposes one developed by CFC (2007), which seems to be relevant to the Tanzanian context (Figure 3.6).

Figure 3.6: Proposed decision tree for strategic national choices for biofuel development



Source: Modified from CFC, 2008

Environmental Impact Assessment (EIA) is mentioned as a precondition for approval of any project intending to invest in production of biofuels and must also comply with the sustainability criteria outlined in the biofuels draft guidelines. Since the sustainability guidelines are inadequate to make decisions for biofuels investment it is also proposed that EIA should use the same decision criteria presented in Figure 3.6. Another aspect that deserves mentioning is that while the guidelines indicate that among other things production of biofuels will enhance energy security and improve foreign currency reserves due to reduced import bills of fossil fuels, it is still silent on mandatory blending targets of biofuels to create a need for local consumption. If there are no mandatory blending targets it is likely that all biofuels will be for export and the country will continue importing fossil fuels and spending quite a big proportion of foreign currency. Consequently, the government may not be able to derive benefits from the sector.

#### 4.0 MAPPING OF BIOFUELS COMPANIES IN TANZANIA

During the research it was deemed necessary to identify and examine in detail the companies currently involved in production of biofuels in Tanzania, establish their nationality, location, the targeted biofuels crops, timing of the project, and the number of people employed. Table 4.1 presents a list of companies operating in Tanzania, their nationality, location, size of the land they occupy for production of biofuels, targeted crops and investment status.

According to the Ministry of Agriculture, Food Security and Cooperatives a total of 44 companies are engaged in production of biofuels in Tanzania; eight of them are investors who have been certified by the Tanzania Investment Centre (TIC). However, not all companies have started operation; some are in different stages of fulfilling legal requirements to start production or they are in different stages of acquiring land or mobilization of resources.

**Table 4.1: List of biofuels companies operating in Tanzania**

S/No	Investor and nationality	Location	Size of land (ha)	Targeted crops	Remarks
1	Diligent Tanzania Ltd. (Dutch)	Arusha Municipality	10,000	Jatropha and Croton	Operational, working with outgrowers schemes, with 35 employees. Have an oil pressing machine with a capacity to press 1,500 litres of oil per day. However, due to limited supply of seeds it produces between 6,00 and 800 litres per day.
2	SEKAB Tanzania Ltd. (Sweden)	Rufiji District	100,000	Sugarcane	Process of acquiring land in progress.
		Bagamoyo District (RAZABA & Bagamoyo Prison)	22,000 + 500	Sugarcane	Seed cane farm planted and a reservoir for irrigation water constructed on the seed cane nursery. Plans to employ 15,000 workers.

3	BioShape Tanzania Ltd. (Dutch)	Kilwa District	80,000	Jatropha	400 ha pilot farm planted, with 300 employees. Integrity of EIA is questionable.
4	SunBiofuel Tanzania Ltd. (British)	Kisarawe District	9,000	Jatropha	Investor requested 50,000 ha granted 9,000 ha. Investor in the final stages of acquiring land. Plans to employ 5,000 workers.
5	PROKON Renewable Energy Ltd. (Germany)	Mpanda District	1,750	Jatropha	Use contract farmers, about 200 farmers are engaged, the production is still low.
6	BioMassive Tanzania Ltd. (Sweden)	Lindi District	50,000	Jatropha	Established nursery but investor absconded. Handed over all operations to the Lindi Local Government Authority. Plan was to employ 4,000 workers.
7	Bio-energy Tanzania Ltd.	Bagamoyo District	16,000	Jatropha	Investor requested 30,000 ha but got 16,000 ha
8	Tanzania Biodiesel Plant Ltd.	Bagamoyo District	16,000	Palm oil	Investor requested 25,000 ha but received 16,000 ha. The process of acquiring derivative right is underway.
9	Shanta Estates Ltd.	Bagamoyo District	14,500	Jatropha	Agreement with villagers signed and process of land acquisition in progress.
10	Clean Power Tanzania Ltd.	Bagamoyo District	3,500	Palm oil	Land acquisition in progress.

11	CMC Agric-Bioenergy Tanzania	Bagamoyo District	25,000	White sorghum	Request for land approved, asked to prepare land use plan.
12	Info Energy Ltd. (UK based)	Mvomero District in Morogoro	5,818	Jatropha	Land acquisition in progress, EIA in progress.
13	SYNERGY Tanzania Ltd.	Rufiji District	20,000	Sugarcane	Plan to create 5,000 new jobs.
14	AFRICAN GREEN OIL Ltd.	Rufiji District	30,000	Palm oil	Operational
15	Biodiesel East African Ltd. (Kenya)	Bahi District	10,000	Jatropha	
16	KIKULETWA Farm Ltd. Alovera plantation (British)	Arusha Chini (Moshi)	400	Jatropha	Operational
17	Fuel Stock (British)	Mtwara	120	Jatropha	Status unknown
18	SUMAGRO	Unknown	3.1	Jatropha	Planted 5,000 plants of imported tissue culture from India.
19	JCJ Co. Ltd.			Jatropha	Unknown
20	KAKUTE (Tanzania)	Arusha	2.5	Jatropha	Demonstration plot operational
21	KITOMONDO Ltd. (Tanzania)	Bagamoyo District	2,000	Jatropha	Operational
22	KINGA	Kagera		Jatropha	Sells seeds to Diligent
23	DONESTER	Kongwa District	2,000	Jatropha	200 ha already planted
24	DIADEM	Mpanda District		Jatropha	

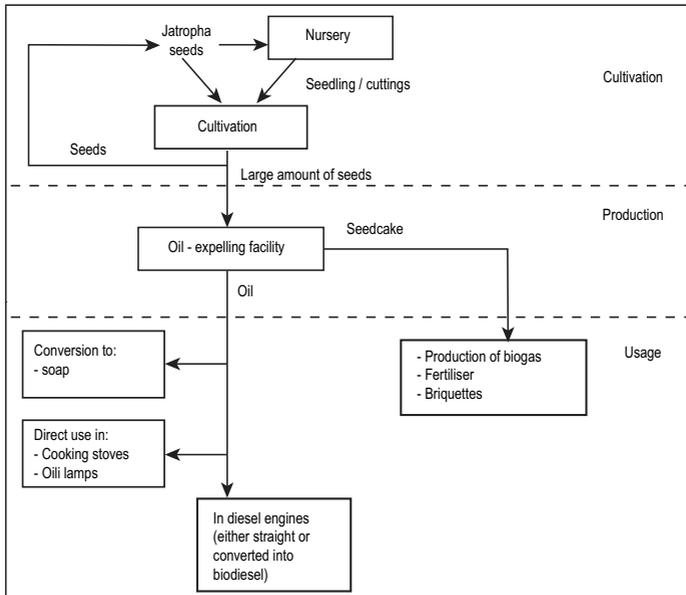
25	FELISA (Tanzania/ Belgium partnership)	Kigoma Region	10,000	Palm oil	Out of the 10,000 ha, 5,000 ha expected to be outgrowers. Already acquired 4,258 ha disputed and currently in court.
26	LUXVERA Ltd.	Morogoro Region			Started using contract farmers
27	Export Trading Co. Ltd.	Korogwe District, Mkomazi	20		Started using contract farmers
28	ECO Green Fuels Tanzania Ltd.	Mikese, Morogoro	500		
29	PRINCIPLE ENERGY				200 million gallons of ethanol and 300 MW of power
30	Euro Mine Export Ltd.	Mikese, Morogoro		Jatropha	
31	SAVANA Biofuels	Handeni, Dodoma and Kongwa	5,000	Sunflower and Jatropha	
32	TANZANIA GREEN (Tanzania)		200	Jatropha	
33	CEPA	Kilosa		Jatropha	
34	NESSTER	Cost region (Disunyala) Lindi	50	Jatropha	
35	RUBANA FARM	Mwanza	400	Jatropha	
36	Rural Upgrade Trust	Kilwa		Jatropha	
37	National Service (JKT) (Tanzania)		700	Jatropha	Operational

38	CHAWAGWA	Kisarawe	200	Jatropha	Looking for partners to start
39	Sumbawanga Local Government (Tanzania)		50	Jatropha	Land preparation
40	Bunda Local Government (Tanzania)			Jatropha	Mobilization of resources
41	Nkasi Local Government (Tanzania)		20	Jatropha	Land preparation
42	Mpanda Local Government (Tanzania)		50	Jatropha	Land preparation
43	Mkuranga Local Government (Tanzania)		6	Jatropha	Trained 50 extension staff
44	Same Local Government (Tanzania)		50	Jatropha	Land preparation

Source: Ministry of Agriculture, Food Security and Cooperatives

Many companies have shown interest to invest in different agro-fuel crops due to investment incentives offered by the government. Most investors prefer *Jatropha curcas* L., as feedstock of their choice (Table 4.1). The *Jatropha*, among other things, gives a chain of products. For example, its oil can be used in diesel engines, in oil lamps, cooking stoves, and in soap-making. The seedcake can be used for producing biogas, fertilizer and briquettes (Figure 4.1). The *Jatropha* tree can reduce soil erosion in arid and semi-arid lands. In addition, *Jatropha* seeds are not edible thus they do not pose direct competition with food crops. Therefore, *Jatropha* could be a policy option for biofuels feedstocks if Tanzania is to decide to go for biofuel production, as long as it is not grown on arable land. The only foreseen competition will be on labour which can be managed under good labour management practices.

