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List of Acronyms

AALS	Affirmative Action Loan Scheme
Agribank	Agricultural Bank of Namibia
AGRA	AGRA Co-operative Ltd.
BMZ	German Ministry for Economic Cooperation and Development
BoN	Bank of Namibia
CCF	Cheetah Conservation Fund
CBEND	Combating Bush Encroachment for Namibia's Development
CBNRM	Community-based Natural Resource Management
CDM	Clean Development Mechanism
CENORED	Central Northern Regional Electricity Distributor
CLB	Communal Land Board
CSA	Consulting Services Africa
DED	German Development Service
DIE	German Development Institute
DoF	Directorate of Forestry
DRFN	Desert Research Foundation of Namibia
EC	European Commission
ECB	Electricity Control Board
EIA	Environmental Impact Assessment
EU	European Union
FAO	Food and Agricultural Organization of the United Nations
FAME	Fatty Acid Methyl Esther
FDI	Foreign Direct Investment
FSC	Forest Stewardship Council
GHG	Green House Gas
GTZ	German Technical Cooperation
GRN	Government of the Republic of Namibia
HPI	Human Poverty Index
IAIA	International Association for Impact Assessment
IEA	International Energy Agency
IRES	Integrated Renewable Energy Solutions for the Rural Namibia
IPP	Independent Power Producer
IPPR	Institute for Public Policy Research

JPC	Joint Presidency Committee of NAU and NNFU
KfW	German Financial Cooperation
KJFA	Kavango Jatropha Farmers Association
KW	Kilowatt
LAC	Legal Assistance Center
LaRRI	Labour Resource and Research Institute
LLB	Lev Leviev Biofuels
LSU	Large Stock Unit
MAWF	Ministry of Agriculture, Water and Forestry
MeatCo	Meat Corporation of Namibia
MET	Ministry of Environment and Tourism
MLR	Ministry of Land and Resettlement
MLSW	Ministry of Labour and Social Welfare
MME	Ministry of Mines and Energy
MoF	Ministry of Finance
MoH	Ministry of Health
MoL	Ministry of Labour
MTCT	Mukwamahlanga Tukondjeni Community Trust
MTI	Ministry of Trade and Industry
MW	Megawatt
NAB	Namibian Agronomic Board
NAU	Namibian Agricultural Union
NBC	Namibian Broadcasting Corporation
NBRI	National Botanical Research Institute
NDC	Namibia Development Cooperation
NFWU	Namibian Farm Workers Union
NGO	Non-Governmental Organisation
NHIES	National Household Income and Expenditure Survey
NJGA	National Jatropha Growers Association
NOCEC	National Oil Crops for Energy Committee
NPC	National Planning Commission
NDP	National Development Plan
NNF	Namibia Nature Foundation
NNFU	Namibia National Farmers Union
NORED	Northern Regional Electricity Provider

NPC	National Planning Commission
OECD	Organization for Economic Cooperation and Development
OGEMP	Off-Grid Electrification Master Plan
Polytechnic	Polytechnic of Namibia
PPP	Public Private Partnership
PRS	Poverty Reduction Strategy
REEEI	The Renewable Energy and Energy Efficiency Institute
RD	Rural Development
R&D	Research and Development
RED	Regional Electricity Distributors
REEEI	The Renewable Energy and Energy Efficiency Institute
RPRP	Rural Poverty Reduction Programme
RSA	Republic of South Africa
SA	Stakeholder Analysis
SABS	South African Bureau of Standards
SADC	Southern African Development Community
SIA	Social Impact Assessment
SRF	Solar Revolving Fund
SVO	Straight Vegetable Oil
TA	Traditional Authority
TWH	Terra Watt Hour
UNAM	University of Namibia
UNDP	United Nations Development Programme
VDC	Village Development Committee
WBGU	German Advisory Council on Global Change
WWF	World Wildlife Fund

1 INTRODUCTION

> *"We face an unprecedented situation for our planet and mankind. It is expected the global population will peak around 9 billion people around 2050. That same population, despite huge inequalities, is richer than ever in history, creating peak demand for energy, food, water, space and every natural resource imaginable."*
>
> *(Faaij 2008)*

The above quote implicitly summarizes the duality that has been subject to heated debates in recent months and years, a duality commonly reduced to the slogan 'food vs. fuel'. Though seemingly a limited resource problem like any other, its repercussions are deemed enormous, leading numerous stakeholders to engage in the discussion, enthusiastically lobbying for their side. Contrary to popular assumptions though, it is not only advocates in fuel-hungry industrialized countries promoting the use of land resources for biofuel, or better bioenergy, production, but also proponents in many regions of the developing world are articulating their support.

In the scientific discourse, arguments in favour of crop cultivation for fuel/energy purposes rest on the following propositions. Firstly, biofuels can have the potential to contribute to greenhouse gas (GHG) reductions through improving GHG balance of energy use, particularly in the transport sector (de Castro 2007). This, so it is argued, can be fostered by mandatory blending requirements, running power stations on ethanol, biodiesel or biogas, among others. Secondly, the sustainable use of fuels derived from energy crops can be an important component in the transformation towards sustainable energy systems (WBGU 2008), therewith increasing national energy security. As to the International Energy Agency (IEA 2006), the share of renewable energy in global total primary energy supply so far amounts to only 14 per cent, with biomass and waste accounting for eleven per cent. Given that global energy demand is expected to at least double or possibly triple during this century (Faaij 2008), sustainable energy from biomass looks as a promising source to (at least partly) satisfy the world's hunger for energy. The third argument is based on the positive effects of bioenergy production on income, employment and rural development (cf. (Kammen 2006). By sparking demand for agricultural products, the creation of new value chains and attraction of investment in rural areas of developing countries, bioenergy production can add to poverty reduction and the achievement of the Millennium Development Goals, so the reasoning goes (cf. (FAO 2005); (FAO 2008).

In the light of all these positive impacts within reach, what criticism could possibly be levied against bioenergy production? The OECD (OECD 2007) chooses to answer this question by expressing doubts as to whether *"the cure is worse than the disease"*. Spelled out, the critical voices base their concern on one or more of the following assertions. Firstly, the GHG balance of bioenergy might be less positive than expected. According to German Advisory Council on Global Change (WBGU 2008), risks to climate change mitigation depend to a large extent on the land use changes undertaken for energy crop farming. Next up, worries are brought forth as to rising food prices as a consequence of competition for feedstock, land, water and other resources (cf. (Faaij 2008); (FAO 2008). An increase in the cultivation of energy crops could eventually lead to a coupling of the markets for energy and food, rendering food prices susceptible to the dynamics of the energy markets (WBGU 2008), possibly threatening food security. Thirdly, a massive increase of land use for bioenergy production intensifies the pressure on natural resources such as soil and water,

exacerbating land-use conflicts, and can pose risks to biological diversity (cf. (IEA 2008). Lastly, the distribution of revenues from energy crop sales could be skewed towards agro-industry, only leaving marginal economic advantages for small holders in rural areas.

In Namibia, potentials and threats of bioenergy production have been and are discussed along the same lines as delineated above. So far, the Government of Namibia (GRN) has issued relevant legislation in the areas of energy (White Paper on Energy Policy, 1998), rural electrification (Rural Electrification Master Plan 2000/2005) and new agricultural initiatives. Even a 'National Bio-oil Road Map' was drafted in 2006, setting ambitious goals for Jatropha schemes. However, neither are food security and rural development effects of bioenergy production explicitly dealt with in any of these papers, nor is a bioenergy policy in place. No substantial political effort has been made to implement the far-reaching bio-oil plans, possibly due to a neither clearly stated nor substantiated fear of negative effects. Also, Non-Governmental Organizations (NGOs) and academia have, as of yet, neglected to take on the challenge of clearly depicted possible ramifications of bioenergy production.

Due to the apparent room for further research, the neutral though critical analysis of opportunities and threats of Namibia´s bioenergy potential will contribute to stakeholders' opinion formation on the topic. The present study adds to this process by:

- assessing the opportunities and threats of bioenergy for poverty alleviation, food security and pro-poor rural development in Namibia, and developing criteria that allow judging the situation in a given context;
- assessing the instruments (policies, institutions, organisations) needed and available to regulate, guide and possibly support bioenergy production in the different sectors and policy domains;
- analysing the two bioenergy value chains most promising in the Namibian case: (a) Jatropha curcas production for biodiesel; (b) conversion of woody shrubs (bush) into bio-energy (charcoal, woodgas for electrification and woodfuel briquettes).

Our working hypothesis is:

> **Given certain preconditions, bioenergy value chains can support pro-poor rural development and food security.**

Our research questions reads:

> **What can Namibia do to make bioenergy value chains support pro-poor rural development and food security?**

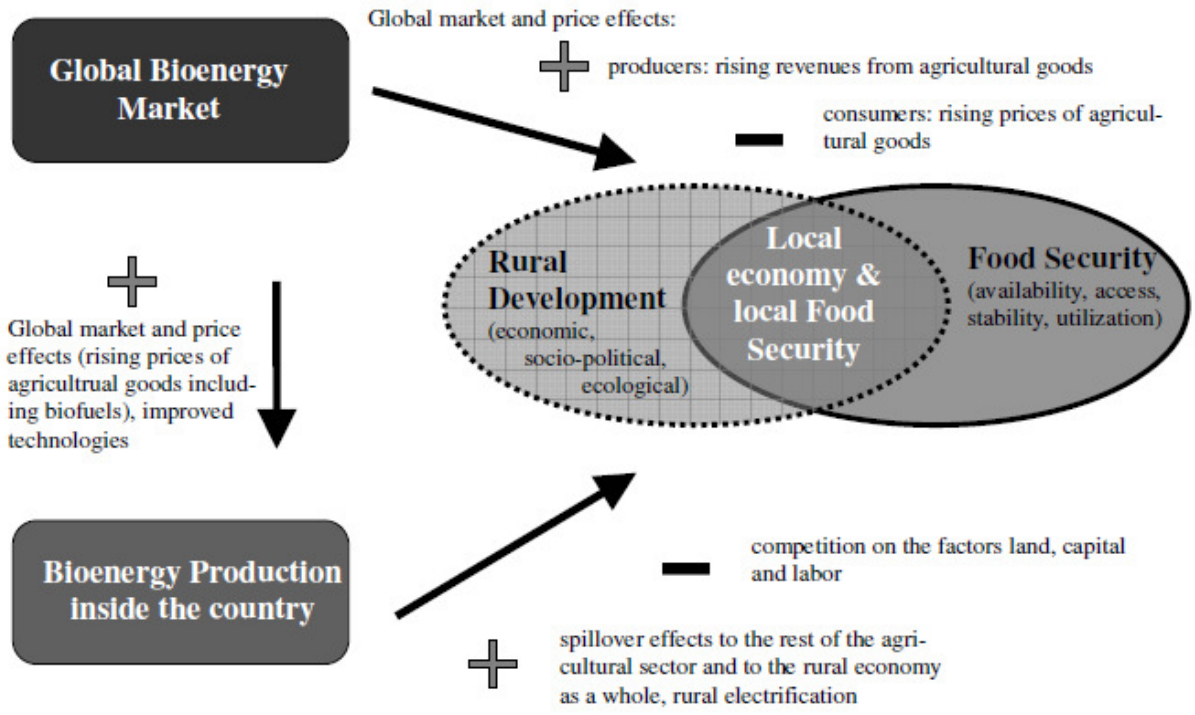
We shall first provide the conceptual background to our research undertaking (chapter 2), and then describe the methodological approach (chapter 3). Chapter 4 deals with rural development and food security in the Namibian context, opening the stage for our empirical approach, followed by analyses of bush (chapter 5) and Jatropha (chapter 6) value chains, business models and impacts. Chapter 7 will merge and discuss the findings of the Jatropha and bush chapters, chapter 8 concludes and gives recommendations.

2 BIOENERGY PRODUCTION AND ITS IMPLICATIONS FOR PRO-POOR RURAL DEVELOPMENT AND FOOD SECURITY

As pointed out in the previous chapter, the international debate on bioenergy is frequently limited to the topic 'food vs. fuel', meaning fuel for vehicles. Hereby, developing countries are mostly seen as victims of rising agricultural prices provoked by increased biofuel consumption in industrialized countries. The effects resulting from bioenergy production inside the developing countries are often neglected or reduced to criticism regarding the exploitation of small farmers and workers in large scale plantations. This chapter will define mechanisms through which both, the global bioenergy market and bioenergy production inside a country, can positively and negatively, directly and indirectly, affect rural development, poverty reduction and food security of developing countries.

In this study the main focus is not put on national food security but on the food security of the stakeholders of a bioenergy value chain. Also, not rural development as a whole is regarded, but certain aspects of rural development relevant to agricultural production and food security.

Figure 1: Impact triangle



Source: Authors' design (2009)

Bioenergy & Biofuels

As definitions of the terms 'bioenergy' and 'biofuels' vary, we will briefly introduce the definitions used in this paper: bioenergy is the final product derived from biomass whereas biofuel is the energy carrier. The public debate often merely classifies liquids as 'biofuels' (WBGU 2008), 23). FAO, however, also includes biogas and solid materials (such as fuelwood, charcoal and wood pellets) into the term. We adopted this definition (FAO 2008),

10).

The liquid biofuels most widely used today are ethanol (currently mostly produced from sugar and starch crops) and biodiesel (produced from vegetable or animal fats). Technologies of the '2nd Generation of Biofuels' convert any biomass such as wood, tall grasses as well as forestry and crop residues (lignocellulosic materials) to liquid fuels.

Pro-poor rural development

The introduction of a bioenergy value chain in a developing country can have positive and negative effects on rural areas through social, political, economic and ecological channels. These four dimensions of rural development can, in turn, affect the food security of a region (BMZ 2001), 7). The four dimensions of rural development compete in some areas such that fostering one dimension might bring disadvantages to another. In this study, we will combine the social and the political effects into the category 'socio-political'.

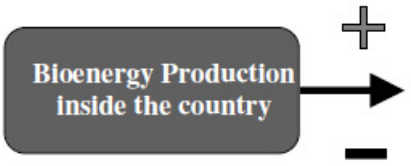
About 75 per cent of the poor in developing countries live in rural areas and the vast majority of them depend directly or indirectly on agriculture. Rural areas are often characterized by isolation from markets and service centres, limited infrastructure, unemployment, lack of livestock and scarcity of cash income sources. Rural development is meant to have a strong poverty notion, i.e. 'pro-poor rural development' is the normative basis against which to judge the effect of biofuels in this study. After attention to rural and agricultural development experienced a steep decline in the last two decades it has recently been rediscovered by development cooperation (World Bank 2007), V; (Levine and Roberts 2007),13).

Box 1: Definitions of 'poverty' in the Namibian context

The Namibian government measures the income-poverty of its population by using a food share ratio. Households are considered 'poor' if more than 60 per cent of their total consumption expenditure is devoted to food. Households with a food share over 80 per cent are considered 'severely poor'. The weak point of this method is that the food share of total consumption generally differs across households for reasons unrelated to poverty and rather reflects differences in the relative prices, tastes and availability (Levine and Roberts 2007), 18). In addition to this method, the UNDP calculates the Human Poverty Index (HPI). The HPI concentrates on three dimensions: life-expectancy, literacy and income (deprivation of longevity, deprivation of knowledge and deprivation of standard of living). By including the deprivation in two more dimensions the HPI broadens the traditional income measure (UNDP 2007), 8).

Depending on who participates in a bioenergy value chain and how the participation is organized, rural development is strengthened or weakened. Such effects can comprise:

Table 1: Effects of bioenergy production on rural development



Rural Development	Areas possibly affected (positively and negatively)
Economic	Income
	Opportunity Costs
	Spill-overs & Trickle-down
	Land
Socio-Political	Health & Education
	Social Structure & Power Relations
Ecological	Biodiversity
	Water
	Soil
	Carbon Sink

Source: Authors' design (2009)

The influence of a bioenergy value chain on rural development is not one-sided: The more "developed" a region is the easier it is to base a new value chain upon existing markets, infrastructure and know how.

