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SUSTAINABLE BIOENERGY- AN ASSESSMENT OF POTENTIAL POLICY OPTIONS FOR GHANA

A research for the Ghana Energy Commission

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Picture: ‘Jatropha plantation’. Source: envirofuel.wordpress.com

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List of abbreviations

BM(s):	Business model(s)
BSC:	Biofuels Supply Chain
BSCM:	Biofuels Supply Chain Management
CO_2	Carbon dioxide
CSR:	corporate social responsibility
DDGS:	Dried distillers grains with solubles
EIA(s):	Environmental Impact Assessment(s)
EU:	European Union
GEC:	Ghana Energy Commission
NGO(s):	Non-governmental organization(s)
PPPs:	Public-private partnerships
SC:	Supply chain
SCM:	Supply Chain Management
SSA:	Sub-Saharan Africa
TOR:	Tema Oil Refinery
UNO:	United Nations Organisation
USA:	United States of America

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Abstract

The use of liquid biofuels –mainly for transportation, but also for household uses in developing countries- is seen as one of the major alternatives to the consumption of fossil fuels, in the efforts to mitigate climate change effects, meet increasing global energy needs and national energy security goals. Although both the supply and demand potential for biofuels are huge, they currently have a very low share in the global energy mix and that is not expected to change soon. On the other hand, the success of the biofuels industry in certain countries –predominantly Brazil- along with the significant production potential for some biofuel feedstocks in many Sub-Saharan African (SSA) countries render the prospects of the development of national biofuels industries very appealing.

The production process of biofuels does not come without difficulties and has raised many concerns in the past as for its sustainability. Specific challenges in SSA relate to land use regimes, the weak governance structures, the poor infrastructure that also increases production costs, indecisive policies with regards to the biofuels policies or general political instability, all of which bring risks to biofuels producers. Moreover, despite the similarities in the production potential of many African countries, there is no common model for biofuels production and even the objectives of adopted policies may well differ. Due to these and other uncertainties, the production of biofuels in SSA in the past decade has often failed to deliver sustainable outcomes across the triple bottom line (economic, social, environmental) or to distribute benefits equitably to local populations.

Consequently, of particular interest for any country which wishes to exploit its production potential are the modes of biofuels production, as well as public sector policies that steer towards the achievement of sustainable outcomes along the whole supply chain and maximize the potential benefits (depending on the national policy priorities). As such a country, Ghana is interested in receiving policy recommendations for the development of a biofuels policy with regard to the business models for the production of biofuels and to the options to stimulate the production and the consumption of biofuels.

Therefore, the objective of the research is to contribute to practice-oriented theory building with regards to the adoption of business models for biofuels production and their implementation, as well as with regards to the appropriate governance arrangements to promote the production and consumption of biofuels in the context of SSA.
That is the main objective and it implies that the results of the research are largely applicable to many SSA countries. After completing the stages of the research to achieve this objective, it is possible to provide the Ghana Energy Commission (GEC) with recommendations for sustainable biofuels policy development, with regard to the adoption of business models for biofuels production and their implementation, as well as with regard to the appropriate options to stimulate the production and consumption of biofuels, based on the country's specificities. The following question has guided the efforts to meet this research objective:

"***Which business models and governance strategies are feasible to contribute to a significant increase in the deployment of liquid biofuels in SSA?"***

In order to answer this question, the following research steps have been taken. First, by means of a literature review all important aspects from the standpoint of the business sector were investigated. The basic business models (institutional and organizational aspects) have been identified that are applicable in the context of SSA along with their impacts and the success factors that enable them to be employed efficiently. This analysis resulted in a typology of four main types of business models with the addition of two sub-types that include farmer cooperatives. A chapter on biofuels supply chain management

(BSCM) describes the operational aspects of the biofuels business that are common for all the business models. A similar analysis was conducted for the options to stimulate the production and consumption of biofuels, outlining the basic implications of each policy option. The stimulation measures were classified in three categories (interventions at start-up phase, production and consumption). At the end of this stage a synthesis of success factors is made and the policy options identified are connected to them, while a classification of them is provided in three different levels.

As a next step, the current situation in Ghana was mapped in detail by means of a literature review and a series of interviews. Barriers identified from the literature guided that stage of research and they were scored as for their importance, according to the interviewees' opinions, while some additional barriers to the deployment of the production potential of the country were identified as well. Next, with an extensive series of interviews the research sought to investigate the possible strategies to maximize the efficiency of the identified business models (again following the same distinction) and to promote the production and consumption of biofuels in the context of SSA, while also addressing Ghana's most important barriers. That stage of the research served to confront the opinions of interviewees with the literature and at the same time to elaborate on the findings of the literature review, while also adding new elements. Regarding the stimulation of investments, production and consumption –apart from the above- the interview inputs largely aimed to assess options previously identified in the literature, but also to elaborate on the possibilities to implement them.

The research concludes by determining which business models are more likely to be feasible based on the current conditions in Ghana and which governance strategies would be required, in order to successfully operationalize them. The clear favourites are the types A and B1, which are large-scale production schemes (the first through conceded land, the second through a partnership of commercial company with smallholder farmers). Small-scale models (Type C) should not be generally excluded, though, as they provide important benefits. A number of recommendations are made to the Ghana Energy Commission. Although most of the direct responsibility naturally lies in the hands of the private companies that wish to invest in the production of biofuels, a strong role is prescribed for the public sector, in order to create the enabling environment, to steer towards the most favourable directions by issuing legal requirements and economic incentives, as well as to adopt a proactive role in mediating between parties and facilitating the efforts of private investors.

1. Introduction

1.1 The potential of biofuels in future energy mixes

Until the industrial revolution, biomass was the basic energy source in the whole world. Burning of wood and charcoal enabled people to heat their homes and cook, while animals were used for transport of people, carriages and for tilling the land. Modern energy/fuel sources have completely substituted these older forms of energy in the developed world. Developed countries have recently turned to renewable energy. This is due to the depletion of oil reserves, the vast population growth in the developing countries, the increase in global energy consumption that is driven by China and India, the need for climate change mitigation and the security of energy supply (Tuominen, 2011). Consequently, biofuels are seen as a major and sustainable alternative to fossil fuels in the transport sector (Lee et al., 2008) and due to the changes in the energy industry, as well as in the global consumption trends, their development is seen as a necessity. Moreover, with the new Paris Accord on climate change (December 2015) policy makers across the world will be looking for ways to further cut their countries' emissions.

Regarding the transport sector –which has the largest contribution in CO2 emissions- it is notable that traffic volumes are expected to increase threefold by 2050, while global carbon dioxide (CO2) emissions are expected to increase by 50% until 2030 (Tuominen, 2011). As a result, there is increasing interest on the production of biofuels for the transport sector globally. However, it must be noted that due to a policy shift in the EU to support 2nd generation biofuels instead of 1st generation, as well as the global financial crisis, the growth that was experienced for biofuels in the previous decade has stagnated since 2010 (Timilsina, 2014).

In theory, any agricultural and forestry biomass can be used to produce bioenergy. Consequently, there is a wide range of feedstocks that could supply the potential bioenergy markets. At the same time the supply and the demand potential of bioenergy are both huge. However, future availability is widely uncertain, as it depends on a range of factors, "such as the future demand for food, livestock and open trade, the productivity of food production and forests and energy crops and availability of degraded land" (Verdonk et al., 2007, p. 3910).

Biofuels and particularly ethanol have been used in some countries for more than a century but their proliferation as a result of environmental considerations is a recent development (Forge, 2007). Their global production and consumption dramatically increased during the 2000s, with an impressive 22% annual growth for ethanol between 2004 and 2008 (World Bank, 2010). The high oil prices have also contributed to it, but the growth must mainly be attributed to the policies of developed countries to promote biofuels (World Bank, 2010). The leading producers of bioethanol are the United States (US) and Brazil, together holding more than 90% of production in 2008 (ibid). France, China and Canada are some other sizeable producers and many other countries around the world are gradually starting to engage into commercial production. Biodiesel production takes place at a much smaller scale; with the US as a leader – having surpassed France in 2008 – and European countries like Germany and Italy following. The growth of production for biodiesel has been 50% from 2004 to 2008. Nevertheless, the sustainability of biofuels was heavily debated during the

previous decade, with strong advocates for and against their production and consumption (ibid, p.11).

In 2010 the share of biofuels in the global supply of total primary energy was 0,5% (2.424 PJ) or 3% of transportation fuels (Timilsina, 2014, pp. 3,9). Estimates for the share of biofuels have been made by various organizations with quite varying projections. According to Timilsina (2014, p.10), a total contribution of 7% biofuels to total transportation fuels globally seems reasonable, while the IEA forecasts a 27% share by 2050 (ibid). In the short term biofuels are to be used for light vehicles, but in the longer term (also) in freight, shipping and aviation (Murphy et al., 2011). More optimistic estimates could also be realized, but that would also depend on the technological advancements for the production of second generation biofuels (ibid). The factors that cause uncertainty –but could be decisive for the potential success of biofuels on a global level – are the high upfront cost of feedstock production as compared to other renewable sources, and the (avoidance of) food vs. fuel competition, while contributing to environmental goals (Timilsina and Srestha, 2011).

1.2 Sustainable biofuel production as a governance challenge

Verdonk et al. (2007, p. 3910) cluster the concerns regarding the production of biofuels in the following four areas:

- **Land use patterns**: deforestation, unsustainable harvest regimes and yields, destruction of natural habitats and landscapes, Regional food and energy supply shortages, leakage effects (shift of unwanted activities)
- **Natural resources and pollution**: Soil degradation, use of GMOs instead of native species, unsustainable agricultural production methods, water scarcity.
- **Socio-economic conditions:** probability that child labour is involved, insufficient production remuneration, poor perspectives for producers and land tenure conflicts, welfare of producing regions
- **Others:** environmental additionality (in theory biofuels must "add" to the energy mix with positive environmental effects, i.e. most importantly the net effect in CO2 emissions, but also the other effects of production in local ecosystems;), traceability (i.e. the ability to trace the origin and modes of production, so as to judge the sustainability of the process), opportunities for local energy supply development.

Choosing between different paths

Among policy-makers, business representatives, academics and members of civil society, different motivations may exist for the use of biofuels. Some view them as a substitute source for high-price petroleum that can benefit consumers, diversify sources – thereby increasing energy security – as well as reduce national trade deficits. Others view biofuels as a great economic opportunity either due to the development they can bring at the national/local level or as a market where companies can invest and profit (Lee et al., 2008). Some of the bioenergy options may be more compatible with one of the above objectives, but it is also good to examine them all, since several may be addressed simultaneously. In fact, the possibility to address several goals and across different sectors is a reason why bioenergy development is often highly valued. Moreover, in forming a strategy for bioenergy the policy goals will ultimately need to prioritize some end-uses or energy

services, while considering the infrastructure and support services that are necessary for various technology platforms.

An important relevant consideration is that of the orientation between the domestic market and exports (FAO/UNEP/UN-Energy, 2012, Module 2). Two relevant issues raised by Bastos Lima and Gupta (2013) for the sustainability of biofuels production are the fact that usually the produce is exported to developed countries of the global North, while locals lack access to energy and the fact that locals face the risks of production, while developed countries are supplied with "clean" renewable energy. Consequently, the orientation that biofuels production takes in producer countries is to be well considered, as exporting all volumes to developed countries (as many countries envisage) may not be as beneficial as it seems at first. On the other hand, biofuel production does not necessarily have to conflict with food production, as is often assumed. It is also possible that energy demand disposes of unwanted agricultural surpluses, thereby keeping crop prices stable but high enough to compensate for the missing investments of the previous decades (Murphy et al., 2011). Therefore, agricultural production for food could be highly complementary with that of energy. Managed correctly the interaction between the two could be turned into a great opportunity, instead of a great threat.

Business Models

In order for a company to achieve economic sustainability, when producing biofuels, various different activities need to be undertaken efficiently. Most of the considerations regarding the efficiency optimization of the supply chain of businesses are common at any scale. According to the findings of Mabee (2007, p.353), "successful policy interventions can take many forms, but that success -measured as biofuel production capacity- is equally dependent upon external factors, which include feedstock availability, an active industry, and competitive energy". This indicates the need to deal with the supply chain in a holistic way.

Especially for small-scale schemes the technical and financial viability of projects can often be a concern, as it is especially a major challenge to keep them affordable, accessible and appropriate to local circumstances (FAO/UNEP/UN-Energy BDST-Module 2). Furthermore, many scholars also argue that for the inclusion of impoverished communities in modern economic systems, different business models are required (e.g. Hall and Matos, 2009). Consequently, the public sector could perhaps promote the development of some of these business types, in order for bioenergy development to live up to the expectations of local communities and policy-makers.

Regarding small-scale production, opportunities for smallholder farmers, who cultivate their land (also) for biofuels, are: access to markets, access to employment development of local infrastructure and spillover effects, such as the acquisition of new agronomic knowledge (Florin et al., 2013). The same authors conclude that there is no one certain model for sustainable biofuel production by smallholders. Case-specificity is likely to depend on the interactions between the drivers, but also on the trade-offs between indicators (ibid).

Stimulation

All renewable energy options will require regulation and stimulation until they become fully competitive with conventional energy (UNEP FI, 2012). Therefore, it is up to the government of each country to create a level playing field between all energy sources. As Tilman et al. (2009, p.2) state, "Good public policy will ensure that biofuel production optimizes a bundle of benefits, including real energy gains, greenhouse-gas reductions, preservation of biodiversity, and maintenance of food security". Other scholars are even blunter that without public policy for their development, biofuels production cannot take off (e.g. van der Horst and Vermeylen, 2011).

However, such policy instruments may well vary as for the cost effectiveness and their distributional implications (World Bank- Rajagopal, 2007). The latter factors may even "dictate the selection of the winning policy" (ibid), especially in the context of Sub-Saharan Africa (SSA) with its limited finances. The relevant policies may eventually form a complex web with particular policies on energy, transportation, environment, and agriculture (ibid). Last, although synergies across sectors and policies are likely to be necessary, some combinations may be contradictory and produce adverse effects (de Gorter and Just, 2010). Therefore, it is important that a combination of policies is chosen with attention to national and local characteristics.

1.3 Biofuel production and governance in Africa

Apart from the other motives, developing countries also view biofuels development as instrumental for rural development and reduction of trade imbalances – by boosting exports and reducing oil imports – and for increasing energy security (Molony and Smith, 2010, Jumbe et al., 2007, Schoneveld et al., 2011). Due to their relatively low production costs and the availability of vast tracts of cheap and agro-ecologically suitable land for cultivation of biofuel feedstocks, developing countries – many of which notably in Africa- (Janssen and Rutz, 2012) are believed to be more competitive producers than industrialized countries (Schoneveld et al. 2011). It must be mentioned, though, that for biofuel production to be of interest to African countries and for individual projects to be viable, the oil prices must be relatively high (Janssen and Rutz, 2012).

Land use for biofuels has been an issue of major concern in the previous years. In general, investors often target idle land that is unused (although the land regimes are different and areas may be managed under common property regimes). However, there have been cases of displacements and land use conflicts (Duvenage et al., 2012). Especially in sub-Saharan Africa the threats that land rights will be violated are more legitimate than anywhere else, since formalized land rights range from 2% to 10% of the total land area (ibid). When competition over land uses increases, it is more likely that the security of tenure is threatened. This in turn may exacerbate rural inequalities, as it will be the poorer and smaller land owners and users who will be less protected in cases of exploitation by local authorities(Schoneveld et al. 2011). Due to such conflicts, there is often suspicion by the part of local communities towards investors (Duvenage et al., 2012). Often, even though consultations of local communities and inclusion processes are followed before an investment, it is not guaranteed that local people can influence investment terms (Duvenage et al., 2012).

An additional challenge for developing countries is the weak governance structures that many of them have. These may be government-supported, but also private and include monitoring mechanisms, local capacity-building (e.g. to negotiate and claim rights) and financial, as well as financial investment instruments (Florin et al., 2013). These structures are important for the efficacy of laws, policies and standards that are designed to contribute to sustainable biofuel production (ibid). Therefore, it is no surprise that although biofuel projects have been initiated in many African countries, many of them are not designed to deliver sustainable outcomes across the triple bottom line (economic, social, environmental). In trying to deliver such sustainable outcomes a range of different barriers exist, such as patrimonial politics and non-inclusive decision-making processes leading to "shady" deals, as well as local bureaucratic pressure pushing towards the preferred directions of politicians. And some states (especially in SSA) that have entered into biofuel development and have weaker governance structures "are more exposed to the financial interests of multinational corporations (MNC)" (Evans 1995, cited in Duvenage et al., 2012, p.995). A relevant concern is that Corporate Social Responsibility (CSR) policies has been weakly implemented by the few MNCs which have adopted them, in absence of law enforcement against non-compliance (Utting and Clapp (2008), cited in Duvenage et al., 2012). According to Duvenage et al. (2012), all these may often result in non-transparent processes against the benefits of local communities. At the same time, the lack of sustainability frameworks around biofuel production results in an overall inability of the public sector to realize objectives of sustainable development.

Regarding the production itself, despite the similarities in the production potential of many African countries, there is no common model for biofuels production. In some African countries like Malawi non-state actors have been involved in projects since the early 1980s. In Uganda and Nigeria, the state works as a facilitator in stimulating private investments, but the state and public universities are the key players, while in South Africa, Tanzania, Malawi and Zambia the private sector has a central role in the development of the sector (Jumbe and Mkondiwa, 2012).

Following the trend to promote biofuels production as a strategy for export- and rural-based development Egypt, Ethiopia, and South Africa – among others – have plans to initiate large-scale biofuels production, while more and more African countries look into the same direction, in order to harness their production potential and become exporters to the EU and the US (Duku et al. 2011, Molony and Smith, 2010). But despite the large resource base and the high potential, little effort has been made in the African context to promote biofuels thus far (Jumbe and Mkondiwa, 2012) and that is reflected by the absence of concrete policies by most countries. The few African countries which have implemented a specific strategy for the development of the sector are Mali, Nigeria, Senegal, Tanzania, Ethiopia, Angola, Mozambique, South Africa, and Swaziland (www.pangealink.org). Some countries have joined the Pan-African Non-Petroleum Producers Association, which "aims to develop a robust biofuels industry for the continent" (Molony and Smith, 2010). As Pangea reports, fourteen more countries – among which Ghana- are in the process of developing specific policies, but without a certain implementation date (www.pangealink.org). All the rest either incorporate bioenergy in their existing energy portfolio or have no relevant policy at all (ibid). It is worth noting that the sector in Africa "is being developed gradually with the

financial and technical assistance of international agencies such as UNDP, UNIDO, UNEP, UN HABITAT" (Jumbe and Mkondiwa, 2012, p.618).

1.4 Knowledge gap and research objective

This research will address the gap that exists with regards to the comparison between the different business models of biofuels and the required conditions that allow for their implementation. This means that the full range of benefits, advantages, disadvantages and requirements for successful implementation must be outlined for each business model, in order to move on to informed policy decisions. It is also not well-understood in SSA countries which governance strategies are appropriate to promote the production and even the domestic consumption of liquid biofuels in the context of SSA, in order to establish a business sector of biofuels with long-term viability. These governance strategies may be initiated by the public sector through stimulation measures, but there is an interplay with the private sector, local communities and even other stakeholders that can pose several challenges. Therefore, it is highly important to outline the roles of all the different actors for all the possible models of biofuel development.

The objective of the research is to contribute to practice-oriented theory building with regards to the adoption of business models for biofuels production and their implementation, as well as with regards to the appropriate governance arrangements to promote the production and consumption of biofuels in the context of SSA.

Once the research steps to achieve this objective are completed, it will be possible to provide the Ghana Energy Commission with recommendations for sustainable biofuels policy development, based on its specificities. The results will have a wide applicability in a great number of SSA countries.

1.5 Research framework and questions

1.5.1 Main research question

Which business models and governance strategies are feasible to contribute to a significant increase in the deployment of liquid biofuels in SSA?

1.5.2 Research framework and activities

A series of distinct research steps must be taken, in order to answer the main research question of the thesis. The following research framework summarizes the sequence of the research and analysis activities that will be undertaken. The blue boxes broadly present the themes of the literature review that will be conducted, the orange boxes present the themes of the two series of interviews and the axis of green boxes at the center of the diagram illustrates the stages of analysis that the researcher will undertake.

At the first stage a literature review will be conducted for both of the issues under study, as well as for Ghana, in order to answer the relevant sub-questions (1.1, 1.2, 1.4). At the second stage of the research the analysis from the literature reviews will lead to a set of basic conditions and strategies that enable the production and consumption of biofuels in SSA countries (sub-question 1.3). A selection of the more relevant factors to elaborate on, in order to answer the main research question will be made. These basic success factors will

also be used to map the situation in Ghana during the respective series of interviews in a detailed manner (sub-question 1.4). Subsequently, at the third stage of the research they will form the basis of the further elaboration that will follow through the interview process on appropriate governance strategies (along with some complementary literature reading) in the following chapters (sub-questions 1.5, 1.6).

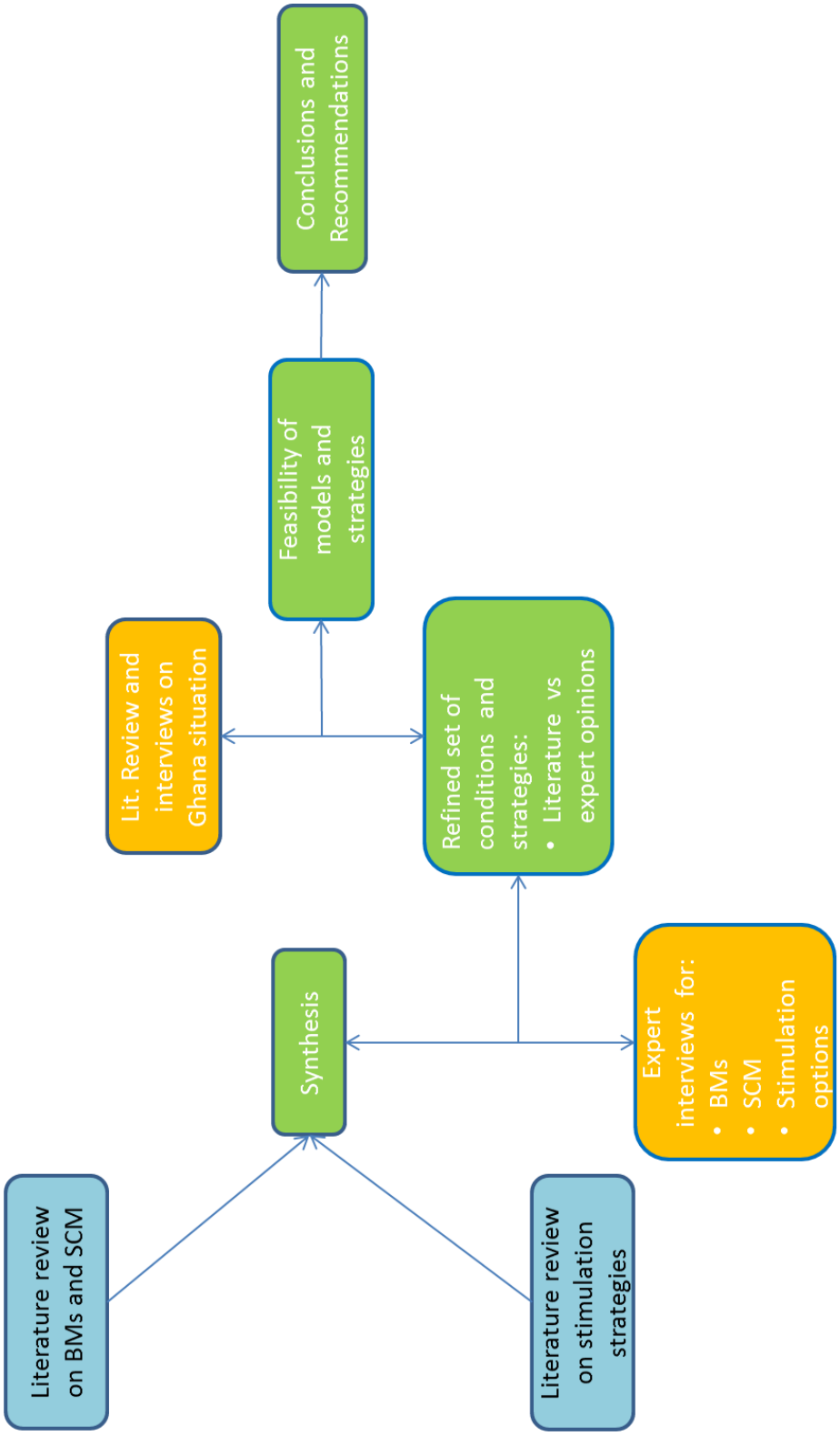

Figure 1.1. Research framework.

Sub-questions:

1.1 Which different business models for the production of biofuels can be found in the literature, that are appropriate in the context of sub-Saharan Africa (SSA), what are their impacts and which are their success factors?

1.2 Which strategies can be found in the literature, that have been successfully employed, in order to stimulate the production and consumption of biofuels?

1.3 What success factors can be derived from the literature for the deployment potential of biofuels in the context of SSA?

1.4 What barriers for the deployment potential of biofuels can be identified in Ghana and to what extent are the required conditions for the successful implementation of the country's deployment potential present?

1.5 In which ways can the identified business models be more efficiently managed and how should the respective challenges of each be addressed, according to experts?

1.6 What are the opinions of the interviewed experts on the most appropriate ways to stimulate the production and consumption of biofuels in the context of sub-Saharan Africa?

1.6 Methodology of desk research

The research objective has been pursued by means of an extensive literature review and by two series of interviews. The first is analysed here, while the details about the second will be explained in chapter 7.

For all thematic areas a thorough desk research was conducted at the very beginning, in order to acquire a good understanding of all relevant aspects. During the early literature review that was conducted for the research proposal, a number of barriers have been identified to the deployment of projects for biofuels, which have been clustered as economic, institutional, socio-cultural and environmental. These were presented in table 5.1.. The documents used for that phase were generic academic articles about biofuels in developing countries or in SSA more specifically (not any documents relating to assessment of policies yet).

In the search for the effects of the basic business models for biofuels production and the requirements to implement them (success factors) the literature sources during the desk research included academic literature, official policy documents of countries with the most advanced policies, some presentations found on the internet or through the researcher's participation in a relevant conference (World Biofuels Markets, Rotterdam-March 2013). Also a number of reports from organisations such as FAO, the UNO group of organisations, and research institutes have also been very useful and inclusive. Next to these, a number of challenges have been identified for each type of business. Ideas on addressing these were also found in the literature and in some cases they led to guided the structure of the following chapters that presented the products of the discussions with experts (e.g.adoption process, stimulation options). The analysis on SCM (chapter 3) was based on academic articles and reports of organisations only.

Regarding the stimulation of production and consumption (chapter 4), applied policies were sought that have been assessed (e.g. in developed countries, such as the EU and USA), as well as suggestions by scholars on possible effective measures and reflections on past experiences. The study of those documents sought for as much detail as possible regarding the advantages, disadvantages, risks and costs with regards to their implementation. The focus was on making clear what their application requires and entails, so that their subsequent assessment by the interviewees could focus on their applicability in the context of SSA -albeit further elaboration also occurred, as expected- and on addressing the challenges identified.

1.7 Outline of the report

The report consists of ten main chapters and three concluding ones (11-13).

1. **Introduction**
2. **The business models for biofuels**
3. **Supply chain management**
4. **Stimulation of production and consumption of biofuels**
5. **Methodology of empirical research activities**
6. **Presence of conditions for Bioenergy in Ghana**
7. **Synthesis of factors for successful biofuel production and consumption**
8. **Strategies for efficient business models for biofuels**
9. **Strategies for efficient supply chain management**
10. **Assessment of possible stimulation options**
11. **Conclusions**
12. **Recommendations**
13. **Discussion**

2 The business models for biofuels

2.1 Introduction

This chapter sets out to answer the following research question:

"Which business models for the production of biofuels can be found in the literature, that are appropriate in the context of sub-Saharan Africa (SSA), what are their impacts and which are the requirements to successfully employ them (success factors)?"

This chapter focuses on the organizational/institutional arrangements that businesses need to undertake –often in collaboration with other actors, such as the public sector or the farmers, in order to operate efficiently and sustainably. The roles of the various actors are of interest to this research, as it aims to make recommendations for effective organization and management of biofuels businesses and for a public policy to contribute to the development of the sector. However, the ownership scheme of a business is by necessity also linked to the conversion technology and to the end-products of the crops being cultivated (FAO/UNEP/UN-Energy, 2012, Module 3). Consequently, it has been determined to separately analyse the operational aspects of business management as well, framed as Supply Chain Management (SCM).

There are various factors that affect the dynamics of biofuels production and different objectives may be pursued through the deployment of biofuels, which relates to the business models employed. Consequently, different options of business models must be examined and as Hultman et al. (2012) recommend for Tanzania, "a flexible but carefully implemented policy framework could encourage biofuel investment that is mutually beneficial to all parties". Moreover, many scholars also argue that for the inclusion of impoverished communities in modern economic systems (which is often a main driver of biofuel development), different business models are required (e.g. Hall and Matos, 2009). Therefore, an analysis is required to identify and discuss the different business arrangements that are possible to be implemented and the roles various actors (can) play in realizing the potential benefits.

The institutional arrangements associated with the production and ownership of feedstock differ depending on three main factors (FAO/UNEP/UN-Energy BDST-Module 2, p.15):

- "The scale and ownership of farming operations, i.e. large industrial plantations owned by the processing company (corporate ownership), large commercial private farms (individual or corporate ownership) or small-scale farmers (private, but often on customary land without individual freehold title). In turn, the ownership scheme of a business is by necessity also linked to the conversion technology and to the end-products of the crops being cultivated (FAO/UNEP/UN-Energy BDST, 2012, Module 3).
- The scale of operations of a processing plant, i.e. large-scale for export or small-scale for local use;
- The relation of the feedstock producer to the processing company: in contract farming, the company buys feedstock from outgrowers; in concession schemes, it produces on its own or leased land;"

Apart from considerations of scale, though, agricultural production in sub-Saharan Africa generally needs to improve, in order to be economically efficient and able to meet demands for food, fuel, feed and fibre (Janssen and Rutz, 2012).

After an introduction to business models and the factors that differentiate them, four basic types of business models for biofuel production will be presented. Each of them has been scrutinised for the requirements to successfully employ them and for their expected impacts with the purpose of giving the reader a comprehensive overview. In doing so, particular attention must be paid to social aspects, such as income generation and employment (ibid). Therefore the advantages, disadvantages and the risks they may entail for the companies, the farmers and for the society/public sector will be presented as found in the literature. Some ways to address the challenges of those types of business models have already been found in the literature as well and therefore will be presented here. These will be elaborated in a following chapter of this thesis.

The lion share of the analysis will be about the partnership models between companies and outgrower farmers, as these are the more complicated from an institutional/organizational viewpoint, and therefore pose major challenges and require great efforts, in order to be effective. Moreover, since outgrower models are –often considered as- the most promising business models, due to their potential to overcome certain limitations, it is important to present a number of variations. The impacts of each model are summarized in a table, while a detailed text about them can be found in the appendix D, , section I. That text additionally includes a few more impacts that have been identified for some types during the interview process with experts.

For the scope of this research the typology of von Maltitz and Stafford (2011) was considered as useful. It distinguishes four main types of business models, which are differentiated by the farm size of feedstock plantations and by the ownership scheme. In theory, farm size is a continuum, however in practice the farms tend to be either very small or very large[1]. The following table additionally distinguishes them in terms of the processing scheme and the intended market of the biofuel with a further differentiation of types B and C in two sub-types each.

Type A models: Large-scale liquid biofuel own plantations (concession scheme).
Type B models: Contract farming partnership between biofuel producer company and private farmers

- **Sub-type B1**: Individual large-/ medium scale farmers
- **Sub-type B2**: Small-scale farmers in cooperatives.

Type C models: Small-scale local energy farms.

- **Sub-type C1**: individual (non-aggregated) liquid biofuel blend farms for small-scale energy production
- **Sub-type C2**: small-scale farmers in cooperatives for local use

Type D models: large-scale local energy plantations for own biofuel use (rather unusual model).

[1] There are few examples of medium-size farms that can be found, (mostly in South Africa) but these are the exceptions (von Maltitz and Stafford, 2011).

Land ownership	Size of land units for feedstock production	Size of processing scheme and intended market	
		Large-scale bioenergy production for national or international blends	Medium/Small-scale bioenergy produced for own local use
Company	Large-scale commercial farms with owned plantations	**Type A**- Concession scheme	**Type D** (large corporate farms for medium- or small-scale biofuel production)
Individual farmers	Small-/medium-scale private farms (including farms that produce for their own on-farm use)	**Type B1**- **Contract farming**: in support for large-scale production	**Type C1-** Medium—small scale private farmers producing for small-scale local energy projects
Farmers organised in cooperatives	Small-scale private farms	**Type B2 - Contract farming**: small-scale feedstock outgrowers in cooperatives providing feedstock to large-scale biofuel producers	**Type C2** – small-scale private farmers in cooperatives producing for local energy projects

Table 2.1. Main ownership/contractual options for bioenergy feedstock supply. Source: adapted from FAO/UNEP/UN-Energy, 2012, Module 2, (which has in turn been adapted from von Maltitz et al., 2009 and Dubois, 2008).

2.2 General (common) success factors for business models

Apart from considerations of scale, agricultural production in sub-Saharan Africa generally needs to improve, in order to be economically efficient and able to meet demands for food, fuel, feed and fibre (Janssen and Rutz, 2012). Regarding the general factors that enable biofuel development, it is well known that "the competitiveness, and/or economic viability of bioenergy projects depends largely on the economic and social attractiveness of alternative options and the reference energy system" (van Eijck 2014, p.382). In remote rural areas, for instance, the relative profitability of biofuels production may be different and it may be a very competitive option.

Next to those, some more specific key determinants of success of any bioenergy scheme are most often the reliability and the cost of feedstock supply (Sims and Venturi, 2004, cited in Gold and Seuring, 2010). Therefore, ensuring a constant supply at a stable price is very important for any producer company and that is another reason why the formation of the business model becomes relevant again. Moreover, it is argued that – regardless of the scale and production scheme- if community members are integrated in the whole bioenergy chain (i.e. growing the feedstock, establishing conversion systems, choosing end-market and products), there are more possibilities to realize the socio-economic and environmental benefits that bioenergy is supposed to provide (FAO/UNEP/UN-Energy, 2012, Module 3), which in turn increase the overall viability of projects.

Additionally, due to their effect on economic competitiveness, the levels of national as well as of regional development, influence the impacts and also the viability of bioenergy systems. More specifically, impacts are affected by the availability of skilled labour, the state of the infrastructure, and the access to goods and services (e.g. machinery, inputs) (van Eijck 2014). For instance, the implementation of projects of high technical requirements in

countries and regions with inadequate capabilities and a low availability of (highly) skilled labour would imply high risks of project failure and the socio-economic impacts that come together with that (van Eijck 2014, p.382).

On the operational side the nature of feedstocks directly affects the ability of an industry to be established without owning large-scale farms (von Maltitz and Setzkorn, 2012, FAO/UNEP/UN, 2012, Module 3). Hultman et al. (2012) underline the gravity of the feedstock choice in conjunction with the business model for the ultimate success of any biofuel project. Most of the considerations regarding the efficiency optimization of the supply chain of businesses are common at any scale. Especially for small-scale schemes the technical and financial viability of projects can often be a concern, as it is a major challenge to keep them affordable, accessible and appropriate to local circumstances (FAO/UNEP/UN-Energy BDST-Module 2). In choosing between these production schemes particular attention must be paid to the end-use markets and to the technology that is adopted (ibid), as these determine their suitability to a large extent. All these aspects will be discussed in more detail in the next chapter on Supply Chain Management. However, there is no general response to the appropriateness of a business model.

2.3 Type A: Large-scale liquid biofuel plantations

Large-scale corporate plantations may range from some thousands to tens of thousands of hectares[2]. There feedstock production is most often dedicated and processed by the same company in its own facilities, although it may also be used in support to other activities. This is the typical model of foreign direct investment (FDI) and has the sole purpose of producing feedstocks for biofuel "devoted to national or international biofuel blending targets" (von Maltitz and Stafford, 2011, p.5). These are mainly monocrop plantations of corporate ownership, well-managed with modern farming practices. Formal waged labour is conducted by full-time or casual workers to undertake the various activities (such as planting, maintenance and harvesting) and a central manager has the overall responsibility (von Maltitz and Stafford 2011). The capital to realise these investments is sometimes raised on foreign stock exchanges or –more often- through private investment (von Maltitz and Stafford, 2011) in countries, where the land is owned by the state or by communities, these investments take the form of leaseholds. In countries with freehold titles the land can be formally acquired.

The objectives of industrial agriculture in SSA may include economic, political and strategic motives, depending on the actors (Janssen and Rutz, 2012). Apart from the common model of the plantation for commercial industrial agriculture, the so-called "super farms" constitute a model that must be distinguished. These are investments in plantations of thousands of hectares for export-oriented food crop agriculture. Therefore these super-farms have a character of geopolitical importance rather than a commercial character and are not a suitable model for agricultural development in Africa (Janssen and Rutz, 2012). This applies to agriculture for both food production and for biofuel feedstock and is important to highlight since many international actors make efforts to get access to huge tracts of lands in the African continent. This model has the highest risks of being unsustainable, because of

[2] For southern African countries von Maltitz and Setzkorn (2012) report that some companies have requested lands of hundreds of thousands of hectares.

dependencies that are created, monopolies and methods that negatively impact the local populations (Janssen and Rutz, 2012). For this model the success factors mainly relate to an overall efficient SCM, which is analysed in the respective chapters. The following table sums up the expected impacts of this model.

	Companies	Farmers/workers (individually)	Public sector/ society
Advantages	• economies of scale → likely to be successful • companies' production of own feedstock→ low supply risk • easy to establish[3]	• economic benefits: a) directly through formal employment, b) through externalities and wider development[4] • Health and environmental benefits (due to reduced pollution) • Better quality of jobs • Higher salaries[5]	• High employment in rural areas • increased opportunities in the global bioenergy markets[6] • Health and environmental benefits (due to reduced pollution)[7] • potential rehabilitation of degraded land[8] and enhancement of rural economy • increased overall energy access • reliable source of national revenue
Disadvantages	• Concerns about local food security, when good land is being used[9]	• unskilled and highly insecure employment[10]	• Threat or perceived threat to food security if scale is very large • Resource conflicts, e.g. for land, water, if proper procedures are not followed
Risks	• Risk of illegitimate land acquisition, even if formal process was followed	• Risk of harmful working conditions for rural workers • risk for displacement of vulnerable groups (e.g. smallholders, indigenous)/ land grabbing • risk of short-term employment, depending on crop and degree of mechanisation	• Deforestation • Peat land destruction • Increased GHG emission resulting from the above • Biodiversity loss • Water shortage • Pollution from the processing operation[11] • Use of foreign labour instead of local[12]

Table 2.2. Impacts of Type A models.

[3] von Maltitz and Stafford, 2011
[4] ibid
[5] ibid
[6] von Maltitz and Setzkorn, 2012
[7] FAO/UNEP/UN-Energy, 2012, Module 3 and PANGEA, 2012
[8] FAO/UNEP/UN-Energy, BDST, Module 3
[9] German et al., 2011
[10] Macedo 2005; Marti 2008, World Bank 2010 in German et al., 2011
[11] Ibid
[12] Cotula, 2011 and von Maltitz and Stafford 2011.

2.4 Type B models- Partnerships between large companies and farmers

Partnership models are the most commonly discussed in the literature, as they entail both difficulties, as well as great potential for development. These can be either of large scale (as the first type) or of medium scale (with a smaller company that collaborates with smallholder farmers). The profile of the large-scale agribusiness firms has been described in the previous section. The medium-scale commercial farmers on privately owned or leased or concession land may also participate in partnership models. Their farm sizes typically range from a few hundred to a few thousand hectares. Their production may either be dedicated for biofuel feedstock or they may have a mixed farming enterprise and they typically sell the feedstock to a processing company or mill, or they may process the feedstock on their farm to use as fuel for their own use (von Maltitz and Setzkorn, 2012). Farms are distinguished by the corporate entities in that they may operate as family farms, the farmer being the principle owner and manager (ibid). It is often difficult to distinguish between these small commercial farms and smallholders (ibid).

Partnerships between an investor on the one hand and smallholder farmers and their communities on the other are referred to as collaborative business models in the context of agricultural investments (IIED, 2010). The notion of collaborative business models links partnerships between investors and local groups to the very core of a business activity, rather than to corporate social responsibility (CSR) programmes that are peripheral to that activity (ibid). Even more specific is the concept of inclusive business models. As such are meant those "commercial arrangements which incorporate small-scale producers and operators into larger enterprises and where the interests of smallholders are recognized" (FAO-BEFSCI, 2012). A truly inclusive business model not only assumes a collaborative relationship to be in place, but also that fair and equitable terms are provided for the relationship to be based upon (ibid).

In the literature partnership models are meant implied to be established between companies and individual farmers. However, due to the potential that farmer organization has, it was chosen that a section about cooperatives is included in this part. Here the partnership models will be presented in two sub-types. That is a deviation from the original typology of von Maltitz and Stafford (2011), that was determined during the research, in order to specify on the possibilities of farmers cooperatives to form partnerships. That choice was motivated, due to the promising prospects cooperatives give to farmers and –as a result- due to their potential to contribute to a more stable partnership. Although cooperatives may of course be established to operate independently on a village level (Type C models), they are even more interesting as an alternative for partnership models.

Type B1 has originally been written to analyse partnerships between large companies and individual farmers. However, the description and analysis of the sub-types and of the impacts exactly fits Type B2 as well. Therefore the analysis of Type B2 should not be seen as distinct of the prior; rather it should be seen as an in-depth elaboration on the specificities that farmers organization into cooperatives (of various sorts) entails, while strategies for B1 are applicable to B2 as well.

2.4.1 Type B1- Contract farming: partnerships with small-scale liquid biofuel blend farms

This model includes small-scale farmers who either produce feedstocks for biofuels in their own-already existing- farms or who establish new dedicated farms especially for that purpose. Contract farming –also referred to as 'outgrower schemes'- is seen as a way for food manufacturers and retailers to also include smallholders in their supply chains (IIED, 2012). Moreover, it is seen as a way to mitigate the risk of displacement that large-scale concession farming brings (FAO/UNEP/UN-Energy, 2012, Module 3). It has been practiced for a long time for the purpose of agricultural production, but since only recently for feedstock production for biofuels (ibid) and its importance is expected to grow, due to the desire of companies to minimize risk through vertical integration. The lessons learned about it mainly come from the agricultural and the forestry sector (World Bank, 2007). Farmers only undertake the task of producing the crop –which is simply a cash crop to them- to sell to the mills, processing plants or middlemen (who then deliver to the mills/processing plants). The feedstock is directed to meeting national or international biofuel blending targets. In the cases when they are linked to larger estates, these farmers are called outgrowers. When they make a contractual agreement (either of short- or of long-term) with mills, they are referred to as participants of contract farming'. Labour in these cases comes from the household level, although it is possible that external labour is hired as an addition, in order to execute intensive tasks (e.g. land preparation and harvesting) (von Maltitz and Stafford 2011). The farmers in this model enter a contract of feedstock supply to the company for one year or for a longer term.

The operations are labour-intensive; in some cases the large-scale estate, mill or independent service providers undertake tasks that require mechanization, such as ploughing, harvesting and transportation (ibid). The mill/company may provide extensive support to the farmers in the form of farming inputs (such as fertilizers, pesticides) or financial support for their acquisition (which is deducted from their final payments), access to machinery and technical support.

FAO/UNEP/UN-Energy (2012, Module 3, p.7) categorise five different types of contract farming:

1) ***Centralised model***: the most typical model of contract farming, where a large processor buys the produce of many small farmers. It is characterized by strict coordination (i.e. for quality controls, pre-harvest determination of quantity). Usually the products require a high degree of processing (may be sugar cane, coffee, milk, tea).

2) ***The Nucleus estate model***: In essence it is a variation of the above model. The company has its own core plantation and is also supplied by smallholder in the surrounding area. This model guarantees a certain processing throughput for the company (FAO/UNEP/UN-Energy,2012, Module 3) and therefore is believed to mitigate the supply risk by having a minimum amount of feedstock produce to be based on.

In many African countries and elsewhere (e.g.Brazil) the 'nucleus estate model' is common mainly for sugarcane and some other crops (mainly perennial crops like oil palm),

that is based on a large plantation of a company that is complemented with some 20% of total production coming from outgrowers (FAO/UNEP/UN-Energy 2012,Module 3). In that model the company is responsible for providing equipment and technical support, while the farmers are responsible for providing a certain quantity and quality of feedstock that has been agreed upon (ibid).

3) ***Multipartite model***: a collaboration between a private company with contracted farmers along with state-owned institutions. In this the providers of inputs and services can be public or/and private. The model has a higher degree of vertical coordination, as the participating entities may wish to exert significant control.

4***) Informal model***: when individual entrepreneurs or small companies make seasonal agreements with smallholder farmers. This typically occurs for crops with minimal processing requirements, like fruits and vegetables. Naturally, the degree of vertical integration is lower than in the aforementioned formal models.

5***) Intermediary (or Middleman) model***: At least three parties are present in the contractual agreement. There is a biomass processor or trader who has a contractual agreement with a collector or middleman, who in turn has a formal agreement with some small farmers.

Additionally, IIED (2010) also reports that apart from the typical "growership" contracts -through which farmers commit to produce from their own land- contracts for land leases can be used for farmers to be employed on the estate or plantation. That is the case in a banana plantation in the Philippines, where a strict precondition exists that the farmers offering their land for lease, provide a clear land title to the companies. Rental agreements in these arrangements are for 15-20 years, during which period either the land owner or a family member is employed by the firm (ibid).