Figure 4.1: Chain of jatropha products



Source: Eijck, 2006

Land suitability classification for Tanzania indicates that marginal land occupies 39 million hectares of land that is about 41 % of the total land area of Tanzania, which is about 94.4 million hectares. Given the yield potential of Jatropha which is about 1,590 litres of oil per hectare (Zeller and Grass, 2007), if investment utilizes only 50 % of marginal land, there will be a yield potential of about 31.01 billion litres of biodiesel. Consistent with the Tanzania economic survey (2005) estimates that the country's annual petroleum requirement will reach 1,736,566 metric tonnes in the year 2010, this production meets local demand by far and provides a surplus of 29,269,434 metric tonnes for export. According to Ugarte (2006) oil prices above USD 45 to USD 50 per barrel are seen as favourable for biofuel production, for low cost producer countries like Tanzania. Similarly, in Brazil, where productivity and efficiency of sugarcane ethanol production is relatively cheap and unmatched by any other country in the world, bioethanol is cost competitive with gasoline only during periods when oil prices are higher. Xavier (2007) contends that ethanol provides fewer miles per gallon than gasoline; in this case, the price of ethanol is competitive only when it costs no more than 70 % of the price of gasoline.

n the same context, if we assume that the consumption of biofuel replaces 100 % consumption of petroleum, there will be a saving of more than USD 1.6 billion at a price of USD 147 per barrel. Assuming the same price is given for export of surplus, the government will generate about USD 27.06 billion. This is the benefit we get from land that could not be utilized for food crop production, and at the same time this crop helps to conserve fragile soils in arid and semi-arid areas. Jobs are also created for the surrounding communities which have been disadvantaged for years in terms of socio-economic opportunities.

While several companies have identified *Jatropha* as a biofuel feedstock for biodiesel production, as shown in Table 4.1, other companies have identified other agro-fuel crops such as sunflower, palm oil, white sorghum, sweet sorghum, and sugarcane. For example, SEKAB, a Swedish-based company acquired 22,000 hectares of land from the former RAZABA ranch in Bagamoyo and 500 hectares from Bagamoyo prison for seed cane nursery and intends to expand its activities in Rufiji District where it has applied 100,000 hectares for sugarcane production. According to the Ministry of Agriculture, companies like Tanzania BioDiesel Ltd., African Green Oil Ltd., FELISA and Clean Power Tanzania Ltd. are targeting palm oil. Other companies and their targeted feedstocks, in brackets, are CMC Agric-Bioenergy Tanzania (white sorghum), Abengoa Bioenergy Company (sweet sorghum), and SAVANA biofuels Ltd. (sunflower), all intended for bio-diesel production.

Crops like sugarcane, palm oil, sweet sorghum and sunflower currently earmarked for biofuel feedstocks in Tanzania are directly linked to food security. As a matter of policy, such crops should not be grown for biofuel purposes. Promoting such crops for biofuel poses threatens food security not only in terms of use but also in terms of land (space) and labour resources involved in the production process. Although literature clearly has it that *jatropha* grows well on marginal land (Eijck, 2006; FAO, 2009), and on land where food crops are not grown, experience in Tanzania shows that investors are targeting fertile lands suitable for food crops. Typical examples are the virgin lands earmarked in Rufiji and Kilwa by SEKAB and BioShape respectively, and the arable land previously used by villagers in Kisarawe District that is currently allocated to SunBiofuels. According to Huggins (undated), about 60 percent of land suitable for irrigation in Tanzania is in Rufiji basin. If this land could be expanded for food crop production through irrigation, it could feed the whole of Tanzania and still there would be some surplus for export.

## 5.0 POTENTIAL IMPACTS OF BIOFUEL PRODUCTION

This section presents the potential impacts of biofuel production. Specifically, it presents the impacts on food security, lives of the people, land and the environment in the study area.

### 5.1 Impact on food security

A number of developing countries including Tanzania that produce or have the potential to produce biofuels are also food insecure. In Tanzania for example, it is being reported that 60 percent of Tanzanians are food insecure and live in rural areas, and about 36 % live below the poverty line (URT, 2007). Raising production of biofuels with the accompanying incentives will result into a worse situation as far as food security is concerned since vital food crops will be diverted to biofuels. As a result, rural communities will not have the financial ability to meet the resulting increased prices of foodstuffs. According to Nyberg and Ramsey (2007) the establishment of energy crop plantations and the impact of the increasing demand for liquid biofuels on food prices might affect at least two key dimensions of food security – availability and accessibility. Availability is likely to be limited due to reduced supply of food crops and competition for production resources such as land, labour and water, between food and energy crops (Doornbusch and Steenblik, 2007). On the other hand, accessibility entails purchasing power, which is likely to be limited especially for rural and urban communities who rely on net importation of food. The impact is expected to be severe for poor women who are the majority, and who stay home to take care of their households.

In view of the above, there have been several debates on the impact of production of biofuels on food security. There are those who believe that sustainable production of biofuels is possible without having any negative impact on food security, and that it all depends on how the whole operation is managed. According to von Braun and Pachauri (2006), production of biofuels can create a demand for energy crops such as sugarcane, soybeans, rapeseeds, and palm oil that are grown by rural farmers and stimulate rural economic growth. In addition, farmers can increase their incomes by growing energy crops such as *Jatropha curcas* on degraded or marginal land not suitable for food crop production. On the other hand, sceptics argue that production of biofuels will threaten food supplies for the poor and it is likely to draw the world into a 'food versus fuel crisis' (Doornbusch and Steenblik, 2007). The argument is based on the fact that any diversion of land from food or feed production to production of energy biomass will influence food prices from the start, as both compete for the same inputs such as fertilizers, water, labour and land.

While supporters of biofuels claim that non-food feedstocks such as *jatropha* are only grown on marginal land, in reality this has not been the case. During the study, it was noted with great concern that *jatropha* and sugarcane have been allocated to prime lands

in Kisarawe, Rufiji, and Kilwa Districts. For example, Rufiji River basin which is the largest catchment basin in Tanzania, and which covers 177,142,000 ha (177,420 km<sup>2</sup>) and has the highest potential for both hydropower and agriculture in Tanzania, has already been targeted for biofuel investment that is likely to create pressure on other land uses and subsequently food security. The Rufiji River basin covers 20 percent of the total land area of Tanzania, has 10 percent of Tanzania's population and 30 percent of its surface water (Manongi, undated). The basin is divided in three parts: the lower Rufiji valley, Kilombero valley and the Usangu plains. A feasibility study done by NORAD in early 1980's estimated that if the entire basin was utilized fully under irrigation, it has the potential to feed Tanzania and rest of Africa. This study further indicates that under irrigation in the upper Rufiji River basin - Usangu plains (208,000 ha) and little Ruaha (4,800), it is possible to practice two cropping seasons. In the rest of the Basin, i.e. Kilombero valley and Lower Rufiji basin with 329,600 ha and 80,000 ha respectively, it is possible to practice three cropping seasons. Given the standard yield of paddy for example of 6 tonnes per hectare this translate to a total of 9,926,400 tonnes, which is about 177.65% of the requirement of cereal crops in Tanzania. The cereal requirement for the whole country is about 5,587,547 tonnes.

In other incidences for example, where DILIGENT is operating, jatropha is being promoted to be grown as live fence or an intercrop with other food crops, which is still making use of portions of fertile soils whenever it is intercropped. Thus, the claim by the DILIGENT manager that jatropha does not have any negative impact on food security may need to be revisited. While it is being promoted as a crop that can be intercropped with other crops, it was revealed by a respondent in Mareu village at King'ori Ward in Meru District of Arusha that Jatropha prevents sunshine from reaching the maize crop when intercropped, so it reduces maize yields significantly. The following excerpts present a story of one of the respondents in the surveyed villages:

“I own seven acres of land. Diligent came to our village in the 2005/2006 season and sensitized us to adopt jatropha and grow it as a new cash crop that could be used to produce fuel for use in vehicles and industries. They started by signing contracts with individual farmers and later on established groups of jatropha growers. Each farmer was promised a loan of Tshs. 20,000 (equivalent to USD 16) to carter for cultivation, planting and weeding. This amount was to be recovered when selling the seeds to the company. Failure to repay the amount within a growing season, would subject the balance to an undisclosed interest rate. Diligent experts told us that jatropha can be intercropped with maize and beans in the first three years. I was one of the few farmers who was willing to grow it but not on contract; so I set aside 0.5 acre for jatropha and tried to intercrop it with maize and beans. Throughout the seasons I have realized that it keeps our sunshine from the maize crop when intercropped, and this reduces the yield of maize significantly. Before intercropping jatropha with maize, I used to get five bags of maize from the same plot but now I hardly get two bags. Given the current price of Jatropha, which is 100 shillings (0.08 USD) per kilogramme of seeds being offered by the company, I do not think I will be able to earn enough money to buy the same amount of food, which I would have harvested from the same plot if I had grown maize alone. Thank God I grow jatropha only on a small portion of my land.

When asked why he had not entered into a contract with Diligent, he said that he wanted to be free to sell his produce to any other customer.

“There are many people coming to buy jatropha seeds. I am serving as both an outgrower and a collection point. I buy seeds from other growers at Tshs. 300 a kilogramme and sell the same to Diligent at Tshs. 400 to Tshs. 500. Sometimes, we have people coming all the way from Kenya and would buy at Tshs. 600 to Tshs. 1000 and I would sell the seeds to them as well, because I am not bound by the Diligent contract. So, the contract would not have given me this freedom and flexibility to sell to other customers. I can collect up to 100 kilogrammes of jatropha seeds per day and sell when I have in stock 500 kilogrammes. Children and women are mostly involved in the collection of seeds in our village.. Those who signed Diligent contracts sell their seeds for between Tshs. 100 and Tshs. 150 per kilogramme.”

Although Diligent told the research team that the company was buying seeds at Tshs. 100 and would start buying at Tshs. 150 in the coming season, it was discovered that the company was offering different prices to individuals or groups of farmers in different localities. These variations in price were also noted in Likamba Village in Arusha where the respondents in a focus group discussion said they were being paid Tshs. 100, while the *jatropha* women growers in Kikatiti Village sold their seeds at Tshs. 250 per kilogramme. Imara Women Group was selling at between Tshs. 100 and Tshs. 150 per kilogramme. This is evidence that the price was very unstable and location-specific. Although Meru District still has insightful levels of production of biofuels, and too low to impact on food security, the price offered by the promoting companies, Diligent in particular, is too low to enable the farmers cope with the ever increasing food prices. The low price as well has demoralized small-scale farmers in the area from further developing the crop. Given the existing situation, the crop no longer poses serious threat to food security because many farmers have retracted from growing the crop because the price is not attractive enough to make any meaningful investment. If prices increase substantially, more land is likely to be allocated to bioenergy crops to replace food crops. With the current pressure on land in Meru District, the impact will be severe compared to other districts in the study area and is likely to be much more pronounced for women who are traditionally denied land ownership.