Food Security

Since bioenergy value chains have an impact on all dimensions of rural development, they can also influence the food security in positive and negative ways. The introduction of a new value chain can, for instance, influence the quantity and quality of agricultural products, the conditions which people live in and the income and resources they dispose of. All of these factors affect, again, household and also national food security.

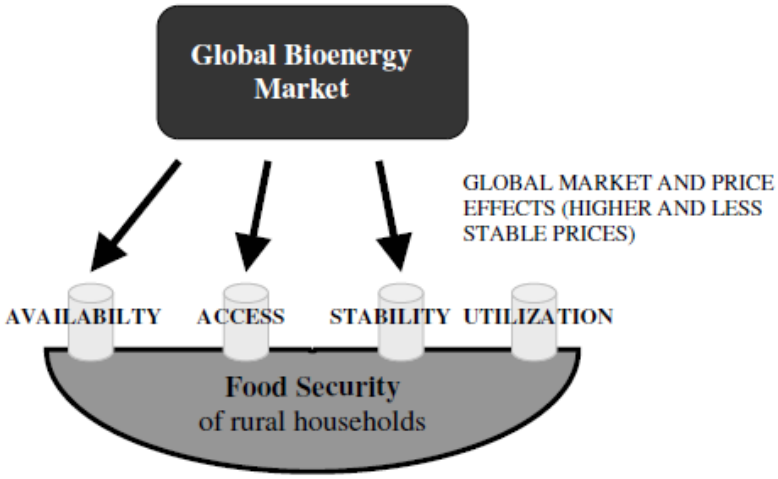
It is therefore necessary not to consider mere 'food self sufficiency' but to use a wider definition of food security, such as the one adopted by the 1996 World Food Summit:

"Food security exists when all people, at all times, have physical, social and economic access to sufficient amounts of safe and nutritious food that meets their dietary needs and food preferences for an active and healthy life."

Following this definition, FAO distinguishes four pillars of food security, namely: availability, access, stability and utilization (FAO 2009). This definition shows that when analyzing the connections of food security and bioenergy neither can one only consider the affordability nor solely the amount of food produced on household level.

When the impacts of an increased bioenergy demand on food security are discussed, the effects on the macro level have gained the most attention among all potential pathways. Here, mostly the (economic) access and the stability pillar play a role. The availability pillar may be influenced in the long term.

Figure 2: Global bioenergy market impact on food security



Source: *Authors' design (2009)*

As many African countries are net food importers, they are especially vulnerable to the effects caused by an increased global production of liquid biofuels. Major agricultural producers, such as Brazil, the USA and the EU increase their import of feedstocks for biofuels and/or reduce their exports of basic feedstock commodities in order to use them in domestic biofuel industries. Thereby, they provoke a joint effect of raising prices of feedstock and consequently also of food and animal feed. The extent of this price push is, however, strongly debated, ranging from 3-70 per cent for maize, the most important feed stock competing with food. Other factors contributing to the rising international prices of agricultural products include: weather related poor harvests, increasing fuel costs, population growth and urbanization as well as the changing structure of demand in some countries and exchange rate fluctuations (FAO 2008), vii). While some parts of the population of developing countries suffer from the rising commodity prices others profit from it. Here, one has to differentiate between consumers and producers as well as between developing countries which mainly import or mainly export agricultural goods. Also, short and long term-effects have to be taken into consideration.

The food security of poor rural households in developing countries can be affected by an increased global demand of biofuels as follows:

Availability: In the long term, the rising agricultural prices can cause farmers to increase their total agricultural production. As a possible consequence, more local food might be available in developing countries in the next years.

Access: The strongest point of criticism regarding biofuels is that the rising international prices of food crops limit the economic access to food for poor countries (net importers of food). The severe food insecurity in many developing countries in the last years and the resulting riots have led to a global debate on this topic.

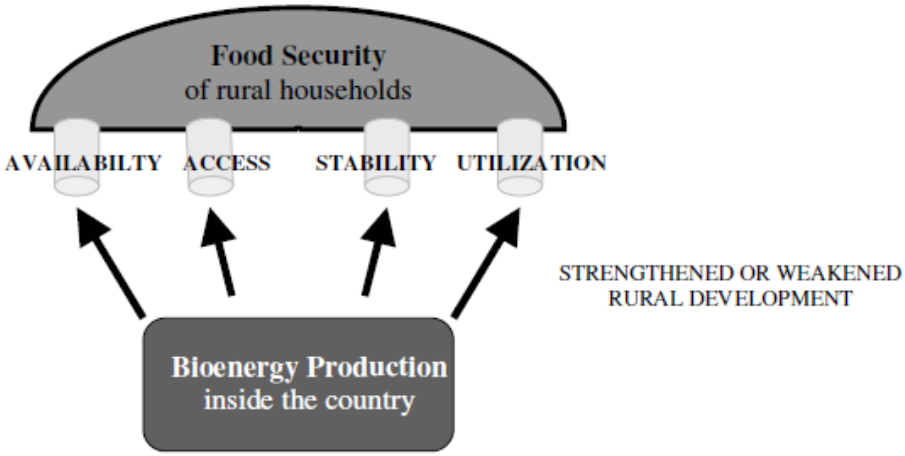
For producers and exporters, however, the rising commodity prices make agriculture profitable again. A positive effect can, therefore, be noticed on farmers and farm workers by

increasing their revenues, income and possibilities of income generation (WBGU 2008), 5).

Stability: Another negative effect of the global bioenergy demand is the fact that the energy and the food market are linked. These linkages lead to a dependency of the international food prices on the dynamics of the energy sectors. This dependency on the energy market also influences the stability of agricultural imports and, consequently, of food security (WBGU 2008), 5).

Both positive and negative effects of bioenergy production on the food security of a developing country can also be noticed if the bioenergy is generated inside a country. Through the introduction of a new value chain, direct changes as well as profound side-effects on the local production system and food markets can be caused.

Figure 3: Bioenergy production inside the country and its effects on food security



Source: Authors' design (2009)

As mentioned above, the rising prices of agricultural products and the potentials of bioenergy production make agriculture more profitable and therefore bear great potential for rural development. Besides these economic effects, however, the ecological and socio-political channels of rural development also play an important role. Through various mechanisms the different stakeholders of a bioenergy value chain can be positively and negatively as well as directly and indirectly influenced. This can have an impact on food security on household, regional and country level.

Food security of poor rural households in developing countries can be affected by the introduction of a bioenergy value chain as follows:

Availability: When analyzing the impacts of a bioenergy value chain in the local context, attention must be given to possible effects of biofuel production on food markets. As biofuel and food production may compete for land, labor and water, food shortages might be caused. The vulnerability of a region depends on the sensitivity of local food markets to changes in demand and supply (which will be larger if markets are small and isolated and lower if markets are large and open). Particularly in Sub-Saharan Africa small local food markets are highly vulnerable to natural variations due to a lack of irrigation, pesticides, other yield and storage loss reducing technologies and high transportation costs.

However, concerning competition for the factor land it must be noted that in many African regions unused land is still available offering opportunities for agricultural activities.

Furthermore, some crops for liquid biofuel production, such as Jatropha curcas, are said to be able to help recover degraded soils. Such crops, therefore, offer a higher probability to be non-competitive regarding the factor land. On the other hand, a profitable cultivation of a cash crop is unlikely to take place under poor agricultural conditions. If a farmer decides to grow Jatropha as a new income source he/she will allocate fertile soil, irrigation, labour and other inputs to this new activity. Depending on the opportunity costs, it is thus possible that labour, capital, land and water formerly used for food production are shifted towards the production of biofuels. This might affect the availability-pillar of food security in a negative way and bears the potential for social conflicts.

The '2nd Generation of Biofuels' and the production of biogas raise hope of partially avoiding this competition between food and biofuel production in the next ten to fifteen years. No competition for land exists if waste products or rampant plants are processed. If encroached agricultural land is made usable for agriculture again, food production and therefore food availability would even be supported. However, competition over the factors capital and labour may continue because the farmer has to hire workers and eventually needs to acquire costly equipment to clear and process the plants. Also, it is not clear if all materials used for bioenergy production can truly be classified as 'waste' or 'rampant'. In many cases they would have been used differently. For instance, grasses and bushes might be important for grazing (livestock and wildlife) or traditionally be used as fire wood. Straw might serve as feed supplement, thatch or a soil fertilizer.

As mentioned above, one possible long term effect of the globally rising agricultural prices is that they might cause farmers to increase their total agricultural production. This would mean, that more local food will be available in developing countries in the next years. Such a positive influence on food availability might also be the case in regions where bioenergy value chains are introduced: the development of such a value chain can encourage investment and innovation in the agricultural sector as a whole and therefore indirectly increase the local food production.

Access: If the production of bioenergy is fostered, revenue and incomes in the agricultural sector potentially increase. A farmer who produces biomass for bioenergy and sells it successfully improves his/her economic access to food.

Additionally, the introduction of a biofuel value chain might cause spillover effects on the rural economy as a whole. These advantages can be reached through various linkages such as better cultivation techniques, a higher mechanization, an enhanced access to financial services, more efficient input and output markets, improved managerial skills, stronger farmer associations and a better local infrastructure. Second round effects might also affect sectors forward and backward linkages of agricultural production such that both on- and off-farm activities improve. A resulting increased purchasing power of the rural population enhances, in turn, their economic access to food. Moreover, bioenergy may provide affordable energy in remote areas which are not included in energy grids or where the transportation costs of fossil fuels are too high. This, again, can create favorable conditions for the rural economy.

Stability: The stability of national food production of many African countries is rather weak due to recurrent droughts and floods. Introducing cash crops for bioenergy production might further disturb the environmental balance and the biodiversity of the region. On the other hand, recovering degraded soils by planting cash crops and clearing encroached areas for bioenergy based on lignocellulosic material might be positive for the environment and subsequently for food self sufficiency. Bioenergy value chains offer special reliability if they are based on perennial and resistant plants or biomass which is already abundantly available.

Regarding the economic effects, the introduction of a bioenergy value chain can create employment opportunities for the rural poor. A diversified livelihood can improve the stability of a household´s income and therefore of its food security. Also, through the commercialization of agriculture, more capital is brought to areas which were formerly characterized by subsistence farming. This brings more security and stability to rural areas.

Utilization: The utilization-pillar of food security refers to health and nutrition factors and is rather complex. It can be influenced, amongst others, by education, income and gender issues, availability of water and customs of food preparation such as cooking with firewood. Here, rural development as a whole and also the usage of bioenergy as well as the integration into a biofuel value chain can have negative and positive impacts, concerning, for instance, the usage of biogas for cooking, the educational background of the stakeholders, the variety of goods available on local food markets, the effects of agricultural production on the water use and quality and the involvement of women in value chains. As effects of bioenergy production on the utilization-pillar of food security are rather indirect, they will not be covered in this study.

It has been pointed out that food security on the household-level is not only a result of food production, but of affordability and socio-cultural aspects of food preparation as well. When observing the impact channels of bioenergy production on food security, all stakeholders, mechanisms and relevant local markets have to be included into the considerations. Not only the farmers growing cash crops for liquid biofuels or owning land rich of lignocellulosic material are influenced by an enhanced production of bioenergy, but also the people living in the same households and communities, the local companies, the employees, the self-employed rural workers, the smallholders´ associations and the local governments. Thus, a variety of actors and complex causal relationships have to be regarded when investigating the opportunities and threats of bioenergy for pro poor rural development and food security. The likelihood that a biofuel value chain is pro-poor increases if more value-added is created in the region and if the poor directly participate in the value chain.

In the country specific context it must therefore be analyzed which stakeholders are affected by the introduction of a new value chain and which institutions can influence the bioenergy production in a way that the rural poor benefit from it.

3 METHODOLOGICAL & EMPIRICAL APPROACH

This chapter describes the methodological approach used to analyze the effects of bioenergy production on food security and rural development. The overall analytical framework builds on four theoretical concepts, namely the Value Chain Approach, Stakeholder Analysis, Institutional Analysis, and Impact Analysis.

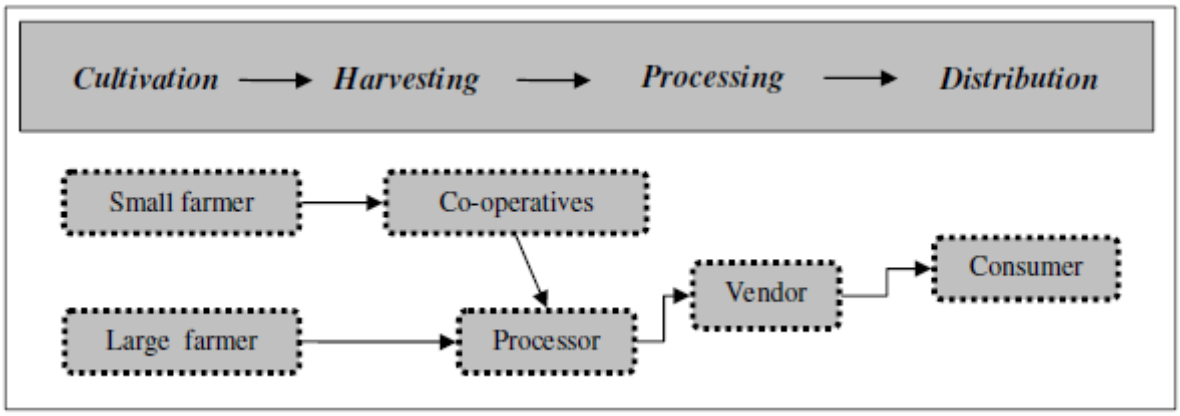
3.1 Basic Concepts

Value Chain Approach

"The value chain describes the full range of activities which are required to bring a product or service from conception, through the different phases of production […], delivery to final consumers, and final disposal after use" (Kaplinsky and Morris 2001), 4). Consequently, the Value Chain Approach assumes that the entire profitability as well as the distributional effects of a given bioenergy technology will be dominated by the efficiency of the internal organization, the costs of production and processing, the institutional arrangements of production and exchange as well as bargaining power of the involved actors.

A basic component of all value chain analysis is its structure of input-output relations (Figure 4) that identifies the important functions (cultivation, harvesting, etc.), actors (dotted boxes) and product flows (arrows) as a basis for further analysis.

Figure 4: A basic agricultural value chain



Source: Authors' design (2009)

As the different functions of the value chain are fragmented among actors, linkages between-those actors receive central attention. The coordination of those relationships is referred to as 'governance', reflecting the fact that some deliberate coordination in recurrent business relations is necessary, be it through anonymous markets or contractual agreements. In this chain of relationships some actors might have the power to determine parameters which have consequences on other participants up- or downstream (Kaplinsky and Morris 2001). Furthermore, an important feature is the distributional effect due to differences in returns and barriers of entry to certain functions or segments that might be acquired by the actors (ibid.,

42).

By analyzing the governance and distributional structures the value chain approach can be used for upgrading the chain by identifying 'leverage points', i.e. finding the key constraints and opportunities that have the potential to advance or impede upgrading (GTZ 2007).

Impact Analysis

Whereas the focus of value chain analysis is on actors *within* the chain, important effects of bioenergy production are assumed to happen outside the value chain, particularly effects regarding food security and rural development. The study, thus, introduces a second analytical dimension, namely Impact Analysis.

In the classic 'development studies' sense, *"impact analyses examine the impacts of interventions to determine what contribution they have made to the achievement of an overriding objective of development policy"* (Neubert 2004), 1). Here, we shall stick to this definition, albeit introduce theoretical and practical boundaries: firstly, we cannot evaluate all the impacts of a bioenergy value chain ex-post but will only do so ex-ante, secondly, we do not aim at *"proving impacts"* which, as to Thilo-Körner (Thilo-Körner 2004), 4), is a central element of Impact Analysis, and thirdly, the application of standard terminology (input, activity, output, outcome, impact) is not relevant in our case, given that we are not looking at a distinct intervention but at complex value chains that are not even in place.