Success factors for Type B models

In broad terms factors that affect the success of these schemes are (FAO/UNEP/UN-Energy, 2012, Module 3):

- The resources made available to farmers,
- The experience in working together,
- The size of the group (the smaller, the better they work),
- The presence of a clear and active leadership,
- Clear perception of the economic benefits of group formation.

Institutional arrangements may also differ depending on political, socio-economic and cultural structures in different parts of the world (FAO/UNEP/UN-Energy, Module 3, 2012). As a result, a number of locally-specific factors are always expected to play a role in the adoption of a model. For any contractual relationship to be sustainable, Shepherd (2013) regards two conditions as essential: a) the existence of mutual benefits for the parties included (win-win situation) and b) a conducive institutional and political setting.

Evidence –also from the cocoa beans industry in Ghana- suggests that with the appropriate policy and infrastructure in place, "small-scale producers are able to farm

competitively and seize new market opportunities" (IIED, 2010, p.7). Moreover, there is evidence that smallholders actually need to partner up with large investors, in order to be successful (IIED, 2010). When it comes to business models that include smallholder farmers, a number of factors are expected to impact the type of outcomes and the level of benefits on the social domain (FAO-BEFSCI, 2012). These –apart from the aforementioned factors of type of crop and land tenure - include the smallholders' level of income diversification, and prior experiences with large-scale investors ibid). Factors that mainly affect the investor's side are the pricing and contract terms, pricing policies, and diversification of market outlets (ibid).

Reportedly, reviews of contract farming and outgrower schemes in sub-Saharan Africa have identified a number of factors that determine social impacts of bioenergy in sub-Saharan Africa. These include (German et al., 2011b):

- the nature of the crop (shaping up-front investment levels and labor requirements),
- land tenure and availability (shaping willingness to invest and to participate),
- farmers' income diversification (shaping farmers' bargaining power and exposure to risk)
- prior experiences with large-scale investors (shaping levels of awareness at the negotiation stage)
- investor practices related to staffing and communication, product grading and pricing, and contract terms (e.g., input provision arrangements, transparency, barriers to exit),
- contextual factors, such as pricing policies (which exert upward or downward pressures on rent capture by smallholders) and diversification of market outlets (German et al., 2011b).

For smallholders to realize the benefits of producing feedstock for biofuels it is preferable that the value-adding stages take place at the site of cultivation. Hotbod and Tomei (2013, p.10) have found that "better resources and connected agribusiness actors who are able to capitalise on the opportunities from increased demand for biofuels". Small-scale producers have been proven to perform better when located close to a large-scale plantation, as compared to more distant ones *(*McIndoe-Calder[13] 2011 in von Maltitz and Stafford 2011*).* In all the successful cases however a common key factor has been identified, which is the high value of the crop (von Maltitz and Stafford 2011). Next to that, support to farmers and secured market access are also important (ibid).

German et al., (2011b) also argue that for the development of small-scale enterprises that produce biodiesel and other products support is likely to be needed in the form of organizational capacity (for instance, for establishing market linkages, or for seeking redress in the face of grievances). However, it must be acknowledged that – due to the scale and scope of the required support- to render such models meaningful for producing volumes that contribute to national targets and with environmental sustainability, concerted government efforts would be required. These would have to take the form of facilitation of access to credit, extension services, and market linkages. Table 2.3 sums up the impacts of the Type B models.

[13] Studies in Zimbabwe

	Companies	Farmers/workers (individually)	Public sector/ society
Advantages	• diversification of the supplier base • reliance on smallholders areas[14]: - saves administration costs for the company - improves flexibility of feedstock supply (diversification) - maintains good public relations with community (through socio-economic benefits and infrastructure) • overcomes the land constraints (and larger overall areas become available) • makes the investment more politically acceptable • builds relations with the community • possibly greater consistency in the quality of the produce purchased • supply is more reliable for a company • reduced risk of losses from diseases, pests or droughts • increased feedstock flexibility, due to the diversified supply • lower overall investment risks (due to limited land investment)[15]	• market diversification for their produce • opening of new markets for farmers[16] • enabling access to lucrative but distant markets • reduced market risk[17] • reduced price risk[18] (when prices are pre-agreed) • income stability (positive for their food security too) • often provision of inputs and the production services by the company[19] • increased productivity and income, resulting from the above[20] • Credit advances by the company to farmers[21] • introduction of new technologies and opportunity to acquire new skills • Some crops are more appropriate for small-scale • Access to credit (possibly)[22]	• Increased employment: a) directly through formal employment, b) through externalities and wider development[23] • requires little government intervention to be promoted (infrastructure and dispute resolution mechanisms) • possibly provision of grants for community projects[24]

[14] UN/FAO, BDST-Module 3, (2012)
[15] FAO/UNEP/UN-Energy, Module 3, (2012)
[16] And active participation to them (Lindholm, 2014).
[17] By having guaranteed markets (Shepherd, 2013, Lindholm, 2014).
[18] Shepherd, 2013. Lecture slides from lecture in conference 'World Biofuels Market", March 2013, Rotterdam, the Netherlands.
[19] Shepherd, 2013, Lindholm, 2014
[20] Lindholm, 2014
[21] FAO/UNEP/UN-Energy, Module 3, 2012
[22] Lindholm, 2014
[23] Lindholm, 2014

Disadvantages	• spatial scattering of farmers increases transaction costs • the internalization of support service costs (inputs, possibly logistics, etc.)[25] • high transaction costs to administer and train partner farmers[26] (a lot of time, management efforts and money must be invested (18)) • Productivity and crop quality of smallholders[27] • difficult to achieve traceability and evaluate sustainability of farming practices[28]	• unequal bargaining situation of farmers vs large companies[29] • loss of flexibility in enterprise choices • inability to benefit from higher prices in the market (as long as prices are fixed) • difficult to enforce the labour regulation→ wages are often low[30] • often monocultures have to be planted→ Loss of flexibility • No or poor income in first years after planting a new crop[31]	• Lower yields than large-scale plantations mean that the land transformation footprint is larger for the same level of production[32] (von Maltitz and Stafford 2011).
Risks	• Side-selling by farmers →inadequate feedstock supply[33] • Discontent of famers, due to poor management or/and a lack of consultation with farmers • diversion of the use of inputs by farmers[34] • contractual delays[35] • Failure of farmers to deliver the crop for other reasons[36] • risk of a company's image, if partnerships collapse • potential operational risk	• Risk of a long-term unequal relationship with company • Risk of dependence on a single corporation • risk of farmers facing a monopsony/monopoly situation by the only one existing processing mill in their area • risks of market failure and production problems (with new crops) (35) • risk of company's	• Risk of traditional farming practices and market linkages getting lost[42]

[24] CSBF 2009 in German et al., 2011b
[25] Shepherd, 2013
[26] von Maltitz and Stafford 2011
[27] IFC, 2013
[28] if participation in a certification programme is required (IFC, 2013)
[29] Hultman et al., (2012)
[30] von Maltitz and Setzkorn, (2012)
[31] Shepherd, (2013), 23, 25, a.o.
[32] "This might be slightly offset through intercropping or the use of agroforestry systems, where a diversity of products is being produced", thereby increasing the net productivity (von Maltitz and Stafford 2011).
[33] FAO/UNEP/UN-Energy-Module 3, 2012 and IFC, 2013.
[34] ibid
[35] Shepherd, 2013 (and later also interviewees), as well as and relating to a lack of willingness to adopt new farming practices (IFC, 2013).
[36] That is relevant to any processor partnering with smallholders (even at smaller scale models), as there may be great challenges in honouring the contracts (van Eijck et al., 2014).

	in the long term, where land regime is insecure • risk of failure of farmers[37] • social or cultural constraints may affect the ability of farmers to produce according to the company's specifications	failure or non-profitability (25) • risk of manipulation of the quotas by company • risk of indebtedness for farmers[38] • risk of social structures and gender relations being disrupted[39] • risk of overdependence in provided inputs[40] • lack of transpanency in contractual terms causing misunderstandings[41]	

Table 2.3. Expected impacts of type B (partnership) models.

2.4.2 Type B2- Partnerships of large companies with farmers' cooperatives

For agribusiness firms it is an alternative option for partnerships if companies and organisations decide to work with existing or that they form local groupings towards a gradual development of associations and then cooperatives. Of the challenges that smallholder farmers face, the lack of organization is commonly regarded as the greatest barrier to their ability to access markets (FAO-BEFSCI, 2012) and as they are also incapable of accessing credit, they are doomed to usually rely on outdated or ineffective farming inputs (ibid). The latter factor results in them being unable to make investments, which will improve their yields and (subsequently) overall performance (ibid). Next to those they face difficulties with the transportation of crops to processing plants (due to high cost) or to sell through middlemen (Baswant et al.-IFAD, 2008).

It is for these challenges that many argue for the need for small-scale farmers to jointly form cooperatives and producer companies. Others more emphatically support that it is in any case inevitable that for the biofuel industry to be fully sustainable smallholders will have to become part of it (e.g. Ser Huay Lee et al., 2011, p. 2513) and that –in turn- can only happen successfully if they are organised. This –if achieved- is an important element of inclusive business models and would also enable to incorporate smallholders in the global bioenergy value chains (UNECA, 2012). Additionally, Rist et al. 2010 (in German et al., 2011) support that provided that cooperatives operate in the interest of their members, they are essential in realizing the potential benefits and to hold them accountable to their contractual agreements.

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[42] Shepherd (2013)
[37] Shepherd, 2013
[38] ibid
[39] ibid
[40] IIED, 2012, Lindholm 2014
[41] German et al., 2011b

A well-known case where that successfully happened is that of the development of Eco-MICAIA in Mozambique (IIED, 2010). In Brazil the dispersion of smallholder farmers, that causes higher transaction costs, has actually resulted in an increased importance for the role of farmer cooperatives. These are typically small operations, but with adequate managerial and technical capacities, that eventually serve as a link between impoverished farmers, biofuel refiners, and research institutions (Hall and Matos, 2009). Therefore cooperatives are regarded as "an important mechanism in the diffusion of technical and basic business knowledge up the supply chain" (ibid).

There is a range of forms that producers' organisations can take, such as farmer field schools, rotating savings and credit associations, farmers' associations, clubs, and cooperatives. Aggregating (aka forming groups) of smallholder farmers is of critical importance to build efficient supply chains as much as it is challenging. It is critical because for a firm with large-scale production it is very difficult to deal one-on-one with hundreds or thousands of dispersed small farmers and the small volumes they contribute with. But it is equally challenging, because such organisations are most usually lacking and the few existing ones are limited in capacity (IFC, 2013).

Success factors and categories of cooperatives

As markets for biofuels are poorly developed, it is difficult for independent growers to sell their produce (von Maltitz and Setzkorn, 2012). Enhancing the access of smallholders to the market would create more opportunities for rural development and income generation, which may ultimately even positively affect food security on the local level (FAO-BEFSCI, 2012). Therefore, the formation of cooperatives is considered to be an important step that could enhance market access of small farmers and provide them the subsequent benefits. Cooperatives are more likely able to bundle the interests of poor farmers and therefore are important in a strategy which has poverty reduction as a goal. More specifically, they can "accumulate and attract capital and partnerships for the necessary investments, organize feedstock supplies in large quantities and, in turn, create a countervailing power to the larger firms operating in the energy market. (Raswant et al, 2008, p.9). This can probably be better done by existing institutions; either cooperatives or private companies.

If farmers manage to bundle their interests, attract capital and form partnerships, they can indeed form an alternative model to that of the large firms that currently dominate the energy markets (Baswant et al.-IFAD, 2008, Hongo-FELISA, 2008). Moreover, to achieve significant production volumes, usually financing and infrastructure[43] must be ensured. Financing could either be in the form of a bank loan or of an advance payment from an off-taker (IFC 2013).

Notably, it is acknowledged that the formation of farmer cooperatives poses many challenges and requires a high degree of involvement by the initiating actors. Disparities in wealth, the quality and size of land, access to labor, and educational background are some of the factors that pose difficulties. An important success factor in the process of initiating the formation of the cooperatives is the understanding of farmers' perceptions and attitudes towards it (Ser Huay Lee, 2011). As has been observed during participation of smallholders

[43] "Infrastructure may range from a locally constructed building to a modern concrete or metal warehouse".

groups in certification schemes, through collective action they are able to more efficiently disseminate information and meet requirements, as well as to develop skills. On the other hand, there have been cases where farmers perceived such centralized activities of cooperatives as infringing on their independence and decided to remain independent (Ser Huay Lee, 2011).

IFC (2013) distinguish three classes of cooperatives in terms of their capacities to manage on the one hand information and on the other hand resources, such as inputs, crops or money. For the analysis conducted in this thesis a simple reference to all types of cooperatives suffices, but the interested reader can find a classification of them in section I-iii of the appendix D. Naturally, forming such groups is an expensive and time-consuming process. However, when successfully done, a number of factors result in cost savings. These are:

- Information dissemination, due to reduced cost of collecting and disseminating information, sometimes already before making the investment (for instance, for companies seeking certified crops or increased suppler productivity).
- Logistical support, as sorting, drying, storing of crops and other functions conducted on aggregate level, achieve substantial logistical savings and may even contribute to product quality.
- Marketing and distribution, as well as loan making and servicing costs are also reduced for firms marketing inputs and /or for financial services provided to smallholders (IFC 2013).

	Companies	**Farmers/workers (individually and on local society)**
Advantages	• Easier to address cooperatives than individual farmers • Likely that partner farmers understand the value of honouring contracts[44]	• Higher possibilities to invest revenue in farms as investment[45] • increased capacities for bargaining[46] • Value-added processing[47] • Brand development[48] • Ability to generate earnings by procuring crops from non-members[49] • Provision of services of wider social benefit[50] • Increased sense of social belonging[51] • improved access to information, finance and infrastructure[52]

[44] FAO-BEFSCI, 2012 and van Eijck 2014
[45] IFC 2013
[46] IFC 2013 and German et al., 2011.
[47] ibid
[48] ibid
[49] ibid
[50] ibid
[51] van Eijck 2014
[52] ibid

Disadvantages	• Inexperience of farmers with partnerships and democratic processes[53]	• The formation and functioning of cooperatives is difficult[54] • mismanagement of assets[55] • lack of inputs and financing[56]
Risks		• nepotism, corruption and other forms of mismanagement[57] • dependence on donor funding[58]

Table 2.4. Summary of impacts of aggregation into cooperatives.

2.5 Type C models- Small-scale local energy farms

Small-scale production for local use typically aims to supply fuel to generators for local electrical power. These projects start up as government or NGO initiatives, usually with the aim to provide fuel for electricity to a local community and are typically managed by locals. Such decentralized small- or medium-scale projects are seen more as rural development initiatives than the commercial private sector-led projects (even though they are founded on commercial principles). They are believed to be a good alternative to large schemes for SSA countries. Moreover, they contribute to poverty reduction and also result in food security benefits (FAO/UNEP/UN-Energy, 2012, Module 3). They are likely more favourable in the pursuit of equity and empowerment (social outcomes) (von Maltitz and Stafford 2011, von Maltitz and Setzkorn, 2012). A number of NGOs have started up such small-scale projects mainly in West Africa with the purpose of rendering rural communities energy sufficiency. Although in many cases the implementation of that model has been successful, concerns generally remain about their fate after donor funding is ceased (reported by GERES, 2008; Nyetaa, 2012; Fact-Foundation, 2006 in Degail and Chantry, 2012). Although reducing energy and financial poverty are important benefits, these projects are difficult to implement and therefore unlikely to be forwarded by the private sector. Consequently, they require government intervention and/or donor support (von Maltitz and Stafford 2011). The benefits to rural development make it easier to justify some subsidies that may be needed. If positive links between the ecosystem services created by these projects (e.g. reducing deforestation or biodiversity loss) can be demonstrated, then subsidies or one-time payments may be appropriate (ibid).

Production at this level often takes place through a multifunctional platform, which produces electricity and performs milling and pumping services (common approach in Tanzania). The platform can be powered by pure plant oil or processed biodiesel that is produced locally. In other cases a local power utility is set up for the purpose of providing energy to the village (e.g. case of Mali Folke Centre project in Mali). Projects have limited resources with the long-term financial sustainability depending on the affordability of locals to purchase the power produced. The biofuel can also be used for household uses, such as for cooking or lighting, although this can be challenging due to the high cost of the

[53] FAO-BEFSCI, 2012
[54] Also because people are not used to democratic institutions (FAO-BEFSCI, 2012 and IFC, 2013)
[55] FAO-BEFSCI, 2012
[56] IFC, 2013
[57] Ibid
[58] Ibid

technology to use pure plant oil (PPO) directly, which most poor households cannot afford (von Maltitz and Stafford 2011). Unlike contract farming, in independent smallholder production there are no contractual purchase agreements with (and corresponding support from) the industry (German et al., 2011b).

According to von Maltitz and Stafford (2011, p.6), "the greatest successes have been when the pure plant oil is used directly in diesel generators to make electricity for rural homes". In these cases the farmer can either sell the feedstock to the power utility as a cash crop or can be a member of a collective whereby household electricity is provided to the community in exchange for feedstocks (ibid). Another possibility is for micro-distilleries to produce ethanol gel for local use, as has been done in projects in Ethiopia and Brazil (ibid).

Most of the literature on small-scale models focuses on the opportunities to enhance the livelihoods of micro-scale farmers (small-scale and subsistence level, owning a few hectares of land). It is reasonable to argue however, in favour of the development of class of commercial farmers, by assisting them "to move from functional subsistence to farming for profit on small- to medium-size commercial farms (von Maltitz and Stafford, 2011, p.39). that upgrading and upscaling led to the successful development of the sugar industry in Kenya and Tanzania (and has been the norm in the developed world). There are two objectives in trying to upgrade the status of small farmers in that way:

a) Providing assistance to microscale farmers to improve their practices, while increasing the farming area, so that they achieve commercial levels and independence,
b) Dividing the large-scale plantations of corporate ownership into numerous plantations of smaller and localized private plantations (von Maltitz and Stafford, 2011, p.39).

The argument to promote that development concerns the efficiencies that relate to the scale and quality of the farming operations. While all constraints that have been mentioned for medium and small-scale farming businesses are relevant it must be mentioned that "land size is a constraint to development of a more market-orientated commercial small-scale farming sector based on the production of biofuel crops" (ibid, p.40). as this is a wider policy development (an agricultural reform would be needed), it will not be elaborated upon here, but it may be mentioned that the sections of ownership, risk and capacity-building of the chapter (no. ?) on the action strategies for BMs are relevant.

Success factors of type C models

Dubois (2008, p.30), lists a number of elements that are believed to be essential for successful biofuel development projects at the level of local communities:

- participatory approaches that involve a broad cross-section of the community, including the poorest groups;
- inclusion of production and supply of biomass as an integral part of the project (because the entire biofuel chain affects the local community) and sensitivity to other possible uses of feedstock (e.g. as food, fodder, soil amendment or fertilizer, construction material);
- minimized transaction costs

- assurance mechanisms, such as contracts and understandings, to keep the community and private biofuel processors together in partnership.
- fostering of a local institution to take responsibility for design, implementation and ongoing management of the project.
- Appropriate financial mechanisms. For poor people, who are not able to borrow from financial institutions, some kind of financial support is needed to realise such projects.
- Involvement of local communities and small farmers in the co-management of biofuel systems. In other natural resource sectors (e.g. forestry) and rural development, the support on that principle has been lowered after the recognition of the challenges that arise – "providing a lesson for biofuel development".

	Organization or Farmers' association	**Farmers/workers (individually)**	**Public sector/ society**
Advantages	• employment	• Increase of energy access • high availability of energy at the local level, • which is more connected to the local type of demand • alternative income diversification to ordinary agricultural production	• significant potential to increase rural development (particularly when all feedstock is locally produced) • Job creation potential (direct and indirect) • generation of revenue for the local economy on the whole • benefits from energy access • Low or positive environmental impact (footprint)[59]
Disadvantages	• difficult to establish[60] • difficult to maintain without donor funding[61] • requires the creation of capacities for the local people • inability of farmers to make investments to improve performance • low capacity of producers and operators to follow sustainability standards[62]		
Risks	• economic failure if not a minimum amount of people can afford the energy		

Table 2.5. Impacts of small-scale business models (type C).

[59] Also in von Maltitz and Stafford 2011 and van Eijck et al., 2014
[60] FAO-BEFSCI, 2012
[61] ibid
[62] van Eijck et al., 2014

2.6 Type D models: Large-scale local energy plantations

The production of energy from large-scale plantations for local use is an unusual model. It may be employed by a corporation to meet its energy needs by itself (most often mining companies or large commercial farms). In this model waged labour is employed to produce power for generators or to cover the needs in liquid fuels for transport. Its impacts are mostly the same to those of type A, albeit with some lower risks for the companies. Contrary to model A, here the feedstock is grown to provide energy for the core operations of the company as a cost-saving measure, instead of commercial reasons (von Maltitz and Stafford 2011).

Success factors of type D models

This model can be considered by mining houses and large commercial farms and plantations. It becomes interesting in cases of deeply rural areas that have poor access to fuels -or where these are very expensive, due to transportation costs- or that have an unreliable energy supply as a result of poor infrastructure (von Maltitz and Stafford 2011). For example, in countries like Zimbabwe, Zambia and Uganda, undersupply of electricity results in rolling blackouts. Therefore companies cannot be based on the national electricity grid for a stable supply. In such cases biofuel development provides an alternative, due to the relative cost-effectiveness and energy security as compared to the fossil fuels.

	Companies	**Farmers/workers (individually)**	**Public sector/ society**
Advantages	• reduction of operating costs[63] • increased reliability of supply[64] • improvement of company's image and public relations • can be linked to outgrower schemes	• economic benefits: • a) directly through employment, • b) through externalities and wider development • Health and environmental benefits (due to reduced pollution) • Better quality of jobs	• rehabilitation of degraded land (e.g. in cases of decommissioned mines) • Increased employment in rural areas • increased opportunities in the global bioenergy markets • Health and environmental benefits (due to reduced pollution) • potential
Disadvantages	• capital intensity and commitment required to realise projects • lack of desire of shareholders to support projects[65] • (limited) concerns about local food security, when good land is being used		• Threat or perceived threat to food security if scale is very large • Resource conflicts, e.g. for land, water, if proper procedures are not followed
Risks	• Risk of illegitimate land acquisition, even	• Risk of harmful working conditions	• Deforestation • Peat land destruction

[63] von Maltitz and Stafford 2011
[64] Ibid
[65] von Maltitz and Stafford 2011

	if formal process was followed • Reputation risk may follow from the above • agricultural performance risk • implementation risk • Logistics(inland and at the port) • Management	for rural workers • risk for displacement of vulnerable groups (e.g. smallholders, indigenous)/ land grabbing • risk of short-term employment, depending on crop and degree of mechanisation	• Increased GHG emission resulting from the above • Biodiversity loss • Water shortage • Pollution from the processing operation[66]

Table 2.6. Summary of effects of Type D (large-scale) models.

2.7 Conclusions

This chapter has provided a detailed presentation of the business models that are relevant in the context of SSA. Four main types have been distinguished with a number of variations for partnership business models between companies and small farmers. The distinction in these types is based on three factors, namely the scale and ownership of farming operations, the relation of the feedstock producer to the processing company and the scale of operations of a processing plant.

The expected impacts of each type have been presented as advantages, disadvantages and risks for the companies, the farmers and/or workers individually, as well as for the public sector and society on the whole. In short, the large-scale concession schemes score higher in terms of the creation of employment and other economic opportunities, low supply risk for companies and generally high potential for profitability and economic success, but come with significant risks, such as that of food security and environmental risks.

Partnerships of producer companies with individual smallholder farmers (Type B1) or their associations (Type B2) were presented separately. Specific characteristics and issues about these subtypes were analysed. Contract-farming is a way to overcome difficulties with land acquisition and reduce relevant risks for farmers, while it may contribute –provided a good partnership with a company is built- to overcoming their main inefficiencies. Smallholders gain access to markets and technology, while benefitting from other mechanisms that can be organized for them too. A proper regulation of investments and provisions for their reward can substantially support smallholders in those cases. Some of the most important benefits include the ability to overcome a number of obstacles that relate to land acquisition processes and social acceptability of investments, the diversification of companies' supplier base, the rural development opportunities for communities and the opportunities of farmers to access new markets, while improving their farming practices. The downside of these models is that they come with many risks –mainly for the companies- and that building a stable partnership with a large number of smallholder farmers is a difficult process.

Farmer's associations may work very well with specific preconditions and mainly, where there is already some experience with them. However, forming new associations is a difficult and time-consuming process. In those cases partnerships for the development of inclusive business models becomes relevant. In general, two conditions are essential for

[66] Ibid

successful partnerships: a) the existence of mutual benefits for the parties included (win-win situation) and b) a conducive institutional and political setting. Moreover, a long-term relationship is an element of success for any partnership and for that investments in human resources from the part of the company must be made.

Small-scale production schemes for local energy production (Type C) can be a means of local-level economic development, if implemented carefully. They can create a number of stable employment opportunities, they provide energy access to deprived populations and score high in terms of GHG balance and overall environmental performance. These projects usually face risks of financial nature to keep the operations running.

Large-scale models for own energy production (Type D) are employed to reduce the operating costs of companies that already own large tracts of land. Most of their effects are the same or similar to those of Type A projects, but negative effects are less likely to occur, due to the direct economic benefit that is expected (although acceptability of project by investors can be a serious obstacle). Additionally, these projects may realise the advantage of rehabilitating degraded land.

Finally, the following table summarises the success factors of each of the four types of business models. These are presented along with some factors that they all have in common.

General success factors across types				
For economic viability: • **economic and social attractiveness of alternative options and** • **the reference energy system** • **the reliability and the cost of feedstock supply** • **nature of feedstocks** **For socio-economic and environmental benefits:** • **levels of national as well as of regional development (skilled labour, infrastructure, access to goods and services)** • **Integration of local communities in bioenergy chain**				
Type A	**Type B1**	**Type B2 (in addition to B1)**	**Type C**	**Type D**
• Efficient supply chain management	• resources made available to farmers • experience in working together • The size of the group (the smaller, the better) • existence of mutual benefits for the parties • the nature of the crop→ high value of the crop	• Linking small farmers to biofuel refiners and research institutions • Overcoming spatial dispersion • Having adequate managerial and technical capacities • Finding new market	• participatory approaches involving broad cross-sections of communities • inclusion of production and supply of biomass as integral part of the project • sensitivity to other possible uses of feedstock • assurance	• existence of large-scale owned land/plantations • Poor accessibility to fossil fuels • Efficient supply chain management

	• a conducive institutional and political setting • land tenure and availability • prior experiences with large-scale investors • investor practices related to staffing and communication, product grading and pricing, and contract terms	outlets for smallholders (i.e. enhancing market access) • presence of a clear and active leadership, • Clear perception of the economic benefits of group formation	mechanisms • render a local institution responsible for design, implementation and ongoing management • Involvement of local communities and small farmers in the co-management of biofuel systems	
• Market stability • cost-competitiveness to fossil fuels	• farmers' income diversification • contextual factors, such as pricing policies and diversification of market outlets • Proximity to the large plantation • Connectedness to agribusiness sector • Support to farmers (inputs and organisational capacity) • Secured market access for small farmers	• Reduced transaction costs (see box of B2 on the right)	Leading to minimized transaction costs: • Dissemination of information • Logistical support on aggregate level • Marketing and distribution functions	• High cost of fossil fuels, due to transporation costs→ cost-competitiveness of biofuels
	• Government support for: access to credit, extension services, and market linkages		• Appropriate financial mechanisms	

Table 2.7. Summary of success factors of the various business models.

Through the analysis provided here a number of important success factors have been identified for the success of each business model as well a number of challenges. Therefore the analysis that has been conducted in this chapter is a stepping stone for the next stages of the research in two ways. On the one hand, it has led to number of specific questions (or sometimes broad) as to the ways in which the efficiency of each business

model can be maximized and therefore the potential for success is increased. That is to be done in tandem with the search for solutions to the challenges that have already been identified. Therefore an in-depth search for elaborate answers must be made.

On the other hand, it already leads to a number of issues that relate to the role that the public sector can adopt if it envisions the development of a sustainable sector of biofuels. Issues such as the lack of access to credit , the need to achieve competitiveness with fossil fuels and others have quickly been identified as burning and require investigation.

3 Supply chain management

3.1 Introduction

The content of this chapter falls under the first of the research sub-questions but focuses on the last part of it in search of ways to successfully employ the business models:

"Which different business models for the production of biofuels can be found in the literature, that are appropriate in the context of sub-Saharan Africa (SSA), what are their impacts and which are their success factors?"

Addressing this sub-question in two different chapters was deemed useful, in order to distinguish between the organizational and the operational aspects of business management, the latter being analysed hereby.

According to Sharma et al. (2013), "supply chain management focuses on integration of all entities such that the end-product is produced and distributed in the right quantity, at the right time, to the right location, providing desired quality, and service level along with minimizing the overall cost of the system". A typical Suply chain (SC) consists of four entities: supplier(s), manufacturer, distribution centres and end-users (ibid). A complete Biofuel(s) Supply Chain (BSC)[67] is also comprised of entities such as blending sites, gas stations or demand zones[68]. The degree of coordination and integration between the actors/entities involved and the degree to which the flow of products and information is efficient determines the performance of the supply chain. Integrating the aforementioned production and logistical processes is crucial in the build-up of an economically efficient and competitive BSC (ibid).

A useful analytical distinction is that between the decision-making on strategic level and on operational level. Although SCM appears to be a linear process, as has been mentioned in the previous chapter, decision-making must precede the organised development of the sector of biofuels. The operational decisions concern "the capacity assignment of production facilities and the demand satisfaction along the time steps composing the time horizon"[69] (Dal-Mas et al., 2009). In the literature the term 'strategic' is more commonly used for all the planning that a company needs to undertake before starting operations. It lies within the objective of this research to encompass the role of the state in decision making and the need to link the decisions of companies and organisations for the

[67] Implying consumption at the region/country of production.

[68] Some different categorisations can be found in the literature, though. For example, one of the leading articles for SCM definines it as: "the systemic, strategic co-ordination of the traditional business functions and the tactics across these business functions within a particular company and across businesses within the supply chain, for the purposes of improving the long-term performance of the individual companies and the supply chain as a whole" (Mentzer et al., 2001, p. 18).

[69] The same authors note that the main variables that require optimization during the planned time horizon are: "(i) geographical location of biomass production sites, (ii) biomass production for each site, (iii) supply strategy for biomass to be delivered to production facilities, (iv) biofuel production facilities location and scale, (v) biofuel market demand satisfaction rate, (vi) distribution processes for biofuel to be sent to blending terminals, (vii) SC profit and (viii) financial risk under uncertainty" (Dal-Mas et al, 2009, p.2). That is an example of a different categorization that could be followed , but is less relevant for the analysis of this report.

operational design of projects with the broader conditions in the country (for reasons that will be motivated). Hence, a broader meaning of the term 'strategic' will be adopted here. The research makes use of the distinction between those two levels, upon which the current chapter is based, also in order to cover all stages of the BSC (from before feedstock production actually takes place until the end-use of the products).

3.2 Strategic Level

According to von Maltitz and Setzkorn (2012), at the strategic level the state must determine how much biofuel can be produced for either national or international blends. Consequently, companies must relate their own strategy to that and other relevant high-level considerations. Village-level projects must evaluate the developmental priorities locally and how biofuels can contribute to meeting them (ibid). Therefore 'strategic' is a useful term for this research as it encompasses concerns of all actors at the planning stage[70].

While the pursuit of certain strategic objectives is a significant driver of the decision-making process, doing so in a manner that is cost-effective and sustainable is equally important (FAO/UNEP/UN-Energy 2012, Module 2). Hultman et al. (2012) underline the gravity of the feedstock choice in conjunction with the business model for the ultimate success of any biofuel project. The choice of feedstocks is crucial in determining the use of resources (land, fertilisers, water) and therefore their implications are significant.

Moreover, the implications of feedstock choices for the end-uses, and subsequently on the viability of the business models and on the efforts to optimize the supply chain are very important. For instance, the nature of feedstocks directly affects the ability of an industry to be established without owning large-scale farms[71] (von Maltitz and Setzkorn, 2012, FAO/UNEP/UN-Energy 2012, Module 3). Therefore, after the adoption of certain objectives, the next step in the decision-making process is to determine which feedstocks and conversion processes must be pursued. As a result of the complexities that relate to the choice of feedstock options[72], the identification of the possible pathways that bioenergy production can take in a country is central in the process of the development of the industry. That is also because if stimulation of certain pathways is to be decided in pursuit of certain objectives, it should be well-targeted towards technically and economically feasible options. The influence of the state in the operational level concerns economic and performance measures that can contribute to the producers being efficient.

This chapter mainly aims to contribute to the operational stage (after the initial assessments have been made). In order to better understand how feedstock options relate to the functions of the business models and to the strategic design, it was determined to also analyse the main feedstock options for Ghana along with their implications for the adoption of business models. That part of the analysis would fit under the operational level,

[70] Furthermore, it is interesting for this research, also because currently the developments in Ghana are at the initial stage, so that strategic decisions have not yet been made. Moreover, the fact that the Strategic Environmental Assessment was undergoing at the time of the research, helps to classify the initial stage under the term 'strategic'.
[71] Although it may be possible also for developing countries to develop second generation biofuels in the future, it is preferable that at this stage the focus be on the commercially available pathways, due to the high cost and the technical sophistication that the development of 2nd generation requires (FAO/UNEP/UN-Energy, 2012, Module 2).
[72] An overview of those is provided in Appendix II, section ii.

but due to its indirect relevance for the results of the research, it is only be presented in Appendix II, section ii.

3.3 Operational Level

The research on the operational aspects of business management for biofuels was organized based on the distinction of five different stages of SCM. The stages are depicted in figure 3.1 below. As Dal-Mas et al. (2009) suggest, regardless of the size of the production scheme, to increase the overall efficiency of the Biofuel(s) Supply Chain (BSC), an effort must be made to optimize cost and resource efficiency at each stage. This section aims to present the stages of the BSC, derive the important success factors and outline the options that may be considered in each stage.

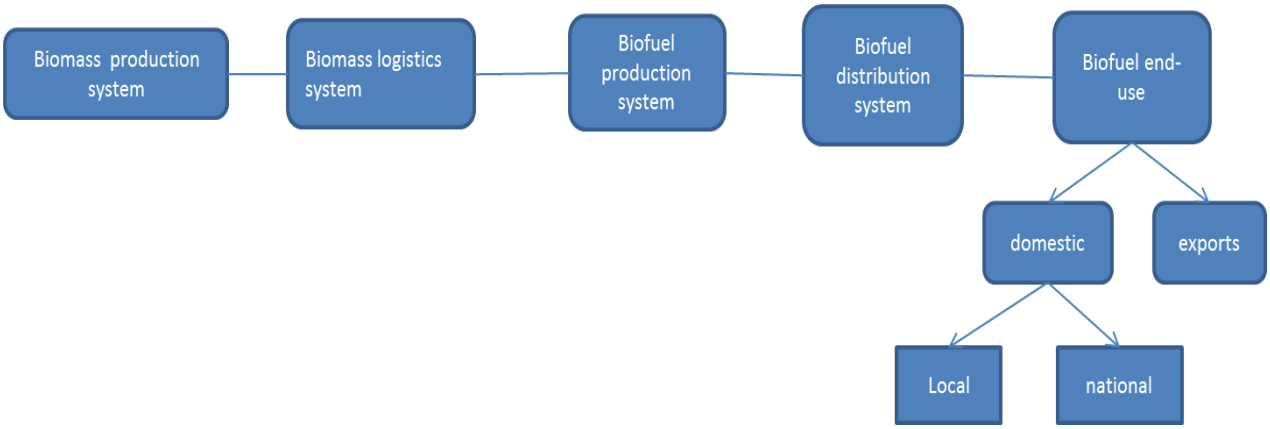

Figure 3.1. The Supply Chain of biofuels divided in five stages.

Contrary to supply chains of traditional goods the BSC faces uncertainties in the supply and availability of feedstock, rather than with regards to the demand for the end-product(s). since the largest shares of costs lie in the first stages of the BSC, the efforts to reduce costs focus on the first stages of the chain (i.e. activities of harvesting, storage, conversion sites, etc.) as well as on building up an efficient structure of the chain. Uncertainties due to seasonality, weather conditions, physical and chemical characteristics of biomass, geographical distribution and low bulk density of feedstocks cause variability in BSCs overall.

3.3.1 The Biomass Production System

Regarding the harvesting and collection of biomass for energy, we can distinguish between: a) the main options for harvesting, collecting and processing, and b) the characteristics of biomass, which impact its harvest, collection and handling (Gold and Seuring, 2010). A characteristic of biomass is its limited harvesting period, due to the seasonality of most types. A single harvest per year means that the capital-intensive machinery and equipment is underutilized, thereby increasing operation costs. It also requires more labour as compared to perennial harvesting and a short harvest period also means that larger inventories are needed, resulting in storage costs and dry matter losses (Gold and Seuring, 2010). The lack of appropriate infrastructure is common in SSA and an important concern, as post-harvest losses may be high (PANGEA, 2013). Next to these, the

harvest frequency affects the acceptability of crops by farmers in developing countries. Also, if crops –like jatropha- take more than one year to grow, more challenges are posed for poor farmers (Gold and Seuring, 2010).

The level of intensity of the chosen agricultural management system (that may range from low inputs of fertilizer, low use of irrigation and herbicides up to high input levels), as well as the level of mechanization, are factors that highly influence the economic performance (van Eijck 2014). The higher the intensity of inputs, and the more mechanized systems that are used, on the one hand result in higher investment costs, but on the other hand result in higher productivity (per unit of land area) than manual low input systems (van Eijck 2014, p. 379).

3.3.2 The Biomass logistics System

As infrastructure in developing countries is usually poor, it is expected to be a hurdle for the transportation of biomass in many of them, the cost of it being affected by the distances and the speed (Gold and Seuring, 2010). That part of the supply chain is an issue in Africa, mainly due to large post-harvest losses. Before converting the cellulosic materials to biofuel, they need to be dried and pre-processed either at the collection sites or at the biorefineries. After that stage both the volume and the moisture content of the lignocellulosic biomass materials is substantially reduced (You et al., 2011). Another practical challenge is that biomass is often bulky and wet, and therefore difficult to convert into a more efficient fuel. Ultimately, the location and the type of the storage facility needed will determine the options available:

a) in the direct vicinity to the farm (UNECA, 2012, Papapostolou et al., 2011).

b) Intermediate storage may be needed for the raw materials, the semi-finished products, or even for the final ones. This is a consideration that heavily affects the behavior of the biofuels supply chains, and examination is needed to determine whether it is preferable for some materials to be stored (if there is storage availability), if the materials can be stored without deterioration and how time-dependent the storage is (ibid). As the transportation density of biomass is low, volume and weighting options for transportation must be considered, but road transportation is the most common way (and shipment when it comes to exports) (You et al., 2011). To minimise the investment risks that a biorefinery project entails, a careful assessment of the options for the transportation, storage and handling of biomass is required (Sharma et al., 2013).

3.3.3 The Biofuel Production System

Biorefineries are classified in four types: starch- based, sugar-based, oil-based, and lignocellulosic biomass-based (Sharma et al., 2013). The conversion technology is chosen based on the type of feedstock as well as on the desired end-product. Energy from biomass is derived either through direct combustion or by the conversion of biomass into fuels with higher energy value (such as charcoal[73] , biogas[74], liquid biofuels[75] and producer gas[76])

[73] solid residue produced by slow pyrolysis of carbonaceous raw material (Sharma et al., 2013, p.610)
[74] gas produced by anaerobic digestion or fermentation of organic matter (ibid)
[75] biodiesel, bioethanol (ibid)

(ibid). Two types of liquid biofuels can be distinguished[77], which can be produced depending on the feedstock used[78]:

3.3.3.1 Ethanol and biobutanol

Ethanol is produced through the process of fermentation of sugar sources, such as plants (Forge, 2007). It can be blended at a ratio of up to 10% with normal gasoline, without any modification in engines, and so currently blends of 5%-10% are the most widely available. However, much higher blends are also possible for modified engines, E85 being the most remarkable and being widely used in Brazil (85% ethanol-15% gasoline) (ibid). Due to its hydroscopic nature (absorbs water molecules), transportation of ethanol -especially by pipeline- is difficult (ibid). Ethanol has the benefit of being flexible as for its uses (cooking , heating/power, transport fuel), while being a final product that can meet international standards, enables it to also be exported apart from domestically used. So it offers good possibilities for market diversification.

Large-scale production of ethanol would require efficient systems for feedstock production and ethanol distribution, production and blending facilities, as well as retail stations (Sarma et al., 2013). The major challenge with ethanol is year-round production and continuous delivery of dense biomass in large volumes. Notably, about 25-30% of the total cost of ethanol production is comprised by the costs of biomass supply, and 90% of that relates to logistics[79].

Biobutanol is also an alcohol produced in the same way as ethanol. Compared to ethanol, it delivers more energy and has slower evaporation and is transportable by pipeline, which are considerable advantages (Forge, 2007). Interestingly, ethanol plants can be converted to produce biobutanol quite economically and BP has already made it commercially available in the UK (ibid). However, it is not widely commercialized yet nor is it discussed as one of the main alternatives, so has not been further considered for this research.

3.3.3.2 Pure Plant Oil and Biodiesel

Biodiesel can be produced from sources containing fats, such as plant extracts, cooking oil, and animal fats (Forge, 2007). For both these fuel types, the energy yield depends on the feedstock used (ibid).

Pure plant oil (PPO) has the large advantage of being possible to produce at any scale and therefore it could contribute both to industrial development, if it meets industrial quality requirements (thus contributing to national economic growth), as well as to small-scale village-level energy production and use (Janszen and Rutz., 2014). Although any

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[76] mixture of gases produced by gasification of organic matter at relatively low temperatures (ibid)

[77] These types of fuels are the main commercialized possibilities. Two other types of biofuels are (World Bank, 2007, p.15):

- Synthesis gas, which is produced by the gasification of wood and is mainly used for electricity generation.
- Fuelwood and biogas, which are produced by anaerobic digestion of plant and animal wastes. These are used for cooking and heating at the household level.

[78] For both these fuel types, the energy yield depends on the feedstock used (Forge, 2007).

[79] Therefore efforts are made by researchers to develop systems of integrated biomass supply chains to achieve cost-efficient delivery (Sarma et al., 2013).

vegetable oil can be converted to biodiesel through the process of transesterification, the production cost is high, because sophisticated technology and high investment capital are required to realise that. PPO can be used in small-scale applications sufficiently, though (ibid).

3.3.4 The Biofuel Distribution System

Regarding this stage, the biofuels will most likely follow the same course as fossil fuels and can use the same distribution network. That means that after the refinery (when it is needed) , the biofuel must be transported by trucks to the gas stations. A system of pipelines is expensive to build and not meaningful at the initial stage in any case. Moreover, due to its corrosivity and azeotrope with water, ethanol is incompatible with a system of pipelines, because it could lead to pipe or tank failure and fuel contamination (Richard et al., 2010). Transporting the biofuel on a national level is easier when road infrastructure is at a good state. It is then faster to also reach a port and therefore to ship the fuel to to Europe or USA.

3.3.5 Biofuel end-use

3.3.5.1 Fuel consumption

In forming a strategy for bioenergy the policy goals will ultimately need to prioritise some end-uses or energy services, while considering the infrastructure and support services that are necessary for various technology platforms. In determining the end-use of the biofuels it is important to bear in mind that the prices of the co-products depend on the markets that exist for them locally and is commensurate to the monetary value that the end-users attach to them (Mulugetta, 2009). Moreover, biofuels have a higher value when locally used, either as vegetable oil for electricity generation or after being processed to biodiesel to power engines and motors (Feto et al., 2011). These factors must be considered before determining to use the feedstock either for biofuels or for other uses.

Another fundamental consideration in assessing the possibilities of a country to become a biofuels producer is whether whatever quantities produced -at least in the beginning- will be driven towards the development of a domestic market or towards export markets. This decision important for both the public and the private sector, also because the options to stimulate production may well differ depending on the orientation. In determining whether the demand to drive the sector will be export- or domestic-oriented, one of the questions that arise is:"how much demand should be steered towards domestic use?". Generally, in analyzing the biofuel industry's priorities and the end-use priorities, the options that cut across sectors and can be produced for both the domestic as well as the export market, are important (FAO/UNEP/UN-Energy, 2012, Module 2).

However, for an infant industry it is more realistic to prioritize one of the two options. Hultman et al. (2012) argue that the experiences so far, cannot give definitive evidence to answer the question. For instance, Brazil has been entirely based on its domestic demand to create and expand the biofuels sector, though at certain periods, that had brought significant costs to the public budget. On the contrary, if, like Tanzania, a country turns to exports, the additional foreign exchange earned may be possible to eventually increase the capabilities to purchase petroleum products (ibid). In such a case a country may

deliberately choose to export biofuels, in order to benefit economically, and to ultimately enhance its energy security too.

Other countries mainly aim to supply their national market and only use excess volumes of produced biofuels for exports (like Brazil also did after the industry had grown very big). Colombia is an example of a country with a policy on biofuels, but which does not import or export (and the latter seems unlikely until the domestic targets are met (Maltsoglou et al., 2013). Argentina on the other hand, developed the production capacities for biodiesel first (based on an export-oriented production model) and later issued a mandate for domestic consumption Production significantly exceeds national demand with about 60% of total production being exported to other markets (Maltsoglou et al., 2013).