Biofuels were also found to be associated both good and bad things as it was revealed by the respondents at Chakenge Village in Kissarawe District; below is the story:

*“One of the good things is the opportunity for employment, which the company (SunBiofuel) has promised us. Some individuals have also received compensation for their land. Thirdly, the investor promised to build us a hospital, roads, a new village government office and schools. However, one of the the bad things is food shortage. This is because the diversity of crops which we grow at present will not be grown in bulky in the near future, especially when our population will have doubled. My instinct tells me that a large part of our land will be owned by guests and we shall not have enough land to continue growing the varieties of crops we are enjoying today. Moreover, all these forests around our villages will be cleared to give way to *jatropha* plantations. We won’t be able to get fish from the ponds or water bodies in the forest. Likewise, it will be difficult to obtain firewood and building poles for building our houses. It will also be difficult to find a place to hang our beehives. Access to forest products like wild fruits, vegetables and mushrooms will be limited. We sometimes sell these products and get money to buy other food stuffs.”*

The story prophesises serious threat to rural livelihoods and long-term food security. Thus, the potential deforestation associated with the establishment of biofuel plantations in Kisarawe, Rufiji, Bagamoyo and Kilwa Districts will definitely affect the surrounding communities in many ways, more importantly in increasing their food insecurity. Similar concerns have also been registered by UN-Energy, (2007).

Throughout the study it became apparent that food prices have been increasing while productivity of agricultural products particularly that of food crops has been decreasing. Several reasons were advanced to account for the low productivity in the area, such as drought, existence of destructive wild animals (elephants and baboons) and disengagement of the youth from agricultural activities. At the time of the survey, a “pishi” (which is a local unit of measurement equivalent to 1 kg) was selling at Tshs. 1200 (USD 0.96) for cereals and legumes, while that of rice was selling at Tshs. 1500 (USD 1.2) A kilogramme of beef was selling at Tshs. 4500 (USD 3.6). These prices were equivalent to 50 percent increase compared to the last season’s prices. These prices were quoted at Mavuji Village, in Kilwa District a village that has offered land to BioShape Tanzania Ltd. and where many villagers are employed by the company.

The sustainability and quality manager of BioShape Company in Kilwa was interviewed for her views on the impact of the biofuels project on food security. She was of the opinion that the biofuels sector has the potential to employ a lot of people, leaving few in the surrounding communities to grow less food, thus impacting on food security and secondly, the people working in the biofuels plantations will be privileged to learn a lot about new agricultural practices, which they could apply to improve productivity in their own farms. According to this senior company’s official, the level of agricultural knowledge among the local communities is still very low. Therefore, if they could learn and transfer the same to their own farms, productivity will be improved so that the question of food security will have been taken care of. In addition, she said the company also uses its tractors to work on community farms at a very small fee of about Tshs. 10,000 (USD 10) per hectare to enable the communities increase the area under cultivation. While this might be commendable, only two farmers had benefited from this arrangement, and no reasons were advanced why other farmers had not been covered. Farmers lamented that they were unable to buy inputs such as fertilizer and pesticides, even after the company had ploughed the land for them. They added that they lacked collateral to secure loans from banks and use it to purchase agro-inputs. During the Agricultural Sample Survey in 2002/03 there were similar findings; it was revealed during the survey that only 3 % of small-scale farmers had accessed credit from financial institutions for agricultural purposes. It would be helpful if the investors would support the communities living around these companies with improved technology and agro-inputs.

Although the companies assume that plantation workers would emulate what the companies are doing to improve food productivity, they overlook the fact that the plantation workers have no time to work on their own farms since they spend most of their time working in the plantations. To testify to this, below is a story by a resident at Mavuji village.

*“I own five acres of land, but surely I cannot do anything with this land. Ever since I was employed by this company, I kind of abandoned my farm. I have an old parent (father) who cannot take care of the farm either. I allowed people to use it for free, so it does not turn into bush. Imagine, I have to be at the workplace at 7:30 in the morning and finish work at 5:00 in the evening. It takes me about an hour to reach home. When I arrive home, it is already 6:00 in the evening and usually I am exhausted. So, I have no time to attend to my farm, and even if I decide to hire a person to work in my farm, I still cannot pay him/her because my salary does not even meet my own needs.”*

The information obtained from the Focus Group Discussions showed that food insecurity is normally felt in the months of December to February, almost every year, especially in the villages where Biofuel companies are operating. This information is consistent with the report by the local government officials in Kilwa District, who said that the district has not been very stable as far as food security is concerned.

The BioShape Company paid the Local Government Authority Tshs. 200 million as compensation fees to the district and respective villages for losing part of their land. It was from this money that the Local Government Authority decided to purchase 19 power tillers that have been distributed to various Wards in an attempt to increase productivity and safeguard the communities from food insecurity. This development is of particular importance because in all the districts there are some by-laws binding the local communities to grow 2 acres of food crops and 2 acres for cash crops. Despite the existing by-laws, the villagers have not been able to achieve these targets perhaps because of their rudimentary tools like the hand hoe, which is still being used. The Prime Minister of the United Republic of Tanzania, Hon. Mizengo Pinda, during the Sokoine Memorial Lecture in 2008, reported that in Tanzania about 70 percent of farmers still use the hand hoe for cultivation, 20 % use the ox-plough and only 10 percent use tractors.

In Bagamoyo District, SEKAB intends to use the former Zanzibar ranch (RAZABA). However, the land and soils in this area have been categorized as class three land, that is not very good for agriculture, although rich in biodiversity. RAZABA land is surrounded by fertile land currently occupied by farming communities (Makurunge villagers). The plan is for SEKAB to establish sugarcane plantations and benefit from the irrigation water from the

permanent Wami River. According to Makurunge's village chairman, SEKAB officials went around the surrounding village communities to try and convince them to accept the intended sugarcane production while the company promised to provide a reliable market for their sugarcane. Furthermore, the company promised to provide sugarcane planting materials and plough farmers' fields using the company's tractors. As a result of such initiatives, there is looming danger on food security in the area because small scale farmers who will be subcontracted by the company are likely to be attracted to grow sugarcane as a biofuel feedstock rather than for normal domestic use. This observation is critical especially for Tanzania that has never attained sugar self-sufficiency. Subjecting sugarcane for multiple uses creates unnecessary competition and therefore sugar shortage.

## 5.2 Social impact of biofuel production

As said earlier, it is claimed that the introduction of biofuel investment in different areas of the country is expected to improve livelihoods of the people in the areas where these investments have been established and in the country at large. Investment in biofuel production might also have some social implications. During the discussion with different stakeholders it was felt that small-scale investors of biofuel production offer greater opportunities for employment generation and poverty alleviation than large-scale investors who are involved in production and processing of biofuels. This is due to the fact that large-scale firms have limited employment capacity; and as the firms mature they tend to adopt sophisticated production technologies to reduce cost of production. Consequently, they retrench employees as a strategy to increase production efficiency and attain a competitive edge. By so doing they fail to create new jobs like small and medium enterprises, which have long production chains and are able to create employment at each point of the production chain.

On the other hand, small scale systems have been assisting small scale farmers especially women to engage in biofuel production and to process the outputs into various products in order to add value and improve their income and livelihoods. A typical case is KAKUTE in Arusha that trained small-scale farmers, especially rural women, to process jatropha seeds. For example, there are several women groups engaged in processing jatropha seeds into various products like jatropha oil and medicated soap. The processed jatropha oil is sold at Tshs. 2,500 per litre to customers for various uses such as running motor vehicles (DILIGENT), and household heating and lighting. Jatropha soap and raw seeds are sold at Tshs. 1000 per piece and Tshs. 100 per kilogramme, respectively.

It was also noted that investors adopted two dominant modes of production – large-scale production in plantations, and outgrowers scheme or contract farming. According to what was observed during the field research, most foreign investors prefer large-scale plantations. It is only when they cannot secure enough land that they also employ the outgrowers scheme or contract farming as a strategy to complement the requirement

of the biofuel feedstocks. In this case small-scale farmers are engaged on contractual bases to supply biofuel feedstocks to processors. A typical case is SEKAB Tanzania Ltd. in Bagamoyo and Rufiji where they could not secure adequate land. As a result, they are planning to use hybrid (plantation and contract farming) mode of production, until they are able to secure adequate land in Kilwa District.

Both modes of production adopted by investors present socio-economic implications that need to be understood before embarking on business. In the course of the study, it was necessary to examine three possible scenarios that small holder farmers can engaged in, in biofuel production and identify the most beneficial scenario to small-scale farmers. The first scenario was for small-scale farmers to sell raw jatropha seeds through contractual farming to large scale plantations of processors. The second scenario was for small-scale farmers to process jatropha seeds into oil and or process further into jatropha medicated soap. Table 5.1 presents the outcome of the cost benefit analysis and shows that soap is much more beneficial per hectare followed by jatropha oil which enables smallholder farmers to generate Tshs. 2,862,000 and Tshs. 636,000 per hectare, respectively. The findings imply that if smallholder farmers are to benefit from jatropha production they should be supported to add value and sell finished products rather than raw seeds to processors or large scale investors.