Following Scharpf's (Scharpf 1982), 92, authors' translation) definition, 'impact' is understood as *"the changing of a situation due to the changing of another situation"*. Thilo-Körner (Thilo-Körner 2004), 2) opts for a similar definition but stresses that whatever change occurs to a given situation has been provoked by a prior '*intervention'*. It is recognized that impacts can be both positive and negative, can happen on a variety of levels (institutional level, household level, etc.), develop in the short- medium- and/or long-term, and can be expected or unexpected results of an intervention. In reality, factors leading to a certain impact could stand in a reinforcing relation, be the trigger for synergy effects, constrain or even neutralize each other. Given their interdependencies, changes in the socio-political, economic, and ecological sphere are likely to provoke alterations in each others' habitat (cf. (IAIA 2003); Mayntz in (Neubert 2004)).

Consequently, impact chains aim at providing a picture, of the relation between cause and effect, impact and consecutive impact, the link between impact and impact recipient, and the connection between causer and impact recipient. Sections 5.3 and 6.3 describe such impact chains for the bush and Jatropha value chains with regard to food security and rural development.

Stakeholder Analysis

A further concept used in this study is Stakeholder Analysis (SA), given that various actors are involved in bioenergy production, carrying different interest and perceptions. They are either directly or indirectly affected by or they exert influence on bioenergy policy or production. Moreover, it is important to keep in mind that stakeholders also exist *outside* the value chain, however not less affected than the ones within the chain. Therefore, SA is a necessary tool for undertaking ex-ante socio-economic and political impact chain analyses of bioenergy value chains.

The most widely used definition of a 'stakeholder' today stems from Freeman's (Freeman 1984) influential work on strategic management, which defines stakeholders as *"any group or individual who can affect or is affected by the achievement of the firm's objective"*.

Freeman extended the definition to not only include *"the firm's objectives"* but also 'actions', 'decisions', 'policies', 'practices', or 'goals' of an organization or institution (Carroll and Buchholtz 2000).

Borrowing from Grimble/Wellard (Grimble and Wellard 1997), Mitchell et al. (Mitchell, Agle et al. 1997), Chevalier (Chevalier 2001) and the European Commission (EC 2004), SA's aims are

to identify whose problems and opportunities are analyzed,

to categorize stakeholders that may influence or are influenced by a system,

to develop an understanding of how this influence manifests itself,

to consider power relations and disagreeing interests, and

to find out who can make change happen.

In the process of problem identification, objective and strategy setting, individual concerns, capacities and interests of the respective stakeholder have to be understood and recognized (EC 2004), 61). Furthermore, in the context of development projects it is usually considered a fundamental purpose of SA to include distributional and equity concerns so as to effectively address the needs of marginalized groups (ibid., 61).

Institutional Analysis

For this study, three issues make it important to analyze institutions. First, rules of production, transformation, sales and interaction among actors of value chains determine the production and transactions costs and thus the incentives to initiate value chain operation (the economic efficiency-issue). Second, they determine the distribution of costs, benefits and risks among stakeholders and the criteria to include the poor and disadvantaged into value chains (the equity or pro-poor issue) (Eaton and Meijerink 2007). This can be called direct or first-round development effects. Third, institutions determine whether broad development effects, the indirect or second-round effects, take place (Dorward and Kydd 2005).

Markets and value chains can be understood as institutional systems (Dorward and Kydd 2005); (Eaton and Meijerink 2007); (Vermeulen, Woodhill et al. 2008). On the one hand, they are characterized by certain institutional arrangements to exchange resources between actors and groups. On the other hand, markets are determined by other formal (e.g. property rights) and informal (e.g. customary law, traditional land use rights) institutions which influence trust among market participants and thus condition behavior of actors. Usually, a variety of formal and informal forms co-exist, frequently complementing each other.

A detailed framework for analyzing the influences of institutions on value chain functioning and pro-poor development was developed by Vermeulen et al. (Vermeulen, Woodhill et al. 2008) and GTZ (GTZ 2007) (see Table 2).

Table 2: Institutions for Economic Development

Level of institutions	Functions of institutions	Institutions supporting exchange
Meta-level	Institutions as ways of creating meaning	Cultural and religious beliefs and values Scientific and conceptual frameworks for explanation

Macro-level	Institutions as basis for control over individuals and organizations	Mandates, strategies and policies. Formal rules and regulations and informal rules
Meso-level	Institutions as associations to achieve social, economic and political objectives	Government, business and civil society organizations Relationships, agreements and interactions between organisations
Micro-level	Institutions as recurring action carried out by individuals or organisations	Regular provision of services, functions and products Regular patterns of behaviour by groups and individuals

Source: *Adapted from Vermeulen et al. (Vermeulen, Woodhill et al. 2008) and GTZ (GTZ 2007)*

Applying the above concept, the study analyzes institutions on various levels that influence value chain immanent issues and chain efficiency. Also, the two levels of equity, i.e. inclusion or exclusion of the poor and disadvantaged as well as wider development effects, are scrutinised.

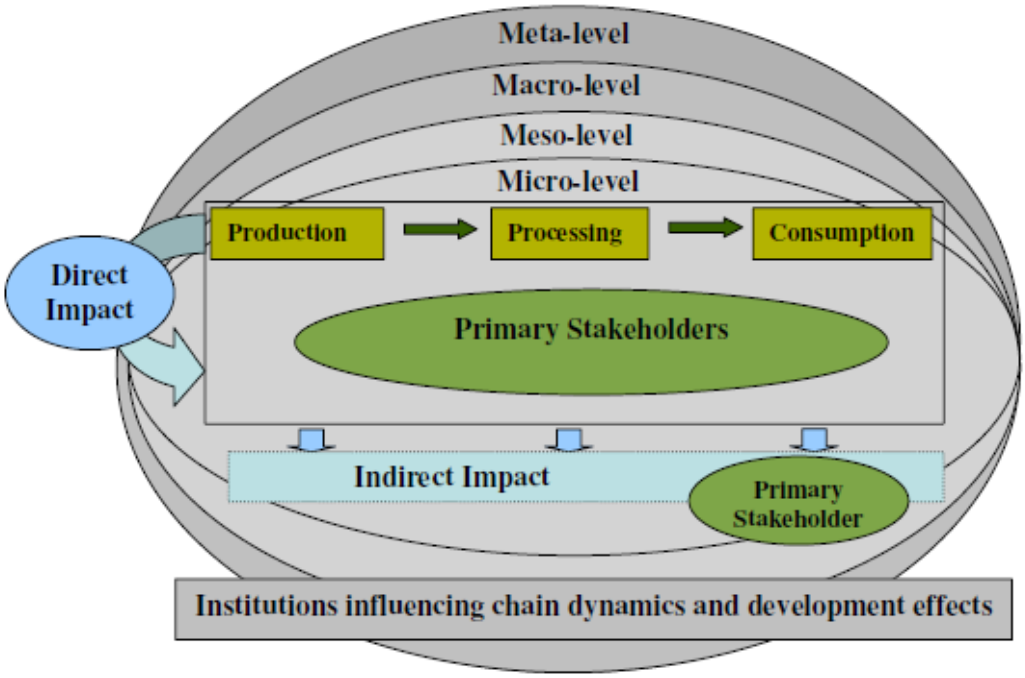
The next step, then, is to identify leverage points ('Drivers of Change'), often key institutions, that have the potential to frame bioenergy production in such a way as to positively impact on food security and rural development. Public policies (price and blending policies, land reforms) will thus receive central attention in this study.

3.2 Conceptual Framework and Analytical Steps

So far, four theoretical concepts have been briefly delineated, namely the value chain approach, stakeholder analysis, institutional analysis, and impact analysis. Here, these shall be combined and visualized.

Departing from a 'naked' value chain, the question arises as to the explanatory potential of such a heuristic. Arguably, it does not take an advanced social science degree to identify at least two elements well suited to add substance to the otherwise actor-deprived chain – stakeholders and institutions. If, now, also the idea of an impact chain, i.e. a series of impacts causing new impacts, is included, we arrive at a compact yet all-embracing model of social interaction (see Figure 5 below). Our approach differs from other value chain analyses as it focuses not only on effects within the value chain (economic effects on small farmers and workers) but also on wider, indirect development effects (three dimensions of rural development and food security).

Figure 5: Conceptual framework



Source: *Authors' design (2009)*

The analysis will start with an ex-ante scrutiny of potential and existing value and impact chains, institutions and stakeholders in order to formulate ideas and assumptions about their functioning. These assumptions are then checked by means of key-informant interviews and literature review. The approach is inductive and must continuously be critically revised, building up on reality-checks. As a last step, recommendations will be made rearding how to make bioenergy value chains benefit (or at least not hamper) food security and rural development. Our analytical steps are depicted in Table 3 below.

Table 3: Analytical Approach

Analytical Step	Key Elements
(1) Value Chain Mapping	Description of the value chain, the actors and product flows Analysis of product markets and barriers to entry (critical success factors)
(2) Identifying Key Stakeholder	Identification of key stakeholders (actors) at various stages of the value chain that are directly and indirectly affected
(3) Assessing potential development effects	Mapping of potential (intended/unintended) development effects
(4) Institutional and Policy Mapping	Identification of main formal/informal institutions affecting the chain identification of secondary stakeholders Identification of other institutions important to create wider development effects

(5) Mapping options for institutional change	Identification of options to make bio-energy production beneficial for food security and rural development Identification of 'drivers of change'

Source: Authors' table (2009)

3.3 Applied Methods

Our methods are of an explorative, iterative and interlinked nature (Grounded Theory), rather than a simple sequential one (c.f. (Mayoux 2003); (Meyer-Stamer and Wältring 2007); (Vermeulen, Woodhill et al. 2008). This is due to the fact that the study looks at bioenergy production in its initial phases, i.e. value chains either do not exist at all or are but initiating. Also, this approach reflects the difficulty inherent in clearly depicting a causal relation between impacts and effects, as well as in identifying 'drivers of change' from an ex-ante point of view.

The selection of interview partners was guided by a non-random purposive sampling technique (c.f. (Nichols 1991). In doing so, we systematically searched for interview partners with special knowledge in our research field (snowballing), always keeping in mind our working hypothesis, research question and potential impact chains. In the course of our research, we kept cross-checking obtained information (triangulation, c.f. (Chambers 2000); (Mikkelsen 2005) in order to both confirm it and follow up on questions that arose and had been left unanswered.

We conducted about 130 expert and/or key informant interviews (see table 6 in the annex) using the semi-structured technique, ensuring that the interviews were structured around core points whilst simultaneously allowing the interviewer the flexibility to pursue specific avenues of interest that arose during the interviews (Willis 2006). The guiding questions were adopted to the varying situations and target groups, demonstrating a learning curve in that they became more specific over time.

In order to speak to our target group (farm workers and small scale farmers), we travelled to the respective and potential production sites, accompanied to local research assistants. We identified these interview partners with the help of our local partner organisation, again making use of the snowball principle. Here, both single interviews and group discussions were conducted, depending on local customs, circumstances and prior experience. See figure 13 in the annex for our fieldwork route.

4 RURAL DEVELOPMENT AND FOOD SECURITY IN NAMIBIA

4.1 Introduction to Namibia's Development Challenges

Economy & Population

Namibia is classified as a middle-income country with an annual per capita income of US$ 3,360 in 2007 (World Bank 2008). However, Namibia's Gini coefficient of 0.7 is among the highest of the world. Namibia has a relatively small open economy closely linked to the Republic of South Africa (RSA). Industry and mining account for 30 per cent of GDP and over 75 per cent of exports (diamonds, metal and uranium ore). Other main economic sectors are fisheries, fish and meat processing, and services. Agriculture accounts for 6 per cent of GDP (OECD 2009).

While overall economic growth accelerated to an average of 4.7 per cent per annum during the last years, the total number of people employed declined and the unemployment rate, in particular youth unemployment, increased (NPC 2008), 44). The overall unemployment rate is high at 36.7 per cent and rural-urban disparities are large (44.7 per cent in rural vs. 29 per cent in urban areas) (NPC 2008), 32). Namibia's economy is also affected by the global economic crisis as commodity prices in the mining sector continue to drop. Growth for 2009 is estimated at 3.4 per cent and expected to drop to 2.7 per cent before recovering. In addition, floods in Northern Namibia in early 2009 have adversely affected agriculture and damaged infrastructure. (OECD 2009).

Another aspect that impacts negatively on the Namibian economy is an overall HIV/AIDS prevalence rate of 20 per cent (MoH 2004). As a result of the AIDS pandemic, life expectancy is set to drop to just 45 years by 2010 (UNDP 2004) .

According to the UNDP Human Development Report 2007, Namibia is making progress towards the first of the Millennium Development Goals, to eradicate extreme income poverty. However, when the poverty definition is expanded to include other measures of essential human capabilities, national poverty levels are in fact increasing (UNDP 2007). Lack of wage employment, low productivity in subsistence farming and lack of access to credit and financial services have been identified as key contributors to poverty in Namibia (UNDP 2004), 11). Access to basic education has become more equitable and primary health care coverage is more widespread. However, drop-out rates are high already in primary school (23 per cent in 2005 – (NPC 2008), 26) and significant rural-urban disparities exist in access to public services. People living in rural areas have lower than average literacy rates and less access than urban dwellers to education, health care and employment opportunities. Only 6 per cent of the population in urban areas are poor by the national income definition (see Box 1 in chapter 2) compared to 45 per cent in the rural areas, and 50 per cent or more in the northern areas of Kavango, Omusati and Oshikoto (Odendaal 2006).

Since its independence, Namibia has established various agencies, strategies and programmes with the objective of contributing to national development and poverty reduction. The most important actor in this field is the National Planning Commission (NPC), which has been defining Namibia's national priorities and directing respective plans and policies since 1994. It coordinated the Vision 2030, the Poverty Reduction Strategy (PRS) as well as the National Development Plans (NDP 1, NDP 2 and NDP 3) and regularly publishes the progress reports on the Millennium Development Goals. Vision 2030 and PRS serve as a

common framework and a broad guideline for Namibia's NDPs. According to both documents Namibia is expected to become a highly urbanized country in the long term. However, the big discrepancy in wealth is seen as a short term problem that needs to be tackled immediately. Concerning the rural communities, PRS states that they could diversify and increase their income through tourism and small and medium sized enterprises. Hereby, the land titling problem is considered one of the main obstacles for obtaining bank credits (NPC 1998). The needs of the rural communities are also in the focus of the current National Development Plan (NDP 3 2007/2008 - 2011/2012) whose overall theme is "Accelerated Economic Growth and Deepening Rural Development". NDP 3 fosters activities concerning rural infrastructure and the diversification of income sources. It also gives special attention to land tenure problems and to the needs of the rural youth.

NPC also coordinates the Rural Poverty Reduction Programme (RPRP), a multi-sectoral programme funded by the European Commission. The Programme's interventions include: rural infrastructure (roads and water), support services as well as grant funding for on-farm and off-farm rural economic development and support to the land reform (Int. NPC).

Concerning the land reform, Vision 2030 states that a "major problem the new government had inherited was that of ownership of land" (NPC 2004). Since land tenure, and more generally, land right issues are key factor influencing all bioenergy and other agricultural activities in Namibia, they are further discussed in the following.

Land right issues

Namibia can be divided into three main topographic regions: the western coastal plain of the Namib Desert, the central plateau stretching from the southern to the northern border and covering more than half of the country, and the semi-arid Kalahari zone lying along most of the country's eastern portion. With a mean annual rainfall of approximately 270 mm, Namibia is rated to have the driest climate in Sub-Saharan Africa. There is wide regional variation in annual rainfall, from less than 20 mm in the western Namib and coastal zones to more than 700 mm at the eastern end of the Caprivi strip in the North (Odendaal 2006).

Land available for agricultural production in Namibia can be divided into three broad tenure categories. Approximately 44 per cent of the country is so-called 'commercial' farmland with freehold tenure, 41 per cent is allocated to communal areas, and the remaining 15 per cent is state land including conservation areas (ibid.). The dualism of communal and commercial land tenure dates back to the first land policy for the territory implemented by the German Colonial Authority in 1892. Under the South African administration's apartheid policy of 'separate development', the system was consolidated with the establishment of 'homeland' reserves in the northern areas by the Odendaal Commission in 1962. Although the tribal names have been replaced with neutral regional names, and some boundaries have changed, these areas remain substantially intact as the present communal areas.