3.3.5.2 By-products

The by-products that can be derived during the production of fuel from biomass account for a large percentage of total industry revenues[80] (Taheripour et al., 2010). Their prices correlate to those of grains and oilseeds. Relevant to that price correlation is that when -due to government subsidies or positive oil price shocks- the production of biofuels is encouraged, the production of by-products is also increased along with that of biofuels. In turn this results in the prices being reduced as compared to other feed ingredients, while encouraging livestock producers to use more of these by-products. At the same time a reduction in prices causes a (direct) reduction of total revenue and is therefore a factor that may possibly halt further growth of the industry. Consequently, the by-products may simultaneously function as both a shock absorber and a price adjuster (ibid, p.279).

Another positive contribution of by-products in the BSC is that they mitigate the environmental effects of the industry's expansion. For instance, DDGS is a substitute for both corn and soybean meal in the rations of livestock (mainly for corn). This, in turn, reduces the consequences of land use for biofuel production, and lowers the demand for chemical inputs (fertilisers, pesticides) (ibid).

3.4 Conclusions

In the preceding analysis it was established that it is important to make a distinction between the strategic and the operational level of the biofuels sector. This way, it becomes clear that state authorities have a say in the development of biofuels, in order to avoid certain negative consequences. At the former the state has a major role, in order to set objectives and to ensure that production of biofuels will not be at the expense of the well-being of any local populations. Here the issue of food security (explained in introduction) is one of the most prominent, but equally important are the implicatons of these choices for the economic viability of biofuels projects. Hence, after thorough technical assessments, crops that have good production potential, while not undermining food security must be promoted[81].

[80] According to the calculations of the same authors, dried distillers grains with solubles (DDGS) produce 16% of the revenue of a corn-based dry milling ethanol plant (Taheripour et al. 2010, p.279). For rapeseed and soybean biodiesel production, the corresponding shares are at levels of 23% and 53%, respectively. The main use of these by-products is as protein sources.

[81] Relevant is the analysis provided –in a brief manner- in the appendix of this report for the biofuel feedstock crops that are most favourable in Ghana.

The operational level is divided into five stages that altogether constitute the Biofuel Supply Chain (BSC). A first conlusion from this chapter is that cost savings are mainly possible in the first stages of the BSC. During the last stage, profitability potential of a project can be increased through quality gains and effective commercialisation (that includes by-products). Companies must make a careful assessment before they invest in a project. The respective sections have described what each stage of the BSC entails and what the relevant options are for a business to choose from during the stage of project design. The following table summarises the success factors that were derived through the analysis on BSC and which will be used further in the analysis and have served to structure the discussions with experts.

Overall BSC Success factors	• **degree of coordination and integration between the actors/entities involved** • **degree of efficiency of flow of products and information**
Biomass Production System	• Length of harvesting period • Harvest frequency • Existence of supporting infrastructure for feedstock production
Biomass logistics System	• physical and chemical characteristics of biomass feedstocks[82] (crop-sensitive factor) • quality of transportation infrastructure • existence of infrastructure for storage
Biofuel Production System	• flexibility of uses[83] • for ethanol: efficient systems for feedstock production and ethanol distribution, production and blending facilities, as well as retail stations
Biofuel logistics System	• existence and quality of transportation infrastructure
Biofuel end-use and by-products	• local value of biofuels • diversity of end-use options (that cut across sectors and can be produced for both the domestic as well as the export market) • existence of by-products and extent to which local markets (sometimes also international) for them are developed • monetary value of biofuel co-products

Table 3.2. Success factors per stage of the BSC.

These success factors served to structure the relevant discussions with experts. Of the specific factors of each stage of the BSC some will be further analysed in search of ways to maximise efficiency and therefore need to be addressed within governance strategies. However, the analysis on the feedstock crops that is provided in section II-ii of the Appendix D that are possible to grow in Ghana addresses them either explicitly or implicitly[84].

[82] If the materials can be stored without deterioration and how time-dependent the storage is.
[83] This factor is similar to the 'diversity of end-use options' of the last stage, but expressed in different words to correspond to the literature source where it was derived from, as well as to specifically refer to fuel uses (instead of including by-products as well).
[84] Therefore that section is very much relevant and interesting for the reader who wants to know more about their operationalisation.

4 Stimulation of production and consumption

4.1 Introduction and outline of the chapter

The starting point of this chapter has been the identification of the need to provide policy support to the sector of biofuels in any country, in order for it to be developed. Rajagopal and Zilberman (2007, in Sparks and Ortmann, 2011) suggest that government intervention to the sector of biofuels, as in any industry, is justified by the need to address certain market failures. The main issue is that only under very specific circumstances can biofuels be an economically viable alternative to conventional fuels (World Bank, 2009). However, these circumstances are usually absent and biofuels are not expected to be economically viable without subsidization and policy support any time in the foreseeable future (ibid). Two factors determine the financial return of renewable energy investments: a) competitiveness with fossil fuel energy and b) the profitability of the underlying technology (UNEP FI, 2012). The following research question has guided the research for this chapter:

"*Which strategies can be found in the literature, that have been successfully employed in other countries, in order to stimulate the production and consumption of biofuels?"*

Different sets of measures have been identified to stimulate the deployment of biofuels. According to Kojima et al. (2007), investment incentives, such as grants, loans and loan guarantees, and tax-related incentives, such as tax reductions, tax holidays, and accelerated depreciation are commonplace in biofuel and related markets around the world. On the contrary, approaches to set up trading mechanisms, biofuel certification systems, and compensation schemes such as payments for environmental services are not common as part of biofuels policies (Sparks and Ortmann, 2011). That is mainly due to the fact that such approaches are directly linked to the levels of production and consumption and are therefore expected to cause significant maket distortions (FAO, 2008 in Sparks and Ortmann, 2011). According to the BDST-Module 3 (2012), the financial mechanisms to support the rural poor are also crucial, while they can be very complex. They need to address both supply and demand. The commonly applied of those approaches will also be examined.

The identified policy options for the stimulation of biofuels will be presented here in detail under a simple clustering that distinguishes between options to stimulate production or consumption of liquid biofuels. Where relevant, specification and explanation of measures that are suitable for certain types of the previously presented business models will be provided. A concluding section will present the highlights of this chapter.

4.2 Production of biofuels

It must have become clear through the previous chapter of this report that the economic risks of the biofuels industry are commonly regarded as one of the major hindrances regarding business development for biofuels in the whole of SSA. The lack of access to credit that results from those risks poses a sort of a 'chicken-and-egg' problem, "where practitioners in the field find it difficult to invest in a new biorefinery until they secure a predictable and adequate supply of biomass, whilst it is difficult for growers to plant large acreages of dedicated energy crops until they are assured of a market in the form

of a nearby biorefinery" (Vertes and Yochanan, 2010, p.524). That is because apart from the sugarcane sector in Brazil, nowhere else in the world is biofuel production cost-competitive to fossil fuels without serious government support, provided that oil prices are below 70$/barrel (World Bank, 2010). Moreover, small-scale initiatives, which often take place in weak rural markets, with total absence of capital, have an even greater need for funding and financing support. These considerations have led the research towards the investigation of possible solutions or alternatives.

Next to the financial support necessary for small producers to be incorporated in the supply chain, Zapata and Niewenhuis (2011) also consider the technical assistance to small and medium producers as a very important element of the success of the Brazilian biofuels policy. Therefore the contribution of smallholders to an overall bioenergy/biofuels strategy should not be disregarded. Another interesting finding of Mabee et al. (2007) was that, if funding is to be given, then it will probably be more conducive for the industry, if it is balanced between research and the creation of facilities (ibid). Moreover, financing for biofuels can be targeted at improving the uptake of existing bioenergy systems, where there is some demand, which is however dispersed (FAO/UN Energy BDST, 2012, Module 7).

Investments in extensive processing capacity will only be made provided that some long-term commitment about the sector's development is in place. The same authors argue that since the agricultural and energy policy sectors are integrated, policy will need to change, in order for the supply of crops to be enhanced.Therefore there is a demand (a necessity according to some) for government incentives to foster the development of biofuels (Rajagopal et al., 2007).

4.2.1 Interventions for large-scale businesses

The international literature on bioenergy development agrees that funding mechanisms for that sector are particularly important, as with other renewable energies (e.g. Chamdimba, 2010). Important to bear in mind with regards to the financing needs of biofuels production is the fact that by the end of the previous decade banks were already increasingly unwilling to lend to first-generation biofuel projects, due to the concerns of the long-term feasibility of robust feedstock logistic supply chain and a still insufficiently efficient bioconversion process technology (Vertes and Yochanan, 2010). To those we can add the presently low international petroleum prices.

4.2.1.1 Production subsidies

The purpose of direct subsidies is to cover the difference between the cost of oil and biofuel per barrel. Either direct or indirect subsidies may apply to cover that cost. In developed countries, direct subsidies have been used in the form of **deficiency payments**[85]

[85] "In the United States, deficiency payments are direct government payments made to farmers who participated in annual commodity programs for wheat, feed grains, rice, or cotton, prior to 1996.

•The crop-specific deficiency payment rate was based on the difference between the legislatively set target price and the lower national average market price during a specified time.

•The total payment was equal to the payment rate multiplied by a farm's eligible payment acreage and the program payment yield established for the particular farm.

to feedstock producers, as well as in other forms (Sparks and Ortmann, 2011). These are direct subsidies, while there can also be a number of instruments, which in fact constitute indirect subsidies, such as tax exemptions etc..

"The deficiency payment is the difference between the target price and the market price or loan rate, depending on which difference is smaller" (Rajagopal and Zilberman, 2007 in Sparks and Ortmann, 2011, p.69). Where deficiency payments have been used in combination with price supports, they are found to have contributed to increasing production and lowering market prices of commodities. In essence, this kind of support is a subsidy for both the production and the consumption of biofuels, as producers enjoy prices above the market equilibrium, while consumers purchase at prices below market equilibrium (Sparks and Ortmann, 2011). Consequently, deficiency payments in biofuel markets result in cost reductions of biofuel feedstock and ultimately also in cost reductions of biofuels and their by-products/co-products.

Feed-in tariffs are offered to renewable energy producers as long-term purchase contracts with a fixed rate or a fixed price premium to the market price (UNEP FI, 2012). With a fixed premium the output price offered to producers can have a roof and a floor price. Such output-based incentive systems significantly improve the risk-return profile of projects. That is because the associated risk of renewable energy are compensated for through the market price premiums, that enhance profitability and also because they mitigate the market risk by offering stable predetermined prices for a certain number of years. The latter provides medium- to long-term certainty over prices and revenues offering the possibility for an accurate business planning (ibid).

Additionally and in a similar vein, Tyner and Taheripour (2007, in Sparks and Ortmann, 2011) examine the possibility of introducing a subsidy scheme with two components; the first focused on national energy security could be based on the energy content of the renewable fuel, and the second linked to the level of the GHG emissions reductions that the fuel achieves. Such a scheme is most likely not applicable for SSA countries, though.

Direct subsidies, on the other hand, come with the risk of transferring large amounts of income to biofuels producers, and even more so in the presence of high crude oil prices (Sparks and Ortmann, 2011). Because of that, Tyner and Taheripour (2008, in Sparks and Ortmann, 2011) introduce the possibility of providing a variable biofuel subsidy, which is adjusted depending on the corresponding increases or decreases in the crude oil price.

According to the research of UNEP FI (2012), energy financiers consider feed-in tariffs as the strongest policy instrument to leverage private investment (ibid). The successful scheme of feed-in tariffs that Kenya has put in place for hydro, wind and biomass power is also expected to bring benefits of energy poverty reduction and job creation (particularly biomass, given the large potential of the country and the labour intensity required) (ibid).

In the latter years of the program, farmers could receive up to one-half of their projected deficiency payments at program signup. If actual deficiency payments, which were determined after the crop year, were less than advance deficiency payments, the farmer was required to reimburse the government for the difference, except for zero, 50/85-92 payments" (https://en.wikipedia.org/wiki/Deficiency_payments).

According to Gardner (analysis for the USA- 2007 in Sparks and Ortmann, 2011), subsidies for ethanol should not be expected to generate net social gains. However, they are likely to have a significant impact in the long term. On the contrary, other scholars (e.g. Wassell and Dittmer, 2006) have found that the external benefits of biodiesel production outweigh the required subsidies.

The most successful programme of public sector subsidies is that of Brazil. Through the Pro-alcohol programme the brazilian government has subsidized the production and consumption of biofuels in two ways. First, through the provision of 'soft loans' to sugarcane growers who were willing to build ethanol distilleries, and second, through incentivising the purchase of purely ethanol-driven cars (Dieperink and Maas, 2011). By the end of 2010 brazilian ethanol was in a new cycle of expansion, notably without any direct subsidies (only being favoured by some tax exemptions) (ibid)

State financing has also been provided in Indonesia to long-term investment projects that are considered important for the country's economic development. Such funds are provided in collaboration with private or state-owned companies to contribute to the development of supporting infrastructure and production facilities (Caroko et. al.-CIFOR, 2011). China has also introduced a system of flexible subsidies which had been used by five ethanol production plants by 2011. Next to that scheme, a value added tax of a rate of 17% has been completely removed for the plants and import tariffs on important bioenergy feedstocks were reduced to promote their importation from neighbouring countries (Maltsoglou et al., 2013).

4.2.1.2 A compensation regime for biofuel companies

In order to encourage investments, it is possible to establish a compensation regime to address cases of project failures[86]. That would alleviate part of the risk from companies and their investors. Implementing such a mechanism would require good screening of projects (possibly by independent audit mechanisms) to be selected for permission and later for support. This selection process can be complemented by other financing incentives to the really promising ventures (Gasparatos et al, 2015). An example of such a regime exists in Indonesia, where next to other incentives, since 2007 the indonesian government provides a guarantee against operational losses (Caroko et. al.-CIFOR, 2011).

4.2.1.3 Loan guarantees

The vulnerability of biofuel projects to policy and technological risks, as well as the current structures of biofuel markets, render such investments unappealing to banks. By addressing the reluctance of banks to lend money to biofuels companies, debt coverage can alleviate part of the risk by guaranteeing to them that they will get their money back (Vertes and Yochanan, 2010). The usefulness of such a fund lies in that (particularly at the early stages of an investment, when costs and risks are high), by investing in an infant sector (and possibly in a country with some negative record already), part of the financial risk could be covered by state institutions. It serves as a cushion and a guarantee for companies' shareholders against a possible failure, during the first stages of an investment. That would allow companies to attract the much needed seed capital, in order to found the company and contributes to a friendly investment climate, while being practically useful (ibid).

[86] In other words, it can be framed as a dedicated fund for "risk money" for biofuels.

Although these authors regard it mainly a measure that addresses the difficculties of large companies to acquire credit, FAO-BEFSCI (2012) mention the possibility of establishing public-private partnerships, in which a private institution lends money to smallholders and/or working capital, while the state guarantees the loans, covering the banks' risk.

4.2.1.4 Mediating between banks and companies/cooperatives

An issue that was identified already through the desk research is that banks simply do not have knowledge on the sector and no experts to consult, when they receive an investment proposal. Due to that, it was considered as useful from the researcher to examine whether some kind of mediation can be organized, in order to bridge the gap. A strategy in favour of smallholders that has been suggested by FAO-BEFSCI (2012) is for a government to arrange on-lending to local regional banks, particularly stipulating that the financing aims at smallholder inclusion. The same idea could be applied to cases of larger companies.

In order to fund and promote the production of biofuels, BNDES, Brazil's national development bank provides credit and loans, which cover up to 70% of capital costs at basic national interest rates. During the stage of construction the interests is not charged and there is a ten-year amortisation period with payments due after six months of commercial operations (Schut et al. 2010).

4.2.1.5 Tax-related (investment) incentives

Tax-related incentives can mainly take two forms:

a) Rebates and fiscal incentives are the most commonly discussed incentives**.** They are other ways of attracting private finance. Tax incentives, for instance tax credits to renewable energy generators, or sales tax exemptions for equipment also contribute to reducing the costs of projects and therefore increase the overall profitability potential (UNEP FI, 2012). These incentives are considered effective by UNIDO and UNEP FI reports that over 11 SSA countries had issued them for renewable energy until 2010. Due to their feasibility and importance, the impacts of excise tax credits are worth analysing here.

According to de Gorter and Just (2008a, 2008b in Sparks and Ortmann, 2011), a biofuel tax credit is "a reduction (or elimination) of the fuel tax charged on sales based on the biofuel content". The purpose of this measure is to decrease the relative cost of biofuel(s) as compared to that of petroleum/diesel. Reportedly, excise tax credits[87] are the most common, policy measure contributing to the cost-competitiveness of biofuels to fossil fuels (ibid), and a straightforward policy signal and –as a consequence- have also been very effective in stimulating production.

The existence of a tax credit constitutes an indirect subsidy to biofuel producers, which is sometimes passed on to the farmers. Its economic effect –when implemented alone- is that it increases the market price of the biofuel above the price of oil price by the level of the tax (ibid). It therefore constitutes a transfer of funds from the taxpayer to both the domestic and foreign biofuel producers. The taxpayers only benefit indirectly by this measure, if oil prices decline as a result of increased supply volumes of biofuels, which would cause on the one hand the average oil price to be decreased (consumers

[87] In other words, 'reductions in fuel excise tax'.

benefit), but on the other hand a total increase in fuel consumption (Sparks and Ortmann, 2011). In total it could be said that fuel price decreases create a large benefit for consumers individually, due to the large volumes of fuels that become available. However, as de Gorter and Just argue (2009a, in Sparks and Ortmann, 2011), the overall welfare effects of it will depend on whether the country is a large importer or exporter in either the feedstock commodity or the biofuel itself.

In countries where taxes on fuels are significant part of public revenues, a biofuel tax credit may have adverse economic implications for the public budget (as tax exempted biofuels replace a certain amount of fossil fuels that would have provided tax revenue) (Kojima *et al*. 2007). It must be paid attention to the fact that, as Rajagopal and Zilberman (2007, in Sparks and Ortmann, 2011, p.66) note, tax credits that do not have a variability based on the crude oil price, nor any caps or "sunset clauses" based on production levels, come with a high risk of resulting in a significant increase of the subsidies' cost, if there is a long-lasting decrease in oil prices (due to a structural break) or a large increase in biofuel production volumes. On the other hand, policies such as mandates and fuel excise tax reductions do not differentiate between imported and domestically produced biofuels and therefore cannot be claimed to cause distortions in trade (they may only stimulate consumption and artificially increase trade) (Sparks and Ortmann,2011).

b) An alternative is to price carbon and issue relevant incentives for carbon reductions only (UNEP FI, 2012). That measure aims at a shift towards low carbon options through the motive of tax avoidance. A different measure is carbon taxes per tonne of carbon dioxide emitted to be used as a levy towards the promotion of renewable energy. The logic behind that is that polluters should contribute to a shift towards lower carbon energy options. It is however, unlikely that developing countries decide to impose such a tax[88].

4.2.2 Interventions Specifically for smallholder farmers/ entrepreneurs

As smallholders are usually too small to independently access finance, they are doomed to rely in outdated and ineffective farming inputs and in a situation of inability to make any investment in irrigation or fertilisers to improve their yields (FAO-BEFSCI, 2012). Most financial institutions currently view smallholders as too risky for their portfolio, thereis a high likelihood that they default and therefore can reduce a bank's overall profitability (FAO-BEFSCI, 2012).

However, development banks have a greater possibility to provide support in the form of – for example- loans with more favourable terms. Next to that, they could either

[88] Policy measures, such as energy and carbon taxes have been applied to some countries, but they are generally considered politically unpopular. As Rajagopal and Zilberman (2007, in Sparks and Ortmann, 2011) report, tax increases result in fuel price increases (the efects being much like those of fuel standards and blending mandates), while their distributional effects depend on the price elasticity o0f biofuel demand. When the latter is relatively inelastic, the additional cost is passed on from the producers to consumers.

create or expand existing financing mechanisms to smallholders[89]. Furthermore, such institutions could also devise new financing mechanisms, such as technical assistance grants, to borrowers that incorporate smallholders, or programmes that target smallholder inclusion and capacity-building relevant to certification (FAO-BEFSCI, 2012).

4.2.2.1 Grants and loans

According to UNEP-UNEnergy (BDST, 2012, Module 7) two approaches exist for the stimulation of demand with financial means.

a) Direct provision of grants and loans to small entrepreneurs to foster business creation. AREED is such an example of a programme in Africa aiming at enhancing energy access as a priority, rather than increasing the use of bioenergy per se. Income generation is also a direct benefit.

   A grant gives the means to smallholders to build an income and then an obligation to pay the loan and also the incentive to continue producing. Loans would be exceptionally useful, due to the aforementioned liquidity problems in SSA countries.

   Additionally, FAO-BEFSCI (2012) adds the option to provide the same kind of financial support through on-lending to local regional banks, particularly stipulating that the financing aims at smallholder inclusion. Therefore this option applies on companies and farmers to participate in partnership models.

b) By supporting and even giving credit for the promotion of local income generation activities relevant to energy generation. These can couple the energy provision of a local population with business creation and economic development. The support can be given through public-private partnerships, in which a private institution lends money to smallholders and/or working capital, while the state guarantees the loans, covering the banks' risk (FAO-BEFSCI, 2012).

Schut et al. (2010) also contend thatthe successful incorporation of smallholders in the brazilian biofuel chain has been based on the government incentives to promote the collaboration between the smallholder farmers and the commercial companies (PRONAF and the social fuel seal programme). There smallholders have guaranteed off-takes and receive credit and training. Additionally, the companies were also stimulated to incorporate them to their activities, by receiving tax breaks, access to low-cost loans and having the possibility to participate in the brazilian biodiesel auctions (which non-compliant companies do not have).

4.2.2.2 Microfinance

A last point of investigation regarding financing possibilities for smallholders is the access to microfinance institutions. The fact that some scholars suggest that alternative funding models for biofuels development be examined (e.g. von Maltitz and Stafford, 2011)

[89] As an example, the Inter-American Development Bank has run a facility called 'Opportunities for the Majority', which targeted smallholders of rural areas, by lending them under favourable terms in combination with providing technical assistance grants (FAO-BEFSCI, 2012).

makes the examinations of such alternative options interesting for this research too. Such alternative funding models may be based on "private sector involvement (possibly supported by favourable state incentives), or direct private sector investment through the development of a model that is fully financially viable, for instance facilitated through the use of technologies that open up options for the sale of surplus energy" (ibid).

Microfinancing is a relatively new approach for the provision of finance specifically to poor populations, such as smallholder farmers of rural areas and has opened a new avenue of development for them in many developing countries.

4.2.2.3 Enhancing market access for smallholders

A problem that has been identified from the early literature review was that smallholder farmers have difficulties in accessing markets (analysed in chapter on BMs). Through a public policy of quotas and other market preferences, support can be provided to small and family farmers, particularly in public procurement. A number of successful examples of such policies around the world exist, the case of Brazil topping the list (IIED-Cotula et al., 2012). More specifically, Brazil's National Programme for the Production and use of Biodiesel (PNPB) had a special focus on incorporating small farmers into the supply chain with regards to castor bean production[90]. The Social Fuel Scheme has been the central instrument to that inclusion of small farmers, as those companies that meet the targets for supply from small farms, are assigned purchase rights and are exempted from certain taxes (Zapata et al., 2010). However, the programme had low participation (particularly in the North-East) and some participants experienced economic losses due to the price fluctuations in the fuel market[91].

The Food Acquisition Programme (PAA) of Brazil had a greater success than the PNPB in terms of inclusion. It was also designed for small farmers aiming for their economic development. It has achieved to give farmers the benefits of secure markets with guaranteed prices, which encourage reinvestment in production, plus improvements in organizational capacity. Low-income consumers have also been benefitted in terms of food security. Increases in quality has also been a benefit for participants. Dependency on the programme has been a serious question, though, as the participating farmers would return to their prior conditions after the programme's termination (IIED-Cotula et al., 2012).

Another idea to protect the position of small farmers in the market (coming from the fisheries sector of Brazil) is to provide them restricted access to export quotas (IIED-Cotula et al., 2012).

4.3 Stimulation of consumption

This section will present three policy options for the stimulation of domestic consumption of biofuels. These are the introduction of biofuel consumption targets, a blending policy and (a set of) restrictive measures to affect the market conditions for biofuels.

[90] Because this crop can even be grown along with subsistence farming.
[91] Moreover, combining small-with large-scale production was challenging and the problem of small farmers voice occurred there too (IIED-Cotula et al., 2012).

4.3.1 Biofuel consumption targets

Bioenergy targets[92] are a way of stimulating the sector, as they strengthen the value of legislation. Targets can be set for the whole bioenergy sector or for the different sub-sectors and are most commonly presented as percentages of aimed production and/or consumption (FAO-UN Energy, BDST-Module 3, 2012). They can provide an important stimulus for the production of biofuels, because they guarantee that there will be demand for the product and pose no direct costs for the state budget. Preferably, both long-term and interim targets are declared. Measures such as a quantitative target or renewable fuel standards or a mandatory blending all stipulate requirements for the fuel industry to domestically acquire a certain percentage of the fuel it supplies from alternative resources irrespectively of their market cost (Sparks and Ortmann, 2011).

4.3.2 Blending policy

The most common and practically effective of these similar approaches is the mandatory blending. Although it should be distinguished for analytical purposes, in essence it is part of an overal consumtion target. Letete and von Blottnitz (in Janssen and Rutz, 2012) argue that in the absence of mandatory blending it is only environmentally conscious individuals and institutions that would be willing to purchase biofuels for their vehicles. Consequently, the market in the country is very limited and fragile. Therefore such quantitative targets have been used as drivers in the growth and development of most modern bioenergy systems. Many national and state governments have used them with great success as a way of stimulating production of biofuels (FAO, 2008 in Sparks and Ortmann, 2011).

Achieving a consistent domestic demand for biofuels can only come about through a mandatory blending with fossil fuels, because that makes biofuels consumption independent of fossil fuel prices, otherwise the prices that biofuel blenders would accept to pay would fluctuate according to the those of petroleum (Chin-CIFOR, 2011). Quota mechanisms –such as a blending mandate- create inelastic demand for a product that potentially meets the supply levels, thereby establishing an industry that could not otherwise exist (FAO-UNEnergy, BDST-Module 3, 2012). As Letete and von Blottnitz contend for South Africa, without clear regulatory obligations to the fuels industry "any local investment into fuel bioethanol would remain in the risk of not securing a local market. This issue exposes a key shortfall of a supply-side driven policy intervention" (Letete and von Blottnitz in Janssen and Rutz, 2012, p.194). Indeed, without a secure and sizeable market, investors cannot help but be very cautious –if not completely reluctant- to to put forward any relevant investment. Ultimately, biofuel mandates mainly aim to reduce the risk to foreign investors and local biofuel producers (Gasparatos et al., 2015). The greatest advantage of a blending mandate is the preditability it offers as for the volumes that will be sold in the market in the respective years while it is in effect[93] (Ziolkowska 2010).

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[92] Mandatory blending, which is a more specific target will be presented separately.

[93] It must be noted, however, that a generalised obligation system, with a blending mandate at its core brings a risk that the fuel suppliers are incentivised to opt for the lowest-cost biofuels they can produce, while provided fewer incentives for advanced generations of biofuels. A study has reported that the EU's obligatory system performs well at increasing biofuels consumption, but is less suitable for promoting special types of biofuels (Wiesenthal et al., 2009 in Ziolkowska 2010).

To achieve the overall goal, there are different approaches. The exact nature of the requirement may differ per country as to its obligatory character, the phase-in period, the total amount of fuels consumed or percentage to be blended and as to whether it is part of a national- or a regional-level strategy. It has become common that a minimum percentage of transportation fuels sold, are comprised by biofuels (Sparks and Ortmann, 2011), but it is also possible to set a quantitative target about the overall volumes of biofuels that must be blended. With regards to the choice between those options, Winkler (2005, in Sparks and Ortmann, 2011) suggests that governments' main responsibility should be to set a quantitative target, while leaving adequate freedom to the emerging renewable energy industry to establish the most cost-effective way of meeting it.

The EU has established percentage targets, in order to tie them to its commitments that arised from the Kyoto Protocol, although perhaps policy effectiveness would be increased in that respect, if the targets were set in terms of reductions of GHG emissions resulting from the use of biofuels. The USA chose volumetric targets, in order to reduce the uncertainty that farmers and biofuels producers were facing. The effectiveness of either approach is affected by the interactions with other policies and/or technical restrictions. On the other hand, although percentage mandates may change as a result of changes in prices of oil and income, volumetric mandates are certain to remain stable regardless of such changes (Ziolkowska 2010).

In Brazil the mandatory blending of ethanol to gasoline at a rate of 20-25% boosted the production of ethanol, enabling producers to reach economies of scale, thereby reducing production costs and developing market competition. Moreover, the orientation of companies towards the export markets led them to expand and diversify their products, but also to invest in R&D and particularly in quality control systems and efficiency technologies. Investments in public infrastructure (e.g. road transportation and ports) followed from this development.

Already in 2007, the European Commision had argued that "the most effective combination of political measures supporting biofuels is the obligation to blend and a simultaneous tax relief (EC, 2007 in Ziolkowska 2010, p.408). The EU has followed the logic that "the legal strength of a target largely determines its credibility, as stronger targets mean that efforts will be made by governments to achieve the targets" (Ziolkowska 2010, p.401). This approach suggests that markets are trusted to offer certainty for planning and realising investments, which in turn favours mandatory instead of indicative targets. Furthermore, by setting a single target for all types of biofuels, the market is offered the flexibility to determine the most cost-effective ways in meeting them. On the contrary, in the USA sectoral targets have been implemented, which are supposed to establish confidence for inducing investments in a broad range of renewable energy sources (ibid).

By regulating the quantity that is consumed, a blending mandate subsequently influences the prices in the market (FAO-UNEnergy, BDST-Module 3, 2012). The scale of a mandate's impact depends on a number of factors, such as whether consumption will be increased at a level that would otherwise not be achieved (e.g. by voluntary national indicative targets), the degree to which the production would increase as prices rise, whether a tax exemption accompanies the mandatory blend, and whether the market is open to external competition.

Regarding the effects on fuel consuption and revenue streams, due to the price increases brought by mandatory blending, the levels of fuel consumption are expected to decrease and so will the public revenues from taxation. However, de Gorter and Just (2009b in Sparks and Ortmann, 2011) show that - depending on the relative supply elasticities of bioethanol and fuel- the prices to consumers may actually decrease (as a result of increased available volumes), therefore increasing consumer surplus (Rajagopal and Zilberman 2007). According to Rajagopal and Zilberman (2007), from the regulatory institution's perspective a mandatory blending is revenue-neutral, while it causes producer surpluses to increase and consumer surpluses to decrease. Due to these effects, Tyner and Taheripour (2008a) argue that binding standards for renewable fuels constitute an implicit tax on fuel consumption (due to higher prices at the pump) and therefore provide indirect subsidy to biofuel producers (Sparks and Ortmann, 2011). For instance, in countries/regions -like the EU- where the biofuels production costs are significantly higher to those of fossil fuels, a mandatory blending requirement will increase the consumer price of transport fuels. To counter that cost increase, the additional cost can be covered by government subsidies, albeit part of the cost will still be passed on to consumers (Ziolkowska 2010). Consequently, the changes in the costs to the companies are passed on to consumers, through the biofuel price at the pump (Sparks and Ortmann, 2011).

Therefore, unlike tax credits, both ways of direct control to the relative market shares of fuels -renewable fuel standards and mandatory blending- result in higher fuel prices for consumers, (ibid). Due to these effects, Rajagopal and Zilberman (2007) and Tyner and Taheripour (2008b) argue that "while renewable fuel standards and mandatory blends are effective in stimulating the production of biofuels, they may be very inefficient in the presence of low crude oil prices (Sparks and Ortmann, 2011). As a result, according to Gardner's analysis for the USA (2007 in Sparks and Ortmann, 2011), mandates (as well as subsidies) for ethanol are not likely to generate net social gains but may have a larger impact in the long term rather than in the short term, due to expected deadweight losses (e.g. reduced consumption and misallocated scarce resources).

4.3.3 Restrictive measures

Restrictive policies are generally treated with scepticism by scholars. Much like taxes and mandates they have the effect of reducing consumer surplus (Rajagopal and Zilberman, 2007). Although certain restrictions may be economically justifiable for limited periods and acceptable in the context of protecting infant industries, there is globally a general trend to remove trade barriers (Sparks and Ortmann, 2011). That liberalisation of trade in biofuel markets can be positive as long as it contributes to increasing competition, thereby also leading to increased average production efficiencies, and in the long-term ultimately increasing the global welfare (ibid).

4.3.3.1 Price regulation

The main argument for the use of price regulation relates to its ability to stabilize the market for biofuels until they have adequate penetration, by controlling the competition with fossil fuels. It is argued that price regulation for biofuels would in practice work, exactly as the price regulation for fossil fuels. At the start of the brazilian Pro-alcohol programme the government had intervened in the market, by guaranteeing that the ehanol price would remain competitive in the market (Dieperink and Maas, 2011). After producers turned their

interest to lucrative export markets, Brazil experienced a supply shock of ethanol in 1989, which has been gradually resolved through price regulation of ethanol that resulted in ensured economic gains for producers, as well as assurance to consumers over sustained supply of the fuel. By 1997 anhydrous ethanol was clearly highly competitive to gasoline (in fact, cheaper), therefore the government decided to liberalise its price, which two years later –in 1999- was followed by the liberalisation of the price of hydrous ethanol too (Dieperink and Maas, 2011, p.3).

4.3.3.2 Bans /quotas and tariffs on imports

Bans are a way of market intervention for the purpose of managing domestic prices (IIED-Cotula et al., 2012). Import tariffs and quotas are used as a way to protect domestic producers from external competition, as well a a way to restrict the benefits to selected countries (Sparks and Ortmann, 2011). Such measures provide economic revenue to governments, but are undoubtedly harmful to consumers (Tomek and Robinson, 2003 in Sparks and Ortmann, 2011).

4.3.3.3 Bans /quotas and tariffs on exports

Restrictive measures such as export tariffs to raw materials have been often implemented as a measure to promote the exportation of finished products from the feedstock producer countries. It is therefore mainly a way of promoting value-adding processing activities domestically. Argentina has applied such tariffs early in a way that is generally regarded as instrumental in the success of the country's biofuels industry (Rajagopal and Zilberman, 2007 in Sparks and Ortmann, 2011).

Export quotas (similarly to fuel efficiency standards and price supports) are also a measure with mixed effects, since they reduce either the cost of the energy service or that of biofuel feedstock and therefore result in an increase of consumer surplus (ibid).

4.4 Conclusions

Due to the economic conditions of biofuels production and -above all- due to the difficulty to compete with prices of fossil fuels in free markets, the industry of biofuels is not viable in any country without government intervention. A literature review has been conducted in search of applied policy options to stimulate the biofuels industry and their expected impacts, as well as for suggestions of scholars on how to operationalize these and other options, also providing some examples from countries which have applied them. A large number of measures have been examined in this chapter as possibilities for the stimulation of the production and the consumption of biofuels. These have been classified as interventions at start-up phase, supply/ production stage and demand/consumption stage. Their relevance for certain scales was clarified and some specific measures for the small-scale production of biofuels were also examined.

5 Methodology for empirical research activities

The options that have been presented here will be further investigated as for their relevance and applicability in the context of SSA. Experts in the industry of biofuels and people involved in bioenergy policy-making will be interviewed, in order to assess the effectiveness of those options, as well as their appropriateness and applicability in the contect of SSA.

5.1 Literature review

Ghana

A literature review was conducted at the beginning to identify the situation in Ghana. This was necessary, in order to ensure that the policy options and strategies that will remain in the end are fit for the context of Ghana. Solutions to these were specifically sought throughout the research process, although not limited to them. A few relevant academic articles or reports have been found in that respect for each of the four main issues in the country, as well as some documents from official sources or the internet (e.g. Ghana Energy Commission, 2011). Due to insufficient information available in the literature, and also in order to gain clear insights a series of interviews with Ghanaian people and businessmen (Ghanaian and not) and public sector officials was conducted.

Policies and governance strategies

Having identifyied the core issues and strategies, an effort was made to investigate policies that have been applied so far and to assess their effectiveness in achieving their objectives. Enabling conditions of the identified policies were sought and are described briefly, but also as much detail as possible regarding the advantages, disadvantages, risks and costs with regards to their implementation. Although, as already stated in the introduction of this report, the focus was on making clear what their application requires and entails, more details about their applicability and implementation strategy were found during that stage.

In order to obtain examples of successful policies and practices, first a case comparability with the Ghanaian context had to be ensured. The research focuses on developing countries and particularly on other African countries, due to the similar economic, socio-cultural and climatic conditions they have with Ghana. While not all Sub-Saharan African countries share exactly the same problems and to the same extent, the aforementioned conditions, as well as the characteristics of biofuels production render almost all of them largely comparable. Food security issues are similar in most of Sub-Saharan Africa and also in South Asia and Latin America, with for example, India and Brazil having had very similar experiences already.

5.2 Interviews

Motivation for interviews and data selection

A long series of interviews was conducted reaching a total number of 33 (including a double one[94]), in order to make an in-depth investigation of the possible solutions to the

[94] I.e., a respondent with whom the researcher discussed both about Ghana and about the business aspects (23- F.Grati). It must be mentioned that this 'double interview' did not

subjects that have already been presented (with regards to the business models, the ways to stimulate the production of biofuels, the rationale behind the creation of a domestic market for biofuels and the subsequent options to create a domestic market). During the research it became obvious that the financial aspects around the development of the sector of biofuels are particularly important. Consequently, a number of interviews included these aspects along with others or exclusively. Meanwhile, with the encouragement of some interviewees, some more sources were consulted, as these were recommended as useful for the scope of the research.

The interviews with people who have personal experience in the business of biofuels in developing countries and could give their own examples of good (and bad) practices, were proven highly useful and interesting. These were in-depth interviews with semi-structured questionnaires, and which had a form of discussion with a certain openness that allowed the respondents to freely express their views. More details on that process will be presented in the respective chapters.

Experts such as biofuel business owners and project managers, all of them with experience in African countries were interviewed regarding the SCM aspects and the business models. Some of them had a particular knowledge about Ghana as well. In total 18 respondents were consulted regarding these operational SCM- aspects. These and four more –totaling 22- were interviewed about aspects of business models. Six people about financial aspects specifically. Eight people were interviewed solely or mainly regarding public policies for biofuels. An effort was made to include varying backgrounds, so the sample included people from the academia, large business owners and small-scale project managers, professionals from the banking sector and NGOs, as well as government officials, all with origin from or experience in SSA countries.

The interviews were mainly conducted through Skype –since most interviewees were overseas- but also face-to-face in the case of some Dutch experts. Three people replied wholly or partly in written via email (10, 34, 42). The interviews had an average duration of one hour and were afterwards transcribed and sent back to the respondents to be reviewed, if they wished so. What created a difficulty for the researcher has been the large number of postponements that were made to Skype appointments, mainly with African interviewees.

Sample size

The method of "category saturation" was followed. When a number of sources –be them literature or interview respondents- have been consulted and could not lead to any further elaboration or coding, it was decided that saturation had been reached. The sample size needed to reach saturation differed per theme. That is attributed to the varying complexity of the issues under study, as well as to the nature of the sources. Particularly regarding the input from interviews, given the choice to consult a range of experts, the answers varied more (compared to the issues for which only desk research was conducted) and therefore a larger sample was needed to reach saturation. Moree details on these variations will be presented in the respective chapters.

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occur randomly. It was sought for a long time, due to the interviewee's experience and when it took place, it was long and detailed with an eagerness to discuss all relevant matters.

5.2.1 Interviews on Ghana

Due to insufficient information in the literature, and also in order to gain clear insights a series of interviews with Ghanaian people and businessmen (Ghanaian and not) and public sector officials was conducted. Those interviews with businessmen took the form of 'helicopter interviews', in order to identify more general core issues about the biofuel business and were helpful to further guide the data collection process (literature and next series of interviews). In total nine people were interviewed for that part, of whom five were business developers (four Ghanaians and one European who was interviewed during the second series of interviews, but had a deep knowledge of the Ghanaian situation and so the interview can be regarded as double[95]).

5.2.2 Interviews on BMs

These interviews followed a thorough desk research on the business models for biofuels and their success factors. In some cases ideas on addressing these were also found in the literature, but the ideas that were gathered were mostly products of the discussions with experts. There was no need to approve or disapprove certain options regarding the business models, therefore any kind of quantitative presentation of the interview findings was not meaningful. Where a debate has been found to occur, that is stated along with the background the respondents that tend to favour or reject some possibilities have. Apart from the contribution in learning to deal with the challenges of the business models, the interviews were also useful for theory-building in many cases. Additional detail derived from information during the discussions with respondents and in many cases, they challenged the dominant views that had been found in the literature.

The analysis aims to address the challenges that are identified for each type of business model from the perspectives of all actors, but –secondarily- also to elaborate on some of the impacts of the main business models. Additional impacts of business models for all parties that were identified during the interviews are discussed in detail in the appendix. References to the sources of information will be provided in the text. For better readability, it was chosen that all references to interviewees in the text are provided in numbers assigned to them within brackets. The names and expertise of the interviewees are provided in Appendix I.

5.2.3 Interviews on SCM

After the first articles on SCM were read, it became clear that it would be useful to refer to aspects of SCM in the interviews with experts specifically. SCM became relevant, due to the quest to achieve as higher an efficiency as possible during the operations of biofuel production. It also became clear that examining the production stage alone was not enough, in the same way that a biofuel producer company cannot be guaranteed that an efficient production stage will make it successful on the whole. Some reasons for that have been presented already. The next step –after identifying the main challenges for producers of biofuels was to seek for solutions to them, both through the literature and through interviews with experts. Therefore the literature search went on in parallel to the interviews too and in conjunction with the research about the business models. Experts such as biofuel

[95] That was Mr F.Grati. It must be mentioned that this 'double interview' was not random. An interview with Mr Grati was sought for a long time and when it actually took place, it was long and detailed with an eagerness to discuss all relevant matters.

business owners and project managers were interviewed regarding the SCM aspects and the business models, all of them with experience in African countries. Some of them had knowledge about Ghana specifically as well. In total 18 respondents were consulted regarding these operational SCM- aspects[96]. Analysis of many arguments takes place in the text. The respondents are cited by a number that was assigned to each, and which can be seen in Appendix 3.

5.2.4 Interviews on stimulation options

The same approach as in the chapters about the BMs and the SCM of biofuels was followed in this respect. A high number of interviews and some comprlementary desk research were conducted with a dual purpose:

a) To identify the ways in which the biofuels sector can be best promoted in a country (focusing on Ghana's specificities),

b) To seek solutions to the barriers/bottlenecks for biofuels production and consumption in Ghana, as well as to other anticipated obstacles.

An effort was made to derive successful examples from the literature that have already been applied and assessed as such. More specifically, countries like Mali, Mozambique, Madagascar, Tanzania, Ethiopia, South Africa, Malawi, which are currently those with the most advanced policies in Africa are of particular interest, because they face the same problems and concerns regarding biofuels production, but have moved forward to expanding production and dealing with all relevant issues. Therefore, academic literature was consulted next to official policy reports and guidelines, to acquire information about the effectiveness of existing policies and highlight strong and weak points, risks as well as additional opportunities. However, as mentioned before, due to the fact that most policies are recent and some have had various challenges, that part of the literature did not provide so much input.

[96] Those and four more were interviewed about the business models as well.

6 Presence of conditions for Bioenergy in Ghana

6.1 Introduction and outline of chapter

This chapter has a two-fold aim: a) to provide a thorough overview of the current situation in Ghana as regards the production of biofuels and b) to identify challenges and enabling factors for the production and consumption of biofuels in Ghana. A brief introduction with relevant background information will be provided first. Section 6.2 will present the results of the literature review about the state of biofuels production in Ghana and following a further and detailed elaboration will be presented, regarding

"What barriers for the deployment potential of biofuels can be identified in Ghana and to what extent are the success factors for the implementation of the country's deployment potential present?"

Special attention is given to the issue of food security in Ghana in section 6.3.2, because it is a very important issue for biofuels production in SSA. The common barriers to the deployment of projects for biofuels in SSA that were presented in the general introduction of the report form the basis of this chapter. The existence of these barriers and the extent to which they are important and relevant in the case of Ghana formed the starting point of discussions with officials and the business managers with experience in the country. The choice to frame them as barriers at this point of the research (although in the 'synthesis' that preceded they have already been reframed and introduced as success factors) is motivated by the need to simply identify through the literature review and the interviews the extent to which they are present, rather than deal with complications and a probable diversity of opinions about their wider importance (non-Ghana-specific) at this stage. Secondarily, the choice is also motivated by the desire to keep this part connected to the theory as it has been derived from the literature (rather than using the reframed terms this research introduced).

The barriers are presented in tables divided in the four general categories. Based on the answers, a simple ranking of the barriers has been made, classifying their importance for Ghana to high, medium or low[97]. Additionally, a number of other barriers have been suggested by the interviewees and are presented in a separate section (6.3.7). The results are briefly explained in the text with additional comments where that was determined as useful. These aspects will be presented for Ghana in general terms in the 'background' section of this chapter, while more specification on the challenging aspects of them will follow in the section about barriers that have been identified. In the conclusions of the chapter the most important points of all those that have been extracted and are important for the next steps of the research will be highlighted.

[97] The classification was not always made clear by the respondents. In those cases and also due to conflictive views on the importance of some of the barriers a choice has been made by the researcher that even if only one respondent considered a certain barrier to have some importance it is included in the column 'medium' at least. Those in the columns 'low' and 'high' were considered as such by a large number of the respondents (if not unanimously).