**Table 5.1: Cost benefit analysis of various jatropha products**

Scenario 1	Yield (Kg/ha)	Gross Income (Tshs/ha)	Production costs (Tshs/ha)	Profit (Tshs/ha)
I. Raw Seeds	6,000	6,000Kg/ha x Tshs/kg 100 = Tshs 600,000	(60% <sup>1</sup> x Tshs 600,000) = 360,000	240,000
<b>Scenario 2</b> ii. Jatropha oil	1,590 litres	1,590 litres x Tshs 2,000 = Tshs 3,180,000	(80% <sup>2</sup> x 3,180,000/=) = 2,544,000	636,000
iii. Jatropha soap	1,590 litres	(1,590 litres/2.5 litres x 30 bars) = 19,080 bars	(85% <sup>3</sup> x 19,080 bars x Tshs 1000) = 16,218,000	2,862,000

<sup>1</sup> Production cost of biofuel feed stock per hectare

<sup>2</sup> Production costs of biodiesel per hectare

<sup>3</sup> Cost of soap production per hectare

The large-scale plantation of biofuels involves conversion of big land into energy crop plantations as revealed in the study area especially in Rufiji (SEKAB), Kisarawe (SunBiofuels) and Kilwa (BioShape). It requires intensive use of resources such as land, water, labour, and other agro-inputs. It also involves massive clearing of land for plantations, which results into biodiversity loss. The idea of acquiring land for biofuel crops might imply landlessness, deprivation and social upheaval for displaced small-scale farmers.

As far as outgrowers schemes are concerned, it was also felt that majority of the people will not concentrate on food crop production and engage in production of biofuel crops, of which market is readily available. The same argument as already given is that production of food crops will decrease and accelerate the problem of food insecurity in different areas and in the nation at large. The problems of food shortage will in turn raise the price of food crops which is already high. It is already evident that the amount of money earned from sale of biofuel products and/or salary earned from working in the biofuel companies is not adequate to cover the cost of buying food. In Arusha where outgrower schemes are already being practiced, the impact has already become evident. The same trend is expected in other areas where biofuel companies are expected to operate.

By law, investors who are to invest in a particular area in Tanzania are expected to offer various social services suitable to the communities where they will be operating like construction of schools, roads, dispensaries, and other social infrastructure. In light of this, the biofuels companies are also expected to do the same as part of corporate social responsibilities. When the respondents were asked whether they had any idea of the services that the investors were supposed to deliver to them, all agreed that they had been promised such services when the investors convened meetings in their respective areas. Some companies have started to fulfil their promises of the social benefits to respective communities; for example, in Kilwa where Bioshape operates the company has constructed a maternity ward in Kilwa Kivinje, a dormitory for girls in Mandawa, and water tanks in Mavuji and Nainokwe villages. Also the company has built a kitchen and offered catering services to schoolchildren free of charge. In addition, the company has provided computers and furniture such as beds, chairs and desks to Ilulu Secondary school.

### **5.2.1 Employment created by companies**

Among the drivers of production of biofuels in Tanzania is to create new employment opportunities in rural areas, thus leading to increases in income generation and rural development. According to the Integrated Labor Force survey of 2006 the unemployment rate stands at 11.0 percent of which 1.0 million are males and 1.3 million are females. In such a situation, any project targeted to address the problem of unemployment is likely to be welcome. The potential of biofuels industry in employment creation is quite notable in other countries already engaged in the production process. In Brazil for instance, biofuels employ about one million workers of which women make 14 percent of the total employees

(Balsadi, 1998). Similarly, in China the liquid biofuel programme is projected to employ more than nine million in the next few years (Bhojvaid, 2006; Moreira, 2005).

The structure of biofuel programmes targeting Tanzania is not different in terms of projections of the number of employees to be created once in full operation. Each biofuels company intending to invest in Tanzania is, among other social benefits, expecting to create jobs for the surrounding communities. During the field research among other aims, the focus was to determine the number of new jobs created, status of working conditions, and health and safety issues associated with the agricultural jobs created by the establishment of biofuel industries. During the research, six companies namely SEKAB, SunBiofuel, BioMassive, BioShape, Diligent and KAKUTE were visited. With regard to the number of new jobs created, we noted there was wide variation from earlier projections, but this might be simply because most companies were either at the set-up stage or they were in different stages of acquiring land.

Since it was not easy to determine the projections of direct employment for each company interested to invest in the biofuels industry, the number of employees presented in this report was derived from the average factor of four companies out of six visited during the research (Table 5.2). The analysis excludes two companies i.e. KAKUTE and DILIGENT because they adopted contract farming or outgrower schemes. For this reason they are not creating direct employment. The average factor was arrived at by dividing the projected number of employees of the four companies (i.e. SEKAB, SunBiofuel, BioMassive, and BioShape) by the total land area applied for investment (33,200 employees/ 248,000 ha = 0.1339 employees per hectare), then the factor (0.1339 number of employees per hectare) was multiplied by the total land area applied for investment by over 40 companies in Tanzania (i.e. 435,839.6 ha x 0.1339 = 58,359 employees). From the calculations it is clear that if we assume that all the current applications for land for production of biofuels are approved (Table 4.1), the biofuels industry has a potential to create 58,359 new direct jobs.

**Table 5.2: Projection and the actual number of jobs created**

Company	Land size		Direct employment created		Remarks
	Applied	Offered	Projection	Actual	
SEKAB (Bagamoyo)		22,000	-	-	Established seed cane nursery
SEKAB (Rufiji)	100,000	50,000	15,000	Nil	In process of acquiring 50,000 ha of land
SunBiofuel	18,000	9,000	5,000	-	Final stages of acquiring land
BioMassive	50,000	7,500	3,200	5	The project manager resigned; all operations handed over to Lindi District Council
BioShape	80,000	400	10,000	300	34,000 ha awaiting President's approval
Diligent			Unknown	35	Working with contract farmers
KAKUTE	-	-	Unknown	Unknown	Working with contract farmers

Table 5.2 summarizes the status of direct employment for the visited companies during field visits. Of all the companies, BioShape is at an advanced stage in terms of land development and direct employment created so far. The company employs 300 workers of which 94 are permanent employees (i.e. 79 % males and 21 % females) and 208 casual laborers. The projection of the company is to create 10,000 new jobs in ten years if it secures 80,000 ha of land requested from the government. The basic farm operations in progress are land clearing, cultivation, planting and management of a nursery for *Jatropha* seedlings and cuttings. All these operations are taking place in 400 ha of land offered by Mavuji village, intended for demonstration purpose. Up to the date of the field visit, in mid-February 2009, about 150 ha had been planted with *Jatropha* (Figure 5.2).

While SEKAB has not created jobs in Rufiji District, because it is still in the process of acquiring 50,000 ha of land in Bagamoyo district, it is not clear how many employees are engaged in managing the established nursery to raise seed cane to be planted in 22,000 ha acquired from RAZABA ranch. SunBiofuel Tanzania Ltd. is in the final stages of acquiring 9,000 ha in Kisarawe District, and the company has paid compensation to 152

people in the surrounding communities. It has not employed any workers because it has not started operations. However, the company's projection is to create 5,000 new jobs. Similarly, BioMassive has projected to employ 3,200 workers, meanwhile it has established a *Jatropha* nursery at Nyengedi village, employed five workers on temporary basis as nursery attendants and security guards. Diligent and KAKUTE which are both in Arusha: have adopted outgrowers schemes. Diligent employs 35 workers on permanent terms. This includes office assistants, technicians, engineers, and field officers. Although Diligent and KAKUTE have employed a few permanent workers due to the mode of production which they adopted (i.e. outgrowers scheme), they have also created jobs to many people in the production chain.

**Photo 1: *Jatropha* plantations in demonstration farm**



Job creation has been one of the strategies used by investors to secure investment opportunities in most developing countries including Tanzania and they have created high expectations among community members, politicians, and government officials. In the study area community members admitted they had released their land with the expectation of being employed. As it is normally the case, employment creation is a strong weapon used to win a battle against someone who is desperate looking for ways to survive, like many rural Tanzanians.

While biofuel production is expected to generate more jobs, it is clear that the created jobs will not compensate for the loss of land as explained earlier. In addition, job opportunities will provide salaries/wages, health benefits and social security to too few individuals who will secure permanent employment since most jobs are not only unskilled but also are seasonal. Hence, as the industry becomes more efficient due to agro-mechanization of farm operations, there will also be decreasing labour demands.

It is also expected that the employment opportunities will attract migrants from one area to another looking for jobs in the biofuel companies. The host communities will have the advantage of earning money from house rent and other services rendered to the immigrants. However, in Tanzania there are more than 126 ethnic groups and each of these has its own culture and ways of living. For example, there are different ways of bringing up the youth including teaching them how to dress, respect elders and good behaviour in general. It is anticipated that the mixing of people as a result of labour migration will have some influence of the culture of both immigrants and host communities. The outcome might be a 'hybrid culture' probably to the detriment of original local values.

Another concern that was raised is the worry of increasing broken marriages. People who will be coming to seek jobs in the biofuel companies might have some love affairs with the males or females of the host community and hence increase tension to many married couples. In addition the problem of HIV/AIDS that is already earmarked as a stumbling block in many areas of the country is expected to escalate due to the expected increase in sexual immoralities. The immigrants are also expected to create pressure on a few available social service facilities such as health services, schools and water in the host communities. Social services like schools, health facilities are always insufficient in most parts of Tanzanian and therefore immigration of more people in the areas that already have problem of scarce resources might worsen the life situation of most societies. All these concerns are anticipated to create chaos that will result into conflict among members of the societies where biofuel companies are to invest.

### **5.2.2 Impact of agro-mechanization on employment**

Taking into account our present environment and the current trend of technological development, attaining employment targets or projections made by these companies remains questionable. Technological advancement allows rapid increase in agro-mechanization of agricultural production especially in large-scale plantations like companies investing in the study area. In such an environment, the number of agricultural jobs associated with the production of liquid biofuels is likely to decrease over time. Johnson and Rosillo-Calle (2007) contend that a sugarcane harvester (machine) for example can replace up to eighty (80) cutters in a sugarcane industry. With the government waiver of import tax for agricultural capital goods to investors, as an incentive for investment in Tanzania, most investors are likely to import sophisticated technologies in the biofuel industry, as it grows. As an example, we have the kind of technology employed by Bioshape Tanzania Ltd. for land clearing, crushing of tree remnants and spreading of mulching materials on the farm; all these operations are mechanized. Furthermore, according to the management, BioShape is planning to introduce a Jatropha harvesting machine for trial purposes. This is clear indication that they are intending to shift from human labour to agro-mechanization, which is a threat to human employment and great disappointment for community members

who will have sacrificed their land for employment opportunities. While agro-mechanization should not be discouraged in the biofuels industry, the community should be educated on its consequences, so that they make informed choices, when releasing land in return for promises about employment.