Due to these policies, access to land in Namibia is very unequal. Less than 10 per cent of the country's population (4,422 white and 324 black commercial farmers) live on 5,124 privately owned farms with an average size of 5,700 ha, collectively making up 44 per cent of Namibia's total land surface (SEEN 2008). By contrast, some 65 per cent of the population, constituting as much as 95 per cent of the country's farming population, live in the communal areas constituting 41 per cent of Namibia's total land area. The fact that the former 10 per cent are mostly white and have a European heritage, adds significant social and political dimensions to the issue (ibid.).

The overriding objective of land policy in Namibia since independence has been to redress

the injustices of the past as far as land ownership and access to land are concerned and to promote sustainable economic development. After independence the Government embarked on two complementary approaches to address this goal:

The Commercial (Agricultural) Land Reform Act 1995 provides for the acquisition of land through the Ministry of Lands and Resettlement (MLR). With the Affirmative Action Loan Scheme (AALS) the State assists formerly disadvantaged Namibians to buy freehold farms with subsidized loans. The AALS programme has proven popular and has supported the purchase of more than 660 farms that constitute some 10 per cent of the land available in freehold areas (Fuller 2006), 16). However, the poverty impacts of the AALS are expected to be limited and indirect as the programme is designed to assist larger communal farmers and benefits poorer farmers only by freeing up communal land (Sherbourne 2004)).

The National Resettlement Scheme has put more people on redistributed land than AALS, but on smaller plots. Resettlement involves purchasing commercial farms on a willing seller/willing buyer basis and partitioning them for middle-scale farmers. Since the pace of redistribution was deemed to be unsatisfactory and political pressure was mounting, in 2003 the possibility of expropriation for commercial farmland was introduced, governed by procedures laid out in the 1995 Resettlement Act as well as in the Constitution. Despite the public attention surrounding this decision, very few of the 150 farms purchased for the programme have been acquired through expropriation (Fuller 2006), 8).

The Communal Land Reform Act 2002, on the other hand, aims to improve communal land tenure systems. It confirms the role of traditional authorities in allocation and administration of customary land rights for residential and subsistence farming purposes and provides for the creation of Communal Land Boards (CLBs) as new statutory bodies. The primary function of the Land Boards is to supervise and ratify the allocation and cancellation of customary land rights by traditional leaders as well as the registration of certificates of rights. Communal Land Boards can approve two types of tenure given the consent of the Traditional Authority: rights under customary rule and leasehold rights. It seems that rights of leasehold generally cover situations that fall outside customary allocations of communal land, such as permission-to-occupy for a tourist camp or for an agricultural plantation project. Leaseholds of a duration of more than ten years or exceeding 50 ha must be approved by the Ministry (LAC and NNFU 2003) Communal Land Boards also are empowered to settle land disputes in cooperation with local Traditional Authorities and can act as avenues of appeal should a person not be satisfied with the decision of the traditional leader (Fuller 2006), 9).

As a central component of the land reform in the communal lands of Namibia, the MLR has started to promote commercial farming through the allocation of large plots of land that is considered to be underutilized as private leaseholds to farmers. It is expected that this will encourage investments in infrastructure, material and labour inputs, will increase productivity of these lands, and will provide employment and income opportunities to the rural poor (LAC 2006), 2)

While most of these leaseholds are still in a planning stage, conservancies and community forests have become more established in Namibia as two complementary components of a broader community-based natural resource management (CBNRM) approach. Both conserv-

ancies and community forests can provide local communities with commercial use rights to a variety of natural resources and potentially constitute a model for more integrated environmental and resource management at community level (PTT 2005), 20).[1]

Agricultural production

Despite contributing only around six per cent to GDP, agriculture is the largest employer in Namibia and supports, directly or indirectly, 70 per cent of the population. The proportionately low contribution of farming is attributed to several factors: the very high capital and technology level of production by other sectors such as diamond mining, the low agricultural capacity due to aridity and poor soils, the lack of market development and low productivity particularly in most communal areas, and the relatively low value added through local processing (Mendelsohn 2006). Of the total production in 2004, 76 per cent came from the freehold sector and 24 per cent from communal areas (ibid.).

The commercial farming sector is well developed, capital-intensive and export oriented. It is dominated by extensive livestock and wildlife ranching, except in the Maize Triangle in the north and some intensive wheat and fruit agriculture on small irrigation schemes along the Orange River in the south and throughout the country. Commercial livestock production supports approximately 11,000 households or 47,000 people on the freehold title cattle ranches (ibid., 42). Cattle and small stock are produced for meat sales to Europe, South Africa and Namibian consumers.

During the last decades, severe bush encroachment has become a major obstacle to farming activities in large areas of the medium to higher rainfall savannas. Encroaching woody species often unpalatable to livestock suppress palatable grasses and herbs. 26 million ha of land has been subject to the invasion and/or thickening of these species. This has severely limited the grazing potential for cattle and sheep in these areas and causes severe economic losses of both communal and commercial farmers. Bush encroachment also has negative impacts on biodiversity, water-use efficiency and underground water tables. Vision 2030 names bush encroachment as one of the main causes for declining agricultural production and of the decrease in security, resulting in migration, rapid urbanization and an increased need for the government to import food (NPC 2004). NDP 3 sets the goal of reducing the areas encroached from 26 million hectares to 22.1 million hectares and targets the sustainable utilisation of unwanted bush to promote restoration of degraded land (NPC 2008), 148).

The communal farming sector, on the other hand, is subsistence-based and labour intensive, with very limited use of technology and external inputs. About 970,000 people are engaged in this small-scale farming (Mendelsohn 2006), 33). Only a few richer households cultivate more than ten hectares. The majority of households are agro-pastoral subsistence farmers with access to cropping plots of 1-4 ha (ibid., 34). Main agricultural inputs are labour and draught power for ploughing while use of more advanced technology and inputs (fertilisers,

[1] Vision 2030 recognises land productivity as a major factor constraining overall land-based economies – including Namibia's economy. Namibia has scarce water sources (surface and groundwater), varying grazing conditions and low biomass. Together, these result in low livestock carrying capacities (NPC, N. P. C. (2004). Vision 2030: Policy Framework for Long-Term National Development, NPC. and limit diversification of land-based economic activities. The Vision aims to ensure equitable access to land and other natural resources while they are used in a sustainable and efficient way. The Vision advocates a shift towards empowering local resource-users' communities to allocate rights and manage natural resources. Many sectors are implementing this approach through the community-based natural resource management and community-based management of water resources strategies. Legislative tools have been developed (the Amendment Act 6 of 1996 to the Conservation Act and the Water Resources Management Bill). However, progress in the land sector has yet to match improvements made in other sectors, particularly in communal grazing areas. (PTT, P. T. T. o. L. R. (2005). Recommendations, Strategic Options and Action Plan on Land Reform in Namibia, MLR.

irrigation, tractors) is low (ibid.; (Ashley and LaFranchi 1997). Large parts of fields are left fallow because of declining fertility after a few years of production. Most of the harvest is used for home consumption and only very little is sold on the market. Most staple foods available on markets and in shops in Northern Namibia are produced by commercial farmers elsewhere in Namibia or imported from South Africa (ibid.).

Another category of farming schemes includes farms that produce on a larger scale and in a commercial way in communal areas. This comprises fenced off cattle ranches in communal areas which range between 1,000 and 8,000 hectares and which were demarcated by Namibian Governments before and after independence. Intensive agricultural production may be considered as another farming system in this category. After independence new irrigation schemes have been introduced, especially under the Green Scheme. These farms are located along the Okavango and Zambesi rivers and are usually relatively small compared to other commercial farms (covering not more than 100 ha). Crops include vegetables, wheat, maize and in recent years also mahangu (pearl millet).

Mahangu, maize and sorghum are the dominant rain-fed cereals grown as staple foods in Namibia. The cultivation of these crops is, for climatic reasons, mainly confined to the northern communal areas apart from a small but significant area of commercial maize production in the so-called Maize Triangle east of the Etosha National Park. Mahangu is the most commonly grown cereal in the communal areas but increasing amounts of maize are grown in Kavango and Caprivi. Wheat is only grown in the commercial areas and under irrigation (Mendelsohn 2006), 37). The total annual production of these cereals has averaged 98,800 tons over the past 15 years, while an additional average of 174,000 tons has been imported each year to meet Namibia's requirements for cereals (Mendelsohn 2006)).

In addition, alternative land use activities have increased the income potential derived from land. Tourism is Namibia's third largest foreign exchange earner. The number of tourists rose by eleven per cent in 2007 and generate about 78,000 jobs although the forecast for 2009 looks less promising due to the global recession (OECD 2009). Enhancing income from tourism and bringing new incomes from wildlife to people living in communal areas has been a prime motive for the creation of conservancies. Community forests, on the other hand, are formed in order to enable communities to benefit from natural resources sustainably (Mendelsohn 2006), 69).

As mentioned above, both the Poverty Reduction Strategy (PRS) and Vision 2030 expect Namibia to become a highly urbanized country in the long term. PRS states that Namibia's agricultural base is too weak to offer a sustainable basis for prosperity. In the short and medium term, however, smallholder crop cultivation is considered an important means of poverty reduction. A special emphasis is put on Namibia's northern regions which offer better water availability and soil fertility than the rest of the country and are home to most smallholders. Initiatives which increase production, crop value and productivity in this region are considered to be worthwhile. Particularly the production of mahangu, the staple food of most of the country's poor, is planned to be increased based on smallholder farming. PRS identifies the lack of services as one of the main obstacles to rural development: too few households have access to new technologies and only a minority of them is reached by extension services. Also, agricultural research is considered underfunded. Concerning irrigation, PRS states that it is only viable if low cost irrigation systems and high value crops are combined. Vision 2030 also rejects the irrigation of low value crops and subsidies that encourage the over-abstraction of water. In regard to agriculture, NDP 3 suggests increasing both the crop and livestock production in a sustainable manner. (NPC 2008) In its forthcoming strategic plan for the period 2008/9 to 2012/13 MAWF names "Renew National

Agricultural Policy" (the current Policy was released in 1995) as initiatives to be taken in the near future (MAWF not yet published), 30). The ministry also plans to create a supportive legal and regulatory framework for agricultural development by coordinating all stakeholders. Additionally, the strategic plan includes the creation of various councils and institutes responsible for e.g. woodland, seeds, agricultural research, agro chemical regulations, bush utilization and capacity building for farmers. Both bush and Jatropha value chains would be influenced in important ways if the Ministry put these plans into practice (ibid., 33-45).

Food security

When it comes to the role of agriculture for food security, Vision 2030 advises against the production of cash crops that do not enhance food security. However, food security is preferred to food self-sufficiency, and it is stated that crops whose production is intensive in the use of scarce resources should be imported. Instead, an emphasis should be put on service provision and other secondary or tertiary activities (NPC 2004), 145).

Through domestic production and food imports, food availability in Namibia is not a problem at the national level, and the majority of the population has reliable access to food commodities. However, affordability is a problem for many households. In most years, most households do not meet their basic food needs from their harvest. The 2003/04 Household Income and Expenditure Survey revealed that in 42,3 per cent of rural households food accounted for more than 60 per cent of total expenditure, and in 6 per cent it accounted for more than 80 per cent of expenditure (NPC 2006). In spring 2009 the worst floods since 1972 were experienced and affected about 600,000 people in Northern Namibia. 82,000 people are left in need of food assistance until the next harvest. 20,000 people lost a total of 49,000 hectares of crops while about 9,000 livestock died as a result of the floods (Mail & Guardian Online 2009).

The MAWF states in its strategic plan that it aims to ensure food security at both household and national level (MAWF 1995), ii) and to develop a Namibian Food Security Plan. According to the strategic plan the access of households to affordable food of sufficient quality and a sustainable quantity should be enhanced. Food security and ultimately also an increased competitiveness of Namibian products ought to be achieved through creating and expanding markets, improving production levels and increasing product development (more products, value addition and diversification) (MAWF not yet published), 20 and 66). MAWF also states that irrigated areas will continue to be expanded and silos / mahangu collection centres will be constructed in various towns. (ibid., 53) These strategic grain reserves and cold storage facilities are also part of the measures to ensure food security (ibid., 66).

4.2 National Strategies and Actors Relevant for Energy Provision and Bioenergy Production

With regard to energy, Namibia relies to a great extent on imports from the RSA. The neighbouring country provides 100 per cent of Namibia´s fuel and over 50 per cent of its electricity. As RSA is facing increasing energy needs, Namibia fears a reduction of supplies and higher prices. Electricity supply sources inside Namibia include a coal fired power station near Windhoek and a hydroelectric plant at Ruacana. NDP 3 suggests several additional electricity sources in- and outside Namibia. (NPC 2008), 39) Energy consumption takes up a relatively high proportion of Namibia´s GDP due to the country´s reliance on

energy-intensive primary industries. The rural population, however, is so far not fully served by the national electricity grid and has very limited access to fuel and energy resources. In consequence, 63 per cent of Namibian households rely mainly on fuel wood energy (Metzler 2006), 7; (NPC 2008), 120-121).

The Ministry of Mines and Energy (MME) strives for providing all households with access to affordable and appropriate energy supplies. Attracting investors is seen as one way of reaching this goal. MME also wants to move towards the sustainable use of natural resources for energy production (MME 2009).

The importance of renewable energies is also underlined in the White Paper on Energy Policy of 1998, which set the goals for further documents. One of the goals is the security of energy supply through a diversity of reliable sources. Hereby, the Policy puts an emphasis on the development and sustainable use of Namibian resources (MME 1998), 3). In 2000, the Rural Electrification Master Plan was completed and then revised in 2005. It identifies the need for the development of on-grid and off-grid infrastructure. (Interim Bioenergy Committee 2006), 13). Furthermore, NDP 2, identifies a number of sites for small-scale power generation in rural areas (about eleven for the Caprivi and Kavango Regions) (NPC 2008), 121).

When it comes to fostering a bioenergy industry inside Namibia, the most important recent document is the National Bio-Oil Energy Roadmap published by the Namibian Agronomic Board (NAB) in August 2006 after an Interim Bio-Energy Committee was established to "draw up a Roadmap for all decisions, institutional arrangements, international agreements, legislation etc. to create a conducive environment in Namibia to grow and process bio-oil" (Interim Bioenergy Committee 2006), 6). This committee considers Jatropha curcas to bear the most potential for bio-oil production under dryland conditions in Namibia. The Roadmap envisages approximately 63,000 hectares of Jatropha to be planted in Namibia by 2013 in order to support a future energy intensive economy. Several concerns regarding bio-oil production such as effects on food security, biodiversity and the eco-tourist economy are included in the considerations. Moreover, the Roadmap touches on the opportunities offered by the Clean Development Mechanism (CDM). The possibility of energy generation through lignocelluloses technology is also mentioned. In this context, however, no linkage is made to the problem of bush encroachment. As the respective processing technologies are not commercially feasible in the near future, the Roadmap leaves further research on this topic to the Directorate of Forestry (ibid.).

In order to advance bio-oil production the Roadmap sets four intermediate objectives:

(1) Bi- and multilateral agreements: e.g. exchange of scientific know-how and technology, arrangements concerning the CDM.

(2) Policy environment and policy instruments: e.g. tax incentives, awareness and communication programmes.

(3) Management of process, product and market risks: e.g. development of product standards, feasibility study of potential anchor markets.

(4) Technology pathways: e.g. development of best operation practices, training programmes extension service delivery systems.

(5) For all four objectives, activities and milestones as well responsibilities and timelines are defined.

A National Oil Crops for Energy Committee (NOCEC) was established, comprised of respresentatives of six ministries among others, to coordinate the implementation of the

Roadmap (MAWF no date), S.3).

In 2008, the Namibian government allowed for a blending of five per cent of biodiesel into regular diesel. (Int. MME). Nevertheless, the importance currently given to the Roadmap is rather weak. This can be explained by scepticism on part of the Namibian Government towards Jatropha curcas, specifically regarding effects on the country's food security as well as environmental and social impacts. However, this scepticism is not clearly expressed and coexists with the positive Roadmap. In order to determine a clear position of the entire Namibian Government, MME, MET and MAWF formed a committee in 2008 which is headed by MME. Currently, studies are being design that should help the committee to formulate the position. (Int. MAWF, Int MME, Int. MET).

