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Economic Impact of Biofuel Investment in Ethiopia: A Review

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1. INTRODUCTION

Ethiopia is a developing nation which depends entirely on the import of fuels from the oil producing countries. This import of fuel constitutes about 60% of the total imports with every single year. As in the rest of the world, the rise of oil prices is increasingly becoming a big challenge for the economy of the country. The share of fuel in import currency has been increase steadily in recent years, and it is expected to grow even sharper following higher demand due to economic growth. This takes up the lion share of the country's foreign exchange earnings. In recent years attempts have been made by the Government of Ethiopia to facilitate policies that encourage the reduction of petroleum consumption by shifting to biofuels.

Biofuels are seeing large-scale production worldwide in recent years. The IEA (2004) projections that annual global production of ethanol will increase to 120 billion liters by 2020, more than two folds from the 50 billion liters produced in 2005 (Banse *et al*., 2007). Production of biodiesel is expected to increase to 12 billion liters from its level of 1.8 billion liters in 2004(IEA, 2004).Many countries have high targets of expanding biofuels. The EU, for example, aims to blend 10% of its transport fuel consumption by biofuels as of 2020 while India plans to meet 20% by 2017 and Brazil is planning to expand its biofuel exports. Ethiopia has entered in to a 10% blend of bio-ethanol.

There are various underlying reasons for the big attention biofuels are enjoying today. Biofuels are claimed to provide a "triple solution" to the problems of poverty, climate change and energy security. Biofuels have arguably low greenhouse gas emissions which make them preferable over other polluting petroleum fuels. They also provide high economic gains by offering an alternative to fossil fuels whose prices are rising rapidly, while, in the production side, enabling rural job creation. Besides, relying on biofuels enhances energy security, reduces oil imports and improves domestic supply (Addisu, 2008).

Addisu (2008) argues that rising oil prices, increasing global energy demand and technological improvements are expected to further facilitate biofuel production by improving the commercial feasibility of producing and transporting biofuels around the world. The advent of bioengineering and other technologies is expected to make the future prospect of biofuels even more promising. On the other hand, there is skepticism with concerns that biofuels will open a 'Pandora's box' of environmental, social and economic problems (Mayat, 2007). It is argued that the sustainability of biofuel production and the socio-economic impacts of expanded biofuel production are not definitely known. Such literature reviewed is important to have an understanding about the impact of bio-fuel investment in Ethiopian condition.

2. OPTIMISTIC AND PESSIMISTIC VIEWS SURROUNDING THE DEVELOPMENT OF BIOFUELS

There are both optimistic and pessimistic views surrounding the development of biofuels. Some are even more skeptical and see it as land grabbing and as the new scramble for Africa (ABN, 2007). There are concerns that land and labour mobilization in the biofuel sector will be taken away from food and cash crop production, which will have a considerable impact on domestic food production and on export crops. According to the optimistic view, allocation of land to biofuel crops will not affect food production because biofuel crops are grown in areas not occupied by smallholders or on land not suitable for cereal production. According to this view, biofuel crops can be planted and grown on arable and marginal lands that are not under cultivation. In addition, biofuel production can enhance agricultural productivity through technology spillover effects and other inputs (van Rheenen and Olifinbiyi, 2007). In addition, biofuels are expected to provide some new market and income opportunities for poor farmers in Africa, particularly for those whose livelihoods depend largely on agriculture (FAO, 2008; Arndt *et al*., 2010). However, the opponents of this view argue that there is no land which simply sits idle, since land is used for grazing, forests, or other purposes. When land is allocated to biofuel crops, both livelihood and environmental implications should be taken into account (Barbara, 2007; Moges, 2010). According to this view, the economic and environmental impacts of biofuel farms, especially in food insecure and fragile areas, can be quite worrisome. The debate on the opportunities created and challenges posed by biofuel production is still ongoing (Azar, 2011; Janda *et al.,* 2011)

3. CURRENT STATUS OF BIOFUEL DEVELOPMENT IN EHTIOPIA

Ethanol Development Currently, there are five potential developers of ethanol in the country of which four are government owned sugar factories and one is private company.

Table 1 Summary of production projection of ethanol from expansion and existing areas of all state owned and private sugar factories

No.	Name of the Sugar Factory/Project	Land under cultivation (ha) 20 11/2012	Land expansion (ha) 2014 /2015	Ethanol production capacity (litres annually) in 2015
1	Fincha‟a SF	14,398	21,000	20,000,000
2	Wonji/Shoa SF	8,662+(3923 OGs2)	16,000	
3	Metehara SF	11,180	21,000	25,500,000
4	Tendaho SF	4,394	50,000	55,400,000
5	Kessem SF	943	20,000	20,000,000
6	Tana-Beles Sugar DP	Na	50,000	
7	Kuraz Sugar DP	Na	150,000	
8	Welkaiyt Sugar DP	Na	25,000	
9	Al-Habasha Sugar Mill	4,000	28,000	
10	Total	47,500	381,000	120,900,000

Source: Ethiopian Sugar Corporation, 2012

Biodiesel Development, The profiles of currently operational developers in Ethiopia are given below. The biodiesel development activity by currently operational developers indicates that more than 100,000 ha of land are currently under biodiesel's crop cultivation; while more than 300,000 ha of potential land are expected to be additionally utilized (See Table 2).