### 5.2.3 Working conditions, health and safety of employees

With regard to working conditions, health and safety risks associated with the agricultural jobs created by the biofuels industry, the study focused on judicial use of agrochemicals, provision and use of protective gear, availability and accessibility to first aid services, working hours, wages and provisions for establishing a workers union. During the field research it was noted that although the management of the companies were aware of health and safety regulations, compliance varied from one company to another. It was evident that some biofuel companies provided partial protective gear such as overalls, hand gloves and gumboots as basic protective gear but could not provide respirators, goggles or hats for workers who sprayed agro-chemicals. At the same time company's spray gangs in one of the companies indicated that they were recruited to spray agro-chemicals without proper training or safety of equipments, something which may have serious implication for the long-term health condition of these workers. In reality this is contravening the *Occupational Health and Safety Act of 2003, Section 65*, which clearly states that "every person who employs person's in agricultural activities shall be under the obligation to ensure that no employees is exposed to: hazardous machines and equipment or harmful animals and insects; or infectious agents or allergens; or hazardous chemicals; or hazardous environment while doing work as agricultural worker". In view of this situation, it is important for the companies to give priority to safety and health of their employees to avoid the associated health risks. They could also be prosecuted for violating the law.

In terms of working hours, some companies abide to a standard 8-hour working day. However, workers from other companies complained that they were working for longer hours (between 24 hours and 36 hours) and without overtime payment. According to employees of some companies, employees work 9 hours a day (45 hours a week) which is contrary to a standard 8 hours a day (40 hours a week). This again is contrary to Tanzania labour laws; it should be strictly avoided by all means by the responsible organs in order to create appropriate working conditions for workers in the biofuels industry. While this could be handled by a workers union, unfortunately all visited companies have never provided opportunity for their workers to establish workers unions, as required by labour laws in the country. This observation is consistent with other studies which linked production of biofuels feedstocks such as sugarcane and palm oil in developing countries to unfair conditions of employment, health and safety risks (Dufey, 2006; IIED, 2003). Given this situation, various interventions need to be taken by various stakeholders including civil society organizations responsible for human rights in collaboration with the responsible government ministries to end human exploitation in the biofuels industry.

While literature indicates that working conditions on plantations including those of biofuels feedstocks tend to have differentiated gender impact; for example, company owners tend to prefer women workers as they are able to pay them less than their male counterparts (ILO, 2002). Fortunately in the study area the situation is different, the majority of employees are males and the payment of wages is therefore not gender-biased. One notable issue, which deserves mentioning, is that a significant number of workers in the study area are employed as casual workers without overhead costs, social security, and medical assistance. Even where they are employed on permanent terms, workers have no legal assistance even to translate employment contracts. This was the case with BioShape and Diligent. Furthermore, there were cases where workers who could not read and write English in Kilwa were given employment contracts written in English by BioShape Tanzania Ltd., and required to sign without a clue what the contents entailed. While employment contracts are basic rights of employees, it is important that there should be mutual understanding between the two parties, before signing up the contracts, otherwise there are possibilities for employees to sign unfair deals. In the absence of workers unions, employees may not be able to realize and demand some of their basic rights from their employers because of little understanding of their entitlements associated with their respective carriers.

Looking at the wages and salaries, all companies were seen to effect payments according to the Tanzanian Labour Laws. In Tanzania there is legislation in place that indicates a minimum wage, sector by sector, as enacted in January 2008. According to the Tanzania Minimum Wage Act for the private sector, regarding large labour-intensive and export oriented enterprises like those in biofuels industry, the minimum wage is Tshs. 80,000. In the study area the minimum wage offered by companies to permanent employees varied from one company to another, ranging between Tshs. 90,000 and Tshs. 120,000. In light of the minimum wage paid to permanent workers, the wage paid in biofuels companies is slightly above the rate proposed by the government. Apart from a salary, employees are also entitled to a 28-day annual leave, employer's contribution to national social security funds, and health benefits for those on permanent terms. It was also noted further that companies preferred to engage seasonal labourers instead of permanent workers because the former are paid less compared to permanent workers and they are not entitled to health insurance, payment for annual leave or other overhead costs, which are usually paid by employers to permanent employees. For example, in Kilwa Districts casual labourers employed by BioShape were being paid Tshs. 3,000 a day, they worked five days a week and wages were paid after every two weeks (Tsh 30,000).

### **5.3 Impact on the environment**

One of the major reasons for promoting production of biofuels in Tanzania is to enhance environmental sustainability in the light of reducing greenhouse gas emissions and mitigate the effect of global warming produced by fossil fuels (MEM, 2008). Although biofuels hold a number of promising prospects, they also present serious environmental challenges on

land (soils), water resources and biodiversity. The impacts on these resources are mainly due to agricultural production and the effects are set to be even more if agriculture is intensified. According to Zeller and Grass (2007) attaining environmental sustainability requires putting in place appropriate policy frameworks, and institutional and technological innovations. While these factors are crucial to the sustainability of the environment, in Tanzania they have not been put in place to support biofuel development; this poses a threat for the long-term benefits of the sector.

Investment in biofuel crops needs to account for the environmental impacts on soils, water resources, climate change and the ecosystem. It entails the exploration of three principal environmental resources: land, natural vegetation and water. As for most agricultural commodities, biofuels feedstocks also grow well in areas endowed with regular rainfall, fertile soils with easy accessibility to water sources. These factors are also essential for human settlement. Therefore, shifting to biofuels is associated with land use changes and hence more environmental impacts.

Throughout the study, it was observed that most investors in biofuels are still in the preliminary stages of setting up their companies. For instance, SunBiofuels in Kisarawe is yet to start any operation while SEKAB in Bagamoyo established seed cane nursery on a 240 ha land; BioShape in Kilwa is setting up jatropha trial plots on a 400 ha land; and BioMassive in Lindi has started with a nursery of Jatropha seedlings on a 10-acre plot. In Arusha, DILIGENT and KAKUTE companies are currently operating through the outgrowers scheme. With regard to this, the report presents some environmental impact assessment based on what was observed in the field and what is expected in terms of the impact of production of biofuels on the environment, focussing on land, biodiversity, and water resources.

### 5.3.1 Impact on land

The introduction of production of biofuels in both large and small scales is associated with changes in land use systems; thus, one of the most telling impacts of biofuels is the change in land use that might take place. The growing use of agricultural commodities for production of biofuels coupled with the establishment of large scale production of biofuel feedstocks is likely to contribute to the increasing pressure on land for various uses. Land as a resource is the most important single item here when it comes to environmental impact assessment because it is the custodian of all the other natural resources.

The study found that biofuel initiatives in Tanzania are largely characterized by acquiring large tracts of land by the investors. As pointed out earlier in this report, more than 40 companies have shown interest in acquiring land for biofuel feedstocks cultivation in Tanzania (Table 4.1). Several foreign and local companies have started initial trials on the production of biofuels. It was established that a total of 435,839.6 hectares of land have

been earmarked for production of biofuels in different parts of the country, mainly Bagamoyo, Kilwa, Rufiji, Kisarawe, Mpanda, Lindi, Morogoro, Mtwara, Kilimanjaro, Arusha, Dodoma, Mwanza and Kigoma. As also noted, these companies are in different stages of setting up company operations, while the government has no policy or regulatory framework to regulate the industry. As a result the biofuels investments have created several land use conflicts which could otherwise be avoided.

While politically, it has been pointed out that biofuels feedstocks will be grown on marginal land, this has not been the practice. For example, Rufiji River basin is the largest catchments basin in Tanzania covering 17,742,000 ha (177,420 km<sup>2</sup>) and has the highest potential for both hydropower and agriculture in Tanzania. According to Hugins, 60 percent of land suitable for irrigation lies within the Rufiji River basin and if this land was fully utilized for agriculture, it has a potential to produce 9,926,400 tones, which is about 177.65% of the requirements of cereal crops in Tanzania. The total cereal requirements for Tanzania are only about 5,587,547 tonnes. Consistently, the feasibility study done by NORAD in 1980's indicated that if the entire basin had been used for agriculture at the time, it had a potential to produce enough food crops to feed Tanzania and the rest of Africa. With the advancement of agro-technologies since 1980's this statistics is still valid today. In view of this fact, definitely the current move to allocate such prime land for biofuel production must have negative implications on food security.

As the price of fossil fuels increases, hydropower becomes a cheaper source of power with little environmental impact. Rufiji River basin is estimated to have a hydropower potential of approximately 3,700 megawatts (Manongi, undated). Mismanagement of this basin would have direct effects on these various functions and their values. Similarly, Kisarawe, Bagamoyo, Kilwa, Mpanda, Morogoro, and Kigoma are targeted for the same purpose. Choosing these areas is an indication that biofuels companies are targeting fertile land with high potential for crop production. If this trend remains unchecked, it is likely to create serious social tensions among people as they fight for land in the near future. The study also found that the process of land allocation for biofuel investment has already displaced 152 villagers in Kisarawe and 13 in Kilwa Districts and compensations for the lost land and crops have been affected by the SunBiofuel and BioShape companies, respectively. The people who were displaced were not provided with alternative land, so after being displaced they will certainly encroach other areas which will start building pressure on land.