6.2 Background

In 2011, biomass resources in Ghana covered about 20,8 million hectares of a total of 23,8 million hectares of land mass in the country, thereby providing about 60% of the total energy consumption (Ren. Energy Bill 2011, p.1). Due to the vast land mass on both arable and degraded land, Ghana has great potential for the cultivation of crops and plants that produce a range of liquid or solid biofuels (ibid). Moreover, three quarters of the land area (18,3Mha) are under tree cover, which gives potential for vast woodfuel production and climatic conditions are very favourable for the production of energy crops (ibid).

The agricultural sector in Ghana is typically one of dispersed small-scale producers, who employ manual techniques and depend on rain. Although not modernised, small-scale agriculture provides over 90% of the food needs of the country (Duku et al. 2011). Crop production in the country is according to FAO "hampered by land degradation, improper field development, use of low-yield varieties, lack of organized seed production and distribution systems and inadequate storage systems" (Duku, 2011, p.406).

In Ghana it was in the 2000s that the interest of the private sector for investments in plantation agriculture started to grow, mainly driven by the horticultural sector and pineapple exports to Europe. But it was not before 2006 and the gradual surge in oil prices that companies started acquiring large tracts of land for plantation agriculture for the purpose of producing biofuels (Schoneveld et al. 2011). Since then 20 companies –mostly foreign-owned– have gained access to about 1.184 million ha of land, an amount that comprises 4,6% of the total land area and 8,8% of land suitable for agriculture (Schoneveld et al. 2011, p.2). In 2010 more than 240.000 ha of land with palm fruit were cultivated in Ghana under small, medium and large-scale farms and there are governmental plans for vastly expanding those cultivations for the production of palm oil, in order to harness the country's great production potential (Antwi et al. 2010).

The Ghanaian government has repeatedly expressed its interest in promoting renewable energy production. The Renewable Energy Bill of 2011 (p.1) declared that "the development of renewable energy and waste-to-energy resources have the potential to ensure Ghana's energy security (by improving energy diversification) and mitigate the negative climate change impacts". Consequently, these objectives must be regarded as the two major drivers for renewable energy policies in Ghana. Next to these, the biofuel industry in Ghana is expected to save foreign exchange for the country and increase export earning potential (Ghana Energy Commission, 2010), create rural employment to reduce poverty, as well as create a market for agricultural produce as a source of income through the selling of carbon credits under the Kyoto Protocol (Duku et al. 2011). Although the government had promulgated "to give legal backing and policy direction for sustainable generation of biofuels" through the Renewable Energy Law of 2011 (The Ghanaian Times, 2012), Ghana has not yet passed any far-reaching legislation that would lead the way to the development of the biofuel sector domestically (CIFOR(2), 2010).

6.3 Biofuels production in Ghana

The energy crops used in Ghana with potential to be extensively used as biofuel feedstocks are mainly maize, cassava, sugarcane, jatropha, sweet sorghum and palm oil by order of importance, but also coconut and other seeds (Antwi et al. 2010). Additionally,

soybean and sunflower are gaining importance as biofuel feedstocks in the country (Duku et al. 2011).

The reference energy system regarding transportation is based in petroleum consumption. Notably, like in many other African countries, there are consumer subsidies in place for petroleum in Ghana, so that people can afford to buy it. However,the Ghanaian government has committed to gradually phase out the subsidies as part of the deal with the International Monetary Fund (IMF) (Acheampong and Ackah 2015). If biofuels are to be produced and consumed in Ghana on a large scale, they would –at least in the initial phases – use and follow the existing distribution network for oil in the country (2). Regarding household uses, the reference energy system is that of burning woodfuel.

It is likely that in some remote areas of Ghana the consumption of biofuels may already be attractive in economic terms. Moreover, the by-products that some crops can give and/or the possibilities to grow some of them next to the main crops that farmers grow can substantially increase the social attractiveness of biofuels/biomass production, as long as farmers have access to the relevant information. Regarding the level of skilled labour and infrastructure, overall development levels outside urban centres are low. Consequently, weak agricultural performance is expected (which makes investments less appealing to businesses). Specific barriers will be discussed in the respective sections of this chapter.

6.3.1 Production capacities and economic performance

Currently levels of biofuels production in Ghana are considered insignificant; and records do not exist (2). Therefore the exact number of operating companies could not be confirmed neither from the literature/internet sources nor through the interviews[98]. Most likely there are around five companies currently producing feedstocks dedicated for biofuels (the number is provided with reservations). What is certain is that many of the companies that were set up prior to 2010 did not survive financially mainly for two reasons: a) either due to their own bad management (often caused by overly optimistic assumptions) or b) due to the combined effects of the financial crisis and the drop in oil prices that rendered competition with fossil fuels even more difficult (3,4,8,23).

The business managers that had been active in Ghana all admitted that the economic performance of their companies was not stable (little or big problems for all). Regarding the possible future consumption, fuel quality has been found to be an issue requiring attention in Ghana, because even though fuel quality standards have been issued, it is difficult to control the small producers (6). No dedicated fuel stations selling biofuels exist (2,3), so the only option to make biofuels widely consumable would be to blend the biofuel at the Tema Oil Refinery (TOR).

6.3.2 Food security in relation to biofuels

Given the low adaptability of the agricultural sector to new developments, production increases in the country have only been associated with the expansion of cultivations and not through efficiency gains (Schoneveld et al. 2011, p.3). Within that context it is officially accepted that “the use of land for biofuel crop cultivation should be

[98] The initial literature search found 12 companies, but it soon became clear that most of them have either since gone bankrupt or have switched to food production.

regulated to avoid the use of fertile land for food crop cultivation" (Ghana Energy Commission, 2010).

No track record has been found during the research for incidents of food insecurity caused by the production of biofuels in Ghana. Of course, most of the companies that were set up between 2005 and the present time have ceased their operations, so there has not been much potential for a threat to food security. What has been mentioned by most of the Ghanaian interviewees however, is that there have been negative campaigns about biofuels in the past, mainly by NGOs (that had even led to project cancellations). Although this does not mean that a threat actually occurred, it may mean that given the current vulnerability, people are wary of biofuels projects. Consequently, and as was highlighted by all the interviewees from Ghana, proper care must be taken to address food security concerns.

It is notable that particularly the Ghanaian businessmen interviewed were absolutely clear that the problem of 'food vs fuel' in Ghana is not present. That is because there is an abundance of idle land that no one uses, so that there should be no competition between the production of feedstocks for either food or biofuels. However, due to the perception of biofuels as a threat, once some investors are interested in acquiring some land, campaigns and negative publicity may start. Therefore, although for Ghana food insecurity due to biofuels production has not appeared as a problem yet, the potentially growing share of biofuels in the agricultural sector, as well as the social concerns call for the development of a proper policy that can guarantee the food security of the population at all times. Moreover, as will be elaborated further on, the production of biofuels even has the potential to enhance food security, particularly in rural areas.

6.4 Barriers for biofuels development in Ghana

During the preliminary literature review that was conducted for the research proposal, a number of barriers to the deployment of projects for biofuels have been identified, which have been clustered as economic, institutional, socio-cultural and environmental. These were used as a basis during the research on the barriers of the biofuels supply chain in Ghana specifically (by interviews). They are mainly derived from a relevant report (for developing countries in general) of the IEA (2007) and were matched and complemented by a study in Ghana (Appiah-Mensah, 2000) and a by a report from CIFOR ((1), 2010). As they constitute very important factors for the development of an industry for biofuels, they will be reintroduced in the 'Synthesis' (chapter 7), in order for the research to include all the most essential factors and challenges.

6.4.1 Economic barriers

The most important barrier according to respondents is the lack of access to credit/funding sources (unanimous), because it makes it difficult to even start up a business or to continue operations at times when the cash flows are stalled. The low cost-competitiveness compared to fossil fuels is considered as an important barrier by some (5,6,7,9); others countered that view however, arguing that this does not necessarily have to be a serious bottleneck (4,8)[99]. Of medium importance is a system of debt service and coverage that could be helpful for businesses to overcome some difficult stages when

[99] Therefore it is ranked as 'medium'.

economic performance is still unstable, but probably difficult for the public sector to implement. Particularly interesting is the issue of the existence of an internal market for biofuels. Although some consider it as a prerequisite for development of the sector, and therefore consider its absence to be a barrier (6,7), most respondents maintain that it is not realistic to depend on this factor and that – even though it would be very helpful – its absence is not a major barrier in itself since there is demand abroad.

Investment risks were not found to be high; however, delays caused by certain processes occur, which naturally affect business operations, then there are risks (9).Transaction costs may pose a challenge either due to the labour intensity of some crops (e.g. jatropha) or due to higher costs (also for labour) when operations take place in remote areas (8). Another barrier is that the bulk of the raw materials has to be imported and since there are no exemptions for most of these inputs, they are expensive (9). Other issues such as the uncertainty of fuel supply and the fact that biofuels production comes with a long pay-back period are not seen as barriers in themselves, but rather as factors that companies will have to address as part of their business model choices and include in their planning.

	Importance		
	High	Medium	Low
Absence of internal market		+	
Lack of access to credit/funding sources	+		
Low cost-competitiveness to fossil fuels		+	
Big investment risks *			+
Long investment pay-back period			+
High transaction costs		+	
Insufficient debt service and coverage		+	
Uncertainty of fuel supply availability			+

Table 6.1. Economic barriers for the successful development of a biofuel enterprise.

6.4.2 Institutional barriers

It was unanimously expressed by the interviewees that the most important barrier of institutional kind is that of the current status of the land regime. Ghana has a non-formalised land tenure regime which has resulted in several negative experiences with biofuel projects in the past. Apart from the risks of land grabbing – often unconsciously by (potential) investors – the current land regime also increases the transaction costs that companies need to include at the pre-investment and initial investment stages.

Next come those which relate to the lack of information. When it comes to investors and business managers the lack of information about the specificities of the country, as well as about the crops they use as feedstock or even about aspects of the biofuels market(s) are of primary concern. Next to that, half of the respondents believe that the local communities' lack of information about the conditions and impacts of biofuels production also qualifies as a barrier to the process. Notably, two of the business managers that were interviewed justify that by their own personal experience too.

Moreover, the respondents unanimously added that the absence of a conducive regulatory/policy framework is of high importance. The general impression currently for the efforts of the public sector is that "they are talking more than performing. Now all the effort is on solar and wind, at the expense of efforts on biofuels" (4). Without a certain policy framework investors and managers cannot be certain for the future and/or the direction of biofuels production in the country. For instance, the status of the taxation regime has been characterised as "uncertain" (5), while the indirect taxes can make it tricky, even though it is generally interesting for businessmen (9).

The relationships with all businesses are generally fine, according to what Ghanaian businessmen said (all of them). However, the administrative process can be problematic: "authorities/agencies may not keep to the time guarantees they give, procedures can be very slow, bad organization and limited computerization of systems (although getting more organised and computerized lately)" (9).

As for human capacities the answers varied a bit. In general, it does not seem to be a problem, while it could be good to have more trained people. KNUST is known to produce knowledgeable people and other research institutions are also respected. However, some businessmen/employees mentioned that companies often have to train the employees themselves, because there is a lack of skilled personnel. Probably, for a really big industry an emphasis on educating people would be necessary, therefore we can rank the importance of that as medium for the present time.

Additionally, relevant to the aforementioned need to import all bulk materials (previous section) is that the time guarantees given by state agencies are often not adhered to, so that delays in processes occur, most notably at the customs (9). The foreign exchange rate is a risk of serious concern, because of the instability of the Ghanaian cedi (8, 9). The last institutional barrier that was identified is that transfering funds to Ghana can be a problem, because of the paperwork that is required (9).

Moreover, the respondents unanimously added that the absence of a conducive regulatory/policy framework is of high importance. The general impression currently for the efforts of the public sector is that "they are talking more than performing. Now all the effort is on solar and wind, at the expense of efforts on biofuels" (4). Without a certain policy framework, investors and managers lack certainty about the future and/or the direction of

	Importance		
	High	Medium	Low
Technical inexperience (contributing to high production costs)		+	
Investors' and managers' lack of information	+		
Local communities lack of information about impacts of biofuels production	+		
agencies and private investors unaware how to approach financial institutions			+
non-formalised land tenure (CIFOR (1), 2010)	+		
Lack of coordination between institutional actors	+		+
Poor management of technologies			+

Table 6.2. Institutional barriers for the successful development of a biofuel enterprise.

biofuels production in the country. For instance, the taxation regime has been characterised as "uncertain" (5), while indirect taxes can make the investment conditions tricky, even though they are generally favourable for businessmen (9).

6.4.3 Socio-cultural barriers

	Importance		
	High	Medium	Low
Lack of information in local communities diminishing social acceptance of projects		+	

Table 6.3 Socio-cultural barriers for the successful development of a biofuel enterprise.

The lack of information in local communities diminishes the social acceptance of bioenergy projects has been classified as a barrier of medium importance. That is because cases of land grabbing from biofuel producer companies have occurred in the past. Due to those negative experiences, bad publicity has also been a problem in the past (e.g. in the case of Biofuels Africa), because a lot of "noise" and the fear of bad press can discourage

investors (6, 7). That is a barrier that can be overcome by companies, however, by taking proper care to provide information to local communities and following inclusive processes during the project development phase. A suggested approach is also to aim for marginal land in areas far from community livelihoods (7), but that view is contested for reasons of productivity[100].

6.4.4 Environmental barriers

	Importance		
	High	Medium	Low
Need for large-scale monocultures, negatively affecting landscape and biodiversity			+
Relatively high demand for water			+

Table 6.4. Environemtnal barriers to the deployment potential of biofuels in Ghana.

The two environmental barriers were not considered as important by the respondents. The explanation is two-fold. First, because these aspects fall into the responsibility of every individual company to take care of and failure to do so would most likely have a negative effect on its performance. Therefore companies should rather do their own environmental impact assessments at the planning stage. Second, because land zoning for investments in biofuels plantations will be conducted.

6.4.5 Other barriers

In addition to the barriers already presented, a number of barriers have been identified that relate to the infrastructure that the BSC needs in order to operate (or as some interviewees named them, 'infrastructural constraints'). These are:

- Lack of irrigation and subsequent dependence on natural rainfall (4,9)
- Difficulties with electricity acquisition (4,8)
- Roads (4,8,9), which are sometimes in a very bad condition
- Traffic jams near Accra (9)
- Difficulties with getting the app equipment (for machinery) through customs (9), or the actual need to import that equipment, since it is not produced in Africa and is expensive (4).

Therefore in general, infrastructure and particularly transportation may pose difficulties, due to bad quality, although it has been noted that the situation is improving (9).

[100] There is disagreement in the literature regarding the possibilities of energy crops to produce sufficient yields. Section II-ii OF Appendix D, clarifies some of the actual production possibilities of biofuel feedstock crops.

6.5 Conclusions

Ghana is a country with considerable potential to produce feedstock crops for biofuels in a number of regions. The current energy system is dominated by petroleum as the main energy source for transportation and fuelwood for household uses. Biofuels are not likely to be cost-competitive to fossil fuels in the near future without intervention in prices (although fossil fuels are subsidized), but for some remote areas of the country production for own use may be an economic alternative. Investment risks mainly relate to uncertainty regarding the national policy for the biofuels industry. A number of possible barriers were identified through a literature review and afterwards were investigated with regard to their relevance to the production potential of the country. Those that have been found to be important are:

- The lack of access to credit
- The cost-competitiveness to fossil fuels
- Absence of internal market for biofuels
- Non-formalised land tenure
- Local communities' lack of information about impacts of biofuels production.

Furthermore, during the interviews with government officials and managers of biofuel businesses with experience in Ghana the following additional barriers were identified:

- The status of the taxation regime
- The absence of a conducive regulatory/policy framework
- Risk of instability of foreign exchange rate
- Lack of reliability of time guarantees given by state agencies- time-consuming and uncertain processes at customs
- Importation of bulk materials (machinery, farming inputs)
- Lack of irrigation and subsequent dependence on natural rainfall
- Difficulties with electricity acquisition
- Roads
- Traffic jams near Accra

These are barriers that may negatively affect the economic performance of companies, but which were not consistently found to be so important that they cannot be overcome by good business management. It would, however, be beneficial to resolve them soon, so that the uncertainty they cause to business managers is removed.

Of all the identified barriers, the ones that are directly relevant to the economic aspects of business management and to the stimulation of the industry by the public sector are interesting for this research to look for solutions to[101]. These are:

- The lack of access to credit and ways to overcome it
- The cost-competitiveness to fossil fuels
- The status of the taxation regime and ways to make it more attractive/effective[102]
- The creation of an internal market for biofuels
- The creation of a conducive regulatory/policy framework[103].

[101] They all lie on the strategic level of the typology of chapter 6 about biofuels development, which is presented in the following chapter.
[102] This is very relevant to the cost-competitiveness between biofuels and fossil fuels.

7 Synthesis of factors for successful biofuel production and consumption

7.1 Introduction

The purpose of this chapter is to assemble the products of the literature review that have been presented thus far, in order to answer research sub-question 1.3:

"*What success factors can be derived from the literature for the deployment potential of biofuels in the context of SSA"?*

The success factors of biofuels businesses and/ or projects have already been presented, but in order to answer this question it is also necessary to distinguish between the various levels of governance with regard to biofuels deployment. That is important because, as it has been observed during the preceding analysis, a range of factors with regards to the deployment of biofuels come into play at various stages and involving various actors. Therefore, at this stage it is important to first classify the success factors that have been identified so far under different levels of governance and to link them to the policy options that can be used to promote the types of business models that are determined as feasible.

To achieve the former -a classification in levels of governance- a certain restructuring of factors under different levels needs to be made as compared to the analysis presented in the following section 5.2. The latter is a simple association of each policy option to the types of business models and also to the stages of the BSC that are expected to be affected by their implementation, which however may be subject to changes after the analysis of the expert opinions is made; they are presented in section 5.3. Where some restructuring has occurred it is motivated, while a brief interpretation of the success factors is provided only where necessary, so that repetition with previous reference to them is avoided.

7.2 Levels of biofuels development and corresponding success factors

In the introduction of this report a number of barriers for the deployment of the bioenergy potential in developing countries were presented. The following chapter will discuss – among others things – in how far these barriers are present in Ghana. Due to the focus of this research on economic aspects, the economic barriers are of direct interest for further investigation. Therefore, they can also be regarded as success factors. Consequently, these 'economic barriers' must be incorporated in the conceptual framework of success factors of the research next to those that have been identified through the literature review

[103] This is not subject to this research per se, however, the mix of policy options that will be determined as appropriate for Ghana can serve for that purpose. The reason that make this point relevant is that a consistent and appropriate mix of policy measures have been identified by the interviewees as fundamental in creating a friendly investment environment and countering any possible investment risks.

on the specific themes of the research, after being slightly reframed, in order to be construed as success? factors instead of barriers. They will hereafter be referred to as:

- Existence of internal market (for biofuels)
- Existence of funding sources
- Degree of cost-competitiveness to fossil fuels
- Sufficiency of debt service and coverage options
- Degree of investment risks
- Reliability of fuel supply availability
- Length of investment pay-back period
- Height/level of transaction costs

Level 1- Strategic

These factors – with the exception of the latter two – lie on the strategic level of biofuels development, which is here to be named as '**level 1**'. They concern the broad and nation-wide economic conditions that affect the possibilities for the development of an industry of biofuels and for the viability of any individual business type, regardless of the model that may be chosen. These factors strongly affect the chance of biofuels to get a larger share in the national energy mix. They can be interpreted as follows:

The first two of those – the economic and social attractiveness of alternative options and the reference energy system – are common country-wide factors that relate to the relative competitiveness of biofuels as compared to the other possibilities (petroleum fuels for transportation and mainly fuelwood for household uses). The existence of an internal market for biofuels and of funding sources positively correlate to the possibilities of establishment for an industry of biofuels, while the sufficiency of funding sources and the degree of cost-competitiveness to biofuels also have a positive correlation, but mainly in order for the industry to prove viable in the longer term. The lower the degree of investment risks, the higher are the chances that investments can be implemented and operations can run unobstructed. Last, the more reliable and the more widely available that fuel supply is in a country the less are the chances that biofuels will actually be produced as a domestic alternative energy source. Reversely, if fuel supply availability is low, biofuels can be seen as an alternative to increase the levels of supply and national energy security and therefore have better chances of being promoted for domestic use (which in turn increases the chances of creating a robust domestic market).

Level 2- Organisational

'Level 2' factors concern the existing conditions in the economic and investment environment in each specific country, which may or may not be biofuels-specific. Although highly important across all possible types of biofuel projects, these success factors vary per project. Therefore, the degree to which they are present may render some types of biofuels development more feasible and/or appropriate than others. They have been identified in the chapter on the BMs and are theorized to heavily affect the economic viability of biofuel projects. Additionally, the length of an investment's pay-back period must be included in the factors of that level. The rest of the factors are case-specific, depending on the choices and

possibilities of each biofuel project with quite direct economic effects on a company's performance.

Moreover, for the realization of socio-economic and environmental benefits, two common factors were identified in the same chapter, the first being nation- and/or region-wide and the second one case-specific respectively:

- levels of national as well as of regional development (skilled labour, infrastructure, access to goods and services), which positively affect the chances of successful implementation, while limiting economic costs, and
- the integration of local communities in the bioenergy chain, which significantly increases feasibility and acceptability.

Additionally, the type-specific success factors that were presented in table 2.1 of the chapter on BMs must be taken into account, when examining the possibilities of each of those types[104].

Level 3- Operational/SCM

Level 3 concerns the success factors on the operational level of biofuels production. These are type-specific and may therefore vary per business model and case even in the same country or region. Some common success factors for all the types on the operational level have been identified, though, and are included in table 5.1 below. Addressing these factors is solely a responsibility of the private sector.

The following tables synthesizes the findings of the literature review as they were motivated here. First, table 5.1 presents the identified policy options in relation to the success factors these options address. The factors that have been identified so far and restructured as described above, have been classified in the same three levels so to correspond to specific policy options.

Level	Success factors/ required conditions	Strategies/policy options
1- Strategic	• Economic and social attractiveness of alternative options and • The reference energy system • Existence of internal market • existence of funding sources • degree of cost-competitiveness to fossil fuels • degree of investment risks • sufficiency of debt service and coverage options • reliability of fuel supply availability	• Tax-related (investment) incentives • A compensation regime for biofuel companies • Loan guarantees (Debt coverage) • Grants and loans to small entrepreneurs • Microfinance • Mediating between banks and companies/cooperatives **Supply/production of biofuels** • Biofuel consumption targets • Blending policy **Restrictive measures** • Price regulation • Bans on exports[105]

[104] Not listed here again, in order to avoid repetitiveness.

2- Organizational (business model-sensitive)	• Length of investment pay-back period • Height/level of transaction costs • Levels of national as well as of regional development (skilled labour, infrastructure, access to goods and services) • Integration of local communities in bioenergy chain • Factors per type as clustered in table X (chapter conclusions)	**Supply/production of biofuels** • Production subsidies • Enhancing market access for smallholders • Bans /quotas and tariffs on exports[106] • Bans /quotas and tariffs on imports[107]
3- Operational-SCM	• Degree of coordination and integration between the actors/entities involved • Degree of efficiency of flow of products and information • Level of intensity of the chosen agricultural management system • Level of mechanization • The reliability and the cost of feedstock supply • Nature of feedstocks	To be developed in chapter 7

Table 7.1. Categorisation of policy options that address the main factors in the three levels of biofuels development.

7.3 Relation of identified policy options to BMs

Table 5.2 continues the synthesis by explicating for which specific types of the business models under study each policy option is relevant and furthermore by specifying which stages of the BSC are directly addressed or affected by each option.

Strategies/policy options	Business model relevance	Stage of SC addressed/affected
Tax-related (investment) incentives	All	Investment (pre-production)
Grants and loans to small entrepreneurs	Type C	Investment (pre-production) and biomass production
Microfinance	Types B (for the smallholders) and C	Investment (pre-production) and biomass production
Biofuel consumption targets	All	Investment (pre-production), biomass and biofuel production, biofuel end-use
Blending policy	All (possibly at a varying degree)	Biomass production, biofuel production, distribution and end-use
Production subsidies	Types A, B and C	Biomass production and biofuel production
Price regulation	Types A, B and C	Biofuel production and biofuel end-use
Bans /quotas and tariffs on imports	Types A, B and C	Biofuel end-use

[105] Classified on 'level 1', because they are a merely protective measure of strategic kind for the whole country overall

[106] Classified within 'level 2', due to their contribution to domestic value-adding activities, i.e. focused on local/ project-level benefits.

[107] Classified within 'level 2', due to their application as a way to protect domestic producers from external competition, i.e. they function as serving the project developers.

A compensation regime for biofuel companies	Types A and B	Investment (pre-production)
Loan guarantees (Debt coverage)	Types A, B and C[108]	Investment (pre-production)
Mediating between banks and producers	Types A, B and C	Investment (pre-production)
Enhancing market access for smallholders	Type B	Biomass production and logistics
Bans /quotas and tariffs on exports	Types A and B	Biomass production, biofuel production and biofuel end-use

Table 7.2. Relevance of policy options to specific types of businesses and to the BSC stages.

7.4 Conclusions

The typology and the analysis presented here are useful for two reasons. First, table 5.1 makes a detailed account of all the factors that need to be considered by project developers of any type of biofuels production, as well as by the public sector officials and policy-makers, in the process of assessing the feasibility of certain paths of biofuels development. By linking the types of business models with specific policy options for their stimulation, section 5.3 (table 5.2) provided a detailed overview of the actions that the public sector could undertake to promote certain paths of biofuels development. In doing so, it is important to make an account of the exact points of intervention that the policy options target or in other words, which stages of the BSC are addressed by each option. That is theoretically as well as practically useful, in order to come up with a fair and realistic policy mix.

The approaches to address the identified factors in ways that increase the chances of success of individual business types and subsequently of a national industry of biofuels on the whole have been subject to further research during this thesis project. They concern actions of both the private and the public sector and will be presented under the same structure and order as the literature review.

By juxtaposing the present conditions in Ghana with the requirements of business models to be run sustainably, as well as with the implementation requirements of the identified policy options, the next stage of the research aims to conclude by identifying which business models may be feasible for Ghana and which governance arrangements are mostly needed and feasible, in order to successfully employ the business models.

[108] For type C the applicability of loan guarantees is more doubtful than for the other types. Whether it is a good idea or not, will become clear after the results of the interviews with experts are presented.

8 Strategies for efficient business models for biofuels

8.1 Introduction

In chapter 3 a typology of business models for biofuels was presented, the expected impacts and success factors of each were introduced, as well as general issues and success factors that are common for all of them in the context of SSA. This chapter continues the analysis, principally by investigating the possible arrangements to efficiently organize and manage businesses, in order to maximise their efficiency[109] and come up with some overall action strategies. The following research sub-question has led the research activities:

"In which ways can the identified business models be more efficiently managed and how should the respective challenges of each be addressed, according to experts?"

The ideas that were gathered are mostly products of the discussions with experts, but in many cases the general approaches and many elements of strategies were first found in the literature and served to structure the respective parts and the interviews (e.g. the first four pillars of the 'adoption process'). There was no need to approve or disapprove certain options regarding the business models, therefore any kind of quantitative presentation of the interview findings was not meaningful. Where a debate has been found to occur, the background of the respondents that tend to favour or reject certain possibilities/approaches is stated along with their arguments. The findings of the research have resulted in strategies presented per type of business models, but due to the overlap for types A and D, these will be merged in one common section. Therefore section 8.2 includes findings for types A and D, section 8.3 those for type B and section 8.4 those for type C.

8.2 Types A and D

8.2.1 Action strategies

In general, for large-scale companies owning the land they produce from, the main requirements to be successful, have to do with the SCM activities. Therefore it is necessary that before the investment takes place the possibilities are studied well, so that the business plan is realistic. Negative experiences in many countries point at the importance of awareness and communication campaigns, as well as with inclusive processes during the early planning stages, as many people from Ghana and elsewhere have mentioned.

[109] While the examination of possible solutions for the challenges that have been identified before or through the interview process was the main research focus of the interviews with experts, a number of additional impacts have been identified as well. Since these mainly constitute elaborations on those identified through the desk research and for reasons of readability, these are only presented in the appendix along with/below the detailed explanations that are already provided in the text there. Therefore, by providing those in the appendix altogether the interested reader can have a full and detailed overview of the expected impacts of each type, while the contents of the main chapters remain focused on the most essential issues and the approaches to deal with them.

To address the risks four distinct action strategies can be put forward by the public sector and followed by the large companies. First, it is important that already at the planning stage of an investment social and environmental risks are identified and mitigated. More specifically, appropriate procedures, such as the conduction of Social and Environmental Impact Assessments as a necessary step to outline a project's effects (Cotula, 2011, p.30), information campaigns and inclusive processes must be set up from early on[110] (UN/FAO, 2012, Module 3, IIED, 2010). The most straightforward way to do that is by introducing standards to regulate not only the environmental matters, such as pollution from fertilisers or pesticides), but also social matters. Having those standards –that may come either from national or international law - enables for the enforcement of rules later on. The appropriate processes must be followed to ensure that farmers ceding their land are compensated and appropriately. Therefore, the tendency of many African countries to focus on environmental variables only must be overcome. As is done in Zambia, social variables must be included as well. These can provide the primary mechanisms for monitoring the actual performance of the investors after the project implementation stage (German et al, 2011, p.38). In that respect, legislation in Ghana, Zambia and Tanzania demands a full declaration of social impacts and also investor commitments for the implementation of appropriate mitigation strategies to account for socio-economic impacts (ibid). A good example to account for such impacts specifically comes from Mozambique, where legislation requires the identification of the exact number of the affected people (ibid).

Second, to ensure good governance for resource management even after project implementation. That points at the need of a set of requirements that must be set for investors. More specifically, environmental legislation in EIAs could be accompanied by provisions for monitoring the pace of implementation of investments. Compliance with terms and conditions can be increased by posing legal requirements to specifically commit on certain volumes of investment, jobs and the provision of infrastructure, just as a government commits to provide land access to investors and to guarantee that it will be maintained (IIED, 2009, p.82). These legal requirements can be stated as contractual provisions as well as national legislation and they entail investors' commitments, monitoring mechanisms and sanctions. In Mali for example, "legislation on the Office du Niger enables the Office management to terminate 30-year leases for failure to pay fees or maintain the irrigation infrastructure" (ibid). This way the leasehold is strictly subjected to compliance with the legislation.

An option for an arrangement regarding the lease is to pay an annual rent to the community to which the land belongs, as is done in Sudan (Cotula, 2011, p.34). This way the security of land rights is increased for the investor –as they deal directly with the community and compensate them for the land they use. In Cameroon a large share of the land fees is directly paid to local groups (40% to municipalities and 20% to affected villages) (Cotula, 2011, p.41). In Madagascar the local landholders are entitled to a share of the produce, a form of compensation.

Third, to optimize nation-level benefits from large-scale production von Maltitz and Stafford (2011, p.20) recommend that some mechanisms are put in place, such as:

- A requirement for joint ownership of investments with a limit on the extent of foreign ownership
- Restrictions on the exportation of profits, by restrictive mechanism, such as an export tax.
- Measures to increase the amount/share of value-adding activities in the country. Perhaps an even better idea is the provision for establishment of community development funds –as in Liberia- or to pose formal requirements to investors for the provision of a set of measures or social infrastructure such as for health, education, water and sanitation facilities (Cotula, 2011), in order to compensate the locals for the land use. This again increases the security of land rights of investors, gaining legitimacy, while providing substantial benefits to the local community (note: in Ghana this is done out of personal initiatives in many cases, but is not required by law) (ibid).

In the same respect, instead of such land leases from communities, an enterprise shareholding model is a more sophisticated development that brings great security to an investor as well (Wily, 2011,p.66). Different forms (for instance, contract-farming is relevant) and levels of shareholding can be agreed with the communities and limit their risks and liabilities within these enterprise developments (ibid). Therefore a win-win situation is achieved with reduced risks for both the community and the investor, as well as reduced resentment from either side (Wily, 2011,p.66). This option is discussed in more detail in section 8.3.2.1.

Moreover, fourth, the obligation by the part of the state to have an exit strategy, for cases of unfavourable developments for the companies could be helpful in minimizing the negative impacts of cessation of operations. Ideally, it could be made possible to transfer the land to other owners and make relevant arrangements, so to mitigate the negative impacts of a company's exit from the country. The same authors (von Maltitz and Stafford, 2011, p.20) suggest that –wherever possible- models that employ more manual labour are encouraged over those that are more mechanized, because the latter require importation of machinery, which is not good for the national balance of payments. That may be a controversial argument however, also due to the higher quality of jobs that mechanized jobs offer, as previously mentioned in this chapter. The following table sums up the identified impacts of type A business models from both the literature review and the interview process.

8.3 Type B models- Contract farming

As before, this chapter distinguishes between two main subtypes of partnership models, namely contract farming with individuals and contract farming with farmers' associations/cooperatives. The arrangements and effects entailed in these types are believed to be the same as in other variations of partnership models and so the analysis provided for them suffices to cover the relevant issues. A presentation of the ways to address the common issues in partnership models will follow, while building on those sets of action strategies a separate section is devoted on the functioning of farmers' cooperatives (relevant for types B2 and C2).

Some opinions of interviewees on the expected impacts on some actors are worth mentioning here, because they contradict from the literature findings. In addition to previously identified advantages for farmers, the benefit of market diversification for farmers was emphasized by 25, while on the other hand the argument of dependency of farmers on one specific company (in IIED, 2012) was rejected by some interviewees. Those claimed that in fact individual farmers are more flexible, while companies tend to be dependent, therefore facing supply risk (24,25,30). Consequently, according to those respondents, it is a misconception that smallholders are more vulnerable if agreements are not followed (24,25,28), as is often read in the literature (and reported in chapter 3). The above can also be described in a "lighter" way as loss of flexibility in enterprise choices (Shepherd, 2013). Coming from that is the inability to benefit from higher prices in the market. As many interviewees reported, that is particularly the case when side-selling becomes a better option for farmers and they do not keep to their commitments.

8.3.1 Action strategies for contract-farming models (common for types B1 and B2)

The experience with contract farming so far shows that companies have not learned much from the past and from the literature. More specifically, it seems that insufficient attention is paid to the development of the relationships with farmers, to the monitoring of their performance and to the provision of resources for them to upscale their production (Shepherd, 2013). Much emphasis has been given in the international literature to the inclusive business models and the development of markets for the poor; however, commercial principles have to be applied and the farmers chosen to participate in partnerships should be the best suitable to perform the job, not the poorest (Shepherd, 2013, 18,19). Therefore from a company's point of view, a choice of farmers must be made, not a random assignment that resembles to charity (Shepherd, 2013).

A number of people mentioned their likeness to the nucleus estate model of contract farming. For the purpose of harnessing the benefits relevant to farmers and rural development, these respondents believe that it is better for a company to operate on a large scale with its own plantations, and also involve outgrowers as part of the operations. In this way the company can possibly set up a collection system and let the outgrowers grow 1/3 of the crops of the project (18). This is relevant in order to mitigate the supply risk, but also due to economic efficiency reasons, in order to achieve economies of scale (at the plant) (ibid).
To ensure that famers entering a partnership understand the contract terms and are not misled in any way, von Maltitz and Stafford (2011, p.28) recommend that support in the process of contracting is provided to them that includes:

- Legal limits on the duration of contracts;
- Legal assistance to ensure that farmers have a fair voice in the contract conditions
- Legal assistance to ensure that farmers fully understand the contract terms of the agreements they sign. Possibly, a funding support by the government can be provided alongside a requirement for contracts to be examined by an independent party or a knowledgeable NGO on behalf of the farmers. Alternatively (where they exist), agricultural extension officers could have an advisory and facilitating role in that process, if they are properly trained.

Afterwards, good relations with the farmers must be developed and maintained[111] (ibid). Moreover, agribusiness firms must ensure that the national and local authorities are fully supportive of the arrangements with farmers and that they understand the reasons behind them. Ultimately, effort must be made to involve the local authorities and the civil society right from the start and to safeguard the continued access to the local resources (Shepherd, 2013).

To address spatial scattering, the company Nandan "works through a network of 'franchisees' coming from within the community or occasionally from local development organisations" (IIED, 2010, p. 118, Shepherd, 2013). Diligent had organized the logistics itself by collecting all the seeds with its own trucks, in order to deal with that (35).

While the above action strategies were merely about the relationship between the companies and the farmers, a number of action strategies that the public sector could implement have also been identified by the literature review. The policies of the Social Fuel Seal and PRONAF in Brazil exemplify how partnerships between smallholder and commercial producers can be initiated and regulated. According to (Schut et al., 2010), partnership production models must be accompanied by penal measures that regulations stipulate for non-compliants, as the Brazilian experience teaches (e.g. no access to auctions, low cost loans or tax exemptions). Programmes like the social fuel seal and PRONAF in Brazil have been effective in provide training on agricultural and technical practices, guaranteed off-take of produce, access to finance, employment and income generation to smallholders (all these options will be discussed in detail in chapter 10) .

Moreover, Schut et al. (2010) argue that for the purpose of stimulating employment creation and local spin-offs through biofuel development an obligation could be issued for biofuel producer companies to hire a certain percentage of their employees from the surrounding areas. Additionally, measures to enhance rural development and income-generating activities could be taken, such tax or other incentives to make investments in local capacity building. In line with these suggestions the Indonesian government had actively promoted the incorporation of smallholders in the production schemes of large companies by obliging the latter to have them attached to a private nucleus at a proportion of 20:80. The nucleus estate plantation owners hold responsibility for the provision of extension services, for collecting as well as for processing the fruit bunches. As expected, smallholder schemes of this kind were attractive to farmers and have facilitated development (Caroko et al., 2011).

Von Maltitz and Stafford (2011) suggest a different model to be considered in partnerships, by reversing the crop sharing agreements. In such a case (Silversands Biofuels used this model in South Africa) the community would partially remain the land owner and it would share the crops on the lands with the company. Therefore -unlike in straight lease agreements- the actual profit is not a fixed amount, but a percentage of the yield. In such a case the crop growers and the land owners share the same risks and rewards.

Finally, von Maltitz and Stafford (2011, p.28) recommend a number of interventions to address the possible monopoly situation of the mill in a local agricultural market with smallholder outgrower farmers. These include:

[111] That point will be elaborated in section 'adoption process'.

- a discouragement of long-term contracts (these do not let farmers change to other purchasers)
- introducing anti-monopolistic legislation
- allowing for more than one mill to operate in an area
- adopting equitable and transparent pricing formulas
- increasing the local storage and processing facilities, in order to diversify the supply chain, while contributing to the (indirect) regulation of the market price[112].

8.3.2 Adoption process

The 'adoption process' is an overall strategy that elaborates on issues that were presented in this chapter and even in previous ones. It is composed of six pillars, which have been identified as important during the research, in order to achieve mutually beneficial and sustainable relationships between farmers and producer companies in partnership models (actions by the public sector are therefore not included). This categorization further elaborates on existing knowledge. The basis of the typology is mainly derived from (IIED, 2010) (the first four pillars), but similar categorisations can be found in the literature by other authors (e.g. Mayers, Bass and Macqueen 2005, cited in Dubois, 2008). The latter two categories, capacity-building and trust, have been more implicitly derived from a number of other literature sources as well as the interviews (especially trust was a concept that was arisen and developed through the interviews). By the time the interview process had been completed, they have been clearly identified as very important sets of actions and therefore became part of this new typology.

IIED (2010, p.97) categorise four criteria for assessing the balance of power and other characteristics of the relationship between the partners:

• who "owns" the process, new business, project, or whatever the partnership calls itself (the ownership question);

• how are issues discussed, and decisions made (the voice question);

• how are risks shared (the risk question);

• how are the benefits and costs shared between the partners (the reward question).

The partnership process is dynamic, thus these factors are not unchanging over time (ibid). Another key factor, firstly for the participation of smallholders in a business model, and then for understanding the implications of certification, is the access to information. Following from that, trust to the information smallholders are receiving proved to be an important element, according to the findings of this study (ibid).

All in all, the following six categories gather and summarise all the kinds of activities that firms must follow from an institutional and organizational point of view, in order to successfully establish partnerships with smallholder farmers/associations. Each category is regarded as a pillar towards the overall adoption strategy that a company must build on, when partnering with smallholder farmers. Ways to address the disadvantages, risks and identified challenges that partnership business models entail, have been gathered and are

[112] Meaning that competition between mills enables to bring the market price down.

presented under these sections. These come both from literature sources, as well as from the interviews.

8.3.2.1 Ownership

To start with, the ownership structure of a partnership is important for achieving inclusivity and it affects the nature and distribution of risk, reward and voice (IIED, 2010). Ownership does not necessarily refer to actual assets, rather it may also be some kind of a stake in the business and/or its management. In the cases of partnerships, the development of inclusive business models becomes even more relevant. As inclusive business models are meant those "commercial arrangements which incorporate small-scale producers and operators into larger enterprises and where the interests of smallholders are recognized" (FAO-BEFSCI, 2012, p.8). A truly inclusive business model not only assumes a collaborative relationship to be in place, but also that fair and equitable terms are provided for the relationship to be based upon (ibid). The benefits of inclusive business models include active market participation for smallholders, and economically attractive opportunities, lower risks, as well as greater capacities for growth for the companies.

Action strategies

Von Maltitz and Stafford (2011, p.28) suggest that a union and a shareholder structure is incorporated into the biofuel company, in order for farmers to be formally represented and for their bargaining power, local ownership and investment are improved. Many interviewees second and elaborate on that possibility. For example, by including the farmers in the management structure, the risks for a stable supply are lowered for a company. It is very easy for farmers to sell their produce somewhere else, if they can achieve a better price for it, thereby defaulting on the contracts they have signed[113]. Therefore, "giving supplying farmers a stake in the company's management system or business is a wise thing to do". This secures the benefits of both parties, because farmers' benefits are guaranteed by their involvement in the company, while the company ensures its supply (29).

If a joint venture is set up between a company and farmers, often equity shares are used -(sometimes valuing the contributions of the parties to the venture), which are believed to contribute towards the increased empowerment and influence of farmers (IIED, 2010). Mali Biocarburant –one of the best known successful biofuel companies in SSA Africa- uses a combination of a joint venture and contract farming. Issuing equity shares for smallholders also enables them to directly access key information for the company (FAO-BEFSCI, 2012).

8.3.2.2 Voice

"Voice" is the ability to influence key decisions of the business, and understandably is usually directly linked to ownership (as for example, company shares give farmers a say in the decisions). It is very commonly argued that community involvement is an essential part of biofuel development and must be an integral part of biofuels policies and practice (Dubois, 2008). However, it has already been mentioned, that the challenges this principle

[113] "These contracts often mean nothing to them (sometimes it is the first paper they have signed in their life)" (23,35,29 a.o.).

brings, tempers the enthusiasm about it. Therefore it is no surprise that also many of the respondents are from skeptical to negative about small-scale biofuel development. There is extant literature that analyses the benefits, difficulties and risks of stakeholder engagement[114]. For the purpose of this chapter it suffices to briefly mention these with regards to the implementation of projects and to explain how these outcomes can be achieved.

A fundamental aspect to the process of engaging local communities is that it requires a long-term view of the partnerships (IIED, 2010). The state may also have a role in that, "by providing (or not providing) space for "voice" to develop and for a partnership to move from its initial formulation through to implementation and investment over the longer term" (IIED, 2010, p.97-98). The benefits of giving voice to the stakeholders are (FAO/UNEP/UN Energy, 2012,Module 6, p.2):

- better management of differences and conflicts,
- improved links between legislatures and citizens
- increased support of external stakeholders to policy-makers through the additional information that the first can provide (particularly useful tactic for biofuels, especially for cases when experts' opinions are insufficient, e.g. uncertain and complex environmental problems),
- improved social accountability, due to more effective delivery of public sector services.
- Overall, it is also of great benefit of the private and the public sector, that early and appropriate engagement of farmers in the investment decisions reduce the investment risks (also the operational risks later) and contribute to the viability of the projects.
- Inclusiveness in the business models is expected to provide higher rewards for both the smallholders and the company (IIED, 2010). An additional benefit for the smallholders is that they benefit from the commercial know-how that the private sector has (ibid).

On the downside, apart from the resources required to facilitate these processes, the time-consuming character they have is also a factor that adds to their difficulties. Of particular attention should be the concerns of potential misrepresentation of farmers (some participants may not have a stake), and of distorted interests (arising either due to conflicts between individuals, groups and organisations, or due to the views of the public sector).

Action strategies

The options to raise the "voice" of partner farmers are highly relevant to those presented in the chapter about the land acquisition processes. According to IFC[115] (IFC, 2007, in FAO/UNEP/UN Energy, 2012, Module 6), negotiation is particularly recommended in projects, that "a) proponents seek right to land and other resources, and b) stakeholder concerns present a significant risk to project operations or the proponent's reputation". It is important that investors gain the "free, prior and informed consent" of local communities for their project, but also that engagement continues throughout the whole project cycle[116] (ibid). Other ways to facilitate inclusive decision-making are:

[114] See FAO/UNEP/UN Energy, 2012, Module 6 for a good overview of the literature.
[115] International Finance Corporation
[116] It must be clear that here we refer to the whole project cycle, starting from the pre-investment stage, when the whole adoption process starts, but without analyzing the land acquisition process.

- Regular meetings,
- consensus decision-making,
- working according to agreed annual benchmarks.

These are factors contributing to an open and transparent business culture (IIED, 2010) and subsequently to a higher degree of inclusivity. A factor that can largely influence the effects of these processes is the balance of the bargaining power the different stakeholders possess (FAO/UNEP/UN Energy, 2012, Module 6). It should be ensured that the farmers also have the ability to actively participate and make their concerns known and heard, whle the appropriate time should be dedicated for that purpose. To make board representation function effectively, an idea is that the board meetings involving small farmers are structured in a way that leaves enough time for the weaker of the members to fully understand the implications of the decisions to be made (IIED, 2010). This may be challenging in terms of time and resources. Notably, in these cases unless the smallholders have a sufficient voting share, there is a risk that they are marginalized (ibid).