4.3 Description of Target Groups – Livelihoods in Kavango, Caprivi and the Ovambo Regions

The target group of this study comprises the rural population of Kavango, Caprivi and the Owambo Regions, situated in the northern part of the country. Approximately 295,000 people (15 per cent of total population) live in Kavango (208,441) and Caprivi (86,437) that have been envisaged as prime locations for Jatropha production in the National Bio-oil-Energy Roadmap (Interim Bioenergy Committee 2006); (NPC 2006). The Owambo-Regions (Oshana, Ohangwena, Omusati, and part of Oshikoto) have a population of 805,000. Population, however, is unequally spread across the northern regions, with strong concentrations along the rivers, roads, and in the regional capitals Rundu, Katima Mulilo and Oshakati.

For the bush-to-energy value chains, most workers stem from the Kavango and the Owambo-Regions. Their main employment area is Otjozondjupa region in the central-north. Given the fact that the poverty characteristics of the Owambo-Regions are similar to Caprivi and Kavango and that the focus of this study is the situation of the target group at their place of employment, livelihoods of the Owambo-Regions will not be discussed in detail.

Rural households in Kavango and Caprivi meet their livelihood needs through a dynamic combination of economic activities and resources; they balance time, resources and risk allocated to various activities: Almost all rural households engage in small-scale dryland agriculture and many have access to some livestock. Even though these might be the households' main activities, they are not the main source of income of all rural households (in Kavango for only 42 per cent)[2]. Wage employment, cash remittances and wild natural resources (trees, grasses, fish, nuts, fruits, and medicinal plants) are other sources of income whose significance varies according to region, household structure, time of year etc..

In addition to civic administration, the Caprivi and Kavango are subject to the *de facto* leadership and governance of Traditional Authorities. The Traditional Authorities are represented at national level and play an important role managing land and resource use and acting as judiciary in matters that can be addressed locally (Mitchell 2009).

Apart from the state-protected natural reserves and the towns of Rundu and Katima Mulilo, all land in Kavango and Caprivi is generally communal. The land is formally owned by the state but local residents can acquire permanent rights for its use. These can either be

[2] Of all households in Kavango, subsistence farming constitutes the main income source for only 33.9 per cent compared to 17.8 per cent in Caprivi (NHIES 2003/2004, 33)

customary exclusive rights to plots used for crop cultivation and residential purposes, foraging rights or grazing rights for livestock on commonages, or formal leaseholds for business purposes such as tourist lodges and designated large farm units. Rights are allocated by Traditional Authorities and can be confirmed by local land boards.

Agriculture

The average farm size in Caprivi reaches 1.7 hectares and 1.9 hectares in Kavango (Mendelsohn 2006), 34). Only about 20 per cent of all cleared land in Kavango and Caprivi is cultivated, the rest lies fallow (ibid.). Farmers grow mainly subsistence food products like mahangu, drought-resistant sorghum, maize (on floodplains) and vegetables and legumes. Surplus grains are sold or processed for sale or in-kind trade for other goods (Ashley and LaFranchi 1997).

Crop cultivation usually starts in November when fields are ploughed and prepared for planting, and ends in July when the mahangu is harvested and threshed. Weeding and harvesting are the most time consuming tasks. Main inputs are labour (particularly women's labour) and draught power for ploughing which is done manually or using ox-drawn ploughs. Use of mechanised and commercial inputs (fertilisers, irrigation, tractors) is low, not only because of limited availability and affordability, but because farmers adopt a low-risk approach ('low-input low-output') (ibid., (Mendelsohn and Obeid 2007), 64).

Agricultural incomes for households living on communal land are very low, mainly because they are excluded from improved farming techniques and lack access to markets and formal credit facilities (Odendaal 2006), 44). Most farming households will not meet their food requirements in most years and are thus not food self-sufficient. Of all Kavango farmers, only 20 per cent of rural households obtain all their cereal requirements from domestic production; 80 per cent use cash to meet some or all of their cereal needs. Only 42 per cent of cereal consumption in rural households stems from domestic production and 58 per cent is paid for in cash. (NPC 2006)[3] Thus, household food security comes largely from off-farm cash incomes. Despite considerable efforts by government and donors to improve mahangu production by providing improved seeds, fertilizer and ploughing services, aggregated mahangu yields are said to be lower than twenty years ago. (Mendelsohn and Obeid 2007), 8)

Some households (less than one per cent) own or have access to up to 20 ha of cropland and up to 200 cattle. These households hire wage labour for farm work or tending cattle. There also exists some intensive agriculture on small, mostly irrigated farms producing maize, wheat, vegetables and fruit (Odendaal 2006). Furthermore, there are extensive areas of land in Caprivi and Kavango that have been assigned to Resettlement Farmers in the course of the national land reform.

Livestock

The great majority of livestock is cattle, whereas the number of goats, sheep, horses and donkeys is rather limited. Men traditionally have ownership of and responsibility for, cattle and hence control of draft animals for ploughing and clearing land for cultivation. Livestock is kept for multiple purposes related to subsistence (meat, milk, draught power), social and

[3] In Caprivi, 43.6 per cent of the population spend more than 60 per cent of their income on food. In Kavango, 50.4 per cent spend more than 60 per cent on food. (NHIES 2003/2004, 121)

cultural activities, for cash income and savings. Animals are used as gifts or for a bride price, and are sold to local markets and the MeatCo company to earn cash. Households owning eleven or more cattle have higher levels of both crop production and consumption, and higher cash expenditure as among those with none (Odendaal 2006). Furthermore, the *mafisa* tradition involves loaning and tending cattle. Generally, cattle tending is exchanged for milk, a percentage of calves born, and perhaps the opportunity to rent out oxen for ploughing. This system directly disperses benefits from large holdings to others in a community (Ashley and LaFranchi 1997); (Mitchell 2009), 25).

Grazing and water are free to the farmer so long as his/her right to use communal natural resources is recognised. The other main input required is labour, either household or hired, which needs to be full-time if cattle need to be moved away in the dry season (ibid.).

Although (Sweet 1998) states that bush encroachment is not much of a problem in communal areas, Namibian national authorities (de Klerk 2004) have acknowledged the negative effects of invader bush on communal development. Invader bush affects an estimated 6 million ha of communal lands. However, communal non-commercial farmers are reluctant to engage in combating bush due to shared rangeland practices. Following the 'tragedy of the commons' phenomenon, farmers who did not participate in bush control measures would equally benefit as those who invested labour and financial capital (ibid.).

Wage Employment and Cash Remittances[4]

Among farming households in Kavango and Caprivi, many rely on cash as the main source of household income. In Kavango, 21 per cent reported wages and salaries as main source of income, 13 per cent pensions and 10 per cent non-faming business activities (NPC 2006). In Caprivi, 26 per cent were cited to depend on wages and 12 per cent on pensions as main income source already in 1997 (Ashley and LaFranchi 1997). Wage income is earned by people working as government employees in school and clinics or in unskilled jobs like cleaning and cooking. Formal private sector opportunities are mainly located in tourism and are very limited otherwise. NGOs are another source of jobs.

Cash remittances received from absent workers are the *main* source of income only for a minority but provide an *additional* income for many more. *Pensions* are another key source of income because of their regularity, accounting for the main source of income for 18 per cent of the poorest 25 per cent of households and 22 per cent of female-headed households (ibid.). *Casual labour and sales of home-produced products*, such as clearing or ploughing land, building and repairing houses, herding cattle, assisting in shops and selling craftwork to tourists is also common. Cash payment is generally N$5-10 per day, but can be as little as N$10 per week. Payment may also be a bag of maize or barrel of locally-brewed beer (tombo).

Harvesting of Trees, Plants and River Resources

For those short of the necessary inputs for agriculture, such as the poorest and female-headed households, collecting activities are particularly important. Wood is collected for construction, making tools or sold as fuel wood. Wild/ veld fruits are a seasonal staple, supplement

[4] The National Household Income and Expenditure Survey 2003/2004 reports the following percentages of main income sources for urban and rural households: in Kavango (Caprivi) 28,1 per cent (32,5 per cent) wages; 12,8 per cent (17 per cent) non-farm business; 33,9 per cent (17,8 per cent) subsistence farming; 11,3 per cent (12,9 per cent) pensions; 5,7 per cent (10,4 per cent) remittances. Disaggregated data for rural households are missing.

diets or are used as medicine and sold for additional income (e.g. Mangetti nuts).

In conclusion, households with sufficient agricultural inputs are likely to be able to meet food needs in most years, and those with good access to cash earnings or substantial reserves are likely to be able to purchase food to meet any deficit. But others have to rely on gathered foods, barter and exchange. Even if a great deal of time is spent, these may be insufficient to prevent cuts in food consumption for a certain time.

Other than for compensating for food deficits and agricultural inputs, cash is needed to pay for school fees, clothes, clinic bills, daily necessities (soap, oil, tobacco, tombo), bus fares and one-off events (funerals, weddings and emergencies).

Farm Workers

As mentioned above, farm workers in the commercial areas mostly come from Kavango and the Owambo-Regions. Although farm workers do not have the same working conditions as wood workers, their state shall serve as an illustration of the situation of farm employment in the commercial areas.

About 35,000 wage labourers work on commercial livestock farms affected by bush encroachment (de Klerk 2004). Livestock farm workers are mainly full-time employees, while wood workers are temporarily employed as independent contractors. Farm workers on white owned farms often permanently reside on the farm and are granted the right to use a small plot of land for personal farming activities or livestock keeping (Karamata 2006). This does not apply to wood workers. Generally, farm and wood workers belong to the most marginalised parts of Namibian society. According to the Labour Resource and Research Institute's study (ibid.), less than 40 per cent of farm workers are registered as members of the social security scheme. They have little voice as over 60 per cent of workers know little to nothing about the existence and the purpose of labour unions, for example. Access to public or private health facilities is also difficult due to lack of transport means (ibid.). Male workers are mainly engaged in farm work while women are employed for household activities (Werner 2002). Their average age is 20-29 years. The average farm worker earns about 350N$ per month with the earning on white owned farms being slightly higher than on black owned farms. Wood workers earn about 300-400N$ per ton of charcoal produced. However, even though Namibia has introduced a minimum wage, only slightly more than half of all farm owners have implemented the new regulation (Karamata 2006).

5 BUSH-TO-ENERGY VALUE CHAIN AND POTENTIAL IMPACTS ON PRO-POOR RURAL DEVELOPMENT AND FOOD SECURITY

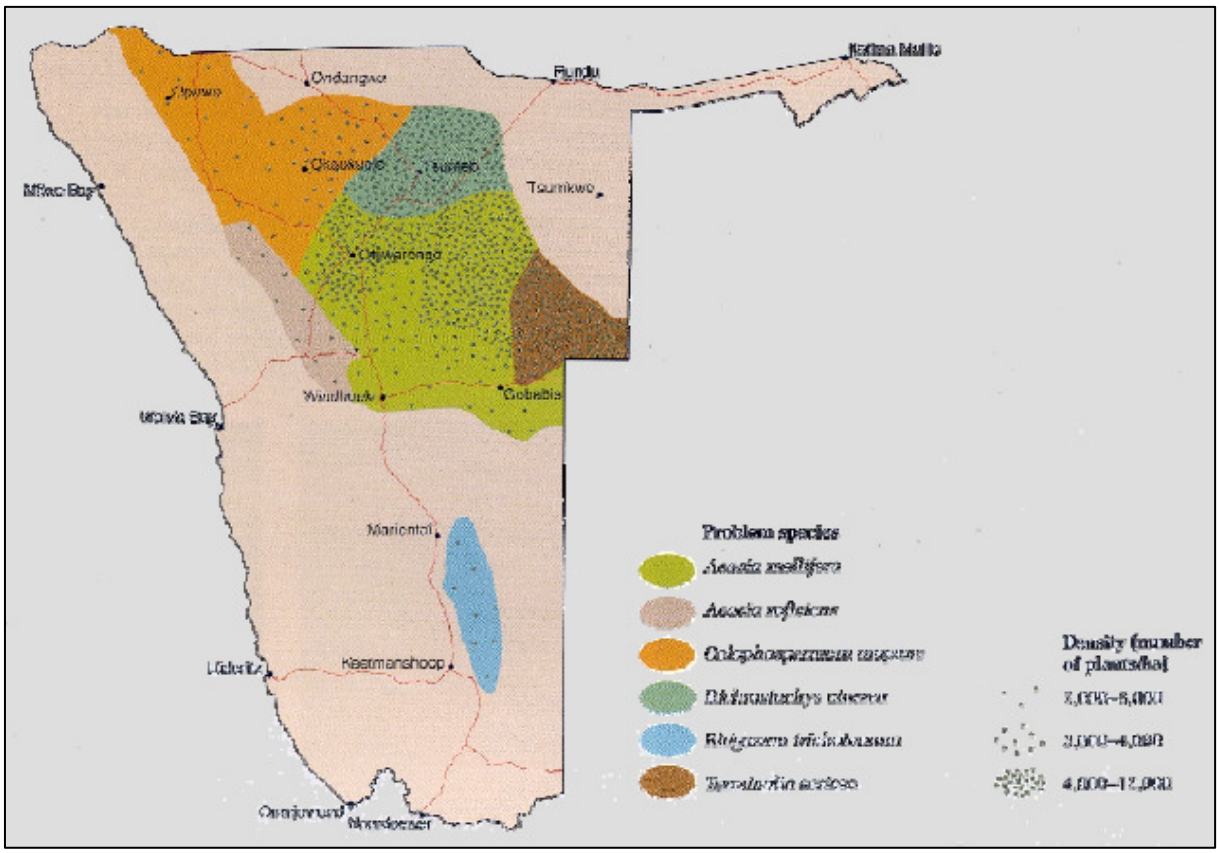
5.1 Background

Before depicting possible value chains originating from harvesting, processing and distributing Namibian bush, the characteristics of these abundantly available woody shrubs shall be described.

As has been mentioned in earlier chapters, bush in the Namibian context is generally referred to as 'the bush encroachment problem'. De Klerk (de Klerk 2004), x) defines bush encroachment as *"the invasion and/or thickening of aggressive undesired woody species resulting in an imbalance of the grass-bush ratio, a decrease in biodiversity, and a decrease in carrying capacity"*. Already more than a decade ago, (Archer, Schimel et al. 1995) reviewed the phenomenon of bush encroachment and concluded that ever since the second half of the 20th century evidence has accumulated leading to the notion that savannas all over the world are being transformed by said phenomenon. In addition, it has been widely recognized in the scientific community that bush thickening is a major economic and ecological problem in many semiarid parts of the world (cf. (Archer, Scifres et al. 1988); (Hodgkinson and Harrington 1985); (Ward 2005). However, although bush encroachment is unanimously seen as a problem in Namibia, the aim is not to deplete and eradicate it completely, but rather to leave remainders for biodiversity reasons (de Klerk 2004).

In Namibia, the most dominant encroacher species are *Acacia mellifera* (Black Thorn), *Acacia reficiens* (False Umbrella Thorn), *Colophospermum mopane* (Mopane), *Dichrostachys cinerea* (Sickle Bush), *Rhigozum trichotomum,* and *Terminalia sericea* (Silver terminalia) (ibid.). Occurrence is strongly correlated to rainfall, the needed quantity of which differs to certain extents for all of the species. As to the geographical extension of bush, Epikuro, Grootfontein, Okahandja, Okakarara, Okonjatu, Otavi, Otjinene, Otjituuo, Otjiwarongo, Outjo, Tsumeb and Windhoek fall into the 'very high density' category. 77 per cent of the 'very high' and 52 per cent of the 'high' density areas lie north-east of the Otjiwarongo-Gobabis axis, while the majority of the 'medium' and 'low' density areas are found south-west of said axis. Approximately 26 million ha of woodland savannas in the country are degraded by bush thickening (ibid., xi), and close to 50 per cent of the commercial ranching areas in Namibia are affected by bush encroachment. See Map 2 below for clarification.