As the pressure on land grows, interested companies in biofuel are still talking of using what would otherwise have been "idle", "marginal" or "underutilized" land. This is definitely a misconception that ought to be corrected because the so called marginalized lands have multiple uses by the local communities. The study revealed that the communities are benefiting in many ways from such lands, for instance, they provide pasture for their livestock, trees for bee-keeping, grasslands for game, and as source of food and other non-timber forest product. This was narrated by one informant, thus:

*“Most people in our village and in the district depend largely on RAZABA forest. Although the RAZABA area is not owned by our village, we are still benefiting quite a lot from this forest reserve. Our major concern is what will be our fate when SEKAB starts its operations? Although it was prohibited by law, people used to collect firewood, medicinal plants, weaving grass, pottery soil, building poles, wild vegetables, fruits and mushrooms and more importantly charcoal. The charcoal you find around the village and even in town, all comes from the RAZABA forest. Grazing is also carried out in the forest.” (Focus Group Discussion in Makuruge Village in Bagamoyo District).”*

Similar concerns were registered in Kisarawe and Rufiji Districts. Firewood and charcoal are dominant energy sources for use by most Tanzanian rural communities accounting for more than 98 percent of the household energy consumption because of lack of alternative energy sources, such as electricity. Considering this, the expected massive land clearing will put the livelihood of the rural communities at stake, that is to say the dependency of rural communities on common pool resources coupled with massive clearing of vegetation is expected to greatly contribute to the scarcity of common pool resources in future. Hence, the fear expressed by villagers surrounding the projects is genuine, for they know they will eventually be denied of common pool resources, which they have been using for subsistence.

### **5.3.2 Impact on biodiversity**

#### **(a) Impact on vegetation and agro-biodiversity**

The land use changes associated with the establishment of biofuel plantations especially in Kilwa District have already started impacting the surrounding communities in various ways. As noted in Kilwa District, particularly in Mavuji Village where BioShape is conducting its activities, the plantations have already replaced the natural vegetation that is mainly dominated by miombo woodlands and patches of coastal forests. The miombo woodlands in Tanzania are important sites which belong to the Global 200WWF list of important biodiversity eco-regions. The coastal forests on the other hand are recognized globally to be rich in endemic species to be given important conservation priority as biodiversity hotspots. The total mangrove area of Tanzania for example is approximately 50,000 ha of which 32,000 ha (64%) is concentrated in the Rufiji Delta (Manongi, undated). Promoting production of biofuels in the area directly threatens the survival of these resources which have economic value.

Todate, there is a growing concern over land because of the competing alternative uses such as forest reserves, agriculture and settlements. The global demand for

biofuels has already created big pressure on land demand for biofuel plantations as observed in the study areas. These plantations are expanding into areas rich in biodiversity or which have certain vegetations of particular importance in the ecosystem. According to the UNEP (2007), large-scale production of biofuels may replace high productivity agricultural areas with biodiversity poor monocultures. This is particularly important with the situation in Tanzania in which thousands of hectares of land that are currently covered by natural forests are set to be cleared up for establishment of biofuels plantations in Kisaraswe, Bagamoyo, Rufiji and Kilwa Districts. Furthermore, in Tanzania all areas earmarked for production of biofuels are largely occupied by dense natural vegetation of forests. In Kilwa Masoko where BioShape is operating, about 50 percent of 400 hectares of forest land have been cleared for a jatropha trial plot at Mavuji Village and 34, 000 ha will soon be cleared after the official lease has been granted to the investor. Land clearing which has started in Kilwa is a threat to biodiversity; it also involves clearing of threatened forest species such as East African Blackwood (*Dulbergia melanoxyton*) or “Mpingo” in Kiswahili, which takes about 70 to 100 years to reach harvesting age. The East African Blackwood is one of the valuable trees in Rufiji, Kilwa, Lindi and Bagamoyo. In view of the trend of the land clearing and growing investment of biofuel production, the species is under threat.

Clearing of natural vegetation or plant communities as is the case in Kilwa District, and in the near future in Bagamoyo, Rufiji and Kisarawe Districts for large-scale monocropping and the replacement of local crops with sugarcane or jatropha crops for biofuels, might lead to simplification of agro-biodiversity. According to FAO (2007), such a simplification would cause a reduction in levels of agro-biodiversity. Reduced biodiversity in this case affects directly or indirectly the availability of food, fodder, fiber, fuels and biomedicines obtained from diversity of animals (domestic and wild), plants including crops, forests and forest products and fisheries.

**(b) Impact on marine organisms, endemic species and their habitats**

Almost all the areas earmarked for production of biofuels in the study area are prime areas covered with natural vegetation. These cannot be regarded as marginalized lands by any definition. For example, it was found that the RAZABA area belongs to the East African Coastal Forest Zone whose dominant vegetation types include marine forests, thickets, woodlands, bush lands, grasslands and forests. These are of particular importance to the ecosystem. For example, the mangroves which occur along the Indian Ocean, Wami and Ruvu rivers trap terrestrial sediments, litter and nutrients and serves as important breeding sites for marine organisms. The coastal forests are also known to be rich in endemic species. Rufiji and Kilwa areas are mainly dominated with miombo woodlands and patches of coastal forests. Given the current demand of biofuels, all these ecologically important plant communities are targeted to be cleared out for biofuels plantations.

During the study, it was learned that land, particularly in Mavuji Village in Kilwa District, had been opened up as a result of removal of valuable natural vegetation cover for large scale trials of jatropha. Deforestation removed the vegetation cover on the land and has made it more vulnerable to agents of soil erosion, especially now when the biofuel plants like jatropha have not been established properly to hold the soil firmly while protecting it against erosion. In addition, land clearing in Mavuji Village has caused direct loss of biodiversity and obviously a disturbance in the ecosystem. Thousands of acres of land largely under natural forests/vegetations will in the near future be cleared to open up the land for production of biofuels (Figure 5.3). Also, another interesting aspect noted during the study was that while the government has restricted export of logs, some of the companies are manufacturing garden furniture from fallen trees for export. Although this is economically feasible to avoid loss of wood products during land clearing, one may not be sure if the government is earning any revenue from the exportation of such finished products. If not, then the government should find ways of tapping this source to generate revenue from secondary products of the biofuel projects.

It should be noted that, jatropha is a potential weed and an invasive plant species as well, whose ecological impacts to the environment, especially when it is grown as a stand alone crop (monoculture) is yet to be established. Moreover, jatropha is known to transmit the cassava superelongation disease and it serves as an alternative host plant for African cassava mosaic virus which is transmitted by white flies (*Bemisia tabaci*). Cassava is one of the major food crops, largely grown along the coastal regions of Tanzania where biofuel companies are settling. Subjecting such a crop to any threat has a direct implication on food security.

**Photo 2: Land clearing in Mavuji village**



It has been reported that the risk of agro-ecosystems to diseases and pests is higher with fewer crop varieties species grown over large areas, making such systems more dependent on pesticides (IUCN/DFID, undated). Although no disease or pest outbreak has been reported so far following the introduction of *Jatropha* in the study area, its introduction ought to be done cautiously. In line with this, it was noted in Arusha and Meru Districts that Diligent and KAKUTE companies are promoting expansion of *jatropha* through outgrowers scheme without taking into account the associated risks in future. It is therefore advised that pilot crops should not be allowed for expansion by the smallholder farmers before adequate research is done to ascertain their environmental impact. Both large-scale production and outgrowers schemes would only be useful after the impact of growing such new crops has been established. Accordingly, the introduction of *jatropha* in cassava growing areas, particularly Rufiji, Kilwa, Lindi and Kisarawe Districts, need to be done cautiously to avoid the risks associated with it in future.

**(c) Impact on wildlife**

Another important observation was that the SEKAB project site is adjacent to the Saadani National Park. Thus the project area is within the home range of many animals and shares many species with the park. Given the vegetation type in the RAZABA ranch, it serves as an important breeding area for mammals such as elephants and birds, reptiles, amphibians, fish and many other invertebrate groups of living organisms. The area has high diversity of both resident and migratory bird species. Based on the information from the residents of Mavuji village which is very close to the RAZABA area, more than 25 species were reported to reside in the area. According to the IUCN red list, at least 34 species of mammals occurring in RAZABA area are threatened. Hence, the expected massive clearance of vegetation in RAZABA area will certainly result in the loss of valuable habitats for most species available in the earmarked project area.

**5.3.3 Impact on water resources**

With regard to water resources, the study revealed that many investors are requesting for prime lands with natural vegetation as it is the case for Kilwa, Rufiji, Kisarawe, and Bagamoyo Districts. This will bring in negative impacts to the environment partly from the massive clearance of natural forests and absorption of water resources. Most of the areas earmarked for production of biofuels in the study areas are forest or woodland areas endowed with various water resources (along major rivers and flood plains), indicating a huge potential for irrigation. Establishing biofuel crops in such areas is expected to create pressure on the availability and accessibility of water resources. Consequently, this will impact food security negatively due to the competing use of water resources for food crop production and production of biofuels.

As pointed earlier in this report, jatropha and sugarcane are major crops being promoted for liquid production of biofuels in the country. For instance, while jatropha is promoted as a crop in 'marginal' areas due to its ability to withstand drought, the study revealed that the area requested for jatropha plantations represent the most fertile lands suitable for food crop production in the country. It is unimaginable that most land in the coastal regions is favoured by biofuels investors in the pretext of being marginal lands. This study noted that the determining factors on the side of biofuels investors in their application for land are not the marginalized or underutilized lands but rather rainfall, soil nutrients and infrastructure. This perhaps explains why Tanzania coastal areas are on top of the list as opposed to the arid and semi-arid areas in the country. Besides, the coastal areas have port facilities, a factor which further indicates that the locally produced biofuels will be for export. A good example to cite here is SEKAB, which intends to produce bioethanol locally from sugarcane in Bagamoyo and Rufiji for export. Although it is in the national interest to have all export value-added, BioShape in Kilwa intends to export raw biofuel seeds to its Terneuzen Factory in the Netherlands. The foreseen danger associated with these undertakings would be a denial of employment opportunities along the value addition chain among indigenous Tanzanians. As a result, the government would also be denied of export gains and untapped technical skills and technology transfer in the process of value addition.

Large scale production of biofuels and processing will increase withdrawal of large volumes of water from both surface and underground water resources. For instance, jatropha plants in Kilwa trial plots were grown through watering. Although there is no irrigation system in place, water is obtained from the nearby Mavuji River and some boreholes that have also been constructed for the same purpose. It is projected that most biofuel plantations will require irrigation particularly sugarcane which is a heavy feeder crop. Likewise, although jatropha is claimed to grow on marginal lands with little rainfall requirements, the experience in Mavuji Village tells that large plantations (economies of scale) will compel investors to seek to grow it in fertile land and even through irrigation. While the use of agrochemical levels is currently minimal, perhaps because most biofuels activities are still in the preliminary stages, it is expected that in future their use will increase when biofuel activities have intensified, leading to problems of underground water pollution. Thus, land productivity is threatened to be impaired in future as a result of polluted water resources.