Voice can also be achieved by different means, such as collective bargaining over inputs and the price of the produce (contract farming). The establishment of farmers associations is expected to contribute much in that respect, as it substantially increases their bargaining power and potentially enables them to induce policy change (ibid). Permanent strong organisational structures (not only when collectively bargaining) are expected to empower smallholders in their negotiations with companies effectively. That means that the higher the degree of vertical integration of farmers in company structures, the "louder" their voice becomes. In a similar vein, having business acumen among the farmers with good understanding of the markets may largely influence their negotiation outcomes (ibid).

When dividends are given to farmers, safeguards need to be put in place, in order to avoid that the profits of the company are eroded by transfer pricing[117] (through the manipulation of prices in transactions between the joint venture company and other companies linked to the investor") (IIED, 2010, p.115). In organizing these processes, it must be considered that power structures within the communities themselves (based on age, income, gender, status) may affect the level of voice, therefore attention must be paid to the ways a company communicates with farmers, as cronyism and nepotism may arise (ibid).

In Tanzania –under the new policy- the Tanzania Investment Centre (TIC) needs to approve, coordinate and monitor investments, of which it has full overview. A project will only be approved after a complete business plan is submitted, obtained permits for natural resource use, and industrial permits and having conducted an EIA and a feasibility study to be attached to the proposal (Hultman et al., 2012). Moreover, the investors "must consult

[117] "Transfer pricing results in the setting of prices among divisions within an enterprise. Transfer prices are charges for goods and services between controlled (or related) legal entities, i.e., within an enterprise. Legal entities considered under the control of a single corporation include branches and companies that are wholly or majority owned ultimately by the parent corporation. Certain jurisdictions consider entities to be under common control if they share family members on their boards of directors.

In principle a transfer price should match either what the seller would charge an independent, arms-length customer, or what the buyer would pay an independent, "arm's-length" supplier. While unrealistic transfer prices do not affect the overall enterprise directly, they become a concern when they are misused to lower profits in a division of an enterprise that is located in a country that levies high taxes, and raise profits in a country that levies no or low taxes, as a tax haven (http://en.wikipedia.org/wiki/Transfer_pricing).

local, regional, and national stakeholders during the feasibility study and project-planning phases and must also develop a memorandum of understanding with the relevant village authorities" (ibid).

8.3.2.3 Risk

Carter and Rogers (2008, p. 366, in Hall and Matos, 2009) define the management of the supply chain risk as "the ability of a firm to understand and manage its economic, environmental, and social risks in the supply chain". Taking into account that primary stakeholders (involved in the transactions of the supply chain) have different interests, claims and perceptions than secondary stakeholders (e.g. academic institutions, NGOs, neighbours, and social activists), there may be ambiguities regarding the perceptions of risk and conflictive pressures may be difficult to reconcile (Hall and Matos, 2009). That proves to be the case regarding the issue of food security[118], meaning that most people blame NGOs or lack knowledge on the debate about food versus fuel in Africa.

Naturally, greater participation of smallholder farmers in a business exposes them to greater risks. Therefore, where local communities collectively or individually have a steak in a business, and carry a share of the risk, attention must be paid that the arrangements chosen give shelter to some key livelihood assets, such as land rights (IIED, 2010).

Price stability in combination with production stability and offtake stability are the most important factors to make biomass production attractive for them (farmers) (25). But as prices for biofuels are volatile –due to the volatility in the energy markets- eventually, having constant and predictable production is a crucial factor (ibid). In fact, when it comes to supply risks, the biofuel producer faces more risks than the farmers, because the farmer usually has two or three places to sell their crop, while the biofuel facility can only feasibly accept feedstock from within a 30-40 km radius (25). Due to the significance of this risk, many interviewees were asked to suggest ways in which this can be mitigated.

Action strategies

To address one of the common risks, state authorities can replicate the following practice. Under Tanzania's policy, approved projects are allowed for five-year probationary leases and after having shown "investment seriousness," the leases are extended to 25 years (ibid). Requirements for land use are set (e.g. maximum 20.000 hectares per investor) and guidelines prohibit the displacement of people, food security threats and adverse environmental effects.

Good and long-term contracts are by many considered as a prerequisite for a good start, so that a relationship can be built upon. But eventually the farmers will sell where they think they can get a better price, so that a good relationship from the beginning is needed with respect to the agreed terms from both sides. After all "if the company pays on time and the farmers deliver on time, then everybody should be happy" (25).

In order to have some checks and balances on the contractual agreement, 18 suggested that "there must be a right of the company that if a farmer does not deliver, it can step into his farm and take the crop in exchange for that". It was also argued that "favourable terms (with mutually beneficial conditions, both for the farmer and the

[118] That has already been clear during the interviews with people from Ghana and was confirmed after later interviews as well.

contractor/investor) must be included in the contracts to oblige the farmers to provide their produce to the feedstock buyers" (31). According to FAO/UNEP/UN Energy, (2012,Module 3), some flexibility from the part of the company can also be beneficial.

In India, the government had set a fixed price for sugarcane. The case there is often that they have to supply a certain sugarcane mill, but as the mills have liquidity problems, they are not able to pay the farmers immediately and then the farmers get disheartened and start selling the cane elsewhere (25).

An approach is to monitor the enforcement of certain contract rules. In Brazil there are minimum prices for certain crops, like coffee, which are set in the contracts between the small producers and the buyers. Based on that, the producers (farmers) have a guaranteed price, which makes them also more trustworthy for a company, and the market decides whether the price is going to be higher or not (36). So this is less of a limitation compared to fixed prices. Fixed prices are by some regarded as part of the above, while others disagree about the appropriateness of that (analysed under 'reward'). On the other hand, in order to initially have farmers motivated and to keep them so, systems where they are paid half before and half after the end of the harvesting period have been effective. These systems help build trust, while not making farmers rely on that they will be paid for everything in advance (31).

Signing up the farmers to associations and through contracts is a way to guarantee that a company will have the feedstock supply it needs. However, a contract often means nothing to the farmers (especially if they have never handed it in before), so that the degree of commercial experience they have had in the past is more important (28). Emphasis has been put by many interviewees on diversifying the suppliers. That reduces risks and also in that respect Diligent did a very good work about that, building a huge network of outgrowers (11). 36 also argues that the formation of cooperatives and -whenever possible- outgrower schemes with foreign traders are a good way of dealing with the problem. On the contrary, he argues that "exclusivity contracts cannot be encouraged in Ghana or other African countries". More analytically, having a contract farming arrangement, "where you have established cooperatives or commercial farmers working together with these small farmers" seems to work well in S. Africa (15), by providing all the necessary inputs to farmers the problem is solved[119].

On the other hand, a number of people emphasized that a company cannot depend on the outgrowers alone. A company needs to ensure that it grows enough biomass itself to operate the facility at the cost-neutral basis, and then it can incorporate smallholders in the business, by creating an interesting business proposition for them (24, 18 a.o.).

However, as S. Sielhorst noted, it also needs to be considered that the opportunity costs of biomass production in countries with high population and increasing purchasing power like Ghana are high, when compared to food production. That makes dedicated biomass production difficult[120] (due to competition with food). "In such countries you should probably look more into biomass from waste by food production systems, than at purely dedicated bioenergy production" (quoted by 24, but also seconded by 29).

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[119] That point is elaborated upon in the section 'capacity-building'.

[120] Also in Ghana.

Other contributions next to the required agricultural inputs such as the provision of weed control, pest control etc. are likely to make farmers more committed to selling their produce to the contractor (thereby reducing the risk of so called side-selling, i.e. selling to other parties than the contractor) (31). Finally, building up a relationship of trust is also considered in conjunction with the contracts and the reward offered to farmers.

8.3.2.4 Reward

There is extensive literature referring to how shared value between the producer company and the farmers that participate contributes to the success of companies with partnership models (e.g. IIED, 2010- Alternatives to land acquisitions). Having a shared economic interest between companies and smallholders is regarded important for the long-term sustainability of a business model (UNECA, 2012). Shepherd (2013) more emphatically stresses that "there must be genuine economic benefits for both parties, the so-called 'win-win situation' " for any contractual relationship to be sustainable.

Most important in determining the distribution of reward across the supply chain are the prices for inputs and for the produce that the farmers get. Next to the above, reward is considered as a means that will encourage the business to ultimately pursue certification (UNECA, 2012).

Action strategies

Collective bargaining can contribute to the efforts of farmers to achieve better prices for their produce, in order to secure their income, while a portfolio of options for the farmers to sell their produce is generally considered as one of the best ways to succeed in that. They must make sure to produce a range of materials and products, so that they can not only sell at different markets, but also at different times of the year. This way their income can be more stable and they can have more certainty about it overall (28, 11 a.o.). At the same time, "farmers have these fluctuating prices, because they do not have enough markets. If there was constant demand for their crop, then the prices would go up and stay up" (25). So market diversification is positive for both sides to have. Therefore a company must not depend on a few farmers (also for cases of crop failure).

For a company it is also good to have farmers who compete with each other, but for this a well-developed market is needed. In turn, that is a matter of market infrastructure, so that a market can function normally, i.e. transparency (farmers knowing each other), communication channels, basic infrastructure for the produce to be possible to be shipped, financial market for sufficient liquidity on both sides (11). Therefore a single intervention cannot solve the lack of a functioning market (ibid). However, as M. Sapp put it, "until they have all the capacity they need, uptake contracts specifically with the biofuel projects are a way to protect the farmers from price fluctuations and associated. This means that clear contract terms and adherence to them is a way to ensure that (18), in accordance to the hypothesis derived from the literature.

Price stability in combination with production stability and offtake stability are the most important factors to make biomass production attractive for farmers (24). But as prices for biofuels are volatile –due to the volatility in the energy markets- eventually, having constant and predictable production is a crucial factor (ibid). The optimization of production leads to stable yields. That is in accordance with Diligent's tactic for pricing. Many companies

use pre-agreed prices, as a way to provide farmers with income security. It can be agreed upon that the prices are based on the market prices of biofuel, (as is done by Mali Biocarburant with biodiesel price) (IIED, 2010). As this idea was regarded interesting by the researcher, many interviewees were asked to express their opinions about it. It is a way to provide more security to both parts, but in practice they are not so easy to apply. 19 favours the fixed payment on a per kilo basis, claiming that otherwise problems can easily arise.

On the other hand, as H. Verkuijl (26- the CEO of Mali Biocarburant) stated, the pre-agreed prices alone are not a solution. In his opinion what is important is to accept that farmers have their own farming system, for which they must be motivated to work on improving. For that it is necessary that they improve their entire production system and so work must be done both for the food crops as well as for jatropha (26). And if following from these improvements they can earn income from both sources, they will keep working with them (ibid). An alternative option from the point of view of a firm is to pay farmers with a fixed wage and also give them bonuses or additional benefits, in cases of high performance during harvesting (23). That is partly in accordance with a suggestion of IIED (2010) and 15 in favour of the use of "progressive pricing" to adjust producer prices according to a transparent formula.

If prices paid to farmers are above production costs (so that they are fair and favourable for farmers) and if the input costs for farmers change (especially the prices of conventional fertilisers that large plants will use change a lot), then it is not easy to find a price that will satisfy both parts; either the off-taker will take too much or the farmer will not get enough money (11). Moreover, if the market prices of crops simply go higher, again farmers will be tempted to sell elsewhere. Bearing these considerations in mind, according to many respondents, it may be more effective to promote a guaranteed minimum price, in order to offer a minimum income guarantee to farmers (e.g. 31). Paying farmers on a kilo base for the seeds they collect, is according to 23 difficult to apply from the beginning and technically less feasible as well. Where he has been involved, companies try to introduce it from the second or third year of full-scale operations –because then they are able to know approximately how much they can harvest per day[121] (23).

Finally, it is commonly accepted that with cooperatives it is much easier to negotiate a contract than with individual farmers (e.g. 25). And if the cooperatives hold shares, the farmers get income based on the value of their shares as well (25). Moreover, achieving a positive local impact, eventually makes the business more sustainable in the long term. For that reason Mali Biocarburant has chosen to work on a small-scale and aim for moderate ("reasonable") profit that is dispersed in the community (contrary to large companies who want to have a large profit and as quickly as possible) (26).

8.3.2.5 Trust

Another important success factor for grassroots involvement in business decisions is the building of trust within the partnership and the strengthening of capacity that is achieved for farmers. Hall and Matos (2009, p.127) mention "mistrust of industry and

[121] Next to that there is a risk that if and when -for example in Ghana- a certain national price for the jatropha seeds is decided, the farmers will no more accept anything different than that price. The effects of these are uncertain and an example of destructive effects for an industry comes from the cotton sector in India.

government policy by impoverished farmers hinders sustainable supply chain initiatives" as one of their findings. The research of IIED (2010) reports that securing a long-term relationship is an element of success for a real partnership and that this is found to be promoted by the investment in human resources from the part of the company. The democratic structures were –according to IIED, 2010- found to be very important in that respect, as the voice of smallholders can thus become "louder". Shepherd (2013) regards trust between the parties as essential for building sustainable long-term linkages. He argues that many linkage activities break down, due to disagreements because parties are remote from each other, they have a lack of understanding, no social capital is invested, and because it is easy for farmers to side-sell and divert the use of inputs.

Action strategies

According to IIED (2010), regarding contract farming, policies that support the smallholders and deal with relationships along the supply chain include: Access to information on technology and markets, contract support, regulation, monitoring, dispute resolution mechanisms. By regulating commercial investments, restricting land ownership and ensuring that adequate prices are charged for land, the smallholders are also supported. Therefore, certain pre-conditions that make it safe for them must be followed (ibid). Much elaboration on and many additions to the above arised from the discussions with the interviewees.

To have smallholders as loyal suppliers it is important to have a realistic business plan, that provisions for the support to smallholder farmers (24). Often business plans assume money from the first revenues to spend to smallholders, but when it turns out that the factory does not do so well, the first to cut back on are the outgrowers. That "creates disappointment to the farmers and is the seed of a negative relationship between the two parts" (24). As a consequence, "using 100% small-scale farming is challenging because producers are reliant on a number of things, such as fertilizer costs, land preparation equipment (a person who only owns one hectare obviously cannot buy a tractor), etc." (15). Therefore those activities must be coordinated at the right time so that they do not compromise the (crop) output (ibid). Some options for companies that have been used to deal with the side-selling from farmers include[122]:

- buying 100% of the harvest including the B and C grades,
- not contracting exclusively with one or few certain farmers for 100% of production (as in the Philippines)

In building trust and increasing the acceptance of information regarding certification, evidence from case-studies suggests that it is useful if a fair broker or external actor participates in the process (UNECA, 2012). When a high degree of trust exists between different parties, proper communication may be sufficient to foster effective negotiations. But when trust-building is at early stages, perhaps it is preferable to call for independent support of the process, as a guarantee that local interests are protected adequately (IIED, 2010). In any case, it is advisable to have long-term contracts between companies and farmers, also for the company to count on certain amounts of feedstock supply. But the

[122] These are presented as options to be considered, but cannot be "strong recommendations", therefore they are not contained in the conclusive figure.

contracts will not solve the problem of side-selling and supply availability by themselves. Shepherd (2013) also suggests that companies adopt a certain flexibility to how the treat the contractual commitments, because "there will always be unforeseen problems". Moreover, companies need to ensure:

- A reliable input supply
- Transparency in their activities, by maximizing communication (including reciprocal visits),
- Setting up transparent procedures regarding grading and pricing. A relevant option to set pricing is to relate them to the world oil price (also mentioned by 15).
- Make timely payments (also mentioned by 23)
- To set up arbitration procedures
- Presence of extension workers "on the ground" (for monitoring)
- To avoid placing unrealistic burdens on the farmers, by avoiding monocropping[123]. However, in doing so, some other measures are also suggested, which may be non-commercial (such as limiting jatropha cultivation to boundary fences only, that results in inadequate supply for a factory).

In the same respect –and adding to the ways in which trust can be built- it is important to have a transparent pricing system and to demonstrate that to the farmers, so that they know their produce is not bought at an unfavourable price (15). That can be done through certain formulas for price setting. For instance for commodities, the price can be linked to the commodity prices and then a certain element of pricing is added, so that at the end both parties are satisfied (ibid).

8.3.2.6 Capacity-building

The idea of introducing programmes for skills development and social improvement alongside the biofuel project to improve the education level and life skills of farmers is commonplace in the literature (e.g. . von Maltitz and Stafford, 2011, IIED, 2010). The research of IIED (2010) also found that models that emphasise on the elements of capacity-building, skills development and in general on long-term rewards (as the company Eco-MICAIA) eventually result in successful ventures.

It is more likely that collaborative strategies for sustainable resource management can achieve sustainable outcomes, however, they bring substantial transaction costs in the short and long term (Dubois, 2008). To reduce these, an option is that key stakeholders are selected based on their influence and importance in the communities and that representatives of stakeholder groups are involved (ibid). But even for companies it can be extremely costly and time-consuming to organize smallholders and even after the formation that does not come without problems. Some of these problems include divergent interests, asymmetric information exchange, and selection and approval of members (FAO-BEFSCI, 2012). Therefore, seeking ways to guide the organization of smallholders became of interest to this research with regards to business models. The following section follows from that.

Action strategies

[123] for instance, in Ethiopia a castor bean programme limits the cultivation of the crop by farmers to one third of the land Shepherd (2013).

Capacity-building efforts as well as extension services that need to be built up will probably need to be carried out with a medium to longer term duration to deliver maximum potential for success (UNECA, 2012). They can be taken up by a range of actors (NGOs, government, private sector) as a task, but because these interventions may not be at the direct benefit (at least not in the short term) of the feedstock buyers, it is most likely that either government agencies or NGOs would need to assist communities in getting organised (von Maltitz and Stafford, 2011). On the other hand, partnering companies to smallholders (individual or cooperatives) must be careful not to raise false expectations about the potential benefits and the management improvements. Instead, they should focus on transfering knowledge to the farmers that can empower them to achieve or increase their business's profitability and sustainability (Ser Huay Lee, 2011).

Moreover, in doing so, it has been proven useful to engage internal and external champions "to help navigate the formation and continued operation of the organization, and ensuring that key quality indicators are measured and addressed" (ibid). There is a long process that one has to go through, when involving smallholders, so the establishment should be done as **a phased process** (28). Then the supply risk is mitigated for, if a big investment is made such as the building of a refinery (ibid). That is also important when thinking about performance, because "for farmers to be able to deliver, training and assisting them with all the inputs cannot be done in a day nor or a year"[124] (20).

After that, what smallholders need most is to be organized into good negotiators with the factory, in order to reach a good long-term price agreement (24). Their negotiating power is expected to be increased, if they are organised. Farmer organization is regarded as a need, also in order to overcome the lack of capacities and corruption problems. To reach that outcome transparency must be ensured among actors both within and outside the organization (ibid). An additional benefit of farmers' organisation is that might enhance their access to credit, compared to if they remain segregated (FAO-BEFSCI, 2012). Therefore this was used as a hypothesis to guide a relevant discussion in some interviews with people who have been involved in business with smallholder farmers.

Having a contract farming arrangement, "where you have established cooperatives or commercial farmers working together with these small farmers" seems to work well in S. Africa (15). Certain services can be centralized and through a programme to provide inputs like tractors and land preparation equipment to farmers, and so that it is ensured that activities take place on time and take care of everything that can be a problem in rural areas. Then for all those farmers, contract-farming becomes a better way to go (15).

However, already through the desk research it was found that "Considering the requirements of the RSPO, it is clear that massive capacity-building efforts are necessary to enable the certification of smallholders" (FAO-BEFSCI, 2012, p.42) and therefore that training of sufficient scale and scope is needed and also follow-up activities to truly enable smallholders to change practices and gain knowledge[125] (ibid). This kind of activities very commonly came up during interviews as an absolute need for any scheme that involves

[124] The need to start an investment early is even greater with jatropha, as the first yield comes after four-five years (26).

[125] But even after these capacity-building activities, whether the certification for smallholders will be continued, will depend on the long-term costs and benefits that will be incurred to the privately-owned mills, as is reported from one case from FAO-BEFSCI (2012).

small farmers in general (and not only with regard to certification). The chances are that yields are improved when a company participates in agricultural outreach programmes, by providing what is needed to boost feedstock volumes, such as training and better seeds to the farmers, irrigation, if needed, as well as helping them to offset the cost of fertilisers (25).

Community representatives must have skills to negotiate effectively. An interesting suggestion that can improve the relationships of smallholders with companies is to gradually open up management posts to local people. If that is an explicit objective of the founding agreement and is applied well, it can produce "the skills and confidence needed to take the partnership forward into the business and "deep end" phases as it matures and grows" (IIED, 2010, p.103). That can be done by selecting some adults from the community, who will shortly take on some junior management posts. Therefore educational opportunities are created (IIED, 2010) and trust between the company and the community is also enhanced. Education for them to acquire the knowledge and skills of pricing is most important in that respect (24).

An interesting point of view that was not expressed from anyone else in such a way, is that of Diligent Tanzania, which focused on ensuring that "the technical capabilities are so good, that you can process so efficiently, that you are able to pay the highest price to the farmer. In the end it's all about the price" (34). Training and involving local people to the management by assigning them certain positions is considered as essential, but naturally requires time to bring results (IIED, 2010). Reportedly, as Diligent did in Tanzania and might work for Ghana, the company worked with NGOs that educate farmers and could also educate them for other crops and new possibilities. That is also positive, due to lower costs to companies to go out and gather the farmers for that (tiresome and time consuming job). So if all these activities can be combined, it is good (35). Moreover, in Tanzania the state employs a few thousand 'field officers' that go to the farmers to assist them. "If for example, there is a company that wants to start with cassava, the field officers could also inform about the new market for cassava" (35). That can additionally lower the costs for potential investors (ibid).

When the farmer and /or community bodies are not strong and organised, it is possible that the state, NGOs and development agencies can assist communities to develop organisations, which can represent them. In doing so, it must be emphasised that "if this process is imposed and not "owned" by communities, these organisational arrangements are bound to fail" (IIED, 2010, p.118). Therefore capacity-building and training activities are of outmost importance. NASFAM in Malawi and the UNFFE in Uganda provide support to farmers when they negotiate contract farming arrangements with buyers (ibid). An alternative is that companies and organisations work with existing local groupings towards a gradual development of associations and then cooperatives as IIED (2010) report for Eco-MICAIA in Mozambique. This approach is favoured by others too (30). Gold and Seuring (2010) also state the importance of interorganisational learning through collaboration that spans along the supply chain and that these can grow a sustained competitive advantage.

External support could take many forms, ranging from formal legal advice and assistance specifically for the needs of local communities (illustrated by the experiences of the Legal Assistance Centre in Namibia and the Legal Resources Centre in South Africa) to training on local land rights, as has happened in some cases in Mozambique (IIED, 2010). Similarly, the state could have a role in the support and negotiation with the agribusinesses.

An example of this is that the state can provide templates for contracts for communities and investors to use at least as a basis (ibid). A relevant option is the support of community workshops from the South African government during the contract negotiation, in order to translate and explain contract clauses to communities. Such activities not only provide support to the ongoing negotiations, but can also strengthen the negotiating capacities of local people for the future as well (ibid). In the same vein, the Social Fuel Stamp in Brazil has placed requirements for knowledge diffusion in Brasil (36, Hall and Matos, 2009) much as the sustainable supply chain literature suggests, although the above authors mention that oftentimes farmers do not follow the advice provided.

As capacity-building we can also regard the provision of inputs to farmers. Other contributions next to the required agricultural inputs such as the provision of weed control, pest control etc. are likely to make farmers more committed to selling their produce to the contractor (thereby reducing the risk of so called side-selling, i.e. selling to other parties than the contractor) (31). It is also important that there is an end point in the training process as a result of the training and capacity-building activities (30).

This section has been composed in order to provide an overall approach to understand and organize the institutional aspects of type B (partnership) models. However, some the same issues apply for type C projects as well –especially considering that those projects are usually set up by western NGOs and other non-local actors- and therefore some of the pillars of the adoption process may be relevant for type C projects as well. The key points of each pillar of the process are summarized in Figure 10 below.

Figure 8.1. The Adoption Process in partnership business models.

8.4 Type C- Small-scale biofuel production schemes

As indicated in chapter 3, these projects are mostly expected to lead to local consumption, as they will most likely not be able to compete at the export market (25). The form these schemes often take in SSA is that of a multi-functional platform for each village, with a mill –e.g. for the jatropha seeds- that is connected with an electricity generation plant. Households are connected to that unit to make local use of the bioenergy (35).

8.4.1 Action strategies (common for types C1 and C2)

What will make a project financially viable, is the market that can be found for the end-use and that depends on the volumes that are produced. It is generally accepted that small-scale production should aim at local uses and it is up to the larger company –if they are its suppliers- to provide additional market opportunities. Kenana in Sudan is an excellent example of the diversification of their agricultural production, that creates value locally, by seeing it as a responsibility to improve livelihoods of the smallholders (25). Therefore, the presence of a big company that can guarantee to buy what they produce, solves the problem (31). A more pro-active point of view is to see the opportunity in actually creating local markets, that of clean cooking being the ideal one at local level (25). In conclusion, the option for small-scale is between either to supply with contracts to a certain project or to supply the local market for other uses than transport (25).

Although challenging, it is possible to implement these schemes appropriately. When it comes to enhancing the technical and financial viability of small-scale projects, the most common answer was that education and training for farmers must be organized, so that they perform the right agricultural practices. Therefore, the section 'capacity-building' of this chapter is highly relevant. Training of people is required for that as well as assigning the responsibility for the running of the plant (18,35).

Small-scale farming is good as long as the quality is fine to use; a precondition for efficiency is that adequate quantities are produced. Small-scale production can be consumed in tractors or for clean cooking. However, in an isolated area, such a produce competes against the price of charcoal or parafin's market, price, so that being cost-competitive to these will make a project financially viable (25). Therefore, as has been explained on the section about contract-farming, a great challenge is to help local communities to create higher value products at local level and then get a higher price (30). Consequently,

a) either people must be assisted to firstly develop a higher value product and then the market channels must come in place to get the produce out at the export market, or
b) if the case is just about transporting goods to a market, then it comes to understanding what the market price is and "trying to be super transparent about the price in the market", so that farmers are assured they are getting the market price (30). With regards to that, mobile phones mobile money and options of that nature come into play (30, 27,28).

What is also important and has been repeated by many respondents (e.g.26,35,29) is that farmers producing at the subsistence level –as those small-scale in Ghana, who grow a mixture of food and cash crops (e.g. cocoa)- should never completely switch into biofuels, as this would render them very vulnerable. Small-scale models that seem to work with individual smallholders are those with very short loops, where biofuel crops like jatropha are combined with food crops and their oil is being used locally for electricity productions etc.

(16). Moreover, to address risks for small farmers an important good practice is the application of crop rotations[126]. Therefore at least three different crops should be cultivated by smallholders –preferably even more- so that a possible bad yield or problem with one will not be totally damaging (31).

On the organisational-institutional level it is suggested (as with type B1) that farmers are made shareholders to the company, in order to ensure smallholder's fair inclusion and participation, controlling a substantial share and having a voice in managing the biofuel projects. It follows that they receive dividends from the profits as well (von Maltitz and Stafford, 2011). Furthermore, a way to safeguard smallholders against the failure of the company (since in that case they would not have the expected benefits) is to provision for the return of the lands to their original users. In that way it would be avoided that the lands are in-perpetuity and indirectly transferred from the communities to the central state in that way (von Maltitz and Stafford, 2011).

Most of the literature on small-scale models focuses on the opportunities to enhance the livelihoods of micro-scale farmers (small-scale and subsistence level, owning a few hectares of land). It is reasonable to argue however, in favour of the development of a class of commercial farmers, by assisting them "to move from functional subsistence to farming for
profit on small- to medium-size commercial farms" (von Maltitz and Stafford, 2011, p.39). That upgrading and upscaling led to the successful development of the sugar industry in Kenya and Tanzania (and has been the norm in the developed world). There are two objectives in trying to upgrade the status of small farmers in that way (ibid):

c) Providing assistance to microscale farmers to improve their practices, while increasing the farming area, so that they achieve commercial levels and independence,
d) Dividing the large-scale plantations of corporate ownership into numerous plantations of smaller and localized private plantations.

The argument to promote that development concerns the efficiencies that relate to the scale and quality of the farming operations. While all constraints that have been mentioned for medium and small-scale farming businesses are relevant, it must be mentioned that "land size is a constraint to development of a more market-orientated commercial small-scale farming sector based on the production of biofuel crops" (ibid, p.40). As this is a wider policy development (an agricultural reform would be needed), it will not be elaborated upon here, but the sub-sections of ownership, risk and capacity-building of section 8.4 are relevant.

8.5 Cooperatives -Types B2 and C2

Cooperatives are generally believed to be a more feasible approach for small-scale farming. This section elaborates on the ways to form and manage cooperatives of farmers for the production of biofuels. The elements presented here apply on types B2 and C2 and must be viewed as complementary to those idenified in the sections about the broad types within which they mainly fit (B and C respectively).

[126] Different crops alternating each other

The importance of forming cooperatives –that was identified by a great number of literature sources- is recognised at least by those of the interview respondents with a business background (e.g. 19,23), even though they may regard smallholders as the weak links in a company's value chain. Therefore this approach was favoured by many, although not without scepticism. At Solidaridad the notion of producer organisations is used more generally, the creation of which benefits all parties involved, because in this way small farmers become effective (24). Apart from the above benefits, in general "smallholders definitely need to be organized as groups", in order to be successful (27). That hypothesis about the potential importance and benefits of forming associations led to a relevant discussion with many interviewees (e.g. 24,30).

8.5.1 Action strategies for cooperatives

When farmers are organized in cooperatives, both the cooperatives and the individual farmers need to have profit. The cooperative needs to add value for the individual farmers, not to be set up just for the sake of doing it (24,26,18). For example, the cooperatives may buy maize from the farmers to process into animal feed, which they subsequently sell on the market. Then there is clearly added value generated for the individual farmers, which is the key concern. If next to that, the farmers can be stimulated to integrate an energy crop into their production system and add value to that product as well, then it can be a meaningful business operation. But without a clear possibility for a standard profit, the cooperative will not work (26).

To overcome these difficulties FAO-BEFSCI (2012) suggest that capacity-building activities from various actors are needed (NGOs, government, private sector). Third parties, such as NGOs (even preferable in terms of corruption mitigation) or a government agency with a mandate to create a viable energy enterprise sector could participate and pay for the costs to establish associations (30), which is in accordance to literature findings about the role that NGOs can play on bioenergy development (FAO-BEFSCI,2012). However, usually governments do not fund NGOs for activities, but they see NGOs as independently supporting them (30).

Regarding the operation of cooperatives it is important that the equipment is managed by someone who knowledgeable, so that it is not destroyed (18). Otherwise, if responsibility is dispersed no individual claims to fix a problem (18,30). Therefore it is also best if one person owns it and looks after it, while the others hire it from him/her, when they need it (18). In order to mitigate corruption, some preconditions are:

- a clear and transparent structure (30)
- clear operating guidelines (ibid),
- regular meetings to report on developments in terms of pricing and sales and market channels (30)
- the idea of some kind of civic education was discussed with 24. That could make farmers better informed about the structures and responsibilities (so that become citizens). If that is not organized, the chances of corruption are increased (24).

The Brazilian example for preferential purchasing of biofuels from small rural-based producers by their governments is suggested as an example to be followed by some scholars

(e.g. Ser Huay Lee, 2011). Additionally, they suggest that government should also strengthen local infrastructure, in order to enhance their market accessibility (ibid).

8.6 Conclusions

The main contribution of the activities conducted for this chapter has been the identification of ways to form action strategies that address the relevant concerns and increase the viability of each type of business model. The following framework summarises the elements that have been gathered during the research. They result from a combination of desk research and a series of interviews with experts. The options presented within light blue colour boxes can be employed as parts of strategies by the private companies. The action strategies in the orange boxes concern options that are implementable by the public sector only, while those in the light green boxes, require the coordinated efforts of both the public and the private sector (biofuel producer companies or farmers'associations) or of the civil society (NGOs) to either organise or implement. Some limited overlap occurs when these summary schemes of types B1 and B2 are compared with that of the 'adoption process'; however, these schemes combined give the full picture of the elements of the required strategies, as well as which actors are supposed to implement them.

One of the certain learnings is that the investment in agriculture of any type needs to start some years in advance (or at least a significant time) of the requirement for feedstock production. That is not only for addressing the technical aspects of biomass production, but most importantly for engaging with the local socio-cultural environment and starting to build a fair relationship. Furthermore, to ensure a stable feedstock supply of any scheme, it is necessary that resource ownership is well-defined and that appropriate institutions be established.

Regarding large-scale concession schemes, four distinct sets of measures can be employed. First, measures can be implemented to ensure that nation-level benefits are realised. Second, the promotion of appropriate procedures, such as EIAs, information campaigns and inclusive processes from early on in the planning stage. Third, good governance for resource management is necessary even after implementation. Moreover, the state could ensure that companies have an exit strategy. Most of the same options arerelevant for type D models as well, although they are less interesting for the public sector to deal with.

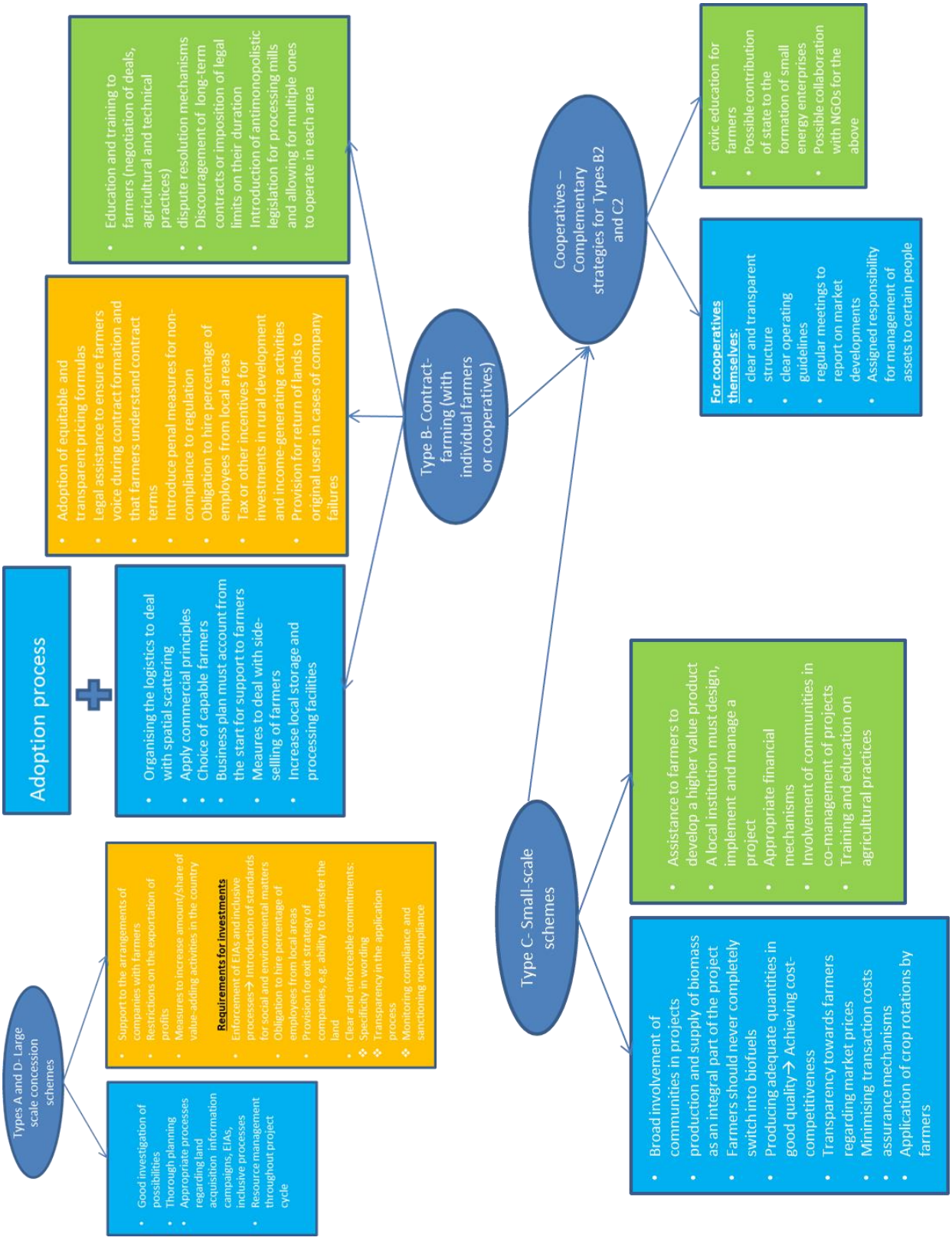

Figure 8.2. Summary of action strategies for each type of business models.

Partnerships of producer companies with individual smallholder farmers (type B1) or their associations (type B2) were presented separately. A presentation of the ways to address the common issues in partnership models was made, but also specific characteristics and issues about each of these subtypes have also been analysed. A proper regulation of

investments can substantially support smallholders in those cases. In order to address all aspects of partnership models, adetailed typology called ‘adoption process’ has been developed. A ll the elements that were found to be important from an institutional and organizational point of view have been concentrated within the six pillars of the process, namely ownership, voice risk management, reward, trust and capacity-building. This typology further builds on existing literature and is considered as a contribution of the research to the domain of business models for biofuels production.

Farmer’s associations may work very well under specific preconditions and mainly, where there is already some experience with them. However, forming new associations is a difficult and time-consuming process. In those cases partnerships for the development of inclusive business models becomes relevant and so do many elements of the “adoption process” as well depending on the situation. Those relevant elements should be followed in addition to the internal strategy that cooperatives must employ.

Finally, regarding type C projects, the major challenge is for financial viability in the long term and in that respect a number of points can be highlighted. These include the broad inclusion of the community in the project, producing adequate quantities of feedstock without completely switching into biofuel feedstock production, while at the same time production and supply of biomass is an integral part of projects. On the other hand, assistance from the public sector and the civil society is necessary for such projects to be set up and carried on.

9 Strategies for efficient supply chain management

9.1 Introduction

This chapters continues from the literature review on SCM, in order to identify possible components of strategies to maximize the efficiency across all five stages of the BSC. It contributes to answering the following research sub-question:

"In which ways can the identified business models be more efficiently managed and how should the respective challenges of each be addressed, according to experts?"

The findings from the literature and the interviews with experts are presented for each stage separately, following the same structure as in chapter 3. The chapter concludes by presenting all the identified strategies in a conceptual model that also distinguishes between actions undertaken by the private sector and those by the public sector.

9.2 Biomass Production System

Of all the cost factors within the BSC, feedstock production costs bears by far the largest proportion. Therefore, it was of central interest to the research to identify ways to make that stage more cost-efficient and the interviewees were specifically asked about relevant possibilities, so to improve the economic efficiency of the whole system.

Maximising efficiency

Increasing the yields is an important point of improvement for Africa in general (Gold and Seuring, 2010). Naturally, it is acknowledged by all respondents that a main way to reduce feedstock prices is to boost the yields. Gold and Seuring (2010) mention that in order to achieve that improvement of crop genetics and cultivation techniques must be pursued. While these factors are reasonable and commonplace in the literature, more details to achieve that outcome were sought for during the interviews. The ways to contribute to the improvement of yields have been identified and summarized as follows:

- The use of high yielding crops and specifically of good quality genetic material varieties, so that the cost per unit is lowered (28, 26, 20).
- The use of the newest technology available (25, 21).
- Proper tests must be conducted with various varieties in advance in at least a quarter of a hectare with each variety that is considered to be planted (19). This is a very important point particularly in the case of jatropha plantation all around Africa. As 16 noted, "only the seeds were given to farmers without looking at the agronomy first".
- The use of the best practices, meaning that good cultivation, soil preparation and quality control should be done in a scientific manner. That was emphasized by a number of people (20,28,18). Research should also be done on practices that have been successfully applied elsewhere in the world and try to find "intelligent and refined execution strategies" to make them applicable for the case (28). This way risks are reduced and it is more likely that production will not be interrupted (20).

- Relevant to the above is the use of ecological farming practices: In other words, working in harmony with nature ensures the long-term environmental sustainability, which also has an economic return (18). In that respect:
    - minimum tillage must be used and
    - using the correct and not too much fertilizer,
    - irrigation and drainage
    - production of compost to use the biological activity in the soil (ibid).
- The application of the appropriate inputs, such as fertilisers (25, 28), pesticides, etc. A problem in that respect is that all these industrial inputs have to be imported, as they are not produced in the African continent (21). To these we can add the compost produced from the plantation itself to be used as a fertilizer (127,22).
- At any scheme where smallholder farmers are involved, it is necessary for companies to have extension services to inform about the agronomic practices and specifically about each crop they use. Important to bear in mind is that smallholders will always have lower yields than large plantations, so just receiving the seeds is for them insufficient (16). Education and training activities for farmers is needed for farmers to learn to perform the right practices (32, 23, a.o.). This is one very common and certain conclusion from the interview process with experts. Therefore, it argued by all respondents who are in favour of partnership business models that farmers must necessarily be assisted with knowledge provision and capacity-building in general.
- Another obvious way to reduce feedstock production costs is "to avoid producing feedstock specifically for biofuels and look for what already exists in terms of wastes and residues from other industries" (27, 29). Many technologies have been developed to use waste oil and municipal solid waste etc.. This improves the overall cost-efficiency, but adds to the processing costs.
- From the above follows that feedstock costs can be reduced by looking at feedstock from already existing crops that do not need to be produced on purpose. "That will also reduce the environmental and social impacts" (27). For instance, small farmers can plant jatropha as hedges around their food field. There must be a focus on local circumstances to perform the most feasible options.
- having large monocrop plantations increases cost efficiency, by achieving economies of scale. However, "this is not a sustainable solution, so should not be pursued" (31). The view that monocrop plantations are unsustainable –at least for SSA- is in line with the arguments in favour of using multiple crops and products, which has been expressed by majority. Therefore it is not included as a recommendation.
- Performing seasonal activities properly: planting and harvesting at the right time (28)

However, while improving yields to increase cost efficiency is important, they ultimately have some maximum levels. That actually turns the interest more to achieving a

[127] Next to these as a rule of thumb to have a competitive biofuel price, N. Gagiano suggests that: a) no less than 2.500 dollars are spent per hectare to establish a plantation and b) that the crop variety used gives back two and a half times the expenses that are made per hectare (19).

predictable and constant yield[128] (23). Thus, after some point, the effort is not so much about increasing the yields, but about understanding and performing the yields (ibid). Discussion with interviewees raised some more detailed points regarding the requirements for farming activities to be as cost-efficient as possible, while environmentally sustainable. These seemed interesting to distinguish from the actions needed to boost yields, as stability of production and supply of biofuel feedstock is one of the challenges for companies.

- irrigation and drainage must also be included here, because they enable for better planning, apart from affecting the productivity(18). be absolutely non-negotiable, "because they ensure that you are going to have a crop and it allows to optimize yields" and also to plan better. A relevant consideration added by 18 is that half or more of the crop will need to be irrigated, also because by optimizing the yields, less land is needed for cultivation.
- knowledge on the crop is essential in order to have good yields and that needs to be addressed before a company starts. In that respect, perhaps a good tactic is to start small and then scale-up, so that learning of crops takes place along time and the most appropriate seeds are acquired (35, 22). In turn, "that is also why it is valuable to have good investors" (22).
- Following the training activities -in the cases of companies- also monitoring should be done from its part, so to ensure that production is going on appropriately. It is important that a company employing farmers takes responsibility for that (20)
- Doing agroforestry (integrating trees in production systems) eventually contributes to making the farming systems more sustainable, as evidence indicates (26).
- Proper use of land repair. For that the knowledge of an agronomist must be advised, in order to examine all options, as it make a difference whether it is new virgin land or agricultural land used for certain crops (19).
- the big quantities of fuel needed for the tractors must be possible to obtain them without interruptions (22).
- A geographically concentrated feedstock supply system should try to enhance the genetic diversity of its crops (including a range of varieties and multiple species, as mentioned before). It should also form contingency plans for supply problems, so that backup suppliers can be found in cases of crop failure or diseases (Richard et al., 2010).

Another relevant consideration is that much about the supply availability depends on the crop and therefore crops that can be harvested in one go are easier and cheaper to supply (31).

9.3 The Biomass logistics System

Specifically, risks to be addressed at this stage include a) the quality degradation of biomass, as well as b) the dry matter losses of the biomass stored (the latter being affected by the storage steps and the duration)(20). A problem is that biomass is often bulky and wet, and therefore difficult to convert into a more efficient fuel. Especially when looking at

[128] 'constant'=year after year, 'predictable'= understanding at the beginning of the season how much volume will be produced (23)

residue streams, “the key part is the collection and pretreatment of residues as early in the chain and as efficiently as possible” (32). However, when looking at the main products -as this research does- this is less of an issue (ibid). Storage costs heavily depend on the location and the storage types, but also on the volume and the duration (ibid). For a country it is best to export the finished product, so attention must be paid at the planning stage to organize it in such a way that facilitates the processing and exportation of the product as well as possible.

Maximising Efficiency

From a company’s point of view an optimization option is about maximizing the capacity of the truck cycle, by increasing the density of biomass (which in turn reduces environmental and social burdens, i.e. traffic congestions) (Gold and Seuring, 2010). That stage does not differ than for non-energy crops (26). The real question regarding that is if a company is able to add sufficient value to the product, so that it can pay for the logistics system (ibid). Reducing costs at this stage is possible, but considering that transportation of a product that has a value of 500-600 euros per tonne, is not a critical cost factor[129] (23).