Figure 6: Map - Bush encroachment areas in Namibia



Source: Atlas of Namibia (2002) in Metzler (2006)

As to why bush became a problem in the first place, representatives of Namibia Agricultural Union (NAU) identify fire control and overgrazing as the main reasons (Metzler 2006), 10). Brown/Archer (Brown and Archer 1999) put forth a different reasoning, arguing that bush encroachment is frequent in areas with only a single soil layer and where grazing is sporadic and light. Especially the latter point is supported by Volkmann (Int.), opining that the demarcation of rangeland with the help of fences triggered a change in customary herd routes. Since vast areas where made impassable for game, the ground was not 'scarified', grass seeds where not pushed into the soil (as would commonly happen), and the more dominant bush seeds sprouted. Other interpretations exist but shall not be discussed in detail in this study.

The major problems of bush encroachment in Namibia are the following:

(1) *Negative ecological effects:* poor water use efficiency increasing artificial droughts, increased evapotranspiration, water run-off and reduced infiltration negatively affecting underground table water and desertification, and bush thickening, leading to changes in biodiversity (de Klerk 2004), 4-5).

(2) *Negative economic effects:* bush encroached areas diminish the carrying capacity of the land and have reduced the total number of livestock in Namibia from 2.5 million in 1958 to 800,000 in 2001, therewith also cutting job opportunities and income in the rural agricultural sector (Hager, Schultz et al. 2008), 2; cf. (de Klerk 2004). The carrying capacity declined from one large stock unit (LSU) per ten ha to one LSU per 20 or 30 ha, and today threatens the sustain-

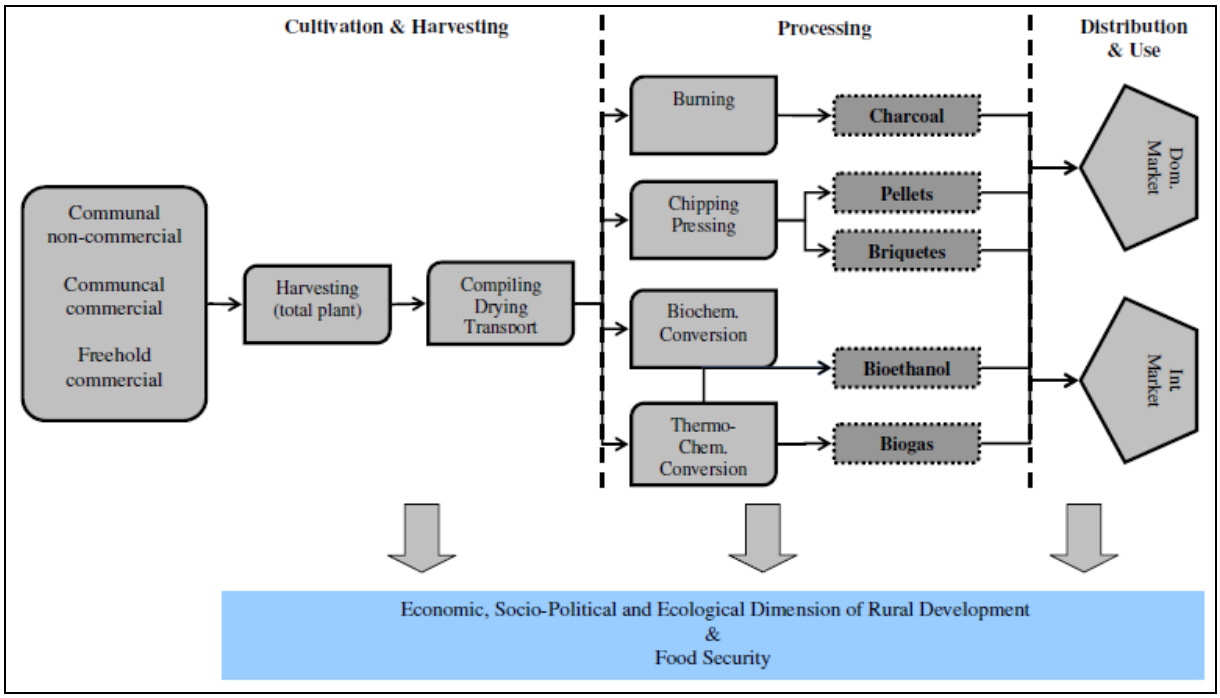
ability of the beef industry (SADC 2006), 10). The concomitant economic loss of more than N$700 million per year has had a direct impact on the livelihoods of 65,000 households in communal areas and 6,283 commercial farmers and their employees (cf. (de Klerk 2004). In addition, the removal of bush is often deemed too costly from a farmer's perspective.

(3) *Negative effects on food security:* Especially in communal areas, bush encroachment aggravates problems related to food security and malnutrition (ibid., xi), since meat and other food crops are not as readily producible.

Despite of all the problems listed above, bush thickening also poses a number of economic opportunities. SADC ((SADC 2006), 10) recommends the conversion of bush resources into biomass energy, either on a 'household cooking fuel level' or on a larger scale, for instance electricity, charcoal, wood chip blocks or ethanol production. All of these options are also considered viable by MET. Furthermore, especially in times of drought and mainly in the communal areas, bush is (to some extend) used as fodder for animals (de Klerk 2004). In an assessment undertaken by the Technical Research Center of Finland, Leinonen (Leinonen 2007), 9) calculates a bush-to-energy potential of 40.8 TWh (Terra Watt hour) per year, thus even exceeding Namibia's total energy need of 1999 (12.6 TWh).

Having said that, on the following pages existing, nascent and yet to be engineered bush value chains are described. The overview below, Figure 7, also hints at the value chains' impact on the three dimensions on rural development and food security. In this context it is worth remembering that, in de Klerk's (2004) opinion, bush encroachment is the single most important factor hampering sustainable livestock production and improved standards of living in rural areas.

Figure 7: Bush Value Chain



Source: Authors' design (2009)

Cultivation & Harvesting

The first step of the bush value chain, cultivation and harvesting, differs notably from Jatropha's value chain described below, and also from any other agricultural crop in general. In the case of bush, no seeds are needed, concomitantly seed import issues, prices, etc. are irrelevant. Bush just grows. Also, cultivation does not take place (yet). Questions related to high yielding varieties are not an issue, and neither are agro-ecological treatments of bush (e.g. application of fertilizer), in addition to a number of factors usually considered when talking about 'ordinary' crop cultivation.

The harvesting procedure, by and large, is divided into five processes, namely making strip roads, felling, compiling, drying, and road transport. Strip roads are made in order to gain access to bush and to facilitate compiling and drying. Felling or cutting crews usually comprise four to eight men. The crews cut the bush manually with axes and drag them to a strip road, where the harvest is piled and left for drying. Drying is undertaken to reduce the moisture content of the plant and make it fit for later processing steps.

In Leinonen's (Leinonen 2007), 17) case study at the Cheetah Conservation Fund (CCF, see a more detailed description of the business model below), the number of bushes encroached on the test plots ranged from approximately 1,200 to 2,000 per ha.

Processing

In general, biomass from plant matter such as trees, grasses, agricultural crops or biological waste material can be converted into and used as solid, liquid or gaseous fuel. In contrast to Jatropha, no bush side-products are perceivable. Consequently, bush can be used either in its raw form as cooking fuel or be processed into either charcoal, briquettes made of fines, wood fuel briquettes, pellets, bioethanol or woodgas. As to the former four products, value chains already exist in Namibia, whereas the latter three (pellets, bioethanol, woodgas) are still subject to investigative trials (if even).

The relevance of the former product group is underlined by Namibia's Biomass Energy Conservation Strategy (MME 2003 in (Hager, Schultz et al. 2008), 7), stating that *"the use of charcoal and briquettes produced from invader bush should be widely promoted to Namibians, especially in communal rural areas, because it would reduce bush encroachment and deforestation and result in a number of other benefits"*. Considering the focus of our study, only the processing steps for charcoal, briquettes made of fines, woodfuel briquettes and biogas shall be explained.

Charcoal: Charcoal forms part of the group that represents 99 per cent of all biofuels used worldwide, together with fuelwood and animal manure (FAO 2008), 4). In Namibia, charcoal from bush is produced by burning the harvested woody shrubs in metal kilns, i.e. by a thermo-chemical process. Heat is used to separate volatile material from the wood matter, producing four different primary products, namely gas, oils, charcoal and charcoal fines.

Briquettes made of fines: Charcoal fines are left-over 'crumbs' from charcoal production, typically about 5-20 mm in size. They are collected after charcoal production, bound together with starch and then compressed into briquettes. They have about the same caloric value as charcoal but need one more processing step (binding and compressing). Charcoal fines are commonly exported to South Africa where they are processed into briquettes, rather than this taking place in Namibia itself.

Woodfuel briquettes: In order to produce woodfuel briquettes, harvested bush first needs first to be converted into bush chips. This is done semi-automatically by a crew of workers

feeding bush into a chipper. After chipping, the woodchips are hammer-milled 8 mm size, dried by hot air and introduced in an extrusion press. The press bonds the material together into long logs that can then be cut to smaller sizes.

Woodgas: Biomass gasification based on pyrolysis produces biogas. In a pyrolysis gasifier, biomass is first exposed to heat which causes the desired gases to be released. These are then captured and distilled. Said gases can later on be used for controlled combustion, for example in an electricity generating plant.

Leftover waste products from pyrolysis and gasification of bush (about 5 per cent of the biomass burned) are labeled char-ash or agrichar, and can be used as crop fertilizer binding carbon into the ground (Lehmann 2007).

Distribution & Use

As Faaij (Faaij 2008), 26) notes, ultimately *"biomass and biofuels can develop into a commodity market"*. The advantages that would come with that include improved market stability and lower prices for bioenergy, be it in solid, liquid or gaseous form. In Namibia's case, commodity markets, and therewith real-life value chains only exist for bush as fuelwood, charcoal, and briquettes, as has been mentioned in the 'processing' section of this chapter. Consequently, the possible distribution and use of biogas has yet to be developed. Once again, we shall look at the different bush products each at a time.

Charcoal: Currently, charcoal made from bush is mostly exported to the South African and European markets (SADC 2006). There, it is used for conventional heating purposes and braais (barbecues), but also as fuel in power plants. In comparison, the Namibian charcoal market is rather small, only absorbing a minor part of total production.

Briquettes (made of fines and woodfuel): As has been said above, usually charcoal fines are exported to South Africa, rather than finished briquettes. However, according to (SADC 2006) briquettes are also used nationally as well as exported to the European markets (ibid., 10). Just as in the case of charcoal, briquettes are used for heating purposes, braais and fuel. Woodfuel briquettes are available in Namibia but are for the biggest part sold on the European market.

Woodgas: Woodgas derived from bush clearing could be used for electricity generation, either at national scale or by means of decentralized rural power plants. The idea of electricity export to adjacent markets (e.g. Botswana and Zambia) has been floated, but in the light of not even *in situ* production for Namibia itself the discussion seems a bit far-fetched at the moment. A technology exists for biogas application in domestic use, but it is safe to assume that the optimal dimension of bush-to-energy is far beyond homestead size.

As to possible trade-related obstacles or quality criteria required by Namibia's trading partners, only the United Kingdom has so far demanded that charcoal imported from Namibia adheres to the guidelines of the Forest Stewardship Council (FSC)[5].

[5] The Forest Stewardship Council is an independent NGO promoting the responsible management of the world's forests. Products certified with the FSC label to are supposed to be produced in a way that does not compromise social, economic and ecological needs of present and future generations. See www.fsc.org for further information.

5.2 Bush Business Models

5.2.1 Charcoal

5.2.1.1 Description

Namibia's charcoal business has the following features: A farmer employs a team of charcoal workers who manually chop the trees. Workers are commonly contracted as self-employed personnel, not as farm employees who are covered under the Namibian Labour Act. Contracts are oral agreements. Under these arrangements, the worker is himself responsible for social security, or any other benefits guaranteed under the Labour Act.[6] The charcoal workers burn the wood to charcoal near to a camp in the bush, and in some cases also at the farm house. The charcoal is sold screened or unscreened, packaged or loose to a retailer mainly for export and also for national sales. The major export markets are Europe and RSA. Under Namibia's Forestry Act, farmers need a permit to debush their land and to export charcoal (for areas exceeding 15ha).

As will be described below, motivations and details of the business model differ. Some production figures are, however, similar: Concerning labour costs, the Namibian Charcoal Producers Association has agreed with labour unions to pay 40 per cent of the selling price to the labourers. This means that at a current selling price of 800-1,100N$ per ton, a charcoal worker receives around 350-400N$ per ton. Prices and wages vary depending on the size of charcoal (charcoal fines, for example, are 200N$ per ton) and on the markets. Currently, export to a silicon factory in RSA scores a better price (around 1,000N$ per ton) when compared to Namibian retailer prices of 850N$ per ton. On average, one worker can produce two to four tons of charcoal per month. Here too, numbers vary considerable as they depend on the worker's motivation, strength, tools used and on the wood species. Wood workers are usually organised in teams but paid on an individual basis. They are provided with kilns. In most cases, all other work tools have to be bought from the farmer on loan. This means that the worker only starts earning after he has repaid the initial expenses. Usually, this is a period of one to two months. Other expenses that are deducted from the wage are food from the farmer's food shop, medical expenses and, in some cases, transport to and from the farm. The farmer acquires his/her workers by word-of-mouth contacts to the Damara, Kavango and Ovambo regions. Other than labour costs, the major production cost is transport. The use of FSC certification is common among bigger producers that have an interest in stable markets and sustainable debushing techniques.

Smaller commercial farmers, white and black emerging farmers, have engaged in debushing using their own land. They employ a small number of wood workers (5-10). The charcoal is sold to a few bigger Namibian buyers or directly to Europe or RSA. The motivation ranges from creating additional income to regaining rangeland and improving rangeland quality by

[6] Under the Namibian Labour Act, an agricultural employer has specific obligations concerningf social security (registration and payment), provision of food (food shops: no more than 1/3 of wage can be given as credit), accommodation (provision of adequate accommodation also for dependants), and general obligations concerning minimum wages/remuneration, hours of work, leave, termination of employment as well as health and safety (GRN, G. o. N. (2007). Labour Act No. 11 of 2007.

combining debushing with planting grass. In the former case, not much attention is paid to actually debush the invader bush. Instead, farmers make use of the stronger trees delivering better quality charcoal. If the aim is to regain rangeland, carrying capacity can increase two to threefold.

For some commercial farmers, charcoal production has become an essential part of farm business. Debushing is a prerequisite for the long term survival of the cattle farming business, while the income from charcoal finances the debushing costs and provides an additional source of income for farm maintenance. Those bigger charcoal producers use additional land from neighbouring farms to produce charcoal or to place their cattle. For debushing, they either lease the land for a fee, a service or for free. Despite the value of clearing for increased carrying capacity, they do not receive money for the service of debushing.[7] Some employ up to several hundred charcoal workers.

Farmers on communal land also engage in the charcoal business, either as an income diversification strategy or as the main source of income. However, the centre of the business is not the restoration of grazing land but the use of wood for income generation. The communal charcoal producers also employ labour teams and pay to debush on other people's land.

Few commercial farmers have made charcoal their main business. They employ harvesting teams to debush on leased land and also buy charcoal from smaller commercial or communal producers. They market their produce themselves, either directly on the FSC or non-FSC markets. Harvesting and production methods resemble those of smaller commercial charcoal producers.

Namibia's Government has an expressed interest in promoting labour intensive bush harvesting methods (National Agricultural Policy, 1995, Draft Bush Encroachment Management Policy in Hager, Schultz et al. 2008; see also Agribank loan scheme). Furthermore, the Poverty Reduction Strategy (2002) states that small and medium enterprises should be promoted. Also, the Key Issues Paper for Namibia's Biomass Energy Conservation Strategy (MME 2003 in (Hager, Schultz et al. 2008) suggests the promotion of charcoal production in communal areas to reduce bush encroachment, deforestation and to create other benefits. The Directorate of Forestry (DoF) has expressed interest in harvesting bush sustainably in order to control ecological impacts of bush encroachment (Int. DoF).

As bush encroachment affects meat production, the parastatal MeatCo has suffered cutbacks in abattoir throughput. Due to better prices, more livestock is exported to South Africa while meat sales to European markets shrink. MeatCo, therefore, has an interest in subsidising debushing for increased cattle production (Int. Agribank).