Table 2 The summary of current operational developers of biodiesel crops

No.	Name of Developers	Type of feedstock	Current land under utilization(ha)	Total Potential land allocated(ha)	Region	AEZs
1	Fri-El Ethiopia	Palm	800	30,000	SNNPR	1
2	Agro peace Bio Ethiopia	Castor	20	2000	Somalia	5
3	Africa Power Initiative	Jatropha, Castor, Curton and Candilnet	3000	13000	Tigray	4
4	Global Energy Ethiopia	Castor	7500 OGs4	10,200	South	3
5	S and P Company	Pongamia	7	50,000	Beneshangul	4
6	ATRIF Alternative Energy plc	Jatropha	80	108	SNNPR	3
7	Giving Tree Nursery	Castor	5	200	Oromia	4
8	ORDA	Jatropha	39,597	79,194	Amhara	4,2
9	REST	Jatropha	19,803	29,749	Tigray	4
10	Save the Environment Ethiopia	Jatropha and Castor	7	70	Somalia	5
11	Farmers	Jatropha	46,000	92,000	A,T,S	
Total			116,819	306,521		

Source: MoWE, 2012

The overall biofuel development activity in Ethiopia indicates there is farmer participation in various ways. Generally, even though the biofuel investment expansion in Ethiopia is not as expected and promoted by the government, it is hoped that the investment will expand. According to the BDCD of MoWE, 2012 the main reason of slow biofuel investment in Ethiopia is the investors' unwillingness to take degraded/less fertile land.

As of the production characteristics, the technology indicates that sugarcane is primarily plantation based and capital intensive while biodiesel crops (jatropha, caster bean and palm oil) are labour-intensive as it requires more labour per land compared with sugar cane and cultivated mostly by out growers and in the form of community development participation. For instance, REST in Tigrai, ORDA in Amhara region are involved in biofuel development using community development model. Some study shows that sugar cane accounted for a larger share of the total land allocated to biofuel crops. In addition, most of the total land allotted to biofuels

production is not utilized in 2012. For instance, about half of the total land allotted to jatropha and castor bean are not utilized yet. While more than 85 percent and almost all of the total land allocated to sugar cane and palm oil, are not yet utilized respectively. This suggests that there is a huge room for further expansion of production by bringing more land into cultivation until full scale operation without displacing smallholders at least in the short- and medium-term. Moreover, current biofuel development status in Ethiopia indicates that all most all biofuel investment is going on the unutilized land.

4. IMPACTS OF BIO FUEL

4.1. Impacts on Economic Growth and Food Security

Sustainable biofuel development can help bring modern energy services to more people, particularly in rural areas. It can also foster greater investment in agriculture, which employs 75% of the world's poor. It can create new job opportunities in rural areas and provide a major new source of income for farmers. By producing transportation fuel, farmers will be entering a market with higher prices and rising demand. Growing energy crops is more likely to attract the kind of foreign investment that can modernize their agricultural practices and increase their food production as well (United Nation Fund, 2007).

The Food and Agriculture Organization of the United Nations notes these benefits as well: "Energy plantations and crops (in particular perennial crops) can help to prevent soil erosion by providing a cover which reduces rainfall impact and sediment transport. Annual energy crops can also allow diversification and expansion of crop rotations. Deforested, degraded and marginal land could be rehabilitated as bioenergy plantations which could combat desertification and increase food production.

Gemechis (2013), studies shows the sectoral impact of biofuel investments. Jatropha and castor bean scenarios involving spillover effect leads to slightly higher agriculture sector and GDP growth rate compared to plantation based sugarcane production. This might be due to large shares of the value-added generated from producing jatropha and castor bean involving spillover goes to farmers. This is, for instance, in the form of increasing farmer's agricultural productivity which in turn leads to higher GDP growth. This result also suggest that the out grower mode of production involving spillover effect mighty be preferable than plantation based production. The industry sector also benefited under sugarcane scenario, jatropha and caster bean scenarios involving spillover effect and combined scenarios, whilst service sector is negatively affected, though small, under the same scenarios. The negative impact on service sector is possibly explained by competition over scares labor resource. On the other hand, the jatropha, castor bean, and palm oil scenarios are found to have no effect on aggregate sectors and real GDP. In general, biofuel investment increases the national GDP growth rate since the gain outweighs the loss.