Storage throughout the supply chain is based on the need to match the supply with the energy demand. Obviously, a short harvesting period and a scattered geospatial distribution of biomass production increase the need for storage, in order to enable for continuous feedstock supply for bio-energy plants and biorefineries (Gold and Seuring, 2010). The shorter the harvest period, the more storage units are needed for buffer capacity. When that is the case, perhaps storage terminals can be used to supply several plants, if the latter do not have adequate storage capacity for themselves (Gold and Seuring, 2010, and You et al., 2011). Moreover, for biomass that needs to be dried, warehouses of closed type may be positioned next to the plant to simultaneously dry the biomass with the use of exhaust heat electricity (Gold and Seuring, 2010).

If the biofuel company does not own (all) the plantations, it is obviously too difficult to collect the feedstock from each and every farm, so there must be a system of transport and also storage (20). In that respect, feedstock may have to be sold to a middleman, who will keep stock and supply it himself and he can later sell it to the plant. But the whole supply chain must be planned properly to ensure that the feedstock can flow to the biofuel plant (20).

As the transportation density of biomass is low, volume and weighting options for transportation must be considered, but road transportation is the most common way (and shipment when it comes to exports) (You et al., 2011). If rail and shipping can be used, then these must be the preferred modes, as they are cheaper to truck transportation, if applicable (18, 33). When large volumes of biofuel need to be transported per day, it is good to have these alternatives anyway (33). To these we can add efficient loading systems and all these factors altogether are crucial in reducing the capital and the operational expenditure of a company (18).

Moreover, in partnership business models, organizing the logistics for the farmers to be able to supply the produce is another idea to deal with that part of the process. Notably,

[129] That is more of a problem for other products like straw, that have a low value and low density. For biofuels, once the vegetable oil is produced (high density and price), the issue gets less important (23).

Diligent[130] was collecting all the feedstock with trucks itself (35). For crops with a single-pass harvest system wet storage systems are well able to reduce harvesting and drying operations and to minimize soil contamination and dry matter losses, altogether adding value to downstream processes as well (Richard et al., 2010).

9.4 The Biofuel Production System

i) Ethanol and biobutanol

A consideration relevant to the use of ethanol is that it is hydroscopic (if blended in high amounts early in the chain), which means that there is a "risk of mixing water along with it in the gasoline-ethanol mix" (32). "Ethanol is the most difficult fuel, if one wants to rely on the existing system. Butanol and 2nd generation biofuels however, are really drop-in fuels (100% compatible with the existing infrastructure)" (ibid).

ii) Biodiesel

It does not differ from conventional diesel as for its characteristics apart from the lower gas emissions it produces after combustion (19). According to 26, diesel differs from ethanol with regards to the conversion possibilities. Biodiesel can be produced at smaller quantities and with low investment levels, while ethanol plants are mainly based on large-scale operations. This makes it easier to perform tests for biodiesel than for ethanol production (ibid).

During biodiesel production 80% becomes biodiesel and 20% becomes glycerine. Glycerine is an international commodity. Can be used as a by-product of biodiesel production. One option is to use it in the cosmetics industry. It's also possible to use it as energy for the industry. So although it is a small percentage, using glycerine as a by-product adds value to the chain (33), therefore the glycerine market must also be addressed (if large enough volumes are produced). The technologies for all scales are available, so it can all be bought easily (20). Usually treatment is done by the big industrial players, but there are some few micro-distilleries in Latin America (by cooperatives probably) (16). Centralised processing is more promising, however (ibid).

For companies it is important to first determine whether it is also a distributor apart from producer (26). Then it also becomes a matter of infrastructure. If a drop-in fuel is produced, it can be blended unlimitedly locally or externally. On the other hand, if a country produces as an intermediate, the feedstock will be sold to a biofuel to a trader to make the biofuels in Europe or USA. In short, it is best for all developing countries to process the energy product domestically, so to reduce volumes (environmental benefit) and transport costs (economic benefit for exporter company), and generate added value in the country (29,35). Furthermore, "if as a country you export the hard product, you have a wider range of possible markets, (but lose part of the added value)"[131] (32). This dilemma raised an interesting point of discussion regarding a choice that can be made from a policy point of

[130] Diligent Tanzania is one of the most prominent and most documented examples of smallholder-based biofuel producing companies in SSA.

[131] For clarification, although the distribution of biofuels to markets fits in that section, it is already discussed under 'biofuel production', because at the time of production a company should know where the fuel will be sold (at least where the company will direct it itself).

view. The majority of the respondents agreed that adding value within the country should be made a priority for policy so that the finished products are exported[132]. The ways to do that will be discussed in the chapter about policy stimulation. However, as a relevant concern, it may be interesting to mention that there is an ongoing discussion in the European Commission to pose restrictions in the importation of biofuels as finished products in the EU[133] (32).

Maximising Efficiency

The achievement of economies of scale is important here as well. Cost reductions are possible following the learning curves, as production volumes grow (29). But it would be wrong from an economic point of view, if at the planning stage a project aimed for low output, due to expected low input, because this is not cost-efficient (19). Both for pre-processing and for conversion systems it is important that operations continue (as far as possible) all year long, in order to be able to amortise the high capital costs of the investments in infrastrucure (for the plant) (Richard et al., 2010), rather than to only run for a few months per year (or even a few weeks for biomass feedstocks with optimal harvesting periods). Concerns due to seasonality constraints and storage requirements can be addressed by the use of systems that are flexible to process a diversity of feedstocks all around the year (which however is a consideration for all stages of the BSC) (ibid).

As mentioned before, at this stage, through the crushing of the seeds and the refining process (from vegetable oils to usable energy), by-products can be obtained apart from the biofuel, which make a substantial contribution to the overall viability of the biofuel projects (Mulugetta, 2009, Awudu and Zhang, 2012)[134]. As a result, it is also important that links are made to additional markets for secondary or complementary products (IIED, 2010). Most of the interviewees emphasized on the need to include a plan for the utilization of by-products in the original business plans[135]. For example, in that respect, Cleanstar Mozambique has a programme to transition smallholders from subsistence to the production of a range of food and fuel feedstocks (28). This way there are multiple outputs, that can be produced for multiple markets and therefore capital costs are spread (costs of setting up the operation, setting up the different revenue streams) (ibid). This view has also been expressed and emphasised by a number of others, who are/were involved in successful businesses (Diligent, Fuelstock Madagascar, Mali Biocarburant). All in all, there is unanimity among respondents that by-products/co-products significantly increase possibilities and economic performance. Therefore it has been suggested that their utilization –even by small-scale production- is a necessity.

In climates with humid conditions the presence of insects implies that a good insect repellent treatment for the fuel is needed (22). Water contamination in biodiesel should be

[132] Only very few respondents expressed some opposition to that and mainly because of doubts about the overall benefit of such limitations in the national economy of a developing country.

[133] With the rationale that since the fuels will be consumed in the EU, some value should be generated in the European territory, if such restrictions are indeed forwarded, they may make exportation from developing countries to the EU difficult. That is useful to bear in mind, when deciding on an orientation between the development of a domestic or exports sector.

[134] it is important to bear in mind that the prices of the co-products depend on the markets that exist for them locally and is commensurate to the monetary value that the end-users attach to them (Mulugetta, 2009, p.1595).

[135] Market links are discussed in the chapter on business models.

monitored by the government. In Tanzania quality controls on normal diesel take place at the gas station, which may already be late (35), but perhaps that is the only applicable option. Fuel quality standards are needed and afterwards a number of policy issues can be discussed, such as norms and codes for the product, fiscal treatment, etc.. Therefore, the proper systems for metrology and quality control must be in place (36).

9.5 The Biofuel Distribution System

Naturally, as 32 put it, "the biofuels distribution system is locked in the fossil fuels system" and when designing the distribution system, the possibilities for the actual fuel use have to be considered. That stage merely poses a distribution optimization challenge, taking into account farm availability, warehousing and other distribution details, the options ultimately being determined by simple mathematical calculations (28). However, when fuel blending comes into play as an option, biofuel distribution may become more complicated.

Ethanol can be blended untreated with gasoline at a ratio up to 10% (after that the blending wall is hit, i.e. normal cars cannot run on it). Thus, unless the cars are adapted as in Brasil (with flex-fuel cars running on any ratio between 100% ethanol and 100% gasoline), it is better to follow the existing distribution system, despite its limitations (32).

It may be reasonable for public institutions to provide improved infrastructure, if the country is keen on producing ethanol (perhaps in petrol stations dedicated to that) (28). But in general that stage is considered as a responsibility of the private sector. If the sector of biofuels becomes a strategic priority, the public sector could facilitate these developments (2). If it is purely a private business, it is most efficient that companies have their own infrastructure and bearing in mind that distribution can use the existing channels of fuels or general consumer goods (ibid). When it comes to exportation, a good harbor is a precondition to export large volumes (9).

Maximising efficiency

The possible options with regards to the distribution of biofuels are summarized as follows:

1. If production is high enough to be directed to a refinery to be blended with oil by the importers and distributors, then the transportation cost as a biofuel is very low, so that is the most preferable option (15). The distributor in African countries normally is the state. Then the same network as with imported fuels can be used[136] (19). But if producers are spread all over the country, there is a logistical problem and that has to be considered at the planning stage (especially when infrastructure is not at a good level) (29).

   In South Africa the initial plan was to make the fossil fuel companies distribute the biodiesel after they did the blending, but later it was realized that it would be better for a biofuel company to blend the fuel themselves, instead of selling the pure biofuel. The difference is that by selling the pure biofuel a company needs to set up a new

[136] That is also the case in Ghana too, but considered as a possibility only if production volumes reach substantial levels (2). Then these volumes can be led to the Tema Oil Refinery (TOR) and distributed to the consumers across the country.

distribution system, while by selling it blended, it can sell the existing distribution network (20). In this latter case the biofuel company can possibly also determine the blending ratio and has the fuel companies as customers of the biofuel plant (37,38, 20).

2. If there are no pipelines, then the nearest depot must be tracked, where the so-called 'slash blending' is done. The fuels are transported by trucks to be blended (15).

3. Another option would be through a network of pipelines. These are regarded as the most efficient option for fuel distribution, but require large volumes and a stable demand before they are built[137]. Then a biofuel plant should be relatively close, so that it can use them. That would maximize the potential to sell to the potential buyers (15). That may be difficult, though, because often the good crop producing areas are far from cities, where a lot of fuel is being utilized (ibid). Of course, there must be enough production to warrant the cost of that pipeline (18), which are currently absent. If production grows, they may start thinking about constructing pipelines, but at the moment this option is considered far from reality for developing countries internally (32). However, it may apply for production to be directed to the harbor for export (ibid).

4. Adopting technologies such as modular generators and small expelling units makes biofuels production relevant also for local communities, as these can be used on a decentralized level and small scale (Gold and Seuring, 2010, p.39). Therefore it should be examined, if it is economically feasible for owners of small-scale schemes to acquire (buy) them/ be supplied with them. If oil is to be used for generators, distribution will take place on the village level[138] (16).

9.6 End uses and by-products

From a government perspective, the decision on the market orientation will be mostly guided by considerations of reduction of energy imports and the possible revenue generation from fuel exportation. Another important consideration relates to the existence of domestic oil resources (32). Taking those into account a strategy of exporting biofuels on a large-scale and using the earnings to purchase petroleum products to increase its energy security and access, may well make economic sense (even though it may seem irrational from an environmental sustainability point of view). Therefore for a country that does have own domestic resources, it is sensible to first use the domestic sources and export the biofuels, if they can provide a net revenue. For a country that does not, it is sensible to reduce energy dependence by consuming their own-produced biofuels, before exporting.

Moreover, a middle way is also possible. It seems reasonable to start with all the options open and as production volumes increase, the focus could possibly shift to become more balanced and stimulate the domestic market as well (14). In any case the ultimate

[137] Naturally, they cannot yet be considered in Ghana (2).

[138] For Ghana there is also an option for the blending of a cheaper product in normal diesel on small-scale in rural areas (i.e. possibility to sell a certain ratio of vegetable oil along with normal fuel at gas stations) (23). That opportunity arises due to the high final cost of fossil fuels, when it has to be distributed in remote areas.

policy objective should be clear and there should be determination to meet it, before getting to the specifics of formulating a whole policy strategy. 28 added a consideration on the volume guarantees that a market offers at a certain price. In that respect, whether the market is internal or external is less important, as long as the producers are assured that there will be offtake for their produce at favourable prices.

Maximising Efficiency and the Different Paths

In that stage there are no issues of efficiency to be discussed. It is believed that to create a market for biofuels in a SSA country, all possible uses of biofuels will have to be examined, because the transport biofuels market will be very limited (25). Therefore it is useful to give an overview of all possibilities.

9.6.1 Domestic Use

The biofuels produced may be used for the transport sector or for electricity generation. Regarding electrification, what is important is to understand the industrial system in a country and use the energy for the local industry (32, 33). The vegetable oil that is produced from the plants, can also be used for power generation, without any processing needed (23). Two options exist to produce biofuel for electricity production[139] (33):

a) If a country is not totally electrified, it is possible to generate electricity from the plant (e.g. from sugarcane), which is particularly useful for non-electrified villages to acquire energy access (23,29).

b) The other option is to lead the electricity (from sugarcane) to the national grid.

c) Ethanol can be used for cooking, which is also a much needed use of renewable energy.

Regarding the transport sector, biodiesel can be used to run cars or the fishing fleet or even to be used by the army and other state fleets (19,22,23,29). Along with the other uses, a The advantages and disadvantages of the development of a domestic market for biofuels are summarized in the table below.

9.6.2 Exports

Many of the interviewees argued that it is perhaps safer to start with an orientation for exports or at least without limitations for exports. That is considered feasible, due to the great demand for biofuels from many areas of the world and also realistic, because it would not take a great effort for the country to issue a detailed and costly policy package to promote consumption for its own sake. After all, "if the export market is very good, then there will be many incoming companies, and there will be more biofuels available for the domestic market as well" (35). Another option is to direct produce to the hydrogenated vegetable oil for the aviation sector (but quantities are currently insignificant compared to the demand of the aviation sector) (23).

The arguments in favour of an orientation towards exports to the international market stem from two reasons:

[139] Both options have the problem of higher cost (than other renewable energies) per KWh to feed into the grid (33).

a) Because the breakeven price energy companies in Europe can take (speaking for jatropha oil) is so much higher than the price that someone could get in SSA (23). Therefore the demand from the developed economies can drive the production in SSA countries.

b) Because it is impossible to gain financial support for jatropha (and other crops) at present, so the much needed equity will have to be found abroad and these investors will want to buy the product (23,22,19).

9.7 Conclusions

The analysis in this chapter considered the ways and efforts that can be undertaken to maximize efficiency in all stages of the biofuels supply chain (BSC). The stages of the BSC fall into the operational level of activities, which are under the private sector's responsibility[140]. However, some possibilities for the public sector to contribute to the private efforts of building up an efficient BSC have been identified on that level as well.

Given the low cost-competitiveness with fossil fuels, economic viability may take a great effort, but is necessary in order to make successful business cases for biofuels enterprises of any scale in the long term. The findings have been clustered as factors relevant to technology, management/planning and -where relevant- even capacity-building[141]. This categorization captures both the technical aspects and the managerial ones, which are related to either planning and managing business activities or managing human resources (capacity-building). The main findings are presented in the above scheme, also distinguishing between actors. The blue boxes concern actions needed to be taken by the private sector only. The orange boxes indicate that apart from the private sector there is a role for the public sector in these activities as well (for one or more of the points contained).

[140] As has been explained before, that is with the exception of the stage of biomass production, as regards the prioritisation and/or exclusion of some feedstock crops, in order to address concerns over food security and of the end-use of biofuels, where the state may also have a say while creating the policy environment.

[141] A certain overlap with the relevant sections of chapter 8 on BMs cannot be avoided in that sense, but that is only natural.

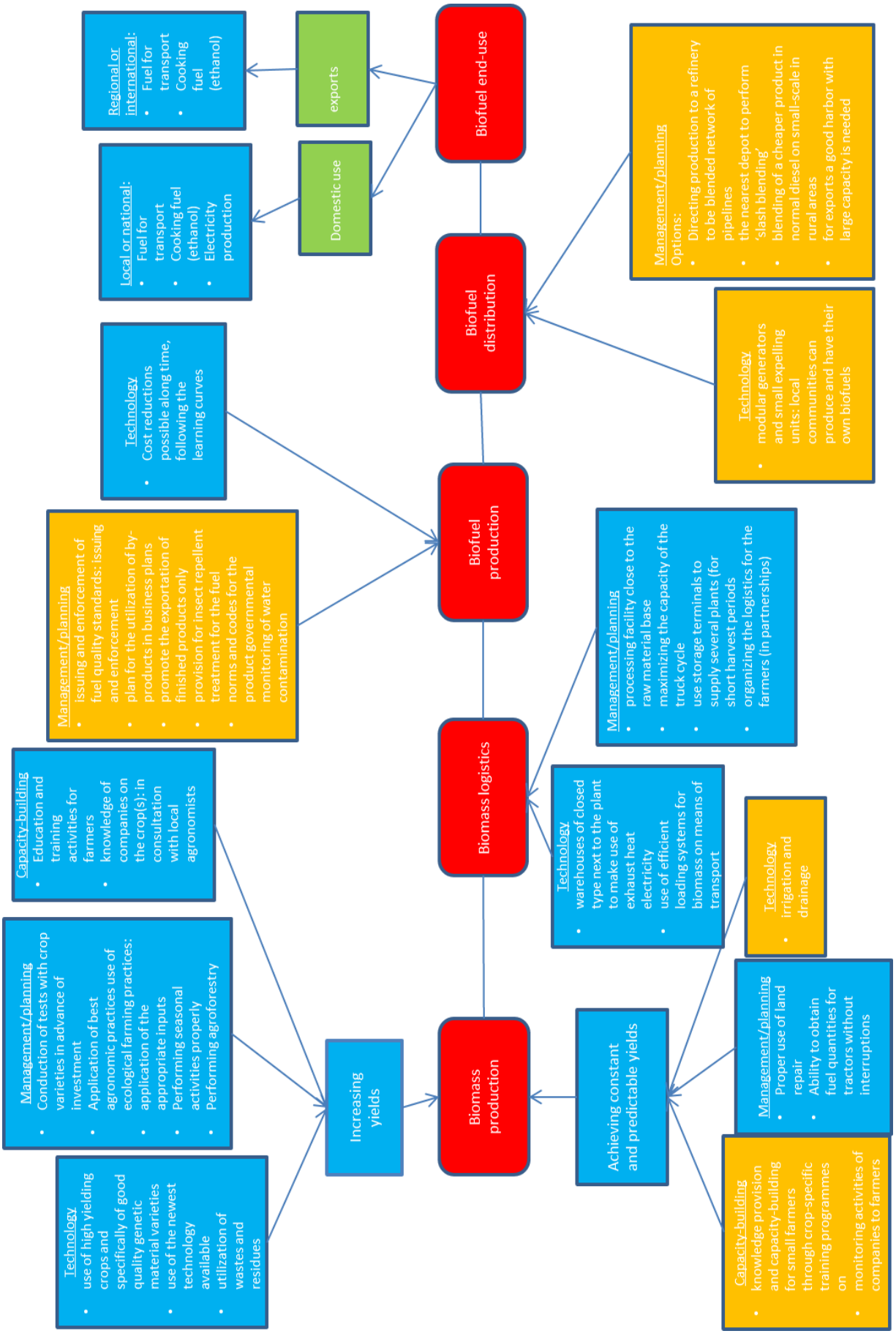

Figure 9.1. Summary of action strategies for the improvement of efficiency along the supply chain.

10. Assessment of possible stimulation options

10.1 Introduction

Following from the presentation of policy options to stimulate the deployment of biofuels in SSA that was made in chapter 4, an assessment of the appropriateness of all these options for SSA will be made in the present chapter. The same structure will be followed to answer the following research question that guided the research activities:

"*What are the opinions of the interviewed experts on the most appropriate ways to stimulate the production and consumption of biofuels in the context of sub-Saharan Africa?*"

The interest in this chapter is on the one hand to elaborate on the impacts of each of the presented policy options[142], and on the other hand to elaborate on their operationalization in the context of SSA, so that it is clear under what conditions and to what extent they are implementable and useful. Since the decisions of the policy makers will depend on the wider policy objectives and capabilities of countries, this research could only reach some broad conclusions on the applicability of measures. Therefore the usefulness of the analysis lies in the effort to outline the impacts and the details of the operationalization of each measure in as much detail as possible, in order to provide an informative guide to decision makers, whatever policy objectives they eventually adopt. It is reminded here that the impacts and contribution of each policy option to the overall performance of a strategy correlate with the rest of the implemented strategies and measures in most cases. That is a consideration that has also been addressed as far as is possible for an academic report of this kind, by indicating relevant experiences from different countries both through the literature and through the interviews with experts.

10.2 Stimulation of investment and production

10.2.1 Interventions for large-scale businesses

10.2.1.1 Production subsidies

Output-based incentives (such as feed-in tariffs) have been found to perform well also because they help the investors estimate the costs and benefits of a business and are secured that there will be production (15,16). A fixed premium can be given to producers per tonne of output. A margin between a floor and a roof price can be agreed upon for a predetermined time period. In this way the risks of renewable energy are mitigated through the market price premiums, offering much desired stability to producers (ibid).

According to the majority of respondents, however, for the SSA countries in general a large scheme of subsidies for biofuels is most likely not realistic. Even if they did, subsidies on biofuels could most likely be generated by a fuel levy imposed on petroleum fuels, so to remove the capital towards the clean technologies[143]. Perhaps some well-targeted subsidies, in order to contribute to the transaction costs that biofuel production entails (make

[142] In section xxx of Appendix xx aggregate tables are provided that summarise impacts that have been identified for policy options in both the relevant chapters.
[143] By charging the fossil fuels with an additional tax that will be used for the levy (15).

demonstrations, bring training, information about the benefits) would be realistic even within limited budgets (18,19). However, if some kind of a direct subsidy is determined, it should have limited extent and given only if the potential market is attractive enough. Subsidies should be designed to decline up to the point when the production efficiencies of biofuels are higher than petroleum. Ultimately, they should be alleviated completely (also the indirect ones), therefore a time plan to transition to commercial activity must be in place. Overall, a subsidies scheme must be well-targeted with a very clear and predetermined beginning and end, which must be clearly communicated to recipients (18, 19). Moreover, attention must be paid for misuse of subsidies not to occur and they must be organised in a way that is administratively possible to manage (for example, subsidies for all small farmers in a region/country would be impossible to manage) (11,18).

10.2.1.2 A compensation regime for biofuel companies

The usefulness of such a fund lies in that a part of the risk that some companies take, by investing in an infant sector and in a country with some negative record already, could be covered. That contributes to a friendly investment climate and can be practically useful, particularly at the early stages of an investment, when costs and risks are high (as analysed in previous chapters). This works a cushion and a guarantee for company shareholders against a possible failure, during the first stages of an investment (30). Some basic requirements for it to function well can be highlighted:

- The success of such a fund would depend on the capacity of a government to manage such a scheme. Good management and a good regulatory framework are needed, otherwise it will collapse. 'Good management' refers to a good financial and regulatory framework, that is clear and precise.
- If it is dedicated, then it can be transparent, i.e. everyone must have the same chances to enter and processes must be fair and transparent (17,18).
- The market must be ready and the sufficient capacity to develop the project must be in place (21).
- A fund has to be placed in a bank, so that a government can make a financial allocation in the form of a dedicated credit line for biofuels production and to place it for example, in the national development bank. From there producers can access this specific source of credit (38).
- With regards to the transparency required for the operation of such a fund it was emphasized that politicians should not be involved in changing rules, after these are set; "everyone must stick to them religiously" (17).

Another drawback is that it is difficult to make the scheme fair and to keep track of how a company uses the money (18, 42). In conclusion, it is possible to set up such a fund/scheme, if the above preconditions can be operationalized. It must be acknowledged, however, that the funds placed in such a scheme will always carry a risk (18,21).

10.2.1.3 Debt coverage

It is possible for a government to set up a fund, upon which money can be drawn in the event of default, such as a debt a coverage or a dedicated fund, which would make the investment environment more secure for banks to participate(17). Debt coverage can

alleviate part of the risk by guaranteeing to the banks that they will get their money back. People from the banking sector find this particularly useful an option for two reasons:

1) the guarantees can ensure that even after some first loss, the projects will still be fundable (18, 37) and that financing will remain affordable and
2) will not be disrupted by changes in policies (37).

A few different options have been identified regarding the creation of a system for debt coverage:

- Debt structuring in the form of subordinated debt can give more certainty to the banks, also because the order of when the money is paid back can be mutually agreed.
- Development grants and other development sources like assistance development funds
- A government fund made by taxes, that will be used for guarantees.

Overall, the majority of respondents was positive about the idea of the public sector providing debt coverage to banks, in order to ease the access of companies to capital. In any case, a very good choice of recipients must be made. There must also be some monitoring of the economic performance of companies. The guaranteed part can be funded to a bank. A few respondents were sceptical about the implementation of the idea and two believe that it will most likely not make a difference. Due to the limitations of a system of guarantees, 36 is in favour of building an investment fund, instead. On the contrary, in the words of 37, “the state can cover the exposure in the market, but not create a vehicle for commercial fund”.

10.2.1.4 Mediating between banks and investors/coopratives

Another point that was identified already through the desk research and was confirmed by the interviews with respondents from the banking sector is that banks simply do not have knowledge on the sector and no experts to consult, when they receive an investment proposal (e.g. 38). From the viewpoint of banks, the main concern in financing a project is security and biofuels is commonly perceived as a risky industry. Therefore, the government standing up and seriously promoting the sector will already have an effect on how the banks treat biofuels (25). That is backed by the arguments of many interviewees that a policy framework and some strong measures, like mandatory blending, would already give a strong signal to the banks that there is a future for the sector and that business becomes less risky. A national development bank is privileged in playing such a mediatory role. The development bank of Ethiopia (a government-owned development bank) is a good example of the influence that can be exerted upon lending policies. The government there has direct ability to influence how blending and financing is done**.**

Indeed, an organized effort to bring the two completely different groups together is regarded as useful by some people (e.g. 25,42), who believe that banks need to be shown the real –not the perceived- challenges, the opportunities, technologies and feedstocks etc.. Overall, the following ways of mediation between financial institution and companies/ cooperatives were identified:

- Creating the incentives for the private sector financial institutions.

- Leveraging the government's agenda through the 'development banks' that are present in the country (37, 39, 42, 23, 30).
- Capacity-building interventions both for government officials and banks, financed and structured by a government, to create linkages.
- Mediation with public sector's involvement could take the form of having consultation meetings with the government to discuss regulatory options that can help the whole sector. In so doing, first, platforms create to encourage more private companies to enter the field/country (12, 18, 30).
- For small farmers a subsidization of credit on the basis of the contracts that the smallholder farmers get for delivery of feedstocks to the mill (17). That can be some kind of a discounting scheme, as the farmers deliver their produce.
- Subsidizing the infrastructure for small farmers, "for example, to provide the farmers irrigation on the basis of offtakes" (17).

Whatever the form of the mediation and whether for equity or for debt is, "the aim will be about reducing the risks" (28). Following, capacity-building can help attract more capital to the business, as the Eur. Commission does (and there is a lot of donor funding for technical assistance that local commercial or private sector finance institutions can avail themselves to concerning renewable energy). Other interviewees, however, believe that these efforts would have no result, as it is hard to find ways for a government to force commercial banks to lend for biofuel projects. Also, since commercial banks are believed not to have the knowledge for that, financing would be up to development banks and microfinance institutions. Notably, those seeing these initiatives more positively have provided examples and also been involved in relevant activities.

10.2.1.5 Tax incentives

Rebates and fiscal incentives are considered by many people as the only feasible way to subsidise the production of biofuels. A carbon tax, not being considered as the best option for economic reasons in developing countries, the interviewees with relevant knowledge unanimously suggested their introduction as the first important moves of a bioenergy policy. The main arguments were that these have no direct economic cost for anyone; only the public sector bears the cost of the revenue forgone from the taxation of the biofuel companies. Moreover, there is also the argument that the percentage forgone as petroleum tax or tax exemption of a producer will turn to an investment that benefits the country (so a businessman actually makes these payments instead of a tax) (19).

Another stimulus that was mentioned is for biodiesel producers would come up if it is possible to sell the biooil at the same price at which normal diesel is landed on the shore (including the tax on diesel). If regulations allow bio-oil to be blended with normal diesel and that this oil is not taxed, that indirect subsidy already improves competitiveness (19).

10.2.2 Interventions for small-scale production

10.2.2.1 Grants

A grant gives the means to smallholders to build an income and then an obligation to pay the loan and also the incentive to continue producing. They have definitely been successful in many countries (grants) and the whole micro-financing industry has come up

because of that need of smallholders for finance (28). The main requirements to be effectively implemented are:

- Need to be matched with education and training.
- Probably better to make them part of a broader programme.
- All farmers should have a bank account. At the moment they deliver the harvest, they get the money in their account. That guarantees to both sides that they will not lose.
- Contracts are also crucial to guarantee that farmers will not run away at the first difficulty. So fair conditions must be set.
- Zero interest grants is good instrument often made available by the AECF (Africa Enterprise Challenge Fund) for businesses in the agro-industry. It has been used to help biofuels in new countries and environments. It gives them the means to improve their income and ways to pay the loans back.
- Grants should only be given to large producers; not small ones
- People must also be motivated to keep working and acquire a sense of shared ownership of the projects.

On the positive side, they can serve to immediately attract people to start working with biofuel crops; however, they have a history of not being effective (18).

10.2.2.2 Loans

Loans would be exceptionally useful, due to the aforementioned liquidity problems in SSA countries. The requirements which were identified as important for the successful implementation of lending schemes programmes for biofuels are:

- Loans must be low enough to be paid back (18, 30)
- Dangerous structures are those where farmers can borrow a lot and the business is undermined (24, 30).
- Must be accompanied by training (ibid).
- Use of progressive loans, whereby people prove that they used the first portion for what they applied it for and then they get the next part of the loan and so goes on (24).
- Contracts are also crucial to guarantee that farmers will not run away at the first difficulty. So fair conditions must be set (18,24).
- Only under conditions when the viability of a project within three to five years is certain, should small-scale producers be given loans. This can be done best through existing credit institutions (micro finance) (30).

However, a different point of view suggests that even under difficult credit conditions, credit will be possible if the biofuel is sold at a price that generates good revenue for the organization and that organization can carry on. So that is another reason for government support to be provided (15).

10.2.2.3 Microfinance

A last point of discussion with some interviewees was the possibility of small farmers to access microfinance institutions, since all other options for borrowing money are from difficult to non-applicable to them. This discussion was done with very few interviewees,

who have had some relevant experience. Getting into more detail with regards to microfinancing would not be feasible and is already at the limits of the scope of this research. However, as it was regarded a possibility for farmers, a basic investigation about its possibilities was made. With regards to energy and microfinance, the following options can be distinguished (30):

- An energy enterprise can be linked to the local microfinance institution and they form a partnership to offer a full package of the energy product as well as the energy product or
- in some cases the energy enterprise itself offers finance for the products they are selling, so they do the financing in house.
- In some cases there is a third party, which connects the energy side with the financing side in a way that facilitates the delivery of loans.
- Another sort of emerging technology (not relevant to liquid biofuels)[144] is 'pay as you go' systems, which allow people to use the transformation in financing of mobile money and doing banking through your cell phone. This is now being used either for energy purchase systems or for purchasing energy services (30).

Some general requirements for microfinancing are: 1) good project selection, and 2) good monitoring. The right people are needed to do the evaluation: engineers, economists, but not bankers. Bankers are good with (comparing) numbers, but usually not good in questioning about the primary data behind the economics. "As a financial institution you need a local expert for that evaluation. Here distinction must be made between the raw material plant and the biofuel plant; For agriculture you can always find experts, but for biofuels, perhaps external advisors have to be hired from other countries" (39).

Respondents from the banking sector tend to believe that microfinance is a viable approach, indeed. To be feasible, it needs to be part of a bigger plan that includes microfinancing as part of it (42). Also, there are kinds of global loans or micro-financing, which means that big financial institutions provide the money to a local financial institution, which guarantees for these funds, and they see the local plans and they can evaluate projects. The EIB also follows that approach (39).

However, while microfinancing is playing a good role in taking people out of poverty over the last years, the micro-nature of it is in itself limitative to achieving national-wide results. Another issue is related to the capital intensiveness of renewable energy technologies that require significant amounts of capital to become a reality (39). Another consideration is that feedstocks used for biofuels take much longer time to grow than ordinary crops, so it is even more difficult. In the current form of micro-financing institutions (MFIs) and given that their credit is expensive, it is doubtful that microfinance will be applicable[145] (41).

10.2.2.4 Enhancing market access for smallholders

A problem that has been identified from the early literature review was that smallholder farmers have difficulties in accessing markets (analysed in chapter on BMs).

[144] It could be relevant for the producers, however, also because they may sell by-products themselves.
[145] For example, because currently, only large farmers and the cacao farmers are seen as credit-worthy in Ghana (41).

Apart from the business-oriented approach to include the smallholders in the supply chain in various ways, respondents were also asked their opinion on a possible role that the state could have, in order to facilitate that market access. The answers much coincided to what was found in the literature before, stressing the success of the relevant programmes that Brazil has implemented for that purpose in the past[146].

10.3 Stimulation of consumption

10.3.1.1 Biofuel consumption targets

Consumption targets in general were unanimously regarded as having high potential to contribute to the deployment of liquid biofuels. Their effect being very straightforward, only a few comments can be added to what has been explained about them before. Consumption targets strengthen the value of legislation, by providing a strong policy message and can increase the effectiveness in mobilizing private investment in any other policy instruments that are chosen. On the other hand, for targets to be realistic a good assessment of the potential must have been done before. This is difficult in many cases –as the experience of the EU shows- and even more when the market and produce is totally absent (16, 18).

10.3.1.2 Blending policy

A blending mandate is regarded by the majority of respondents as the first major measure that can stimulate the creation of a domestic market. It is expected that if the demand for the fuel remains constant in the long term despite the price increase, then the blend can be a possible outlet for biofuels (meaning that people's access to energy is not lowered). The following requirements have been identified during the interview process for a blending policy to be successful:

- Blending should be mandatory for the oil companies; not optional (21).
- Oil companies must use biofuels or pay a penalty . The height of the penalty is more or less the difference between the fossil fuel and biodiesel price. So, the fossil fuel price + penalty gives the biodiesel price (actually a little bit lower than the penalty).
- If demand for the fuel remains constant in the long term despite the price increase, then the blend is a possible outlet for biofuels. (meaning people's access to energy is not lowered).
- If demand is lowered, then GHG emissions will be reduced, but energy access may have been undermined (energy mix and alternatives are important considerations in that respect)
- blending volumes targeted should be realistic so better start with low targets. Stiff penalty to companies that do not follow the mandate
- A realistic target, must be based on the current availability of feedstock in the market; attention is needed not to hit a blending wall.

[146] Other measures such as of the 'command-and-control' type ("fines and fences") rarely work in practice, because they are difficult to enforce and are not cost-effective. Considering the context of Ghana, these difficulties would apply too, thus such measures are not advisable (31).

If blending becomes mandatory, the next question is how high it should be. If it is very low (3%), no problems are likely to arise. With a higher mandate it must be first investigated how this could affect the lowest income groups, due to the higher fuel prices. Following, policy-makers should investigate if a subsidy is needed to these lowest income groups. However, such a scheme is difficult to implement without wasting a lot of money for people, who can actually afford higher fuel prices (11). Next to that an additional disadvantage that is worth attention is that if domestic production is not adequate to meet the target, then imports will be needed that harm the balance of trade (32).

Contrary to the views of the majority of people, who argued in favour of a low blending target, 36 argued that it is best to have a maximum blending target, which can mainly be achieved through own production of a country. If it cannot be achieved, imports can be used to fill the gap. This approach would clearly be driven by a decision to establish a domestic market and industry in the long term and not by short term economic benefits for the country. Next to that, fears for market distortions may be raised (15,32)

The mandate cannot only secure producers within the country, but also the importers from the neighbouring countries, who can supply steadily. The mandate can be supported by an import tax and perhaps also an export tax, that can make a protected market (like the EU has done) (32). However, it is noteworthy that two prominent biofuel business owners/developers were against mandates for the reason that they may create market distortions (such as those of fuel price increases in a volatile fuel market) and that – as the example of the EU shows[147]- they are not necessarily effective (19,23).

10.3.1.3 Restrictive measures

Price regulation

Naturally, price regulation would only be meaningful for a (growing) domestic sector. It is possibly a measure complementary to a blending mandate (according to some respondents e.g. 16). Many interviewees argued that there must be at least a reference price at which ethanol or biodiesel can be sold to the market at least at one level (for instance, at the producer level or the wholesale level). The biofuel price must be based on the price of the conventional fuel with attention not to lead to a price distortion. Specifically, it should be calculated on the basis of a 15% investment return that is guaranteed (18).

However, price regulation does not come without challenges. Price regulation of fossil fuels in Brazil brought complications. In India it only worked for a very short time (producers asked for an increase after six months) and generally it is not known to have worked anywhere (25). Thus, the first move would be to lower the subsidies on fossil fuels and let the biofuels find their own prices (ibid).

If the focus is on the domestic market, then businessmen like the idea of regulated prices, because they can be based on that for their planning. With a focus on exports, price regulation is pointless. However, if the export market poses difficulties at some point, price regulation could be a useful instrument in the effort to try to absorb the production internally, so to support the industry (14). What is undesirable is the creation of two fully separate markets, because that would work against efficiency improvements (32, 38).

[147] Even in the EU only 40% of the biofuels consumed are produced domestically (23).

For the effective implementation of a price regulation system the following requirements must be met:

- If it happens, it is necessary that the pricing formula is negotiated between the producers and the government (15,17).
- It should not function in the direction of creating two fully separate markets (32,38).
- The basis of the price regulation can be an internal margin over certain thresholds. To make it, the big cost drivers must be known and a margin of return should be secured for the industry (11).
- The monitoring and enforcement should be done by an energy regulatory body (15).

Bans /quotas and tariffs on imports

The reasons why such restrictions on imports are not favourable by many people are similar to those why restrictions on exports are also not viewed as useful. Most importantly, restrictions on imports are not beneficial to build an internal market. There must be openness to imports, so that the internal market benefits from the international competition (11, 14,15, 21). Morever, export limitations can often end up being counter-productive (such as in Argentina) (35).

Bans /quotas on exports (or other restrictions, e.g. tariffs)

They are a way of market intervention for the purpose of managing domestic prices (and of keeping quantities within the country). At high urban spending levels and under liberal trade conditions, domestic production may be undermined by the possibility for cheap imports.Therefore protective measures may be needed to support the imports. Restrictive measures are favoured by some, due to the need to protect an infant industry with high risks, but are also highly opposed by others. Also, the choice on these measures depends on the needs of a specific country, the feedstock availability and relates to whether the price of biofuels is regulated, to ensure that local producers do not suffer (10). Therefore they were mainly opposed and these options were not discussed in great detail.

Notably, even those recognizing some usefulness of restrictions , such as tariffs, emphasise that the duration of those measures should be limited. These restrictions should be lifted as soon as the market is ready to function autonomously. At the same time the imposition of a ban also requires pricing mechanisms and market forces that make it attractive for the biofuel producers to sell locally. In conclusion, the majority of respondents regards restrictive measures undesirable. Many times the arguments were supported by the experiences of other countries, where unintended consequences occurred as a result.

10.4 Conclusions

The possible measures that were presented earlier in this report have been assessed in this chapter for their appropriateness as options for the stimulation of the investment and production of biofuels on the one hand and of the consumption on the other. Regarding the first, debt coverage seems to be a favourable approach to provide some financial stability to the investors, who want to participate in the production of biofuels. Production subsidies are considered difficult for SSA countries to provide, but tax incentives can have a very positive effect, while not posing an economic burden on government budgets. Therefore they are considered the most feasible and realistic option, that should be pursued by any country

with ambitions for the development of a biofuels industry. The other measures can be considered too, but their impacts are more ambiguous.

If the development of a domestic market is deemed possible, biofuel consumption targets are a costless option for the stimulation of consumption that provides assurance to producers that there will be (growing) demand in the future. Mandatory blending is considered as an essential policy measure in that respect, the extent of which can be determined by the production potential of the country, or it can also be complemented with imported volumes. Price regulation is a measure that could provide stability in the market of liquid fuels, but it should be very carefully used, if adopted. Other restrictive measures, such as bans and quotas proved highly controversial. While, a number of interviewees acknowledged a potentially positive contribution of these to the development of a domestic market for biofuels, it is also acknowledged that they come with risks and negative perceptions. On table 10.1 below the most favourable options are summarized for large-scale and for medium-/-small scale schemes respectively.

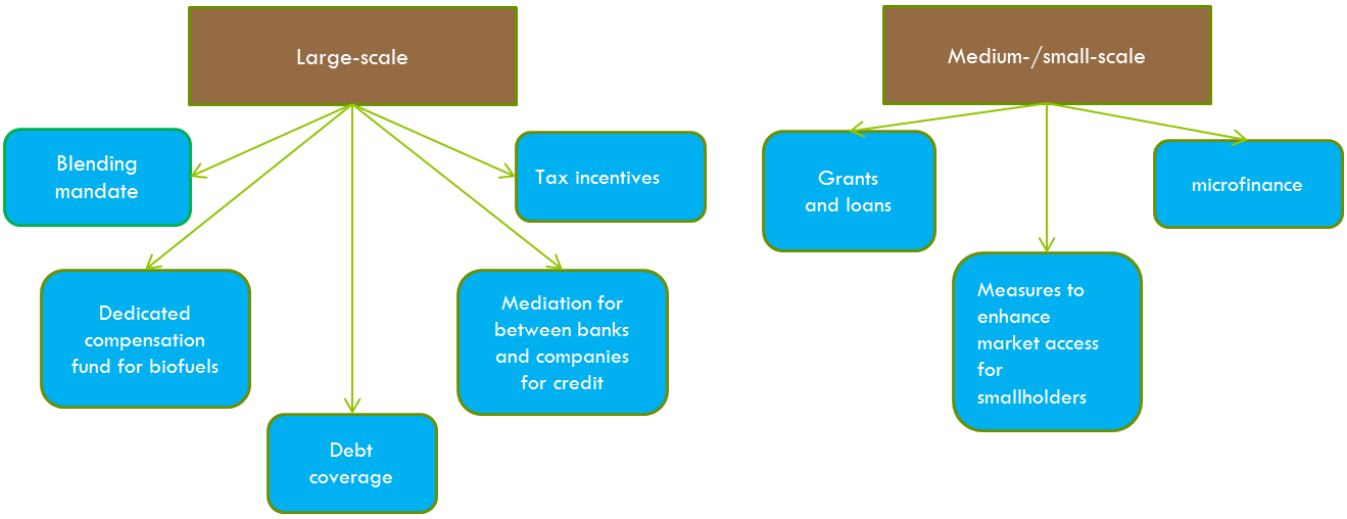

Figure 10.1: Favourable stimulation options for biofuel production schemes in SSA.

11.Conclusions

The Ghana Energy Commission was interested in studying the business models for biofuels and the options to stimulate production and consumption, since the country was in the process of policy making for biofuels. Desk research and interviews with experts on the business and policy sector of biofuels were conducted to study the relevant aspects. The general conclusions that are widely applicable to the SSA context are presented here, while some specific recommendations for Ghana will follow in chapter 12.

In the process of answering the main research question a number of stages had to be completed. First, a typology including the business models that are applicable in the context SSA was created. It distinguished between four main types and sub-types that include farmers' associations, which have been added in the typology by the researcher.The analysis of business models was separated into a part solely dealing with the business models and one about supply chain management. A synthesis of the identified success factors and governance strategies has been made through which they have been clustered into three levels, namely strategic, organisational and operational.

The interviews with experts that followed the extensive literature review had a major contribution to the results of the research; on the one hand by refining and more accurately formulating arrangements led by the private sector and on the other hand by assessing and elaborating on the previously identified policy options that can be emloyed by the public sector. The applicability of the strategies that the private sector can employ is considered very wide, while that of the policy options may differ depending on countries' specificities and predominantly on the economic conditions/budget. The state has a major role in the strategic level of development (early stage); on the one hand in order to set objectives and to create a positive and stable enabling environment and on the other hand in order to ensure that production of biofuels will not be at the expense of the well-being of local populations. In fact, carefully made decisions should result in increasing national and/or local welfare levels. These choices are highly sensitive to the policy objectives that have been adopted and must be examined one by one.

A favourable investment environment is important in order to support the development of the sector. This may consist of measures such as bioenergy targets, standards and investment protection measures, while tax incentives for large- and medium-scale businesses can form an attractive enabling environment. Such measures are effective and the most likely to be adopted by SSA countries with tight public budgets. In the last stage of policy-making a number of options can be examined to steer the production already taking place in the country. In order to address the challenges of the business models and to contribute to increasing their efficiency, dinstinct sets of actions have been outlined for each type. These may also include actions by the public sector alone or even by the civil society, or involve some interplay between the private and public sector. Experts largely prefer indirect support measures as opposed to the provision of direct financial support (subsidies, loans, etc.). The 'adoption process' for partnership models (type B) addresses the whole range of their challenges through actions and measures structured in six pillars. The analysis on the Biofuel Supply Chain focused on the efforts and possibilities to maximize efficiency in all its stages. Done well, these efforts can increase the relevant cost-competitiveness to

fossil fuels, while eliminating all sorts of operational risks that may threaten the viablitity of a company or project.