There are few retailers in Namibia. Jumbo Charcoal as the biggest one buys about one quarter of Namibia's overall production. As others, they use FSC standards for the biggest share of their production because they have an interest in sustainable harvesting methods and secured oversees markets. This secures the long term supply of wood.

The main motivation of the rural poor to work as wood workers is income generation and the prospects of sending remittances. They often have no other income generation options as they are unskilled and often illiterate.

[7] If a farmer leases additional land to place his/her cattle the price is around 30N$ per head, with 15-30 ha per head needed depending on bush density.

5.2.1.2 Obstacles & Potential Impacts

Obstacles

A major challenge in the charcoal business is the labour issue. Most farmers employ wood workers on an output basis as independent contractors. Self employment usually implies that the payment is the outcome of negotiations with the employer and that the contractor provides all equipment himself. However, this is *de facto* not the case. Farmers argue that employing wood workers under the Labour Act would make the enterprise too costly. Connected to this issue is the seasonal character of charcoal production. On the one hand, charcoal production goes down in the rainy season and, on the other hand, many wood workers often stay only for a limited period of time as they go back home to attend to their own fields.

Currently, payment is organised through an agreement between the Charcoal Producers Association and the unions. The unions are now calling for a fixed wage of 700N$ per ton. Farmers said that this would make the business no longer viable for them considering that the selling price lies between 800 and 1,000N$ per ton. Negotiations between the charcoal producers, unions and government representatives including the Ministry of Labour have been going on for years but so far no agreement could be found. The Woodland Management Council, which currently only exists in an interim form, is seen as a forum of discussion (Int. Commercial Farmer). Prospects of the council assuming full operation are, however, dim.

Another major obstacle is the lack of communication and understanding by the stakeholders which hampers the negotiation process. Farmers have criticised, for example, that political negotiating partners do not have sufficient knowledge of the realities of the charcoal business and therefore cannot understand the farmers' possibilities and constraints (Int. Commercial Farmer). In addtition, the capacities of unions, namely the Namibian Farm Workers' Union (NFWU), are weak, both in reaching out to the people they claim to represent and in negotiating power (Int. LaRRI). On the one hand, most workers do not know the unions. On the other, farmers have expressed serious concerns over the legitimacy of NFWU to represent the case of wood workers while having little knowledge of their conditions and needs (Int. Commercial Farmer).

Besides Namibian workers, many farmers also employ Angolans. They are valued for their endurance and their hard work. Commonly they do neither possess identity cards nor work permits. This means they are illegally employed. Farmers have expressed the wish to regulate their status (Int. Commercial Farmer). However, government shows little interest in the issue as the political goal is to create employment for Namibians first (Int. MoL).

The question of labour is also connected to more practical or even emotional concerns: Many farmers do not want to have a large number of foreigners on their land. Strangers are thought to be the cause for insecurity, illegal actions such as poaching, hygiene problems, fires and theft. Also, the farmer acts as a social arbitrator and has to assume social responsibility over his workers – a burden that many are not prepared to take. They thus prefer other, non-labour intensive methods to fight the bush problem (Int. Commercial Farmer, (de Klerk 2004)).

In the communal areas, charcoal production is inhibited due to the communal land tenure system. According to the so-called "problem of the commons", those who do debush do not necessarily benefit from regained rangeland. The consequence is that those who do debush do not actually clear land to strategically restore rangeland, but they cut down trees in order

to produce charcoal as a mere income generation activity. This unsystematic cutting might lead to less 'returns to investment' that would otherwise be the case.

On the market side, price fluctuation of non-FSC charcoal means high insecurity especially for small scale producers. This inhibits debushing in a sustainable manner as demand has to be met when the prices are good. Market access in general and, in particular, to FSC markets, is a challenge for small scale producers who cannot afford high transport costs and higher investment costs for FSC production (Int. Commercial and Communal Farmers).

Lack of financial capital was also mentioned as a constraint to start the charcoal business. Farmers suffer from cash-flow problems and indebtedness due to reduced production capacities (droughts and bush encroachment are some of the causes) (de Klerk 2004); Int. Commercial Farmer). Government had introduced a subsidised Agribank loan scheme (four per cent interest rate for debushing using labour intensive methods) in 2008 which was, for non-disclosed reasons, stopped at the beginning of 2009 (Int. Agribank). Access to credit in communal areas is even more difficult due to the fact that communal land cannot be used as collateral and there are currently no special Agribank schemes that would address the problem.

If the main aim is to debush the farm, the decision of a farmer whether or not to produce charcoal also depends on the availability and viability of other options. Herbicide spraying is preferred by many farmers as it requires very little labour and has almost immediate effects. On the other hand, it has ecological consequences (indiscriminate application), high capital costs, it is unsustainable, does not generate additional income and is not suitable for all soils. A second factor is the development of land prices: if land prices are low, farmers prefer to rent additional land where they place the cattle, instead of restoring their own rangeland through debushing and charcoal production. Currently, however, land prices have risen which is attributed to the land reform process (Int. Agribank).

The question of knowledge and skills transfer is particularly relevant for communal areas and emerging farmers. While emerging farmers might get support from their white neighbours and also from government support programmes, the extension service has not embarked on training communal farmers in rangeland management. Their focus is more on food crop production (Int. Agribank). Also, research on bush encroachment is mainly done in the commercial areas. There is, thus, a lack of knowledge on bush encroachment in communal areas.

Impacts

Economic Impact

The most relevant economic effect resulting from charcoal production is income generation by the target groups. Bush-to-energy creates additional income mainly for the male part of the rural poor from the Kavango and Owambo regions. Remittances also play an important role for wood workers. They thus broaden the income effect. Small scale communal farmers can generate additional income from selling feedstock or charcoal. Estimates for charcoal production from invader bush, for example, show that 4.5 times more labour is needed in comparison to simply clearing land (de Klerk 2004).

Considering that bush encroachment has become an economic threat to Namibian commercial farmers, regaining rangeland for livestock production would in the long run secure employment and income of existing and/or potential new farm workers. In the case of small-scale communal farmers, recovering grazing land would also mean securing livestock

production. On the processing and distribution side, labour demand and thus additional income could also result for members of the target groups. This, however, depends on the operational requirements of the plant and on the distribution system, i.e., off-grid or on-grid solutions.

There are also factors limiting the scope of positive effects. As labourers are mostly unskilled and illiterate, they show a high dependency on the farmer as their sole provider of cash income, food and other goods. Although people with high production outputs earn more than normal farm workers under minimum wage, wages are too little (esp. when wood workers have to repay loans for food and tools during the first months) and inconstant. Work arrangement are informal and too insecure to raise workers above sustainability level. Due to the seasonality of the work, it does not secure workers with cash income throughout the year. Also, the Charcoal Producer's Association currently debates options for mechanised bush harvesting (Int. Charcoal Producer Association) which would have severe negative effects on employment.

Ecological Impact

Reducing bush encroachment has positive impacts on water tables, as it significantly reduces transevaporation of trees. In a drought prone country like Namibia, water is an essential asset for agriculture and livestock keeping. The scope of the ecological impact depends, however, on the degree of bush removal. Complete clearing, for example, leads to loss of soil nutrients. Therefore, the goal usually is to thin out bush infested areas and not completely remove bush (JPC 2008).

Mammal biodiversity, especially species requiring browse or dense cover for predator evasion, is likely to decrease with extensive bush control. On the other hand, species that rely on fleet-footedness in evading predators could benefit from clearing. There are over 70 bird species, among which several game birds and endemic species that would be negatively affected by bush control. Other birds with different habitat requirement could benefit from clearing. Yet, debushing is likely to increase plant diversity. In any case, the impact on each species depends on the extension and intension of bush control measures (de Klerk 2004).

Positive climatic effects can be expected if coal-fired industries are replaced by charcoal from invader bush because it is a renewable source. European companies have, for example, expressed interest in Namibian charcoal using the CDM (Int. Jumbo Charcoal/CSA). At the same time, the destruction of invader bush means the destruction of a carbon sink. There are, however, no calculations as to the total GHG effect of a bush utilisation. Positive ecological effects can only be expected if bush is utilised in a sustainable manner. The problem of wrong economic incentives, like going for older trees only or completely eradicating bush for higher production outputs, has considerable negative ecological effects.

Socio-political Impact

Generating additional income has positive effects on the socio-political situation of workers. After food, the bulk of the wood workers income is spent on health services, school fees, remittances and clothing (Int. Commercial Farm Workers). This means, the income benefits a broader part of the community and is used for enhancing local capabilities. In Namibia, alcoholism is a severe problem for young adults, resulting from unemployment and idleness. Employment creation can help reduce this problem by giving people a task and sense. Furthermore, if employed under formal arrangements, workers do also benefit from Namibia's social security scheme.

From a gender perspective, debushing mainly gives work to men. Some women are, however, employed in the charcoal packing. Concerning the communal areas, if debushing is used to open new grazing land, increased cattle herding can enhance social well being due to the cultural values attached to livestock ownership.

On the other hand, the migration of young men to the charcoal production areas also has negative effects. Not in all cases the worker can move with his family, thus leaving them behind. As labour force is reduced in communal areas, additional work load is put on the rest of the family, mainly the female part. As explained above, due to *de facto* low wages, remote location, extremely harsh working conditions without proper protective clothing and little control by the labour inspectorate, wood workers are exposed to high health risks.

Impact on Food Security

The economic effects are relevant for food security in terms of access to food. Generally, poor people spend very high percentages of their income on food (von Braun 2008). Household figures in Namibia give us a first indication that in the relevant central-northern region, Otjozondjupa, about half of the households spend up to 39 per cent of their income on food consumption. Another quarter spends 40-59 per cent of income on food. (National Household Income and Expenditure Survey 2003/2004). A study conducted by the LaRRI (Karamata 2006) found that workers on white-owned commercial farms spent over 50 per cent of their wages on food and another 22 per cent was send home. Interviews with wood workers have confirmed this pattern. As stated before, many come from Ohangwena and Okavango regions where food consumption as a share of household income is higher (National Household Income and Expenditure Survey 2003/2004). Effects on access to food might therefore be even greater than the figures suggest here. Accordingly, additional income would have a significant impact on access to food.

On the other hand, the availability of food depends on factors that are not directly influenced by bush-to-energy production but to market functioning and the broader institutional and economic setting (see chapter 5.2.). On a national level, increased carrying capacities in the commercial areas through rangeland restoration can also enhance meat availability. In the communal areas, increased cattle production has a positive food security impact on the local level. Wood workers also benefit from in kind payments (meat and milk for example). Farmers are obliged to also pay in kind if the workers are employed under the Labour Act.

As to the negative effects, in remote rural areas the farmer usually is the sole supplier of food. This mean that workers borrow from shops and are often heavily indebted with the farm owner. Prices in the shops are higher than market prices due to transport costs. There are also some accounts of profit making on the farmer's side through food shops. In the long term, this negatively affects the worker's food security. Also, as cattle production in communal areas has cultural and social value, it does not necessarily increase the availability of meat on household or regional level, as economic principles of production, buying and selling are not adhered to. Also, if migration reduces labour capacities in the rural areas, this does compromise local food production on household level.

5.2.2 Woodgas

5.2.2.1 Description

In the Bush-to-Woodgas project, all investment costs are carried by an external funding agency. It is designed as a pilot project that tests feasibility and viability of gasification plants and electricity production in Namibia. A local NGO in coalition with local partner organisations serves as the project's implementing body. An independent power producer (IPP) is established to operate the gasification plant. The bush is chopped manually and fed into the power plant. The electricity is fed into the national grid. The project is currently in the planning phase. Potential independent power producers have been identified and the tender for the gasifier are being reviewed.

The Desert Research Foundation of Namibia (DRFN), a local NGO, has with an EU grant initiated a project that seeks to use bush to produce electricity. The aim is to turn the bush encroachment problem into an economic opportunity and test the viability of electricity production using invader bush, rehabilitate rangeland as well as create employment opportunities for the unskilled labour force from rural areas. The project funding is secured until beginning of 2010. The independent power producer will operate a 250 KW electricity generator. The project will use sustainable harvesting methods in order to ensure regrowth rates of five to eight years (Hager n.d.). The plant will consume about 50 tons of dry, chipped woody biomass per week. The gasifier will continuously run and produce electricity (Int. DRFN). The full CBEND business model is currently being developed. Therefore, a production cost – revenue analysis cannot yet be delivered.

For the farmer operating the power plant, the gasifier signifies a major part of his overall business. As of now, electricity production would work alongside the bush harvesting for charcoal. It is, thus, an income and risk diversification strategy. Just as in the charcoal case, debushing for electricity generation fits into the Government's strategic goals of reducing poverty in the rural areas through employment creation, and at the same time supporting the cattle production in communal and commercial areas. Also, producing electricity in Namibia is in line with the goal of reducing Namibia's dependence on electricity imports (NPC 2008), (Interim Bioenergy Committee 2006). As with charcoal production, the main incentive for people to work as wood worker is the generation of income.

5.2.2.2 Obstacles & Potential Impacts

Concerning the labour issue, similar challenges will arise as described in the section on the charcoal value chain (5.2.1.2). Keeping in mind that CBEND as a pilot project carries the poverty reduction banner, making bush-to-electricity an economic opportunity and not an exploitative business is essential. The outcome of negotiations between the MoL, farmers and the Unions on the wood worker issue will therefore highly influence the impact of the gasification project on employment. It could even be that by making labour conditions for wood worker's more attractive, labour shortage, particularly for upscaling the project, could be countered.

As to the output market, the crucial aspect for economic viability is the feed-in tariff. In Namibia, the electricity market is regulated by the Electricity Control Board (ECB). The

parastatal Nampower provides electricity and manages the network at a national level. Regional Electricity Distributors (RED) buy electricity from Nampower and distribute it to the final consumers. So far, there is a Nampower feed-in tariff of 0.11 N$ per KWh. An IPP, such as a gasification plant could sell power to Nampower or to a RED (Int. ECB). The relevant RED feed-in tariffs for the pilot project have not yet been officially agreed upon. There are indications that the basis of negotiation will be about four times higher than Nampower's current tariff. However, it was indicated that tariffs should be six to eight times higher in order to make renewable energy production viable in Namibia (Int. REEEI). Beyond the pilot project, viability becomes even more important as the revenue needs to cover investments costs. This means not only tariffs are crucial. Also, the financial foundation of the IPP needs to be stronger and more stable than in a subsidised project. According to present calculations provided by the CBEND project, the break even point would be after 13 years (Int. DRFN). Furthermore, costs calculations will be negatively affected when the successfully upscaled production makes bush a valuable resource and therefore triggers a rise in debushing and feedstock prices.

On the technical side, interviewees have expressed concerns over the local availability of technical know-how necessary to run a gasifier plant. Expertise on the subject is low in the country and particularly difficult to attract into a rural environment. Also, there is a trade-off between farming capacities and management time of a gasifier plant. It has been argued that operating a gasifier would mean full time employment. In turn, the operator would have reduced capacities for his or her original cattle farming activities. Especially when speaking about upscaling this might contradict the original goal of enhancing cattle production.

Following Hager, Schultz & von Oertzen (Hager, Schultz et al. 2008), 4), although the gas obtained could be burned directly, it is not apt for combustion engines powering turbines. According to them, it needs to be cooled first, having the negative effect of producing waste products such as condensation water and tars. These, in turn, tend to clog up piping and combustion chambers. Further challenges in the gasification process are due to the varying moisture content of the bushes used. The higher the moisture content is, the greater the accumulation of vapors which exacerbate the tarring problem. While using charcoal instead of bush biomass could abate the tarring problem, the energy efficiency of charcoal is notably inferior to the option of using bush directly in the process. Solutions to the problems have been proposed, so could a thorough drying process reduce the moisture content in the woody shrubs, and also have manufacturers of gasification equipment developed procedures to minimize the production and/or impact of tars (Eckerman 2007 in (Hager, Schultz et al. 2008).

Impacts

Economic, socio-political, ecological impacts and impacts on food security would resemble those described in the charcoal business model.