Generally, cereals (food) production sector largely gains from biofuel investment while production of both cash crops and other agricultural activities are slightly increased. Specifically, jatropha and castor bean involving spill over effects and combined scenarios increased cereals, cash crops and other agricultural activities production. This might be due to the existence of strong linkage between cereals production and jatropha and caster bean production involving spill over effect. Biofuel investment involving spill over effect benefits small holders by increasing farm productivity for instance, through wage employment, income earning by supplying biofuel crops for the processing companies, improved farm practices due to access to some agricultural inputs (e.g. chemical fertilizer, improved seeds, insecticides), and soil fertility etc. On the other hand, jatropha, castor bean, and palm oil scenarios have no effect on cereals production whereas the effect of sugarcane scenario is positive but small in magnitude. Cash crops and livestock sectors also benefited from this new investment to some extent. Furthermore, other agricultural activities gain from biofuel scenarios involving spill over effects, sugarcane and combined scenarios, while other scenarios have no effect on it. Contrary to the ongoing critics that expansion of biofuel investment might exacerbate food insecurity problem of developing countries, for Ethiopian condition it reveal the opposite. Given the assumption that the ongoing biofuel investments are on the unutilized land (land not occupied by smallholders); our simulation shows the complementarities between "bio fuel" and "food" production. Mersha, 2013, observe the impact of biofuels investment on price of cereals and his finding shows that biofuel investment intervention involving spill over effects decreases cereals prices. This might be due to higher productivity growth in cereals which in turn leads to increase cereals production. In contrast, the other biofuel scenarios have no effect on cereals prices.

4.2. Distributional (welfare) effects

Bio-fuel investment raises national GDP and factor returns which in turn increases both rural and urban households' income. Even though, the overall/combined distributional impacts across household groups have similarity, which is positive, bio-fuel scenarios have varying effect on household groups. According to the studies of Gemechis (2013), the change in households' equivalent variation, this is a welfare measure that controls for changes in prices. That is, EV measures the level of income (in money terms) that the consumer needs to (presumably) pay before the shock to leave him as well off at the equivalent level of utility loss after the

price increase. Jatropha and castor bean scenarios involving spill over effects have a significant positive effect on welfare of all households. Under sugarcane scenario the welfares of all urban households and half of rural household groups improved. The competition on land and labour can explain the reduction in welfare of some rural households. On the other hand, jatropha, and castor bean scenarios have no significant effects on the welfare of households. Moreover, the combined scenario records strong welfare improvement of all households which may be attributed to increased productivity caused by jatropha and castor been production involving spill over effects.

4.3. Impacts on Poverty

An important characteristic of biofuels is that developing countries in the tropics have comparative advantage in producing them. That is biofuel production is a labor intensive activity and employs a large number of people and is also substituting fossil fuels by locally produced bio-fuels in order to save and earn foreign exchange as result of the high rise in fuel prices (Adissu, 2008). As a result, the expansion of biofuels is considered a useful opportunity for the poor agrarian economies of the developing countries to reduce poverty.

The potential impact of biofuels on poverty reduction is large, whether it is through employment, wider growth multipliers and energy price effects (Peskett *et al*., 2007). The importance of biofuels production in poverty reduction is two folds: on the one hand it generates income for the rural poor, and on the other hand it enables the poor to access cheap energy sources. The main role of large scale liquid biofuel production in rural communities is, however, income generation. This is because biofuel production is a labor intensive activity and employs a large number of people.

Brazil hosts the world's largest employer ethanol industry with an estimated half million worker as in 2006 (Adissu, 2008). In the long term, countries like China are planning to employ as many as 9 million workers, whereas Sub-Saharan Africa is expected to have around 1.1 million people working in its biofuel industry (World Watch Institute, 2006). Some estimates show that each hectare of land under biofuels cultivation can possibly employ one worker (De Keyser and Hongo, 2005). It is, however, not clear to what extent poor farmers can reap the benefits of expanded biofuel production.

Some Bio-fuel has impact on poverty, according to mersha studies (2013), the changes in consumption growth from base line for all household groups. In the combined scenario, for instance, we found greater percentage increment than the others simulations where consumption grew by 0.13%, 0.14%, 0.19% and 0.18% for rural poor, rural non-poor, urban poor and urban non-poor, respectively. An almost similar trend is recorded in jatropha and caster bean scenarios involving spillover effects, while the sugarcane scenario improves consumption expenditure even though the magnitude is small. On the other hand, the jatropha, caster bean and palm oil scenarios have almost a null effect on all household groups" expenditure.

4.4. Macroeconomic and Sectoral Impacts of Biofuels

Biofuel expansion has effect on total national output (GDP) increases if such expansion generates spillover effects. For instance, while the impact of biofuel expansion without spillover effects on total output is negligible, GDP increases by 0.22% and 0.19% if jatropha and castor bean expansion are accompanied by spillover effects (Tadele *at al*., 2013).