Finally, as a conclusive answer to the research question of this thesis, it can be said that three out of the four main types of business models presented have the potential to contribute to a significant increase in the deployment of biofuels in the energy mix of SSA countries; the large-scale production for own use –type D- by definition has no significant contribution. The large-scale business models –types A and B- are those that can have a significant contribution at the national level, by producing either for export markets (at least in the beginning) or for domestic consumption. Partnership models will always be challenging, but the formation of cooperatives can contribute to overcoming many challenges. Small-scale models may be successful, when developed with care. Based on realistic assumptions, their benefits are likely to be very localised, while nevertheless important for local communities. Large-scale models are also easier for the public sector to promote and support. Their development might therefore be the priority of any policy of SSA country, always accompanied by a set of appropriate measures. Such measures are certainly necessary components of governance strategies. Even in countries with a very limited budget for renewable energy, some measures must be implemented, at the very least aiming to demonstrate a commitment to the development of the biofuels sector. Positive measures[148] are generally favoured in that respect. The most feasible measures for all countries are tax-related incentives and consumption targets for biofuels, with a blending mandate at the core of the strategy (if possible to produce adequate volumes for domestic consumption). As further actions, a country might choose to provide some limited economic support, which should be well-focused and within a clearly limited time span. In theory there is also a possibility to intervene in the financial market to ease the lending conditions to biofuels entrepreneurs. But the undertaking of such initiatives largely relies on the willingness and commitment of the public sector, in order to change a situation that is most often perceived as being outside its realm.

[148] As opposed to restrictive measures, which are in that sense the negative ones.

12. Recommendations

From the analysis that was conducted about the presence of barriers and success factors for biofuels development in Ghana the following factors turned out to be most important for the country to address:

- The existence of funding sources
- The degree of cost-competitiveness to fossil fuels
- The existence of an internal market for biofuels
- The status of the taxation regime
- The creation of a conducive regulatory/policy framework (as an overarching goal that links to all the measures forwarded, even some that are not included here).

Some solutions applicable for Ghana are briefly introduced here. Ghana does not score well on the possibilities to access finance for investments in biofuels and this will not be easy to change. To address this issue the state authorities could provide loan guarantees to banks, which lend money for investments in biofuels and even mediate between them (in an organized, holistic manner), in order to ensure that finance is provided to project developers on favourable terms. Microfinance could be a relevant option to promote small-scale production schemes.

To increase the relative cost-competitiveness to fossil fuels, the provision of as many tax incentives as possible to biofuel producer companies is regarded as the safest and cheapest stimulation option. Therefore a set of tax incentives can be recommended without reservations, as they contribute essentially, as well as politically, by demonstrating the commitment of the state to the support of the sector of biofuels. Some experience with instability of the taxation regime in Ghana points out the need to provide a set of incentives as part of a medium- to long-term plan, in order to ensure investors of the existence of a stable enabling environment.

The adoption of certain strategies to deploy biofuels and the particularities of their implementation must be determined after relating them to the overall possibilities and policy objectives. At the initial stages of policy development the declared policy objectives for the deployment of biofuels in Ghana were the increase of energy security and access, as well as climate change mitigation. In order to create a domestic market for biofuels, a number of options can be assessed in conjunction to one another and related to the overall objectives. Bioenergy targets and bioenergy standards are two important options to drive the development domestically. Mandatory blending is the most common suggestion in that respect. However, it must be emphasised that these should not be ends in themselves. If no proper care is taken in that process and if the assumptions for the deployment potential are unrealistic, the policy measures could have distortionary effects and the policy may fail. Therefore, if the development of a domestic market is not deemed feasible at the industry's infant stage, an orientation towards export markets can be chosen. That comes without risks for the public sector, but in that case, direct support to the industry is less relevant (tax incentives still make economic sense, however).

Last but not least, as the interviewees from Ghana have highlighted in complete accordance with the international literature, the existence of an overall conducive

regulatory/policy framework is of highest importance. Some suggestions about this can be expressed with certainty (since they also arise from both of the above sources). First, in the course of formulating a specific policy on liquid biofuels, conscious choices must be made on the strategic level. Therefore it is important that a thorough assessment of technical and market possibilities is made in advance of policy developments and not vice versa. At this stage strategic decisions must be made concerning the promotion or rejection of certain feedstock options for biofuels, so that the unsafe options are removed. Land suitability assessments are very important in that respect. Moreover, and since relevant concerns exist in Ghana, land zoning would substantially contribute to making investments in agriculture safer (by assigning certain land areas in sensitive regions to certain crops, while dismissing other areas for a free development of the agri-business sector). That would also be a strong communication tool, signifying that food security concerns are addressed. The possibilities for the development of plantations must be examined in conjunction with the aforementioned assessments, something that can also contribute to a safer development of private businesses.

Specific legal requirements must be set for investments, so that the social and environmental impacts are accounted for. Investors should be required to conduct EIAs and monitoring of project effects during the whole project cycle should be organised. Setting official requirements for companies (medium- and large-scale) to contribute to the agricultural performance of farmers is an interesting option for partnership business models.

Some recommendations can be made about the promotion of certain types of business models, which relate to the available feedstock options. The crops with good chances of success in the country are the following and are associated with types of business models that were determined feasible for them:

- Starch crops, such as cassava- Possible at any scale, under any model
- Sugar cane- Types A and B1
- Palm oil- Preferably B1 with nucleus plantation model
- Sunflower- B1 with many outgrowers, but C1 and C2 couls also be possible, if yields are good and stable enough in Ghana.

Following from these recommendations and from the analysis of the institutional and economic background of the country, it becomes clearer that large-scale business models –A and B1 are far more attractive from the viewpoint of the public sector and are more likely to be successfully implemented. It is also more meaningful for the state authorities to promote them, considering the magnitude of benefits they can produce. Moreover, bearing in mind that there is currently no domestic market in Ghana and that only large-scale models can –currently- produce large enough volumes for exports, it is also reasonable to focus on them. However, a number of measures could be targeted at the support of small-scale production of biofuels. Production on that scale can produce multiple benefits, which are desirable for Ghana and other SSA countries, and thus should not be disregarded. Although support to that level of production –especially financial- is regarded risky, certain options exist, often with the contribution of other institutions. It is therefore advisable that these options are examined as well, in order to attempt to facilitate small-scale production of biofuels, where conditions make it possible.

13.Discussion

The number and variety of stages of the research give ample opportunity for reflection on the research strategy that was employed and on the outcomes. First of all, the methodology was appropriate to meet the research objective. All stages and activities of the research have had a substantial contribution to answering the research question. The research cannot give specific definitive answers about strategies for each and every country or even for Ghana, since the kind of decisions to which this research contributes depend on wider policy objectives and the willingness to implement sets of governance strategies. It gives some definitive answers, however, on ways to address the effects of the business models and the expected impacts of certain policy options once they are applied (although the latter must always be assessed in conjunction with the general policy environment in detail). The research also resulted in some clear and strong advice on strategies that the private sector can employ to increase the chances of success of biofuels projects.

The literature reviews on each theme were comprehensive and for the most part an effort was made to present a range of views from the literature regarding the themes under study. However, that effort was less relevant to the theme of supply chain management, due to its technical/practical nature (although even for that some brief references to alternative typologies and structures were made). The same effort was made throughout the process of interviews, both by interviewing experts with a very representative diversity of backgrounds, and by confronting their input with that of the results gathered until then (both from the literature and from the input of other, previously interviewed experts). This research thus encompassed a strong triangulation of sources.

For example, the factors identified during the literature review proved to be important ones for Ghana as well. Although the input from the interviewees with experience in Ghana added a lot of details to the picture and contributed to a clarification of the current situation, they have not added much to the theory that resulted from the extensive general literature review. This is because the most important factors had at that stage already been identified. That is mainly a positive outcome, since it indicates that saturation of data has been accomplished. The same effectiveness of the research activities applies to the business models as well as to the stimulation options.

An exception, however, may be the section on microfinance, which was only touched upon and not examined in detail. The choice to include it in the analysis is motivated by the possibility it gives to provide an alternative source of finance in areas with severe constraints. Nevertheless, the analysis conducted for this thesis is not sufficient to illustrate all its possibilities and effects, interesting as it may be. Therefore -and considering the heavy workload that the research activities entailed on the whole- it might be said that including that section might have been a step too far.

It may also be noticed that the analysis of business models is unequal in length (for instance, very long analysis of type B and very short of type D). The reasons for these have been motivated and it is hard to imagine it conducted in any different way. It must be acknowledged, however, that it may take an extra effort to follow the exact structure of those parts of the report as a result.

In accordance with the research objective, the research contributes to the existing knowledge with some innovative elements. First, there is innovativeness in closely

examining the success factors of business models in relation to applied policy options. Second, the sub-types that include farmers' associations, which have been added by the researcher in an existing typology, constitute a contribution to the existing theory. Third, the 'adoption process' for partnership models (type B) was developed that addresses the whole range of challenges through actions and measures structured in six pillars. That is an important relevant contribution of this research for a holistic approach to the types of biofuels businesses that are most challenging, while growing in importance in SSA.

Since the industry of biofuels is new to SSA, there are a lot of areas where further research can provide new insights. The business models for biofuels have been subject to a lot of research in general, but the same does not apply to small-scale local-level projects run by either individual farmers or their cooperatives. This is an area where more in-depth research could be useful; even more so in conjunction with the possibilities to provide stimuli and support to the farmers to take the initiative and start up (or simply to accept to participate in) such schemes. Microfinance is a relevant interesting possibility in that respect, which has already received a high academic as well as practical interest in the developing world. Microfinance specifically for biofuels could be an interesting topic to address, since it is widely acknowledged that small-scale production models -either for renewable energy or for food production- must and will have a growing role in the future.

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Appendix A- List of interviewees

Ghana interviews

Name	Organisation/position	Specialisation
1) **Mr Kwabena Out-Danquah**	Director of Ghana Energy Commission	
2) **Wisdom Togobo**	Ministry of Energy, Ghana	
3) **Francis Kemausuor**	KNUST research institute	Bioenergy research and …
4) **Issah Sulemana**	CEO, Tragrimacs Ltd	
5) **Dorothy Adjei**	Ghana Energy Commission	Programme officer, Renewable Energy-focus on bioenergy
6) **Julius Nkansah-Nyarko**	Ghana Energy Commission	Senior programme officer
7) **Michael Eshun**	Scanfarms, former Scanfuels	
8) **Christian Marfo**	CEO, KIMMINIC	
9) **Steinar Kolnes**	CEO, former New Solar Harvest Ltd.	
Federico Grati[149] (double interview)		

Policy-oriented respondents

Name	Organisation/position	Specialisation
10) **Lusubilo Chakaniza (Mrs)**	Malawi Ethanol Company (ETHCO), Malawi	
11) **Tjasa Bole-Rentel (Mrs)**	Presently: Independent consultant in South Africa. Formerly: Energy research centre of the Netherlands	Specialized on policies
12) **Estomih Sawe**	TATEDO, Tanzania. –(a Centre for Sustainable Modern Energy Initiatives in Tanzania). Executive Director since 1997	
13) **Joseph Kalowekamo**	Malawi, Ministry of Energy	
14) **Mahama Kappiah**	Executive director (head) of ECREEE	
15) **Sibusiso Ngubane**	CEF, South Africa	Experience on the policy sector
16) **Rainer Jansen**	COMPETE, Germany	Work on policies, smallholder schemes, sustainability certification,

[149] Assigned a number in the section, where his expertise relates more to.

		Has a good overview of everything
17) **Andrew Makenete**	President Southern African Bioenergy Association	

Large-scale business perspective

Name	Organisation/position	Specialisation
18) Rademan Janse van Rensburg	Grown Energy Zambese	
19) Nicolaas Jacobus Gagiano	Niqel Lda, Managing Director	
20) Adam Mostert	Involved in big biodiesel projects in S.Africa	
21) Fannie Brink	Involved in a big biodiesel project in S.Africa	
22) Peter Hanratty	Biofuel company from Jatropha in Madagascar	
23) Federico Grati	Manager of many biofuel projects, also in Ghana in the past (SmartOil)	

Smalll-scale business/ NGO perspective

Name	Organisation/position	Specialisation
24) Sven Sielhorst	Solidaridad	Dealing with smallholders in developing countries
25) Meghan Sapp	PANGEA - Partners for Euro-African Green Energy	Director
26) Hugo Verkuijl	Mali Biocarburant S.A., CEO	
27) Sebastien Haye	Roundtable on Sustainable Biomaterials, consultant	
28) Micael da Costa	Cleanstar Mozambique	Business management-focus on small-scale
29) Winfried Rijssenbeek	FACT Foundation, the Netherlands, director	
30) Ellen Morris	Energy and Environment Faculty School of International and Public Affairs Columbia University,USA Also: Embark Energy	
31) Amarens Felperlaan	Consultant, CREM Energy, the Netherlands	Has worked with smallholders in Africa, specialized on certification

Researchers-academics-consultants

Name	Organisation/position	Specialisation
32) Martin Junginger	Utrecht University	technological development and cost reductions of (renewable) energy supply

		and energy demand technologies. Has worked on biomass plants in developing countries
33) João Fernando Chidamoio	Biofuel expert of PFI in Mozambique. Used to work at the Minister of Energy. Knows the situation in Moz very well	
34) Charles Jumbe	Academic- Centre for agricultural research & development, University of Malawi	Economist. researcher and author of some articles on biofuels policies
35) Janske van Eijck	Utrecht University	Researcher. Experienced on small-scale business (was manager of Diligent, Tanzania).
36) Federico Dimas de Paiva	Projetos, Brasil	Business and research background. Basically expert with experience on applied policies and businesson

Financial aspects

Name	Organisation/position	Specialisation
37) Karin Ireton	Standard Bank, SA	Sustainability manager
38) Paul Bosch	Rabobank, NL	Specialised on renewable energy. Knows the bioenergy sector well.
39) Oliver Henniges	European Investment Bank	Knows the bioenergy sector well.
40) Gloria Visconti	Interamerican Development Bank	
41) Ishmael Edjekumhene	KITE, Ghana	Various activities with this organization in renewable energy, Recommended by Umar Lawal (AFDB)
42) Leandro Azevedo	African Development Bank, Project finance department	

Appendix B- 1st series of interviews- Ghana respondents[150]

Questions to officials, experts and businessmen from Ghana

Introduction on the interview

Purpose

The purpose of this interview is to get a better understanding of the performance of the sector of biofuels in Ghana and of how the needs for improvements. There is an interest in both the overall performance in the country, but also in that of individual companies. This series of interviews is part of my master thesis research project. The aim of the research is to make recommendations to the Ghana Energy Commission –which employs the research- about the development of a sustainable policy on biofuels. It is being conducted in collaboration with the consultancy firm *Partners for Innovation* in Amsterdam, the Netherlands, where I am doing an internship.

Recording and confidentiality in reporting

Before starting with the questions, I would like to clarify that requests for confidentiality will be absolutely respected. If you consider that some questions/answers are delicate and that you would prefer that your name is in no way associated with the respective information, please indicate that. I will make sure to take proper care of such concerns. I intend to record the interview for my personal use for the scope of taking detailed notes, unless you would not like to be recorded. The records will only be used by me personally and will be kept in my archive until the end of the master thesis project.

Moreover, I aim to send the transcriptions to each one of my interviewees. This enables both the interviewer and the interviewee to check whether there was correct understanding during the discussion. If I receive no comments back on the transcription after a reasonable amount of time, I will regard that you had no comments on it. If you do think that something was not correctly understood, please contact me about it, specifically stating your comments.

A. Questions for officials/experts

i) Introductory questions

-Please explain what your position is, your expertise and involvement in the sector of biofuels.

-What are the latest developments in the policy on biofuels in Ghana after the Draft Bioenergy Policy of 2011?

ii) Relationships with and performance of the private sector

[150] Both Ghanaians and not Ghanaians (two were Europeans).

-How are the public sector's relationships with biofuels companies managed? Are they organized in a particular manner?

- How is the formal process of setting up the business? Do you think that biofuels investors face certain problems during that stage (e.g. encountering a long application process, lack of transparency or other problems)? Can you name some weak and strong points?

- Do private companies have any problems/difficulties dealing with the public sector after they are established? If yes, at which stages of the production process do they occur and with which agencies/services?

iii) Public sector's capacities

-Do you think that the state agencies have the necessary capacities to foster a large development of the sector of biofuels? More specifically, do they have adequate staff and the expertise to examine investment proposals in sufficient detail (e.g. accounting for environmental impacts, impacts on local communities and certain risks)?

-Are economic resources adequate?

-As above, do they have the necessary capacities to enforce and monitor certain requirements towards investors? Do you think that the involvement of NGOs can have beneficial results in this respect, as to complement this work?

-How would you characterize the level of coordination between different public organizations (ministries, agencies such as the GEC and others), as related to the sector biofuels? Can coordination be improved?

iv) Production capacities and economic performance

-Do you think that there is an adequate number of people with the necessary knowledge to underpin a significant development (technical knowledge, business management knowledge, understanding of environmental and social impacts of biofuels etc.)?

-More specifically, do you know if there is an adequate number of trained people that can be the staff in the biofuels plants and business?

-Generally, would you say that there are certain risks for the biofuel enterprises in Ghana that need to be mitigated (like the instability of markets and feedstock prices, uncertainties in capital costs and transaction costs)?

- What is the status of the infrastructure necessary for biofuels (processing, logistics, transportation, distribution and storage)? Can the public sector contribute to the improvement of these?

-Do you think that the acknowledged risks of food security and land acquisition processes pose risks to biofuels enterprises as well?

-How professional are the companies? Why have many closed down?

-Based on your experience and perception, can you point out at some factors that hinder a better economic performance of biofuels companies?

-Any other limitations/barriers to the overall increase of production capacities that you may be aware of? For example,

- Lack of access to financial institutions
- Non-formalised land tenure
- Difficulties with infrastructure and especially transportation (also distribution?)
- Social concerns.

v) Investment environment and stimulation

-What is your overall impression about the dynamics of the biofuels sector in Ghana? Do you think it is viable?

-Do you feel that the investment climate in Ghana is friendly for biofuels enterprises? Can you support your answer by relevant feedback from entrepreneurs/ examples of companies?

-Do you think that there are specific laws/regulations that may obstruct a company to work as well as possible? If yes, can you point out at the effects?

-Can you point out at some inefficiencies that companies face? What about the following factors?

- lack of access to credit
- investment risks
- uncertainty of regulations
- status of the taxation regime
- insufficient debt service and coverage
- uncertainty of fuel supply availability within Ghana
- low cost-competitiveness to fossil fuels
- lack of information from the part of investors and managers

-Do you think that the public sector should get more involved in facilitating the establishment of biofuels enterprises?

-If yes, why - what should this involvement address (perhaps addressing some inefficiencies that were mentioned)? And how can governmental involvement resolve relevant difficulties in your opinion?

-What kind of interventions do you believe that could contribute to businesses being run better after they start their operations?

vi) Biofuels Consumption in Ghana

-What are the current patterns of biofuels consumption in Ghana? Is it possible that they are substantially increased, and if yes, how?

-What do you think about the prospect of the development of an internal market for biofuels in Ghana? Is it realistic and feasible in the medium and in the long term?

- Specifically, are there certain barriers and/or inefficiencies that must be overcome to achieve that? What is missing to establish the market for biofuels in your opinion?

-Which factors would you name as bottlenecks during that process (so bottlenecks for biofuels consumption)?

- Adequate quantity of produce
- Fuel quality
- Lack of competitiveness of biofuels to fossil fuels
- Preference of producers to export the biofuels, because it is more profitable

-What kind of measures do you think can contribute to meeting the targets set by the government?

vii) Final comments

-Overall, are there other relevant aspects you would like to emphasise on as important to maintain as they are or important to be adjusted/changed?

-Would you like to make any other comments?

Request

I would like to ask you if you know other people from the biofuels business in Ghana that can also answer my questions and offer their useful opinions about biofuels in in the country.

Interested in receiving the final report?

Finally, I would like to know, if you are interested in receiving my final thesis report that will officially be submitted to Utrecht University. I will send it to every person interested when it is finished.

A. Questions to businessmen/experts in Ghana

A. About the company

i) Company's profile[151]

[151] The questions of this first section were thought to be interesting in the beginning to identify the entrepreneurial characteristics of biofuels enterprises in Ghana. They mainly had the role of giving a character of a 'helicopter' interview to assist the researcher identify some important aspects of

-Please give a description of your company:

- size of the company
- crops used
- fuel(s) produced and fuel quality
- volume of final product treated and/or exported
- are by-products produced?
- market of consumption

- What is the company's ownership and production scheme? Please describe in some detail (own plantations or possibly a partnership with other companies or smallholders, scale of operations, central/decentralized production).

-If applicable, is there any cooperation with local communities at the sites of production? If so, in what ways are people from local communities involved in the company's activities? (level of involvement in production process, participation in decision-making, capacity-building through e.g. training programmes, etc.)

-Does the company have any specific Corporate Social Responsibility activities or even a strategy? If yes, please name.

-If applicable, does the company provision for benefit-sharing, value-sharing, risk-sharing with local communities? If yes, please briefly describe how the activities are organised.

ii) Economic performance

- How is the economic performance of the company? Is it stable in general? If not very stable, why?

- Are there some factors that (may) hinder a better economic performance of the company?

-Are there stages of production where particular inefficiencies or risks are faced, from harvesting until shipping the biofuel to be exported? E.g. refining, logistics.

B. <u>About the perception of the biofuels sector in Ghana overall</u>

i) Institutional aspects

-How are the relationships with state agencies?

- How was the formal process of setting up the business (e.g. did you encounter a long, bureaucratic application process, lack of transparency or other problems)? Can you name some weak and strong points?

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business models and their perception by the businessmen. However, although useful for an overall impression, their relevance to the research was low and they were abandoned (particularly the last four of them).

- Do private companies have any problems/difficulties dealing with the public sector after they are established? If yes, at which stages of the production process do they occur and with which agencies/services?

ii) Production capacities and risks

-What do you think about the human capacities and the technological capacities in Ghana (that determine the overall technological capability)? Is there an adequate number of trained people that can be the staff in the biofuels plants and businesses?

-And is the relevant technology possible to acquire or not (due to high cost or other reasons)?

- What about the status of the infrastructure necessary for biofuels (processing, logistics, transportation, distribution and storage)?

-Any other limitations relevant to production?

-More generally, would you say that there are certain risks for the biofuel enterprises in Ghana that need to be mitigated (like the instability of markets and feedstock prices, uncertainties in capital costs and transaction costs)?

- What is the status of the infrastructure necessary for biofuels (processing, logistics, transportation, distribution and storage)? Can the public sector contribute to the improvement of these?

-Do you think that the acknowledged risks of food security and land acquisition processes pose risks to biofuels enterprises as well?

-Based on your experience and perception, can you point out at some factors that hinder a better economic performance of biofuels companies? For example,

- Lack of access to financial institutions
- Non-formalised land tenure
- Difficulties with infrastructure and especially transportation (also distribution?)
- Social concerns.

iii) Investment environment and stimulation

-What is your overall impression about the dynamics of the biofuels sector in Ghana? Do you think it is viable?

-Do you feel that the investment climate in Ghana is friendly for biofuels enterprises?

-Can you point out at some inefficiencies that companies face? What about the following factors?

- lack of access to credit
- investment risks
- uncertainty of regulations
- status of the taxation regime

- insufficient debt service and coverage
- uncertainty of fuel supply availability within Ghana
- low cost-competitiveness to fossil fuels
- lack of information from the part of investors and managers

-Do you think that there are specific laws/regulations that may obstruct an enterprise to work as well as possible?

-If yes, then also based on that answer, what do you think could be improved for your business?

-Do you think that the government should be more involved in facilitating the establishment of biofuels enterprises? If yes, why - what should this involvement address? And how can governmental involvement solve them in your opinion?

-Do you think that the public sector should get more involved in facilitating the establishment of biofuels enterprises?

- What kind of interventions do you believe that could contribute to businesses being run better?

iv) Biofuels Consumption in Ghana

-What is the current status of consumption of biofuels in Ghana?

-What do you think about the prospect of the development of an internal market for biofuels in Ghana? Is it realistic and feasible in the medium term?

- Specifically, do you think there are certain barriers and/or inefficiencies that must be overcome to achieve that? For example, the absence of an internal market, cost-competitiveness to fossil fuels

-Which factors would you name as bottlenecks during that process (so bottlenecks for biofuels consumption)?

- Adequate quantity of produce
- Fuel quality
- Lack of competitiveness of biofuels with fossil fuels
- Preference of producers to export the biofuels, because it is more profitable

v) Final comments

-Overall, are there other relevant aspects you would like to emphasise on as important to maintain as they are or important to be adjusted/changed?

-Would you like to make any other comments?

Appendix C- Questions of 2nd series of interviews

During these interviews, in-depth discussions were made with experts from various fields. The following are the questions most commonly discussed. Respondents were free to add their own points during the interviews, which often took the form of a discussion. Particularly on the financial aspects, some more questions were added, which differed per interview.

Questions

-Please, briefly explain your experience and involvement in the sector of biofuels.

A. Business models

-In adopting a certain business model, which are the primary concerns for an investor and why?

-The following crops are currently cultivated in Ghana or are believed to be suitable for the country:

- ***Maize***
- ***Jatropha***
- ***Starch crops (e.g. cassava)***
- ***Sugarcane***
- ***Palm oil***
- ***sunflower***

In what scales is it feasible to cultivate them (large, small or both), as far as you are aware?

-Based on the above, which business models can be employed to harness potential benefits from the cultivation of these crops (large-scale management contracts, contract-farming, small-scale production for local use)?

-Can you name some requirements to successfully employ the respective business models? What effects, risks or uncertainties do they entail that need to be addressed?

-How can the supply chain of these crops be made more efficient and profitable (e.g. by minimizing costs during some stages) either for large-scale or for small-scale production?

- ***biomass production system (e.g. increasing yields)***
- ***biomass logistics system***
- ***biofuel production system***
- ***biofuel distribution system***
- ***biofuel end-use (e.g. use and sell by-products)***

-More specifically, can feedstock production costs be reduced, in order to make biofuel production cost-competitive to fossil fuels?

-What mechanisms can encourage employment to local communities and income-generating activities, where liquid biofuels projects are undertaken?

-What elements/measures can you think of as beneficial for securing farmers' income? For example, pre-agreed prices (can that work in all cases without any problems/side-effects?). Others?

-How can the regular supply availability for a company be ensured (mostly a question in cases of outgrower business models)?

-It is argued that large-scale companies targeting national markets and exports are likely to have will and capacity to comply with sustainability standards, while small-scale producers are not likely to follow that. Do you agree that certification will not work for them? If yes, which ways can be used instead, to make these schemes adhere to sustainability standards?

-Regarding small-scale schemes (production for local use): In which ways can the technical and financial viability of such projects be guaranteed/enhanced?

B. Domestic market vs Exports

-"In general, large-scale production is capable of producing enough quantities and with cost-competitiveness to lead to exports of biofuels. Small-scale production can only be used on the (very) local level". Do you agree or disagree with that statement and why? 185

- Regarding bioenergy exports: what policies can be used to promote added value bioenergy development (e.g. emphasise on processing biofuel feedstocks)?

C. About the domestic market

-Do you think that the creation of an internal market for biofuels is necessary to foster the development of the sector of biofuels in a country?

-What policy measures can be used to drive the development of an internal market for a country like Ghana?

- ***Blending mandate***
- ***Subsidies: Are they necessary for infant markets? How high, for how long? What if a government cannot afford them?***
- ***regulation of prices for biofuels within the domestic market. Why/how is it expected to work?***
- ***a ban on exports of biofuels***
- ***Similarly, is a ban on imports of biofuels an appropriate measure?***

-Can you name some ways to enhance the access of smallholders to local markets?

C. Financing of biofuels

-Can the public sector contribute to facilitating the access of companies and smallholders to finance? How could that be organized? For instance,

- ***as debt coverage***
- ***with a dedicated fund for "risk money" for biofuel companies***
- ***mediating between banks and companies/cooperatives***

-Which of the following stimulation measures do you think that are beneficial for small-scale producers and why?

• grants and loans to small entrepreneurs

• providing credit and/or supporting local income-generating activities for which reliable energy services are not currently available

• tax incentives (exemptions), subsidies

Examples of further questions to respondents with financial/banking expertise:

-What do you want to see in a renewable energy (or specifically biofuels) project, in order to approve a proposal to finance it?

-For countries like Ghana with limited financing possibilities, what role can the public sector have to facilitate the access of investors to credit?

- How can linkages between farmers and financial institutions be created?

-Is microfinancing a viable approach? If yes, which conditions enable a successful implementation of such financing schemes?

Final comments

-If you think that I missed something important or if you want to add something, please feel free to do so.

Appendix D- Additional descriptive information

I. Impacts of business models (Chapters 2 and 8)

In this section the detailed explanations on the expected impacts of each type of business model are presented. First the findings from the literature review are presented in each sub-section categorized by actor in normal font style and where additional findings from the interviews can be added, they follow in italics, so to visually distinguish the two.

i) Type A models

a. Advantages of Type A models

For companies

Large-scale projects are relatively easy to establish, quick and can provide a consistent volume and quality of feedstock . Additionally, these projects can be started up and run as conventional corporations, which makes it easier to attract investor finance and set them up as companies (von Maltitz and Stafford, 2011). In terms of economic efficiency it is clear that the main advantage of this model is the ability to achieve an economy of scale. Equally important is the fact that they produce their own feedstock, so that they do not face supply risks (FAO/UNEP/UN-Energy, 2012, Module 3).

Regarding the economic benefits large companies may provide to the local society, many respondents claim that they can completely change the local economic reality and generate income, also by creating externalities of the biofuels sector (23,25), acknowledging however the importance of the level of mechanization as a relevant factor (van Eijck). Sugarcane for instance, provides a good example of a business that can generate a lot of jobs, if harvesting is not mechanized, but which jobs are of low quality and low-paid. But if job creation is targeted at more modern types, then the jobs will be better valued and can contribute to the development of the support industries and externalities (such as small businesses supporting harvest, agricultural inputs, maintenance for machineries, small-scale banking and others) (25).

Regarding labour and wages, the general tendency is that labour becomes more expensive over time and so the degree of mechanization is increased, while the demand for labour declines. That is an important consideration to account for when looking at the overall benefits a business can provide in the long term (ibid).

For farmers/workers

Formal employment is one of the main advantages of this model, although the rates may vary depending on the feedstock crop (German et al., 2011) and on the degree of mechanization chosen for the different production and processing operations (FAO/UNEP/UN-Energy, 2012, Module 3). There have been experiences however, where large companies demonstrate a bias towards workers experienced in sedentary agriculture, and depriving indigenous communities of the potential benefits later in the process (Colchester 2010 and World Bank 2010 in German et al., 2011).

Local farmers are likely to receive higher salaries than what they would earn as independent small-scale farmers, as well as social benefits (mainly medical insurance) and they may also be benefitted by the externalities created and the wider development opportunities around the main investment (Smeets 2008, Assad 2007, Moraes 2007 in von Maltitz and Stafford 2011).

For society/ public sector

The benefits large companies provide to the local society are a great cash injection and employment in rural areas (more than other models) -which are usually very poor- and contributes to keep people in their livelihoods rather than fleeing to urban centres (FAO/UNEP/UN-Energy, 2012, Module 3, van Eijck et al., 2014). Large corporate farms are expected to ensure the necessary feedstock supply, that can guarantee real industrial development around which more development opportunities can arise (von Maltitz and Setzkorn, 2012). The improvement in the quality of jobs results in environmental and health benefits as well. These are due to less emissions and smoke at the local level, by biomass burning (PANGEA, 2012). Additionally, more biomass is made available at the local and national level, which means that energy access is increased. Lower GHG emissions also provide increased opportunities in the global bioenergy markets (FAO/UNEP/UN-Energy, 2012, Module 3). Large projects often also result in substantial improvements in infrastrucure such as roads, clinics and schools (Cushion et al. 2010 in *von Maltitz and Stafford 2011*).

It is important for the state that large companies are more easily taxed and regulated, therefore being a reliable source of national revenue. Moreover, these companies may intentionally contribute to benefits such as the stimulation of production from outgrowers (at a later stage) and the subsequent enhancement of the rural economy, as well as to the reclamation of degraded or marginal land through the use of advanced agricultural practices (FAO/UNEP/UN-Energy, BDST, Module 3).

b. Disadvantages of Type A models

For farmers/society

A disadvantage is that employment tends to be unskilled and highly insecure in large plantations, due to the its temporary character, therefore only providing limited benefits to poverty alleviation (Macedo 2005; Marti 2008, World Bank 2010 in German et al., 2011). Furthermore, for investments at a very large scale there will be concerns about food security that the authorities will have to address, in order for the investment to be realized (German et al., 2011).

As was known already, many respondents emphasised that a clear disadvantage of these investments is the fact that if good land is being used, then there will be an argument about food security. With large feedstock plantations -larger than 5.000 hectares for instance- people start to have concerns and these must be respected (even if in some countries -like Madagascar- plantations could be of even 100.000 hectares)[152] *(22). With previous negative experiences in many countries this point also raises the issue of awareness and communication, as many people from Ghana and elsewhere have mentioned.*

c. Risks of Type A models

For companies

It must be noted that although the agribusiness firms are usually considered the strong players in this field, conflicts over resources can have seriously damaging impacts for them as well. A large investment can be delayed or halted, production costs may soar, while returns drop significantly and the credit worthiness of the investors is reduced to the risk of operating conditions (FAO/UNEP/UN-Energy, 2012, Module 3). Eventually, the interest for

[152] even if in a country like Madagascar plantations could easily be of 100.000 hectares (22)

investments may be even withdrawn, as has happened in many cases. Moreover, it must be mentioned that in the context of SSA, even when an investor has acquired the land legitimately following the official process, it may still not be secure, if the local people regard the land occupation as illegitimate (ibid). Moreover, due to negative history in some countries, a company investing on a large plantation is very likely going to face some opposition, due to food security concerns, when good land is being used.

A number of risks are particularly relevant for large-scale businesses (type A mainly) and have been identified through the interviews. Although these appear across most business models, a company producing large quantities of feedstock or even the biofuel is more sensitive to these in economic terms. They mainly concern the stages of SCM and are the following (19):

- *the agricultural performance risk, meaning the yields of the crops. It is particularly high for large-scale companies with a business plan based on biofuel production, because they have less flexibility compared to other (smaller scale) models. A bad yield for them, due to weather conditions for instance, may have a larger effect on them.*

- *the implementation risk: Regarding the operating environment (e.g. harbour, logistics, power), it all "needs to be of such a nature that you can do everything on time and within budget" (9,18).*

- *Logistics: both inland and at the port (for exports).Energy is a low value product, so it should be cheap to transport the fuels, otherwise there is no use in transporting the fuel (specially shipping it to Europe) if it costs a lot.*

- *the management: There is need to attract people that manage the project successfully. (18).*

Moreover, regarding the risk of land acquisition, it must be mentioned that in the context of SSA, -as has been implied by the literature review- even when an investor has acquired the land legitimately following the official process, it may still not be secure, if the local people regard the land occupation as illegitimate (ibid). This seems to be exactly the case in Ghana as well, (23,9) and it renders the activities around the land acquisition process as of the highest importance also for companies.

For farmers

On the social level, risks include the often observed harmful working conditions for the rural workers and also the displacement of some vulnerable groups from some areas by force (FAO/UNEP/UN-Energy,2012, Module 3). Moreover, also after the land has been acquired, good governance is essential for the use of natural resources, in order to prevent conflicts (FAO/UNEP/UN-Energy, 2012, Module 3). The appropriate processes must be followed to ensure that farmers ceding their land are compensated and appropriately (analysed in the respective chapter). The use of water is another potential source of conflicts. Moreover, the displacement of traditional agricultural practices in favour of modern ones are of concern (*von Maltitz and Stafford, 2011).* Last but not least, there is a concern by the part of farming communities that the job opportunities will be fewer than those promised *(von Maltitz and Stafford, 2011).*

Ideally, higher productivity enhances supply security, but there is the risk of seeking that through using more land (thereby causing problems) (22,25). Farmers may cede their land to companies in return for jobs (promises), but if a company goes bankrupt, farmers are left

worse than before. Therefore the state needs to ensure that companies coming in have an exit strategy (e.g. they can acquire the land for five years, but if it doesn't work they give it back two the owners) and not cede it to the company for 99 years or alike, as has often happened (25). and therefore the need for good governance even at later stages is. For these reasons many interviewees also emphasised the need to establish good governance with respect to the risks faced by local communities.

Public sector/ society

A lot of attention should be paid to the potential negative environmental impacts of large-scale investments. Although the same impacts may arise from medium-scale schemes, when it comes to large plantations, the risks are bigger and include deforestation, peat land destruction, increased GHG emissions resulting from the above, biodiversity loss, water shortage, pollution from the processing operation[153] , loss in ecosystem services and reduced resiliency as a result of biodiversity loss and deforestation due to direct and indirect large-scale land use changes (Koh and Wilcove 2008, Koh and Ghazoul 2008, Sala et al. 2009, von Maltitz et al. 2010 in von Maltitz and Stafford 2011).

The risk of conflict for resources is highly relevant to this production model, land grabbing being the most well-known problem of this kind, but water management conflicts are possible too(FAO/UNEP/UN-Energy,2012, Module 3). Ideally, higher productivity enhances supply security, but there is the risk of seeking that through using more land (thereby causing problems). Finally, there have been cases where foreign labour has been used instead of local, thereby creating conflicts of locals with migrant labourers and a missed opportunity to boost local employment (Cotula, 2011, von Maltitz and Stafford 2011).

ii) Impacts of Type B models

a. Advantages of Type B models

For farmers

When it performs well, contract farming can have a range of benefits for farmers, such as enable them access lucrative but distant markets that would otherwise be unavailable to them (FAO/UNEP/UN-Energy-Module 3, 2012, and Shepherd, 2013), reduce market risk (because they have a buyer), and create income stability for them. It also provides potential for smallholder empowerment and collective action (IIED, 2012). This is relevant to the advantage of farmers having a more secure income, which in turn indirectly affects their food security as well (FAO/UNEP/UN-Energy-Module 3, 2012). Research in the agricultural sector has shown that contracted farmers enjoy higher income and profit levels than non-contracted farmers (Bijman 2008 in *von Maltitz and Stafford 2011*). Additionally, apart from the above, a number of relative benefits exist as compared to other business models.

- Not only is there an increase in the equity of ownership , but there is greater national ownership instead of foreign, as compared to estate plantations (ibid).
- Lower likelihood of displacement of existing land users.
- An important benefit for farmers is that-when the arrangement no longer works at their benefit (and no long-term contract is in place)- they can change their crop production (ibid).
- active market participation for smallholders
- Employment. Increased employment occurs either because of the increased labour demand within the existing farms (e.g. smallholders hiring additional labour) or due

[153] Ibid

to the expansion of the non-rural economy (aka creation of externalities, such as processing, transportation, marketing and others) (Lindholm, 2014).

- Input support. (Input intensive) technology transfer is a benefit of farmers through direct provision by companies or through extension services provided. That kind of support is important for the productivity of small farmers to be increased and for their ability to meet the companies' quality requirements. This support can take various forms, such as seeds, fertilizers, pesticides, farm equipment, and skill transfer (Lindholm, 2014). Additionally, this support and provision of inputs is expected to have positive spillover effects either to the cultivation of other crops by the supported farmers or to other farmers outside the contracting scheme. For some proponents of contract-farming these spillover effects have a high value by themselves (Shepherd 2001; Da Silva 2005 in Lindholm, 2014). However, if the inputs and technologies are limited to certain crops, the spillover effects will be minimal (Lindholm, 2014).
- Resulting from input support there is an increase in productivity and therefore in farmers' income. The actual increase depends on the pricing mechanism stipulated by the contract and on the extent to which the agreement I honoured by the firm (Lindholm, 2014). If –as has happened in some cases- farmers' participation is conditional upon a debt relationship between the farmer and the buyer of the feedstock, the actual income increase can be lower than promised/advertised (ibid)
- guaranteed markets, by having secure market outlets, farmers can be encouraged to diversify their production and be better able to respond to market opportunities (Lindholm, 2014). Next to that –according to Eaton and Shepherd (2001 in Lindholm, 2014) agreed fixed prices protects the participating farmers form the price volatility in markets.
- grants for community projects (CSBF 2009 in German et al., 2011b)
- access to credit is another side-benefit, which would not be possible for farmers without having a large firm as a partner. That can happen either by using the contracts as collateral for the banks, or by receiving a loan directly from the firm (Lindholm, 2014). Credit is often necessary for farmers to make the investments that will enable them to produce and is usually offered with certain conditions relevant to the cultivation of the contractual crop (e.g. buying buying specific inputs).

In turn some companies may choose to only collaborate with farmers that have a minimum amount of resources (landholdings, facility of access to credit, extension services) (Lindholm, 2014). A relevant concern, though, is that dependency on the agribusiness firm can be created for the constant supply of inputs. If that happens, contract farming will only foster smallholder production that is unable to reproduce itself outside the partnership with the large firm (McMichael 2013 in Lindholm 2014).

For companies

Through these schemes companies are likely to experience economically attractive opportunities, lower risks, as well as greater capacities for growth for the companies. More specifically, by incorporating smallholders they diversify their supplier base (which increases the security of supply), which in turn increases their flexibility, they save administration costs (because production is outsourced and they build/maintain political acceptance for the project and good relations with the local communities (UN/FAO, BDST-Module 3, 2012).

Relevant to land acquisition for companies, the partnership with farmers overcomes the land constraints, which is particularly important if not large areas of land are suitable for plantations (FAO/UNEP/UN-Energy,2012, Module 3, Shepherd, 2013). With contract farming

the risk of farmers losing their land rights and being evicted from their land are reduced. Next to that, the partnership with small farmers makes the investment more politically acceptable, than the simple employment in estates, for instance (ibid)and can build relations with the community that on the basis of goodwill strengthens a company's "social license/legitimacy " to operate in the medium- and long-term (FAO-BEFSCI, 2012). Moreover, there can be greater consistency in the quality of the produce purchased by partner outgrowers, than if the produce is bought on the market (*writer's note: so this gives potential for a lower transaction cost too*) (ibid) and compared to open-market feedstock purchases, the supply is more reliable for a company (although risk still exists, as explained before). Due to diversification, there is reduced risk of losses from diseases, pests or droughts, since the suppliers are diversified (UN/FAO, BDST-Module 3, 2012, Shepherd, 2013).
Here the discussion around certification of biofuels becomes relevant, as large companies can be certified for fairly employing smallholders in their value chains. It can be assumed that certified biofuels will see the same willingness to pay by consumers as for the niche food products, but if that does not happen, then the possibilities to obtain price premiums will be lower for bioenergy companies that incorporate smallholders (FAO-BEFSCI, 2012).

A number of benefits are expected for companies, which include smallholders in their value chains. These include (ibid): Access of companies to new markets, (as there is a growing trend among consumer demand to connect directly with farmers and a growth in demand for products with a "story"), higher price premium for such products (although it usually stays with the largest retailer/purchaser). Even niche and specialty suppliers who may seek such products. However, it is not yet clear what role these factors will play in the bioenergy markets.

For society/public sector

Economic development for the country on the whole is an argument that the proponents of contract farming use. This is supposed to occur through the farmers' access to markets, productivity gains and increased income which enables them to escape poverty and make investments (Lindholm, 2014).

Contract farming requires little government intervention to be promoted apart from the provision of some basic public goods and that is mainly infrastructure and mechanisms for dispute resolution (Vermeulen and Cotula, 2010). The promotions of equitable forms of contractual relationships however, can be facilitated by the state and NGOs. The inclusion of smallholders into value chains of large companies provides to both parts the benefit of diversification; for companies diversification of the supplier base (FAO-BEFSCI, 2012).

b. Disadvantages of Type B models

For farmers

On the other hand, the fact that small farmers are brought to direct trading relationships with larger businesses, entails risks for farmers as well. If not proper attention is paid, it can have damaging impacts for farmers, such as locking them in a long-term relationship that poses an unequal burden on them (in terms of cost and risk, while receiving a limited return). These risks for farmers are higher in cases where the market is concentrated (*at the hands of few corporate actor*s), unequal bargaining positions are held by parties, or asymmetry of information that allows powerful corporations to push the risks to them and to push prices down. Moreover, farmers may become dependent on a single corporation and investments may cause negative social and environmental impact at the level of the community (Vermeulen and Cotula, 2010, cited in IIED, 2012). The above can also be

described in a "lighter" way as loss of flexibility in enterprise choices (Shepherd, 2013). Coming from that is the inability to benefit from higher prices in the market.

Even in the case of Brazil and the very successful 'Social Fuel Seal' programme smallholder farmers were facing difficulties in their efforts to negotiate contracts with companies and in general conflicts over the terms of agreements are common (German et al., 2011). From the part of farmers the common complaints include the terms of repayment and land ownership, the failure of companies to keep to their promises, as well as the tendency of middlemen (private or governments) to act on their own interests (German et al., 2011).

Farmers are often forced to plant monocultures under contractual terms (e.g. Shepherd, 2013), so that their systemic and individual flexibility is lowered. Here –apart from the environmental downside- the disadvantage for farmers is that they are unable to determine their selling price, when/as this is being set at the international market. This way they may in a way be turned from land owners to labourers.