## 6.0 LESSONS LEARNED

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- The bulk of global production of biofuel is still consumed domestically in developed countries like EU, Japan and USA. However, with mandatory blending targets in these countries expected to increase, consumption of biofuel will not match geographically with the scaling up of production. The expected mismatch between demand and supply presents export opportunities for low cost producers.
- Tanzania has a huge potential of biofuel production if well-managed, especially if it involves smallholder farmers. It may contribute to create new employment and become a sustainable source of income in rural areas and enhance energy security. These benefits all together address concerns of rural women in Tanzania who are the majority, and who are involved in collecting firewood as a major source of energy, and practise subsistence farming that has not helped much to improve their livelihoods.
- The foreign large scale plantations of biofuels in Tanzania may not be a suitable mode of production under the existing policy environment since it involves taking up large pieces of land that may create immense pressure on land in the near future. This may lead to social conflicts as the population grows. Similarly, these companies may not be able to address the problem of energy security and foreign currency saving since most of these companies are foreign and perhaps strictly export-oriented.
- While there are many reasons for Tanzania to promote biofuel production, the conceptual initiatives, technological base and investment capital are externally driven. At present, the biofuel industry is dominated by developed countries that may not necessarily be motivated by compassion for the poor, but driven by self-interest and profit-making. In the absence of policy and regulatory framework, Tanzania may not be able to benefit from the sub-sector as expected.
- The guidelines are not enforceable by law and therefore will not address the need to bind investors to conditions that will ensure smallholder farmers and the nation as a whole benefit from the biofuel industry. Therefore, the government should see the urgent need to formulate a policy and regulatory framework before the nation loses good bargain during the interim period.

## 7.0 CONCLUSION AND RECOMMENDATIONS

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### 7.1 CONCLUSION

The global policy goals that have driven production of biofuels in the world can be used to explain the current shift to biofuel production in Tanzania. Primarily, Tanzania has been motivated by the concerns over an unprecedented increase in price of fossil fuel and hence the need to reduce import bills, save foreign currency equal to the value of imports substituted, mitigate the problem of climate change through reduction of greenhouse gases, create employment, markets for agricultural energy crops and diversify rural economy. The government is therefore doing all it can to promote biofuel investment, and over forty companies have indicated interest and are in different stages of the investment process. While this is happening, there is no policy governing investment decisions, a situation that has contributed to *ad hoc* investment arrangements.

In the absence of such a policy, the government has been caught in a situation where it has had to borrow some clauses of other policies to guide investment decisions. However, these policies were formulated for other purposes, and for this reason, they are not adequate for biofuels investments, due to the complexity of this kind of investment. After the government had realized this, it formed a National Biofuel Task Force mandated to formulate a regulatory and institutional framework to regulate and provide incentives for development and growth of the biofuel industry in Tanzania. The NBTF has released draft guidelines for sustainable development of liquid biofuels and co-generation in Tanzania, which are open for discussion by various stakeholders. Regarding the draft guidelines, this study is of the opinion that they are not enforceable by law and therefore will not address the need to bind investors to conditions that ensure smallholder farmers and the nation as whole benefit from the biofuel industry. This calls for an urgent need for the government to formulate a biofuel policy before it loses good bargain during the interim period.

Despite absence of a regulatory and institutional framework to govern biofuel investments, Tanzania has huge potential for biofuel production. It is endowed with diverse climatic conditions that can support growth of various biofuel feedstocks, adequate marginal land of about 39 million hectares that can be converted to biofuel production with minimal competition with food crops, abundant labour force and a gateway for export via the three harbours (i.e. Dar es Salaam, Tanga and Mtwara), along Indian Ocean. While these potentials are there, the sustainability of the biofuel sub-sector will depend much on the selection of feedstocks adaptable to marginal land and the mode of production that will be suitable to address national objectives such as energy security, reduction of import bills and foreign currency savings, creation of employment, diversification of rural economy and mitigation of climate change. However, mismanagement of the sub sector may cause several unforeseen social, environmental, and food security impacts.

Regarding the types of biofuel feedstocks in Tanzania, companies have chosen various types namely, palm oil, sunflower, sugarcane, white sorghum, and jatropha. While jatropha is reported to perform well on marginal land and one would expect to be grown on such land, in practice this study found that investors are targeting arable land instead. This is going to pose serious competition to food crops in terms of production resources such as land, labour, water and agro-inputs. Similarly, palm oil, sunflower, sugarcane and white sorghum, adopted by other companies are used for food; so, changing use of these crops to energy sources will push prices up for these crops and have similar implication on food security. The problem is expected to be serious for poor rural women who are main caretakers of their households.

With regard to the mode of production, this study identifies two dominant modes of production, i.e. large scale plantations and smallholder farmers or contract farmers who supply their feedstocks to developers at a low price which does not improve their livelihood a lot. A similar trend is expected as the biofuel industry expands. It was noted that large scale plantations were expanding into areas rich in biodiversity and fertile lands, and this creates pressure on food security and also leads to significant loss of biodiversity. Another registered concern is that large scale plantations may not address our national objectives of biofuel production since most of them are foreign companies motivated by self-interest and profit gains. If Tanzania is to achieve its objectives there is a need to promote and support local small-scale farmers to produce biofuel feedstocks and process such feedstocks to add value so that they can fetch good price. The focus should be on selection of biofuel feedstocks suited to marginal lands (i.e. jatropha), which will not compete directly with food crops. By supporting local small-scale farmers there are several advantages, as follows:

- Reduces land conflicts which may arise because smallholder farmers will grow such crops on their own land.
- Avoids direct competition between jatropha as a biofuel foodstock and food crops because the former is a non edible oil seed and grows well on marginal land that is not suitable for food crops.
- Ensures energy security, because it is more likely for local companies to produce biofuels for local consumption than foreign companies which are export oriented.
- Enhances foreign currency saving equivalent to the amount of import of the fossil fuels foregone as a result of using biofuels.
- Creates sustainable employment at all stages from production, processing and selling of jatropha. It will also increase the income of the rural poor and help them to get out of poverty.

However, by promoting small-scale farmers, it does not mean there should be no large-scale investment in the biofuels industry. Since this is a new technology, the government should encourage a limited number of foreign large-scale industries that will be used as

role models where small-scale farmers can learn and apply production techniques in their firms. But the focus should be to encourage a hybrid mode of production whenever large-scale firms are to be established, to involve contractual farmers who will be able to sell their feedstock.

## 7.2 RECOMMENDATIONS

- a) Large scale plantations of biofuels take up large pieces of land, and this leads to several social impacts to the community in a particular area. Such impacts involve displacement of people, loss of property, creation of pressure on land resources and other social tensions. To safeguard land rights of smallholder farmers, foreign investors should only be tasked to ensure value addition during the processing, while actual production of biofuel feedstocks should be restricted to smallholder farmers who will be contracted by investors/developers.
- b) Experience from successful stories from other countries like Brazil indicate that biofuels production is costly and requires government intervention during the initial stages of investment. This implies that the Government of Tanzania should invest heavily on Research and Development from the actual production of biofuel feedstocks to the processing of finished products (bioethanol / biodiesel); at the same time it should offer attractive credit guarantee and low interest loans to local companies interested to venture in the energy sub-sector.
- c) Unrestricted transfer of funds on free convertible currency from the country to other countries by investors is likely to weaken foreign currency reserve, which is a threat to the sustainability of the economy. To address this problem the government should restrict transfer of funds to capital goods and set a maximum amount of proceeds/profit that can be transferred on free convertible currency.
- d) Local government authorities should facilitate development in their areas of jurisdiction. Since the development process requires resources which are limited to most local government authorities, partnerships in biofuel investments between local government authorities and investors will open up more avenues for financial resources, which will eventually improve the ability of the local government authorities to spearhead development in their localities. Whenever necessary investment in biofuels should be allowed with a minimum of 25 percent local/ local government ownership to ensure sustainable benefits go directly to the communities or to local government authorities.
- e) The process of land acquisition and use has brought some challenges and controversies especially when it directly involves foreign investors to negotiate for land with communities. In view of this, it is strongly proposed that investors should

not be involved in the process of negotiating for land with the local communities. TIC should acquire land from various communities through LGA's and hold the land through a land bank that will be made available to investors through derivative right.

- f) To avoid disputes on land and contractual issues, and to safeguard the income and quality of employment of poor people residing in these areas, communities should be educated on legal issues relating to contracts and land rights so that they are aware of the impact of the decisions they make.
- g) Export of raw biofuel feedstocks denies employment opportunities in the chain of value addition, loss of export gains, untapped technical skills and technology transfer. The government should ban export of raw biofuel feedstocks to maximize the potential benefits that could be realized from biofuel investments.
- h) The current government compensation rates should be revised to accommodate the realistic value of land and associated property, and this should apply especially when land is taken for commercial purposes like investment in biofuels.
- i) Land use planning governs land use decisions and avoids land use conflicts that may result into social conflicts. Proper land use planning allocates adequate land for common pool resources (CPR) to the communities and other uses, takes care of the growing demand/needs as a result of population growth and other factors. Based on this fact, proper land use planning should be a prerequisite for biofuel investments and should be done in all potential areas earmarked for biofuel investments. Investors intending to invest in respective areas should restrict themselves to such available land, and stick to the purpose for which this land was earmarked.
- j) To reduce dependency on fossil fuels, enhance energy security and reduce import bills, the government should set mandatory biofuels blending targets to promote the development of local consumption of biofuels in Tanzania and restrict export of biofuels to 40%; the balance of 60% should be retained for local consumption.
- k) The government should increase support to local investors in the biofuels sector, who are predominantly small-scale farmers, to enhance value addition of biofuels and create sustainable income and employment in the value addition chain.