Regarding sectoral effects, biofuel activities with technology transfer, such as improved farm management practices, generate positive impacts on sectoral production. Agriculture benefits relatively more than other sectors, For instance, agricultural GDP would increase by about 0.48% and 0.41% if jatropha and castor bean activities generate positive spillover effects. In particular, the impact of jatropha and castor bean with spillover effects on food crops is positive. Cereals production increases with spillover effects, suggesting no evidence of a trade-off between food production and biofuels. However, cash crops seem adversely affected by biofuel expansion, especially in the case of castor bean, indicating that farmers reallocate land away from traditional cash crops to food and biofuel crops (Tadele *at al*., 2013).

According to (Mersha, 2013) findings contribute evidence to the debate on whether or not biofuel production, especially in agriculture-dependent countries, has adverse impacts on food and cash crop production. They do not find negative effects of biofuel on food crops production in Ethiopia, especially when spillover effects are considered. The positive impact of biofuel on food crops is quite strong compared with the negligible effect of biofuels on cash crops. This could be due to the fact that farm households give priority first to food crop production and then to biofuels when deciding land allocation. As out-growers, farm households allocate a certain fraction of their farm land (e.g., up to a third) to growing biofuel crops. Given the small size of landholdings, the remaining land will be used for the production of cereals. In a land constraint setting where food security is a major issue, cash crops will be the first to be replaced by alternative and competing crops such as biofuel crops. Even then, production of cash crops on a very small plot of land could increase due to improved farm management practices that are acquired from biofuel crop activities. However, the impact of biofuel expansion on cash crops is limited. Otherwise, the replacement of cash crops with biofuels crops would have a

considerable impact on the external sector of the economy.

4.5. Effects of Biofuels on the External Sector

Although both exports and imports show a decreasing trend due to biofuel expansion, the decline in exports is greater than the decline in imports, indicating worsening of the trade balance. There are at least three factors at play here. Competition for land could lead to less production of cash crops, which are mainly grown for the export market (Gebreegziabher *et al.*, 2013). On the other hand, there is less need to import oil, so foreign exchange is conserved. However, the decline in exportable commodities such as cash crops means less foreign exchange, leading to real exchange rate depreciation, which is not strong enough to stimulate exports.

Whereas most scenarios have no effect on cash crop production, the jatropha and castor bean scenarios that involve spillover effects actually have a positive effect on production of cash crops (traditional export commodities) in some regions. However, in the simulation where land is assumed to be fully employed and mobile, biofuels strongly and negatively impacted cash crop production in all regions, but only in the jatropha and castor bean scenarios that involve the spillover effects. Given limited farm size, farmers reallocate land from traditional cash crops to biofuels and food crops. This is mainly dictated by food security motives and by the tendency to self-insure when a portion of their land is used for biofuel crops, indicating a trade-off between biofuel crops and traditional cash crops. This may indicate a kind of 'Dutch disease' in which resources are diverted to the new biofuel crop, thereby leading to contraction of traditional export items.

However, more importantly, biodiesel production also has increased, which eases the country's imports of fossil fuel. The country can substitute imported fuel with domestically produced biofuel, thereby saving foreign exchange. A reduction in total imports, though small compared with exports, could be due to a fall in imports of gasoline. In other words, domestic bio-energy serves as a buffer against oil-market shocks and as a way of conserving foreign reserves, which can then be used to finance other import items (e.g., food) (FAO, 2008).

An increase in biofuel crops leads to a depreciation of the real exchange rate, which is not strong enough to stimulate exports. Hence, a decline in traditional exports is due to reduced production of export crops. In addition, reduced production of traditional exports commodities implies that less will be supplied to the export market. This worsens the net external balance.

Overall, the macroeconomic and sectoral effects of biofuel investment are growth enhancing if such investment generates technology transfer. However, the impact of biofuel expansion on the external sector, especially on exports and imports, is negative. In addition, given government's ongoing huge investment in road infrastructure in the country (e.g., see MoFED, 2010), access to unused land might no longer be constrained by inadequate road infrastructure. Hence, further biofuel investment might also be undertaken on unoccupied lands, at least in the short- to medium-term.

5. CONCLUSIONS

Bio-fuel investment is a good opportunity to enhance economic growth, food security, improve welfare and reduce poverty. Biofuels' expansion also play vital role in stabilizing the macro economy by minimizing the dependence on oil import. This implies that, so as to further increase the gains from biofuel investment, it is important to expand biofuel investment on the land that is not occupied by smallholders for cultivation. This can be achieved by expanding infrastructure developments and attracting investors by providing different incentives. It is also important to flourish biofuel feed stocks and products "market in order to increase biofuel developers" participation in producing and supplying biofuel feedstock's, processing and distributing biofuel.

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