It was further highlighted that a main disadvantage of smallholders producing for biofuel feedstocks is the fact that they face large difficulties in accessing the markets. In the words of F. Grati, "outgrowers without a market is a suicide. That is what happened all around Africa, with farmers planting individually as hedges or on the wild. Only after the market is there, is it meaningful for individual farmers to produce by themselves". That is a strong argument in favour of contract farming arrangements. These problems are usually due to a number of inefficiencies:

1) *storage (25) to be able to sell when it is most profitable for them. In that respect building storage infrastructure is one thing a developer can do, if they see them as long-term suppliers. Another –kind of- logistics intervention can be that certain facilities are created (for cassava) with drying units; thereby bringing a smaller unit further down the chain (35).*
2) *Transport. An investor can help farmers acquire semi-mechanic vehicles, so that smallholders can bring their goods to market. These first two (transport and storage) are the barriers that usually block them (28).*
3) *Public finance (again, "so that they have some access to finance to be able to produce crops when it is or more profitable to produce them and sell them when it is most profitable to sell them").*
4) *Information, "so that producers know when and where someone is buying". There is a lot of scope for application of mobile phone platforms to help in that area and that is done successfully for such services in many countries, and particularly in Kenya. They probably have that in Ghana too (28,30,35).*
5) *technology access is one of the biggest obstacles. Both for a yield but also certain sustainability requirements (like for cultivation practices, substitution of certain pesticides etc.) are related to some advanced technologies. (27)*
6) *Capacities: Farmers are most of the time illiterate with very little awareness of sustainability issues and good practices. So there is a lot to do in terms of capacity-building to support them (27).*

Although these are difficulties which pre-exist, they have to be overcome, in order for farmers to be able to participate in partnerships. As a consequence, "using 100% small-scale farming is challenging". Next to the above, producers are reliant on a number of things, such as fertilizer costs, land preparation equipment etc." (15). Therefore those activities must be coordinated at the right time, so that they do not compromise the (crop) output (ibid). In doing so, however, for a company working with smallholders, the spatial scattering is an

issue that significantly increases transaction costs and is greater as greater the number of famers is.

For companies

For a company working with smallholders, the spatial scattering is an issue that significantly increases transaction costs and is greater as greater the number of famers is. To address this, the company Nandan "works through a network of 'franchisees' coming from within the community or occasionally from local development organisations" (IIED, 2010, p. 118, (Shepherd, 2013).

Additionally, the lower yields that are achieved by smallholders in comparison to large-scale plantations mean that the land transformation footprint is larger for the same level of production[154] (von Maltitz and Stafford 2011).

- Productivity and crop quality of smallholders are often low (IFC, 2013)
- Most often smallholders lack the knowledge to mitigate social and environmental impacts (ibid)
- Inability to upscale their production, due to poor farm management skill and lack of aggregation[155]
- Where food safety and sustainability requirements are desired, an extra effort would have to be made by a company to achieve transparency and traceability
- Through many layers of collectors and middlemen in the supply chain, it is difficult to achieve traceability and evaluate sustainability of farming practices, if participation in a certification programme is required (ibid).

c. Risks of Type B models

For companies

For a company it is challenging to use 100% small-scale farming, because producers are reliant on a number of factors. It must be highlighted that the side of the biofuel producers is reliant on the feedstock producers (farmers). Additionally, there is a risk of a company's image being undermined, if a partnership collapses (e.g. cases of Petrobras, San Miguel Corporation) (Shepherd, 2013).

The following risks are the most important as for the partnership and the performance of smallholders:

- Side-selling means that farmers "divert some or most of their increased productivity to other buyers" (IFC, 2013, p.14), which brings a big risk to processors that they will not be able to recuperate their investment costs. In a supply chain with only few buyers and a high dgree of supply loyalty the risk of side-selling is lower. In contrast, where many suppliers offer feedstock and feel less committed, the risk is higher. Side-selling is more likely to occur with farmers that live on subsistence or who rent their land, because in conditions of poverty they simply cannot afford to think of the long-term benefits of a stable buyer-off-taker relationship and so they sell to the highest bidder at the time (IFC 2013).
- Farmers may not adopt the more efficient agricultural practices that the company has invested in and expects them to perform. That may occur because farmers may

[154] "This might be slightly offset through intercropping or the use of agroforestry systems, where a diversity of products is being produced", thereby increasing the net productivity *(von Maltitz and Stafford 2011).*

[155] "The term *aggregation* describes the process of working with groups of smallholder farmers rather than individual farmers. When discussing farmer aggregation, this handbook uses the term *producer organization* because it includes small and large, as well as formal and informal groups" (IFC 2013, p.29).

not be convinced about the improvements or when they cannot afford to perform them. Lack of access to finance and high interest rates exacerbate this problem (ibid).

- Relevant to the above is that the new farming practices are not sustainable within the conditions that smallholders operate. That may be because –even though productivity is increased- the practices are ultimately not cost-effective. For instance, if the required product and labour costs of using fertiliser are higher than the additional income gained by the increased output, then the farmers will reduce or completely stop the use of fertiliser.

  When using new farming inputs most farmers expect dramatic productivity increases, which however are not possible under the limitations they operate. Additionally, not being able to practically measure the small gains they achieve, they may easily be disappointed and abandon the new practices (since they require more labour) (ibid).

- A great disadvantage for the processors partnering with smallholders is that the feedstock supply is actually not secure even when clear contracts have been signed. That is because in many developing countries there are great challenges in honouring the contracts. The best way to address that challenge is to pay an attractive price to the farmers. This is better possible by making investments in efficient processing and the producing and selling of by-product, thereby adding value to the overall operations (van Eijck et al., 2014).

For farmers

In many places contract farming has not been successful at improving the participation for local farmers in multiple stages of the value chain (Hultman et al., 2012) and that is a point which many people in the interviews emphasized on (the need to achieve that). That results in a risk of market failure of farmers applies when the circumstances in the market change or when the operations of the company become unprofitable for other reasons. Examples of such instances have been seen in Brazil and Indonesia. That risk becomes particularly relevant in cases of long-term crops, such as palm oil (Shepherd, 2013). Inefficient management by farmers or problems with marketing pose a risk of manipulation of the quotas, so that the company does not buy the whole contracted produce. That risk is exacerbated, if the staff of a company is corrupt and quotas become a concern in such cases (FAO/UNEP/UN-Energy-Mod. 3, 2012).

For farmers the potential risks to achieving social benefit, that result from shortcomings in contracts include: low prices, unfair input and produce pricing mechanisms, under-grading and under-weighing of farmer produce, unfair input credit conditions, and punitive loan recovery methods (CCJDP, 2006 in German et al.,2011b). Additionally, lack of transpanency in the terms of the agreements have in some cases caused misunderstandings of the farmers' commitments and cases where the costs of extension services were generally deducted from the reward paid to farmers without this being understood by farmers when signing (ibid). Such non-transparent practices even undermine the ability of companies to monitor these services and ensure value for money (ECI Africa Consulting
2006 in German et al., 2011b).

Interestingly, CSBF (2010 in German et al., 2011b) refer to a study of that year in the biofuel sector that found that 72% of growers were dissatisfied with the outgrower scheme "because contracting companies failed to provide the follow-up support outlined in the

contract or because of low prices". In general and although in many ways partnerships with smallholder farmers perform well (and are particularly positive in terms of ownership of equity), it is possible for exploitation and abuse of terms to occur from both sides (von Maltitz and Stafford 2011). For example small-scale farmers may employ other workers for some tasks and pay them less than the minimum wage and child labour from the household is common on substistence farms, but would not occur on corporate farms (ibid, p.26).

Another possible risk of biofuel development concerning the local economy is that competing processing mills are unlikely to be established at close distances from each other. As a consequence, each mill is likely to have a monopoly over the local agricultural market, therefore being able to lower the price it pays to farmers for the supplied feedstocks (von Maltitz and Stafford, 2011, p.28).

iii) Types B2 and C2- Models that involve farmers' cooperatives

Categories of cooperatives

Class C producer organizations are groups or assemblies of farmers with the only aim of managing information. Such organisations may- for instance attend regular trainings on centrification or improving productivity. Another example could be a plant/factory that serves as a hub for the individual producers that bring their feedstock and where trainings and dissemination of information can take place. Therefore by offering a place for gatherings, a class C organization offers to the firm an venue for efficient dissemination of information about techniques to improve productivity and certification requirements (IFC 2013).

This class of organisations does not imply that there is a shared purpose or trust between group members. In sum their contribution to the firm is due to (IFC 2013, p.32):
• "Providing a central location for information transmission
• Building and strengthening loyalty among suppliers
• Identifying farmer leaders to support future interventions"

Class B producer organisations function as small enterprises, which collectively manage resources (inputs, crops, savings, land, or water, depending on the case) that belong to their group members. Many of these organisations operate on a village level only and have a small number of participants (20-30). That small size implies that aggregation is a benefit, albeit with limited savings in procurement, since the volumes are still too low to be considered as efficient. They may be formally registered with a bank account or with formal tenure over land.

More important, though, than the formalization is the group's cohesiveness. Trust among members and in the leadership of the organisation is required, in order to manage the resources collectively, as well as shared views on the overall purpose and the business plan. Having these elements of cohesion creates the dynamics that enable members to take action together. Oftentimes such groups may be developed through religious organisations, where members already feel connected and trust each other.

Next to the services that Class C organisations provide, those of Class B are additionally able to (IFC 2013, p.32):
- Pool resources to purchase inputs in bulk
- Share labour to grow crops on individual or communal land
- Combine harvested crops to facilitate transport and marketing

- Save money as a group
- Allocate and schedule water use for drinking or irrigation

Class A producer organisations enable for efficiency in the supply chain and for reducing costs of marketing inputs and purchasing of crops. The functions that enable for these benefits are the management of external resources and the coordination of farmer members throughout the production process. That role is similar to the typical one of a middleman, because these producer organisations earn a margin from trading.

Sometimes a number of small grassroots producer organisations come together, so as to increase input and crop volumes. These types of organisations are called “depots” or “fora”. Individual producer organisations may in other cases receive loans from financial institutions or advance payments for crop purchases by off-takers.

Organisations of this type are likely to be formally registered and operate actively in markets. The elements of cohesion that are needed for Class B organisations are needed for those of Class A to an even greater extent, as they additionally have needs for business development. Therefore they must have systems for managing crops, cash and inventory, and establishing a track record. Adequate time must be attributed to building these systems and to establish relationships of trust with outside parties.

It must be mentioned however, that extended training (often required for two-three marketing cycles) brings costs so high that the firms may find it prohibitive. For instance, to effectively develop capacities of producer organisations would require hiring trainers with business development skills, that normal agricultural extension agents do not possess. Since the development of such organisational capacities is a complex process, dedicated staff would need to deal with it, however, that would be very costly to the firms (IFC 2013).

In addition to the services that the two other types provide to firms, Class A organisations are expected to:
• Aggregate crops from a significant geographic area
• Manage loans to purchase inputs that might then be resold to other farmers
• Take advances from off-takers or loans to purchase from members and non-members
• Coordinate post-harvest processing, drying, storage, and transport
• Improve traceability to smallholder farms
• Reduce side-selling through group cohesion
• Facilitate fair trade certification, which requires crop purchases through formal producer organizations.

a. Advantages of type B2 and C2 models

A number of important benefits arise from the aggregation of farmers to cooperatives of any form. They can be summarized as follows:

- Enhanced ability to negotiate higher prices, due to their control over larger quantities of crops. Sometimes, firms view this as negative, however that is a short-sighted view (for more details see IFC 2013, p.30). Additionally, Rist et al. 2010 (in German et al., 2011) support that provided that cooperatives operate in the interest of their members, they are essential in realizing the potential benefits and to hold them accountable to their contractual agreements.

- Farmers receiving equitable prices are more likely to invest some of their revenue to their farms, which in turn –through increased productivity- will be beneficial to both the farmers and the firms.
- Access to information
- Value-added processing
- Brand development
- Ability to generate earnings by procuring crops from non-members, which are re-sold to large firms (while the non-members benefit by gaining market access)
- Producer organisations may provide services of wider social benefit, such as road repair, construction of health clinics. Cooperatives which are certified by fair trade organisations may use their price premiums they receive to fund community initiatives (IFC 2013, p.33).
- The organization in cooperatives of feedstock supply could contribute to ensuring that farmers understand the value of honoring contracts, that they receive proper payment for their labour and that they are properly trained in a smallholder model (van Eijck 2014).
- Increased sense of social belonging

As partner to a company, a farmers' association, is viewed as an effective arrangement for farmers, due to the increased capacities for bargaining it has (16). Bargaining with a cooperative of smallholders is an advantage for the company as well, because it only has one negotiator on the other side of the table (24,27).

Cooperatives enable farmers to share costs for the equipment and provide the benefits of better training, knowledge sharing and motivating each other. These are important, in order to improve their agricultural performance and become more efficient (18,31). Moreover, it is easier to address them for training purposes/technical assistance, when they are organized like that, so that companies are interested to them. Harvesting and transport activities can also be organized within cooperatives (31). Then the produce can be sold to the traders and to processing units at the best price. Therefore it can tackle the problem of logistics of individual farmers (27).

b. Disadvantages of type B2 models

On the downside of cooperatives/associations is the fact that the overall functioning is challenging, since community members are not accustomed to the required processes (e.g. collective decision-making, coordinated production and delivery processes, etc.). A common reason of failure is the lack of proper management of assets that relates to the educational level and the inexperience of farmers (FAO-BEFSCI, 2012).

The major disadvantage of cooperatives is that their formation is not easy and as people are not used to democratic institutions, it may be difficult to function like that (24). It requires a lot of time and effort to make farmers' cooperatives work and they actually perform best, if they already exist (ibid). Interviewees with relevant expertise emphasized on the need of partner companies to use an inclusive approach. Therefore the adoption process, that is analysed later, is equally relevant to partnerships with cooperatives as to those with individual smallholder farmers.

c. Risks of type B2 models

A great risk of failure of producers' organisations comes from phenomena like nepotism, corruption and other forms of mismanagement that arise when member are not sufficiently involved in the selection of the leadership and in monitoring the operations/activities (IFC 2013). Another flawed practice of the past has been that the existence of the organisations

was dependent upon donor funding or– in case when governments tried to promote or even force the formation of organisations- handouts such as fertilizers where given to groups from the start, so that there was no interest for the groups for the business activities after the subsidies ended (IFC 2013). However, even without the above deficiencies, the mere lack of inputs and financing may result in low effectiveness or even failure.

Proper management of assets and overall functioning of cooperatives/associations are also weak points (18,24 and FAO-BEFSCI, 2012). Moreover, corruption in their management is a serious risk (ibid). A relevant discussion was made with few interviewees with experience on partnerships with smallholders were asked about ways to mitigate corruption. It was further highlighted that farmers' organisations may also work as vehicles for corruption. That is because whenever interests are organized, "there is a risk that corruption is organized in that process" (24).

iv) Impacts of Type C models

a. Advantages of Type C models

Small-scale bioenergy production schemes provide significant potential to increase rural development, especially when the feedstock use is all locally produced (FAO/UNEP/UN-Energy, 2012, Module 3). There is an increase of energy access at the local level and the energy produced is more connected to the local type of demand. Job creation potential –directly as well as indirectly- is substantial and so is the amount of income that is spent for energy production locally rather than for imported energy (such as paraffin or diesel). However –naturally- it cannot be compared to the job creation potential of large-scale schemes (ibid). Nevertheless, local energy production may provide an income diversification alternative to ordinary agricultural production for food (FAO/UNEP/UN-Energy, 2012, Module 3) and consequently, generation of revenue is also a benefit for the local economy on the whole. Local energy provision is of great social benefit (e.g. children being able to read at night) and is a driver of economic development as well (for instance, because local industries dependent on electricity can be established). Local biomass production is also highly efficient in terms of environmental impact (von Maltitz and Stafford 2011). In sum, smallholder models score higher on land rights, GHG balance and the benefits can reach more people (van Eijck et al., 2014).

A number of interviewees positively evaluated the fact that there is an increase of energy access at the local level with these schemes and the energy produced is more connected to the local type of demand. Job creation potential –directly as well as indirectly- is regarded as substantial. Although –naturally- cannot be compared to the job creation potential of large-scale schemes (ibid), many contend that –as has often been found in the literature- the new economy that is created even through localized bioenergy schemes, produces significant benefits for the local communities (e.g. 25,23,29).

b. Disadvantages of Type C models

Small-scale schemes are difficult to establish and difficult to maintain after the donor support is alleviated. As with partnerships of companies with smallholders, these are time-consuming processes and demand the creation of capacities for the local people.

As has been mentioned in the section about cooperatives, the lack of organization of smallholder farmers is commonly regarded as the greatest barrier to their ability to access markets (FAO-BEFSCI, 2012). Their lack of access to credit dooms them to a reliance on outdated or ineffective farming inputs and an inability to make any investment to improve their performance. Another disadvantage is often low capacity of producers and operators to follow sustainability standards. Therefore their level of production may not be high or

stable enough to sustain the performance of local-level production unit (ibid, van Eijck et al., 2014).

A few respondents were negative about the possibilities of smallholder farmers being involved in their own biofuel production projects, as they can have no financial viability, due to high interest rates and because they live on subsistence in general, so they are struggling to survive (mainly 21,22, but others were also sceptical). 23 mentioned that it may technically be viable when the diesel costs for them are very high, for instance in some remote places in Ghana, where the diesel price differs due to distances and transportation means, and also in cases where diesel is not available at all. However, it must be mentioned that these respondents have a strong large-scale orientation.

Another disadvantage is often low capacity of producers and operators to follow sustainability standards. However, as the scale and the purpose of a scheme are key determinants for the risks of the projects, small-scale projects are likely to be less risky in economic terms.

c. Risks of Type C models

As the scale and the purpose of a scheme are key determinants for the risks of the projects, small-scale projects are likely to be less risky in economic terms. That is even more so, because there is guaranteed demand within a local circular economy (producing for their own electricity). However, there is a certain risk of economic failure, if deteriorating economic conditions result in the inability of a minimum number of locals to pay for the electricity (van Eijck 2014).

The implementation of small-scale schemes with multi-functional platforms often goes wrong because of organizational problems, inability of locals to maintain them after the establishment (usually by an NGO or donor funding). Also, sometimes not enough households are connected to the plant, so that it cannot run feasibly (35).

v) Impacts of Type D models

a. Advantages of Type D models

If biofuel development takes place indeed, it can provide benefits such as reduction of operating costs, and increased reliability of supply (von Maltitz and Stafford 2011). It also improves a company's image and public relations, as it creates more job opportunities for the surrounding communities. It is a model that can be linked to outgrower schemes. In cases of decommissioned mines, biofuel production could also contribute to rehabilitating degraded land (ibid, p.31). The rest of the impacts –positive and negative are very similar to those of type A projects. Apart from them a number of constraints to establishment can be mentioned.

b. Disadvantages /Constraints to establishment of Type D models

The constraints of these projects are similar to those of large-scale plantations, but most likely with less frictions over land use (since the companies should already have usage rights). Possible additional constraints are the capital intensity and commitment that would be needed, as well as a lack of desire of shareholders to support projects outside the core activity of companies (von Maltitz and Stafford 2011).

Notably, the risks that have been identified about type A –apart from the agricultural performance risk- do not apply to type D (as the other impacts), due to the fact that the biofuels are produced for own use.

II. Analysis on possible feedstock options for Ghana

i) Importance of feedstock selection

The choice between various feedstock options and conversion routes may be a complex process and the concerns about food security make that choice even more important. Several considerations need to be accounted for at the strategic planning phase (FAO/UNEP/UN-Energy, 2012, Module 2):

- That there is no one-to one mapping that can be made between feedstocks and conversion routes and –especially for the case of liquid biofuels- nor between conversion routes and energy carriers or products. Therefore, a system-based evaluation of the various combinations of options is needed, next to the analysis of specific options.
- Various co-products can be obtained in most of the paths, the application of which has to be considered when judging these paths in terms of cost-effectiveness (if this is prioritized) and also in other terms, such as food security.
- Moreover, following from the above, some pathways produce fuels and co-products across different energy carriers, such as heat, mechanical power, electricity, liquid fuels, gaseous fuels. This can be an advantage in terms of efficiency and utilization, however exploiting this potential requires sophistication in matching the output of these to the markets (demand side), and in having the necessary capacity to establish and maintain the relevant infrastructure.

As a result of the complexities that relate to the choice of feedstock options, the land availability and suitability assessments must be followed by a technical assessment for conversion options and afterwards an evaluation of the existing technical capacity to absorb the relevant technologies can be made. This spatial assessment must also account for the infrastructure requirements that are necessary for the feedstock supply options and for the operation of plants (conversion platforms) (FAO/UNEP/UN-Energy, 2012, Module 2). Thus, strategic decisions also concern the geographical location of biomass cultivation sites, the logistic definition of transport system and the supply chain node location (Dal-Mas et al, 2009). These decisions must be made both by the state –at first, in order to avoid resource conflicts- as well as from producers, before they decide to invest.

Considering the above, and in order to understand the functions of the business models that have been analysed, it was determined to also analyse the main feedstock options for Ghana along with their implications for the adoption of business models. That part of the analysis only contributes to some specific recommendations about Ghana, which however were not essential results in meeting the research objective. On the other hand, this analysis correlated the possibilities and expected impacts of certain crops with the suitability of certain types of business models. Therefore this analysis serves as a sort of a case study for the partial application of the analytical framework of the thesis with a specific focus on Ghana.

ii) The main possible crops and their products

Through desk research and interviews with experts, the analysis in this section presents all the considerations the more favourable crops in Ghana entail, as well as their implications for the adoption of appropriate business models (feasible scales for commercial cultivation, direct crop co-products and by-products. Therefore the relevant success factors that were

identified in the chapter on Supply Chain Management are taken into account for each crop in this analysis. Additional considerations have been introduced in some cases as a result of the discussions with the experts.

That analysis can conclude that palm oil and sugarcane –where possible- are the best options. Other crops, have good potential for volumetric productivity as well, but are also staple crops (such as maize and cassava), so attention must be paid when using and promoting them. Jatropha –which was once considered as the 'miracle crop'- has been found to be less favourable for a number of reasons. However, it is possible to make productive use of it under certain conditions.

Maize

Scale: Maize can be commercially cultivated at any scale and is very common in many African countries. Therefore it is a good side-crop to have (35).

Products: Biodiesel and maize for food and edible oil
By-products/co-products: none

Advantages	Disadvantages
• can be commercially cultivated at any scale • Well-known crop; already cultivated • Generally good for ethanol production, when conditions are suitable • Easy to harvest and yields are very predictable (23,33) • On a very large scale, large production could lower the price for maize (35). • Cultivated on small-scale it is possible to use maize as a side-crop (although risky for farmers to lose their food market for maize) (35) • The discharged part of maize would be suitable (29)	• It is a main food product, so may undermine local food security (or at least raise concerns) (unanimously) • Rainfall affects the yields. Alternatively, requires irrigation, which means infrastructure should be in place (18). • Edible oil to the food market is likely more profitable for farmers (16,18) • the fact that it may simply be possible to get a better price for it for food, than for biofuel, makes it less attractive and risky for investors (36) • it may be stolen by the farmers (as in Madagascar), on any scale (22). • Collecting maize from various outgrowers is difficult. • It is energy break-even (18) and not expected to produce yields high enough for profitability in Ghana (23, 33)

Table A.1. Advantages and Disadvantages of maize as a feedstock option.

Conclusion: Should be used mainly as a food crop. It would require large-scale plantations to produce biofuel from maize, which may undermine food security. It is advisable not to do that. The discharged part of it could be used for biofuel production, however. If the climatic and land conditions allow, it can be grown as a side-crop for biofuel, for when farmers can benefit from that. The benefit from GHG emissions is also not present (18). Does not seems beneficial overall. South Africa has banned the cultivation of maize for bioenergy, due to food security concerns (20,21,15).

➔ **Options for business models:**

a) In small-scale farming it can be used as a side-crop for farmers to gain an additional income. Therefore, if a biofuel producer company could collect enough produce within a radius that is not large, and also if it could make use of the discharged part of the maize used for food, it could potentially become an attractive business

proposition. However, the difficulties in implementing that option should be well-studied before.

b) On suitable agro-ecological zones it can be very profitable for large-scale, but the aforementioned concerns must be taken into account.

Jatropha

Scale: It was formerly regarded as the "miracle crop" and as suitable also for marginal lands, however it has become obvious that it has difficulties and there are certain requirements to successfully cultivate it. It can be used in the future more widely when the varieties are improved (most common answer e.g. 23,35,36). Its yielding potential and the appropriate scale (if there is one). According to Feto et al. (2011), on large-scale jatropha plantations it is important to use the optimal level of agricultural inputs. Small-scale is favoured at the moment, as it is not profitable enough for large-scale156 (35). However, due to the high upfront investment costs, it is likely that only large companies can invest on jatropha (by partnering with outgrowers). Therefore, it is advisable by many people to start on a small-scale in some parts of the country, also in order to experiment, and then gradually scale it up very carefully, if it has potential indeed (35). The more dense a planation, the easier it will be for farmers to harvest (and more profitable, in cases of pre-agreed prices) (26). The opinion that jatropha should be grown on marginal lands is common in the (outdated) literature and was encountered during the interviews with some Ghanaian people as well. However, during the next series of interviews that view was strongly contested, as many people reported that results of jatropha performance in marginal lands have been disappointing everywhere. Therefore the relevant assumption was not confirmed and an interesting point of attention occurs here for Ghana.

Despite the disadvantages, however, a number of companies have been successful, also on large scale (Nigel-19, Fuelstock Madagascar-22). These businessmen argue that only large-scale is possible, so that enough quantities are produced, but their success lies on the fact that they do not rely on jatropha production to make profit for their companies. It is only through the production of by-products that Mali Biocarburant is able to be efficient enough (26)[157] and 22 clarified that in his company, which is also successfully using jatropha, the share of that crop is around 50%.

Products: Biodiesel only

By-products/co-products: Currently none. However, one respondent (15) mentioned that detoxification has already been applied (in S. Africa) to turn the seedcake into fodder.

Advantages	Disadvantages
• Not a food crop	• potential of jatropha is highly doubted currently. Will take at

[156] Before converting the biomass to biofuel, the material needs to be dried, so in the process of bush clearing, it is possible to use the timber coming from the planted land, in order to use it as fuel to dry the jatropha (19). The climate in Ghana favours that as well, because the rainfalls are at that time of the year and jatropha also produces fruit then (ibid). But vegetable oil is possible to produce also at village level, by pressing the seeds. That also enables to look at the uses of the seed cake, which can also have decentralized use (ibid). It is useful to bear that possibility in mind when analysing the potential that the crops grown in Ghana provide.

[157] Notably, 26 regarded the reasons behind the economic success of his company a confidential issue, therefore he could not make them known, apart from the aspects of the business model they employ.

• Does not need a lot of attention • If possible to grow on marginal land, even with small productivity, it becomes a positive option (32) • Arising opportunity for industry called 'organic indigo jatropha' (22) • Could possibly be used as biomass for boilers (25) • jatropha seeds are easily transportable and less capital intensive, which renders outgrower models viable (von Maltitz and Setzkorn, 2012).	least a decade of research until the difficulties are overcome (36,29,32). • yields of jatropha depend highly on soil suitability and the climate • low volumetric productivity (33) • May indirectly compete with food crops, for the same land (32). • remains questionable if the most efficient use of the oil is by producing biofuel (35) • It has a lot of pests and diseases (25,35) • Harvesting difficulties, such as inconsistent harvests (and twice per year) (25) • labour-intensive, to pick the fruit→ has higher production costs than other crops (as harvesting can/can hardly be mechanized) (25) • → social issues due to labour intensity during harvest period[158] • Where it does not grow naturally (also in Ghana) most of the expenses of a company would be about convincing farmers to plant it. Then expenses for land clearing, inputs, etc. →high upfront investment →difficult to attract investors (so probably subsidies would be needed for that in Ghana) (35) • First revenue comes after four-five years • Risky from a market perspective. Due to tis poisonous factor, does not have other uses[159] (23,29 a.o.).

Table A.2. Advantages and Disadvantages of feedstock production from jatropha.

Conclusion: Its potential at the moment is not favourable. It is not expected to become an internationally traded commodity soon, because the quantities currently produced are very low. It must always be grown along with other crops, also in the cases of outgrowers (22). *(Note: There were contradictory comments about whether harvesting of jatropha can be mechanized or not)* However, it can very well be used on the local and national level and contribute to the substitution of oil imports in African countries (22). But given all the disadvantages, if farmers have good land, it may be better to use it for other crops.

➔ **Options for business models:**

a) Large company employing an outgrower scheme. Then the farmers can plant jatropha as a fence aside their main crops and sell to the company.

   Applied on large-scale by a company that also uses other crops and does not base its economic viability on jatropha cultivation

[158] "It has two harvests a year, the fruit bunches do not mature at the same time, so if they are harvest altogether, some of the seeds have low oil content, some have high, and consequently there is no consistency. Some branches are so weak that harvesting cannot be mechanized, so you have to do it by hand. But it takes 2-3 people per hectare to harvest, so 30.000 people are needed in a project of 10.000 hectares for only two months a year. "So then you have social issues; what are you going to do with these people the rest of the 10 months of the year?" (25).

[159] See comment on 'by-products/co-products' above the table that counters that statement.

Starch crops (e.g. cassava)

Scale: These are very common and can be cultivated at any scale, as it is very easy for small farmers to grow as well (33). It must be borne in mind that as population density increases, people switch from the food consumption of ordinary grain crops to that of starch crops (29). That is what happened in the Netherlands and the whole Europe, so this is an important consideration for country-level policy-making (ibid).

Main Products: Ethanol and food.

By-products/co-products: Starch produced from cassava can produce glucose syrup and a lot of starch with a value much higher than as biofuel. These are high value products.

Advantages	Disadvantages
• high agricultural productivity. All starch crops are believed to have good potential • the fact that it is a food crop give farmers the option for two different markets, which is positive (35).	• is a food crop. Relevant is that as population density increases, consumption of starch crops increases (29) • it needs a lot of care, but it must be replanted every year or two, so it requires some more labour than jatropha (35). • requires large pieces of land to produce biofuel • Turning cassava to ethanol is not always easy, and attention is required to produce good quality ethanol[160] investments must be carefully made (29). • The by-products have higher value (e.g. starch for glucose syrup), so that using it for energy would not make business sense (18).

Table A.3. Advantages and Disadvantages of feedstock production from cassava.

Conclusion: Starch crops and predominantly cassava have very good potential for ethanol production. However, as they can be used for food and by-products, a very careful assessment of the potential impact on national and local food security must be made. If the overall conditions are positive, then farmers of any scale can supply a biofuel plant with cassava to be processed. Alternative uses, such as fodder from the cassava peels, must also be considered at the planning stage. To address food security concerns, perhaps the best approach is to use the main cassava product for food, while the by-products for ethanol.

→ **Options for business models:** It is a very easy and common crop and it can be cultivated at any scale.

Sugarcane

Scale: It can be developed on different scales and can be grown on a larger scale than other crops without problems (29). Sugarcane works better in a plantation model or in a nucleation model (combination of plantation and outgrowers) (Hultman et al., 2012). The processing of sugarcane needs to be done at the local level, as it otherwise has high transportation costs and a rapid degradation of the cane after it is cut. Large-scale processing is also capital intensive, so it better be centralised (von Maltitz and Setzkorn, 2012), as an economy of scale is needed to make it work in total (15).

Moreover, to participate in the ethanol industry, an investor needs guaranteed feedstock flows, so outgrower models are not favourable for this crop, as they entail risks (ibid). While, it can be grown at any scale, it can be difficult for small-scale due to the expensive agricultural phase (33). So it is possible to do it under outgrower schemes if a large company buys the produce (19), otherwise it would be too expensive for farmers to set up small-scale

[160] Lower levels of ethanol in the brew or broth requires a high energy consumption for the distillation to make the quality ethanol that you want to have (like 85% or 99,5%, whatever you want) (29).

treatment (15). In Tanzania usually 50% of the plantations is owned by the companies and the rest 50% by outgrowers (a few hectares each usually), who can also use their land for their own subsistence. This is also good for the company, because they would not fully work with outgrowers and that combination links the production with the existing industry (16). Also, production can be large enough to be used for exports (22).

Products: Sugar is the primary product

By-products/co-products: Ethanol is the by-product. For high profit, it is better for a company to produce sugar first and then use the molasses to produce ethanol, as well as the bagasse for electricity by co-generation (33).

Advantages	Disadvantages
• Very favourable for cultivation in Ghana. best net energy gain than any other ethanol-based crop. • production cost is very low, while the productivity very high→ very favourable crops for investment in any case. • positive fact that there is a lot of experience in Africa with it (35). • best net energy gain than any other ethanol-based crop. • Two possible markets for producers (i.e. ethanol and sugar) (32, 35 a.o.)	• two possible markets without a dependence on one use only • the possibility of producers to choose and switch between markets can be a disadvantage from the viewpoint of the public sector → possibly large price fluctuations due to the competition, as in Brazil (36) • The expensive agricultural phase can make it challenging for small-scale production (33). • requires a lot of water, so potential exists where irrigation is possible (35)

Table A.4. Advantages and Disadvatages of feedstock production from sugarcane.

Conclusion: In the areas where it grows well, sugarcane can be very profitable.

➔ **Options for business models:**

a) A large company with its own large-scale plantations. That can lead to high profitability for the company.

b) A large company using an outgrower scheme (nucleus estate model is favoured) to provide all the technology and inputs to the farmers, who can grow the sugarcane in their own plantations. The benefits of these –apart from the company's profitability, are the boosting of rural development (also through the high income the farmers can gain). On the national level, sugarcane plantations can lead to high volumes of bioethanol that can either be consumed domestically or exported, benefitting the national economy accordingly.

Palm

Products: biodiesel, palm oil for food consumption (many processed foods contain palm oil as an ingredient) (wikipedia.org).

By-products/co-products: glycerin (glycerol);

Scale: It can be employed on any scale in Africa, Malaysia and Indonesia (20,29,32), but as with sugarcane, a big company is needed to buy the produce and turn it to biodiesel (19). With palm oil (and sunflower) the glycerine and the micro-chemicals must be taken out, in order to achieve quality standards (of Mozambique, at least). As farmers are not able to process the oil, a company with a factory is needed to buy the seeds, press and produce the oil out of them. Following, a company can either produce the biodiesel, or if the law requires that -as is the case of Mozambique now- the government distributor will agree to turn the oil to biodiesel and can then distribute it blended (19).

Advantages	Disadvantages
• One of the best two energy crops • grows very well in Ghana (25,36 a.o.) and is the best crop for biodiesel (more productive than e.g. soya beans) (F.D. Paiva). • does not need a lot of land and is (36)	• It needs a lot of water (35) • Yields in Ghana will probably not be as high as in some neighbouring countries, such as Nigeria and Ivory Coast→ lower regional competitiveness for Ghana (23) • risk of food security problems (19) • it takes around seven years before crop can be harvested

Table A.5. Advantages and Disadvatages of feedstock production from palm.

Note: Ghana is a net importer of palm oil. This on the one hand means that it is needed for food and on the other hand that it gives potential to substitute imports.

Conclusion: Palm gives a very good option for biofuel production in the areas where it is suitable. If it can be ensured that food security is not undermined, it becomes a very good option for a producer company, as well as for farmers to profit from it.

➔ **Options for business models:**

a) Most likely partnership model with outgrowers needs to be employed (preferably) with a nucleus of owned plantations. This is much favourable for palm oil.

b) In theory, a company could fully be based on the supply by small producers and only be a processor (as usually in Brazil) (36), but due to the importance of palm oil for food consumption, that is probably not a safe option, as smallholders may not be reliable suppliers. In these cases smallholders need to wait for seven years before they make the first harvest (if trees are not planted already), so for them growing palm trees for biofuels can be down as a secondary activity, by planting the trees as a hedge crop –similarly to jatropha- while continuing with other crops.

Sunflower

Scale: Small and large scale are possible, although somewhat debatable. Large is regarded as difficult for farmers, but can certainly not be excluded. Appropriateness for Ghana is also debatable[161]. The same treatment as with palm oil is needed, so that farmers are not able to process the oil (19).

In general, it is considered a good crop for biodiesel (18,35). However, as with maize, some believe that , if a country is a net food importer, growing it for biofuel is not a good idea (e.g. 16). Already during the desk research it was found that it can be produced by outgrowers (Hultman et al., 2012) (and as KIMMINIC does in Ghana[162]). The crop is increasingly popular in East Africa because seeds less sensitive to daylight have been developed and it can take place on small scale too (29) and in Tanzania small-scale production for cooking oil from sunflower took-off quite quickly (35)[163].

Products: biodiesel, sunflower oil for food consumption (cooking oil).

[161] Although this is outside the scope of this report and technical analyses need to determine that, 23 argued that sunflower is more appropriate to the Mediterranean climate and so much to SSA, using the example of a company (KIMMINIC) that is not getting good results, while 36 tends to have the opposite opinion, thinking it is interesting.

[162] Pers. comm. with 8.

[163] These two comments are of those cases, when it the interviews were able to provide evidence about new developments on business models, which would not have been found in the literature.

By-products/co-products: can be used for animal feed too.

Advantages	Disadvantages
• has high oil content (21) and high quality oil is produced (33) • it can be very profitable • can also be used for animal feed • it can take place on small scale too (29,35).	• is an international commodity, so that it is debatable whether it is a suitable crop (33). Possible conflict with use as cooking oil. • as with maize, if a country is a net food importer, growing it for biofuel is not a good idea (16). • The above already raises concerns about its social acceptability • Difficult for farmers to plant on large scale (21)

Table A.6. Advantages and Disadvatages of feedstock production from sunflower.

Conclusion: It is a crop with good possibilities in certain areas and produces good quality biofuel. The possibility to produce animal feed raises the chances of success when appropriate business arrangements are made.

➔ **Options for business models:**

a) A company using many outgrowers, who supply the sunflower is a favourable option.

b) As in Tanzania, small-scale farmers can also produce sunflower for local consumption, that is either processed into biofuel for transport or for edible oil.

Soya beans

Scale: It is applied on a huge scale in Latin American countries (like Argentina). In Mozambique it is done on small scale (35). Growing soy in the right way requires the use of a no tillage system164 (29), for which specific equipment is needed, so that it would be difficult to implement on a large scale in SSA countries at the moment (35). Perhaps it can start small and be gradually scaled-up. it is unlikely that it becomes possible for biofuels in African countries in general, but a feasible business case cannot be excluded, if all conditions are in place (ibid) .

Products: biodiesel

By-products/co-products: animal feed

Advantages	Disadvantages
• considered a good crop for Ghana, but not better than palm oil in any case (F.D.Paiva). • possibly mixed output along with biofuel, if used for cattle feed→ two industries can run in parallel (29)	• very intense in cultivation, so large monocultures are probably needed • it needs to be replanted every year (35). • high volumes need to be produced, which means that a good transport system is needed (35,29)

Table. A.7. Advantages and Disadvatages of feedstock production from sugarcane.

Conclusion: The crop has good possibilities, but has mainly been applied on a very large scale, that for African countries is somewhat scary. Further research could identify under which conditions it can be made a feasible option. The possibility to produce animal feed raises the chances of success when appropriate business arrangements are made.

➔ **Options for business models:**

[164] (not tilting the soil)

a) Very large scale has mainly been applied elsewhere. In theory it is possible for African countries too, but in fact many concerns would be raised in trying to implement that.

b) Perhaps, it can start on a small scale in a somewhat experimental manner and then be scaled up, if it is desirable.

iii) Summary of expected effects of various stimulation options

This section has been included with the purpose of bringing together all the findings regarding the expected effects of the stimulation options that have been presented in the main part of the report (simply clustered as advantages and disadvantages). That was deemed useful, in order for the interested reader to be able to have a complete and brief overview of the findings resulting from both the desk research and the interviews with experts. Additionally, a section with some further comments on the opinions of experts for the possible market orientation further detail is provided in the begining.

a. Opinions on market orientation (domestic use vs exports)

Interestingly, the answers in favour or against a particular orientation did not seem to vary depending on the background of interviewees. Rather, respondents seemed to stress their own concerns, while the sector of biofuels grows. Those with an orientation towards large-scale production tend to believe that the importance is on creating the enabling environment (e.g. 18,19,22) and that finding the market is a concern of the businessmen. Some respondents with a strong orientation towards international markets (all Europeans) emphatically argued against domestic consumption of biofuels in Ghana and alike countries, thinking that this is unrealistic (e.g. 23,38, 39). Those from the academia showed a moderate stance, arguing much in favour of examining local uses of biofuels too (e.g. 33,35,36) and stressing the prioritisation of objectives (32,36). Respondents from NGOs and small-scale businesses tend to acknowledge the difficulties and risks of the large-scale commercial production and therefore emphasise on the very beneficial and safe local uses of biofuels. Lastly, it was noticed by the researcher that the origin of people may affect the views of people on the possibilities for the production of biofuels. The African interviewees seemed more positive about the prospects, although all are well aware of the challenges (34,15,17,14), compared to the more critical respondents from outside Africa. Notably, the Ghanaian businessmen seemed more positive –at least about the potential- than all interviewees. Although it is out of our scope to judge their perceptions, it might indicate that the challenges in the international markets are not well-known before investments are decided. The following table summarises the advantages and disadvantages of an orientation towards exports.

Advantages	Disadvantages
• Starting at the local and national level first may be safer (29) • Job creation • Enhancement of the energy mix • Enhancement of energy security • Environmental benefit • Forms a base for the development of the industry (16,29) • Savings of foreign exchange • Local market enhances interest of local society in the sector→ drive in the academia and society, fosters development of skills can be gradually developed and knowledge can become more widespread (16,29) • Adding value domestically more beneficial in the long run from the public sector's perspective (29,32,35) • Confidence for the country. Different approach than the colonial one of producing with the sole purpose of exporting everything (16)	• May put a burden on the public budget • Questionable if adequate quantities can be produced and how soon (19,34, 38,39)

Table A.8. Advantages and disadvantages of the development of a domestic market for biofuels.

Advantages	Disadvantages
• Acquiring foreign exchange (important for the state and for the producers-investors) • the breakeven price energy companies in Europe can take (speaking for jatropha oil) is so much higher than the price that someone could get in Ghana→ export markets seem more lucrative for businesses • impossible to gain financial support for jatropha at present in Ghana, so the much needed equity will have to be found abroad and these foreign investors will want to buy the product (22,23,19). • Exporting to neighbor countries, such as Nigeria, may be an interesting move (ethanol for cooking) (25,16,30).	• Relying on exports may bring vulnerability, because these countries may take protective measures (e.g. EU import duties) (32,11). • Missed opportunity to gain all the benefits a domestic market provides

Table A.9. Advantages and disadvantages of an orientation towards exports.

b. Summary of impacts of po0licy options

Production subsidies

Advantages	Disadvantages
• Benefits like job creation and others • promote the development of local businesses (also entrepreneurship) and local development, because of wider job creation in comparison to the oil and gas industry. • can help cover the upfront costs that are high for businesses. • Contribution to transaction costs that biofuels entail.	• Subsidies are costly for the state budget • hard to control and in practice difficulties arise • often create addictions/ reliance and particular care should be taken to avoid that • Subsidies alone are not enough anyway(18,21)

Table A.10. The advantages and disadvantages of production subsidies

A compensation regime for biofuel companies

Advantages	Disadvantages
• Cushion for investors, at the riskier initial stages of investment • May save an investment, if financial contribution is given to a company, due to a sudden and unexpected problem, which can be overcome later.	• difficult to make the scheme fair and to keep track of how a company uses the money • May not be an appropriate role for the public sector, because it does not look at risk analyses, which banks look at (38) • Very risky money. It would have to come from private people investing in biofuel companies, but currently people are careful/hesitant and leaving that business (18,21) • Then difficulties would still remain (ibid) • The government should support an industry that already makes profit. Investors should carry the risks of their own choices (19,21).

Table A.11. The advantages and disadvantages of a dedicated fund for the support of biofuels companies.

Debt coverage

Advantages	Disadvantages
• Enables companies to borrow money • A guarantees system (if it is about sovereign guarantees) has certain limits.	• It does not work for other sectors well, so why would it work for biofuels? • politically questionable whether money from the taxpayers should be used to de-risk that business • probability that people with lousy business models will be recipients too, even though they do not deserve it • complicated when governments start to interact with private financial institutions • Probability that even with state guarantees, banks will still not accept the risk • (Guarantees for outgrowers would be an administrative nightmare with high transaction costs, which would possibly outweigh the value of it)

Table A.12. The advantages and disadvantages of debt coverage.

Price regulation

Advantages	Disadvantages
• difficult for a new product to come into the market at this scale without any price control → price regulation is a useful measure • a floor price only (guaranteed minimum price) –which can be adequate- is positive, due to not very strong state control. • useful, if export markets pose difficulties for some time, so that the production is driven for and absorbed in the domestic market (this way the industry can be protected, even if export-oriented) (32). • positive for companies if domestic-oriented; enables good planning.	• Danger that with regulated prices at the beginning the market created would be artificial. • also a kind of an indirect subsidy • risk of creating two fully separate fuel markets→ against efficiency improvements (32,38).

Table A.13. The advantages and disadvantages of price regulation for biofuels.

Bans /quotas and tariffs on imports

Advantages	Disadvantages
• Not beneficial to build an internal market. There must be openness to imports, so that the internal market benefits from the international competition	• export limitations can often end up being counter-productive (such as in Argentina)

Table A.14. The advantages and disadvantages of restrictive measures on imports of biofuels.

Bans /quotas on exports (or other restrictions, e.g. tariffs)

Advantages	Disadvantages
• Tariffs and quotas could provide assurance about building the domestic market and then to becoming competitive on the international market. • A response to the protective measures that developed countries also take for their markets • consumers will be guaranteed that there will be adequate volumes of product available	• Can be scary and even disastrous for the investment climate. They scare foreign investors and may lead them to abandon their business in the country (as happened in Mozambique). • Bans often create unresolvable distortions • Would harm investors, because they would lose the opportunity to acquire stable foreign currency. • quotas tend not to be enforced in countries with weak control systems. Similarly limitations like bans and tariffs may lead to "black trade"

Table A.15. The advantages and disadvantages of restrictive measures on imports of biofuels.