## REFERENCES

Banse, M., Meilj van H., Tabeau, A. and Woltjer, G. (2007). Impact of Biofuel Policies on Policies on World Agricultural and Food MARKETS. Paper submitted to the GTAP CONFERENCE 2007, Produce, University Indiana.

Barashishwa, J. K (2007). An Assessment of Factors Contributing to Household Food Security in Tanzania: A Case Study of Mvomero Village, Kilombero District. A Special Project Submitted in Partial Fulfilment for the Requirements of the Degree of Bachelor of Science in Agricultural Education and Extension, Sokoine University of Agriculture, Morogoro, Tanzania.

Bhojvaid, P. P. (2006). *Biofuels: Towards a greener and secure energy future*. New Delhi: The Energy and Resources Institute.

CFC, (2007). Biofuels: Strategic Commodity dependent Developing Countries. Prepared for the Common Fund for Commodities by Annie Duffey, Sonja Vermeulen, Bill Vorley. International Institute for Environment and Development, London, UK.

De Fraiture, C., M. Giordano, and L. Yongsong. (2007). *Biofuels: implications for agricultural water use*. Colombo (Sri Lanka): International Water Management Institute.

Doornbosch, R., R. Steenblik (2007). *Biofuels: Is the cure worse than the disease?* Round table on sustainable development. Paris: Organization for Economic Cooperation and Development (OECD)

Dufey, A. (2006). *Biofuels production, trade and sustainable development: Emerging issues*. London: International Institute for Environment and Development (IIED)

Dufey, A., Vermeulen, S., and Vorley, B (2007). 'Biofuels: Strategic Choices for Commodity Dependent Developing Countries', Common Fund for Commodities.

Ejigu, M. (2008). *Toward energy and livelihoods security in Africa: Smallholder production and processing of bioenergy as a strategy*. Blackwell Publishing Ltd.

European Commission (2006a). Communication from the Commission. An EU Strategy for Biofuels. COM (2006) 34 Final. Brussels.

European Commission (2006b). Communication from the Commission to the Council and the European Parliament. Renewable Energy Road Map. Renewable energies in the 21<sup>st</sup> century: building a more sustainable future. COM (2006) 848 Final. Brussels.

FAO (2007). Proceedings of the first FAO technical consultation on bioenergy and food security. 16-18 April 2007. Food and Agriculture of the United Nations, Rome, Italy.

FAO (2009). The right to food and the impact of liquid biofuels (Agrofuels). Rome, Italy.

German Technical Cooperation (GTZ) (2005). Liquid biofuels for transportation in Tanzania: Potential and implications for sustainable agriculture and energy in the 21<sup>st</sup> Century, August.

Guo, L. B and Gifford, R. M. (2002). *Soils carbon stocks and land use change: A meta analysis*. *Global change Biologie* 8:345-360

Huggins, C. (undated). *Water tenure and conflicts in Tanzania. Institutional responses to changing tenure patterns*. African centre for Technology Studies, Nairobi Kenya.

Hoogwijk M, Faaji, A. Erickhout, B. de Vries and Turkenburg, W. (2005). Potential biomass energy out to 2100 for four IPCC SRES Land use scenarios, *Biomass and Bioenergy*, 29, 225-257.

IEA (Undated) Biofuels for transport: An international perspective.

IIED (2003). *Feasibility study for a generic supply chain initiative for sustainable commodity crops: Findings and recommendations*. [Online] available at [http://www.defra.gov.uk/environment/consumerprod/accpe/research/pdf/accpe\\_sustainablecrops.pdf](http://www.defra.gov.uk/environment/consumerprod/accpe/research/pdf/accpe_sustainablecrops.pdf) (last accessed 05/02/2009)

ILO (2002). *Women and men in the informal economy: A statistical picture*. Geneva: International Labour Organization.

Information bulletin (2004). Tanzania Food Insecurity

International Energy Agency (2006). *World energy outlook* OECD/IEA 2006.

IUCD/DFID (n.d.). Food security and biodiversity. Biodiversity in Development – Biodiversity Brief 6, 49.

Johnson, F. X. and Laub, R. (2007). *Biomass, livelihoods and international trade*. SEI Climate and Energy Report 2007-01. Stockholm: Stockholm Environment Institute.

Meijl, H. van, T. van Rheenen, A. Tabeau, and B. Eickhout (2005). The impact of different policy environment on land use in Europe, *Agriculture, Ecosystems and Environment*, 114-1: 21-38.

Moreira, J. (2005). "Agreeing and Disagreeing". *Policy debate on global biofuels development*. Renewable Energy Partnership for poverty eradication and sustainable development.

Nowicki, P., H. van Meijl, A. Knierim, M. Banse, J. Helming, O. Margraf, B. Matzdorf, R. Mnatsakanian, M. Reutter, I. Terluin, K. Overmars, D. Verhoog, C. Weeger, H. Westhoek (2007). Scenar 2020- Scenario study on agriculture and the rural world. Contract N0. 30 – CE – 0040087/00-08. European Commission, Directorate-General Agriculture and Rural Development, Brussels.

Nyberg, J. and Raney, T. (2007). Bioenergy and Food Security – A concept note. Rome: Food and Agriculture Organization of the U.N.

Oxfam (2008). Inconvenient Truth: How biofuel policies are deepening poverty and accelerating climate change. Oxfam Briefing Paper, Oxfam International.

Pimentell, D. and Patzek, T. (2006). Green plants, fossil fuels and now biofuels. *Bioscience*, American Institute of Biological Sciences, November 2006, Vol. 56, No. 11 World Watch Institute. 2007. Biofuels for transport. World Watch Institute/Earth scan

Sanga, D. (2008). *The Impact of introducing Biofuel Production on House Hold Food Sufficiency: Case Study of Monduli District – Arusha*. A special Project Submitted in Partial Fulfilment for the requirements of the degree of Bachelor of Science in Agricultural Economics and Agribusiness at Sokoine University of Agriculture, Morogoro, Tanzania.

Sauti ya watu Tanzania (2009). (Jumanne, Februari 24, 2009) ISSN 0856-9762 Toleo no. 1544 (<http://www.state.gov/r/pa/ei/bgn/2843.htm>)

Shimba, H. J. M. (2000). *Women, weeding, and agriculture in Iringa Region, Tanzania*. Hifadhi ya Mazingira Iringa (HIMA/DANIDA), Iringa, Tanzania.

Sokoine Memorial Lecture (2008). Prime Minister of the United Republic of Tanzania, at the Eleventh Sokoine Memorial Lecture, Sokoine University of Agriculture, Morogoro.

Tauli-Corpuz and Tamang, V. P. (2007). *Oil palm and other commercial tree plantations, monocropping : Impact on indigeneous peoples' land tenure and resource management systems and livelihoods*. United Nations Permanent Forum on Indigenous Issues (UNPFII), 6<sup>th</sup> session, New York, 14-25 May 2007.

World Fact Book (2009). Central Intelligence Agency

Ugart, D. and de la Tourre, G. (2006). Bioenergy and agriculture: Promises and challenges. Developing Bioenergy: Economic and social Issues. 2020 vision for food, Agriculture, and the environment, focus 14, Brief 3 of 12, December 2006. [Online] [http://www.ifpri.org/2020/focus/focus14/focus14\\_03.pdf](http://www.ifpri.org/2020/focus/focus14/focus14_03.pdf)

UNICA (2002). Data from [www.unica.com.br](http://www.unica.com.br)

UNCTAD (2008). Biofuels development in Africa: Supporting Rural Development or strengthening corporate control. Workshop of civil society Forum, April 19 2008.

UNDP (2007). *Human development report 2007/2008 – fighting climate change: Human solidarity in a divided world*. New York: United Nations Development Programme.

UN-Energy (2007). *Sustainable bioenergy: a framework for decision-makers*. United Nations. Available at <http://esa.un.org./un-energy/pdf/susdev.Biofuels.FAO.pdf> (2009/2)

UNEP (2007). *Global environment outlook 4*. United Nations Environment Programme.

URT (1994). Fact sheet: Women, agriculture and rural development. SD: People: Gender and Development (<http://www.fao.org/waicent/faoinfo/sustdev/Wpdirect/Wpre0010.htm>)

URT (1996). The National Investment Promotion Policy. Government Printer

URT (1997). The Tanzania Investment Act, 1997, Government Printer, Dar es Salaam.

URT (2005). National Strategy for Growth and reduction of Poverty (NSGRP), Vice President's Office.

URT (2007). The Economic Survey: Ministry of Finance and Economic Affairs, Dar es Salaam, Tanzania.

MEM. (2008). Draft guideline for sustainable development of liquid biofuels and co-generation in Tanzania. Ministry of Energy and Minerals, Dar es salaam, August.

URT (2002). Population Census 2002, National Bureau of Statistics, Dar es Salaam.

URT (1992). *The energy policy of Tanzania*. Ministry of Water, Energy and Minerals. Dar es Salaam.

USDA (2007). USDA Agricultural projections to 2006, long term projections report OCE – 2007: Available [Online] at [http://www.usda.gov/oce/commodity/archive\\_projections/USDA%20Agricultural%20projections%20to202016.pdf](http://www.usda.gov/oce/commodity/archive_projections/USDA%20Agricultural%20projections%20to202016.pdf)

World Watch Institute (2006). *Biofuels for transportation. Global potential and implications for sustainable agriculture and energy in the 21<sup>st</sup> Century*. Report prepared by the Germany Federal Ministry of Agriculture and Consumer Protection (BMELV). WWI, Washington DC, USA.

Xavier, M. R. (2007). The Brazilian sugarcane ethanol experience. Advancing liberty from the economy to ecology, issue. *Analysis* No. 3.

Zeller, M. and Grass, M. (2007). Prospects and challenges of biofuels in developing countries. Paper prepared for presentation at the 106<sup>th</sup> Seminar of the EAAE pro-poor development in low income countries: Food, agriculture, trade and environment 25-27 October 2007; Montpellier, Franc



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