5.2.3 Woodfuel Briquettes

5.2.3.1 Description

The third business model for the productive use of bush goes partly along the same lines as CBEND, in so far as that it is a donor funded program carried out by an implementing agency, an NGO. Wood workers are employed either permanently or temporarily (through a contractor) on the farm, but do not necessarily live there. Debushing is done on the farm itself. In contrast to other models described above, the harvested biomass is not converted to the end product on the spot but transported to a processing factory. Also, it is not charcoal that is produced but wood fuel briquettes, and consequently, thermo-chemical conversion is not part of processing. The larger part of the produced output is destined for the international market. FSC certification is an integral part of the business model.

An existing example of the above model in Namibia is the Cheetah Conservation Fund (CCF), located near Otjiwarongo in central Namibia. The NGO was founded in 1990 and is the sole owner of CCF Bush Pty Ltd, a company established to harvest, manufacture and market wood fuel briquettes under the label 'Bushblok'. CCF's primary objective is not the production of said Bushblok, but ensuring the long-term survival of the cheetah in Namibia. In the pursuit of this objective, the NGO designed a habitat improvement programme with the help of donor funding, utilizing intruder bush as a productive resource, therewith also creating income generation activities. CCF believes that by creating a market for biomass products habitat rehabilitation projects may well become economically interesting, and as a consequence, bush encroached cheetah habitat could be restored (CCF 2009).

The production process of Bushblok mostly relies on manual work. In a first step, bush is harvested by axe and left to dry along strip roads for at least four weeks. The felling and cutting crew is composed of four men, and so is the crew that collects the bushes and drags them to the strip roads (Leinonen 2007). With 10-15 per cent of the original bushes left on the field, the harvested yield was seven wet tons per ha (20 per cent moisture content). Once the bush has dried, a chipper crew of 5-12 people goes through the strip roads with a tractor hauling a wood drum chipper. The shrubs are manually fed into the chipper and the woodchips are directly blown into a trailer following the chipper. The woodchips are then transported to the processing plant situated about 45 km away from the farm. At the plant, the woodchips are hammer-milled to 8 mm size, further dried by hot air (depending on their moisture content) and introduced in an extrusion press, where the material is bonded into long logs. This logstream is then cut into smaller sized logs and packaged for sale (CCF 2009). Bushblok can be used either as cooking fuel or for heating.

Currently, CCF is employing about twenty local workers either directly or through a sub-contractor (Int. CCF). Six workers are living permanently onsite. The chipper crew is brought to and from the farm every working day. Since the chipper crew is sub-contracted, CCF Bush buys the bush from them.

As of now, CCF produced 6,000 tons of FSC certified wood fuel briquettes per annum (Int. CCF). CCF's farm comprises 40,000 ha in total, amounting to 410,000 tons of available woody biomass. The targeted buyers are retailers and organic niche markets. Bushblok's most promising output market is considered to be the European (UK, Germany) and South African market. Generally, it is believed that in both of these markets high potential exists for products that follow sound environmental and socio-economic standards. In Namibia,

CCF sells either Bushblok, raw chips for high efficiency chip burning stoves or logs for braais. Vast potential in the Namibian market is expected, given the extensive use of wood for cooking and heating in rural areas (CCF 2009).

The economic viability of the business model is questionable at the moment, given that market demand for Bushblok is currently rather low (Int. CCF). As to production costs, running of the chipper and transport of both woodchips and workers make up for the biggest chunk of overall costs. Manual harvesting, on the other hand, is comparatively cheap. The General Manager estimates an average market price of N$ 850-1100 per ton of Bushblok, and identifies Poland, China, and possibly South Africa as the biggest competitors. CCF Bush produces about 25 containers per year and theoretically has a production capacity of 30t per day.

5.2.3.2 Obstacles & Potential Impacts

Obstacles

As has already been mentioned, the biggest obstacle for CCF Bush at the current stage is economic viability. First, market demand is insufficient for private sector-style Bushblok production. Although FSC certification was expected to open up a larger (European) market in the long term, it apparently has not done that so far, according to Brewer, the General Manager. Brewer opines that Bushblok will become viable also without donor support once the right buyer is found. So far, it cannot be said that CCF Bush has surpassed the level of a pilot program demonstrating that something can be done about bush encroachment. Second, transport costs are high due to the fact that the production facility is 45 km away from the harvesting side. However, plans are being designed in order to bring the plant to CCF's farm, therewith reducing rent and transport costs. Third, CCF cannot deliver large quantities at industrial level (> 1,000 containers/year) (Int. CCF), which is what, for instance, power plants would require.

Impacts

Economic Impact

Positive economic impacts of CCF Bush's business model are various. First, employment opportunities are created, opening up the possibility of additional income for local and/or migrant workers. Not only is labour needed for manual harvesting and chipping of the raw material, but also for transport services to the processing plant and at the plant itself. Regarding further mechanization of the harvesting process, the General Manager argues that this would only make sense if more bush raw material was needed for production and no labour was available in the short term (Int. CCF). According to him, job creation through manual labour is one of the most important outcomes of the business.

Second, CCF Bush's production plant in Otjiwarongo adds to industrial development processes in the area, initiating and strengthening forward and backward linkages to other businesses. Therefore, supply chains are fostered.

Whether these positive economic impacts are sustained in the future will depend on a number of factors. For instance, in order to keep the production going, the business model either needs to become economically viable as a private sector type venture or must attract

more donor funding. Also, if the scale of production was to be increased in order to cater to bigger buyers, CCF would need access to more raw material. This means that either additional farms have to be rented or supply chains with other farmers that debush need to be established. Functioning input and retail markets, clear land tenure arrangements and transport infrastructure are vital in this regard. Furthermore, if business development services and investment promotion policies were in place, the likelihood that CCF Bush was upscaled to more than a pilot project would be greater.

Ecological Impact

As to positive impacts of Bushblok fabrication on Namibia's environment, the same arguments can be put forth as in the case of charcoal production. Essentially, less bush improves water tables and positively impacts on biodiversity in the region (here especially restoring cheetah habitat). In addition, if in course of business development the domestic market was opened up further and firewood was substituted with Bushblok (as unlikely as that seems), this could lead to reduced depletion rates of forest resources. Also, substituting coal-fired plants with Bushblok would reduce carbon dioxide emissions and, to certain extents, counteract climate change. Lastly, in the case of CCF Bush, an 'eco-friendly' package for Bushblok in which the wrapper is burnable, biodegradable, recyclable or has a secondary use is a high priory development goal (CCF 2009).

However, ecological impacts heavily depend on harvesting and aftercare methods. A sustainable bush resource use is questionable if an area is completely cleared and roots are taken out. Also, herbicides used for killing invader bush might negatively affect the environment. Although CCF Bush has FSC certification, they do not want bush to re-grow (Int. CCF), posing risks for the above mentioned sustainable use.

Socio-political Impact

Employment generation is the biggest positive impact of CCF Bush's business model. It does not only provide income for the respective workers and their families but might also lead to increased remittances to relatives at home. Recalling CCF's initial aim, enhancing the long-term survival of the cheetah in Namibia, it might well be that acceptance for predators is increased among the community, improving human-wildlife relations.

As to negative socio-political impacts, not much is to be mentioned, except the rather theoretical argument that human-wildlife conflicts might increase when assuming that more habitat for the cheetah leads to greater cheetah population. The logic here would be that an increasing number of cheetahs leads to more cattle being hunted and killed.

Furthermore, just as in the case of charcoal workers, the new labour law could pose a problem to CCF Bush's business model if labour regulations become too rigid and forbid seasonal labour and output-based salary.

Impact on Food Security

Since Bushblok can be used as cooking fuel, it could impact on food security through the 'utilization' dimension. However, considering that Bushblok is not cheaper than conventional fuelwood or charcoal, it cannot be said that it enhances food security via this dimension, but it does represent an alternative.

The more direct impact on the access dimension of food security is through additional income of farm and wood workers. If CCF used the regained rangeland for livestock

husbandry, availability of food could increase.

No negative impacts on food security can be discerned at the moment.

5.3 Comparison of Bush Models

Table 4 below summarizes the findings from the different bush-to-energy business models as explained above for overview purposes. The table contrasts the three models according to their effects on the three dimensions of rural development (economic, socio-political, ecological) as well as food security. Each dimension was further specified including only the most important and visible effects.

Figure 8 shows a simplified bush-to-energy impact chain. As has been stressed in the methodology section, impact chains aim at providing a picture of the relation between cause and effect, impact and consecutive impact, the link between impact and impact recipient, and the connection between causer and impact recipient. Without spelling out the chain in detail, only one example indicating how to read it shall be given here:

Production and harvesting of bush can either be done on freehold or communal land. The decision whether to harvest at all is based on whether the farmer considers this to be (economically, ecologically, etc.) viable. A number of institutions and institutional arrangements have an effect on the viability of this undertaking, for instance Government and Traditional Authorities, labour regulations, the land market, among others. If the farmer decides to debush to produce bioenergy, then the economic, socio-political and environmental impacts are also shaped by institutions and institutional arrangements. Once more, labour regulations, available output markets, social structure, environmental regulations etc., determine the impacts of a given bush-to-energy value chain on rural development and food security.

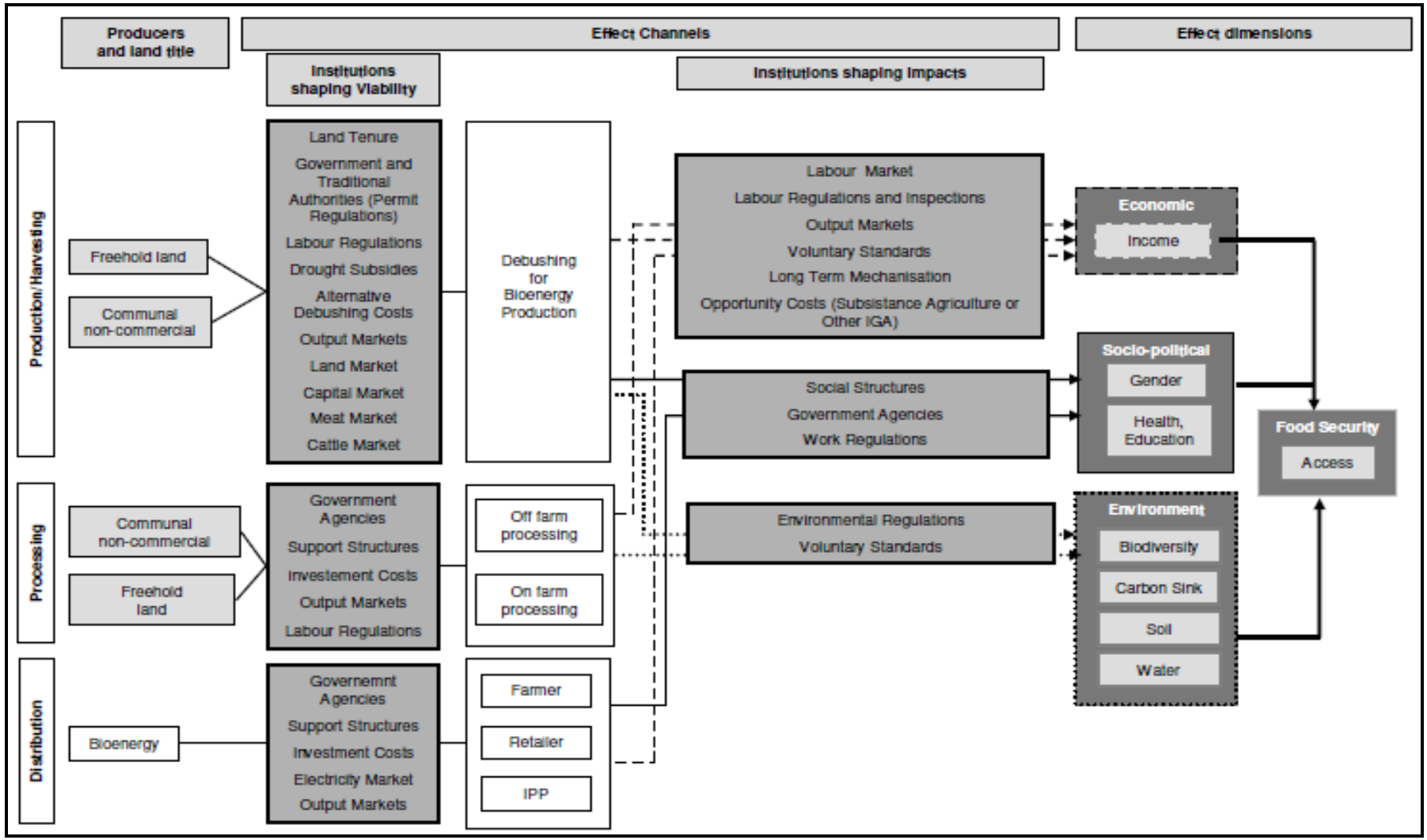
Table 4: Comparison of bush-to-energy business models

Impact	Specification	Charcoal	CBEND	Bushblok
Economic	Income	Need for unskilled labour for debushing and burning charcoal, loading and unloading, packing Need for semi-skilled labour along the value chain (truck driver, supervisors) Potential need for semi-skilled labour if mechanised harvesting More income through restoration of rangeland Remittances make up big part of expenditures, Kavango and O-Regions benefit from it	Need for unskilled labour for debushing and chipping, loading and unloading, packing Need for semi-skilled labour along the value chain (truck driver, supervisors) Potential need for semi-skilled labour if mechanised harvesting Need for skilled labour to operate the plant Remittances make up big part of expenditures, Kavango and O-Regions benefit from it	Need for unskilled labour for debushing, chipping and transport Need for semi-skilled and skilled labour in the production factory In both cases, however, less labour needed than in the case of charcoal and CBEND
	Land	Additional leasing of land possible, either for increased charcoal production or for placement of cattle In communal areas 'problem of the commons' hinders debushing	Additional leasing of land possible in order to reach necessary feedstock quantity In communal areas 'problem of the commons' hinders debushing	No significant changes expected
	Opportunity Costs	Subsistence farming (labour force engaged in debushing instead)	Subsistence farming (labour force engaged in debushing instead)	Subsistence farming (labour force engaged in debushing instead)
	Special Risks	Market uncertainty (exchange rate, FSC vs. non-FSC charcoal demand)	Economic viability unclear, so far donor-funded High capital costs, especially when scaled up	Economic viability unclear, so far donor-funded More cheetahs might increase loss of cattle or game
Socio-political	Health & Education	Increased expenditures on education and health, but still little access	Increased expenditures on education and health, but still little access	Increased expenditures on education and health, access possible due to proximity to urban area (possible perception of farmers)
	Social Structure & Power	Reduction of social problems resulting from umemployment	Reduction of social problems resulting from umemployment	Social impact small, given the scale of production and employment generation

	Relations	Increased responsibility of the farmer for belongings of his workers Work opportunity mostly form men, women stay behind in the rural communal areas	Increased responsibility of the farmer for belongings of his workers Work opportunity mostly form men, women stay behind in the rural communal areas	Work opportunity mostly form men, women stay behind in the rural communal areas
Ecological	Biodiversity	Bush-grassland equilibrium is restored Risk that protected tree species are harvested for economic gains	Bush-grassland equilibrium is restored Sustainable harvesting methods envisaged so as to establish a harvesting cycle	Tree-depending species (birds) threatened due to possibly complete bush eradication
	Water	Reduced transevaporation and restoration of water tables	Reduced transevaporation and restoration of water tables	Reduced transevaporation and restoration of water tables, though smaller scale than in the case of charcoal and CBEND
	Soil	Loss of nutrient supply of woody biomass is removed Effect mitigated if FSC standards are applied.	Loss of nutrient supply of woody biomass is removed Effect mitigated if FSC standards are applied.	Application of aftercare poison might negatively affect soil quality
	Carbon sink	If not harvested sustainably, carbon sink is being destroyed	Carbon sink restored due to revolving "cultivation" and harvesting system	Carbon sink destroyed
Food securtiy	Availability	Increases through farm shops Possibly decreases if production in communal areas is affected by lack of work force	Increases through farm shops Possibly decreases if production in communal areas is affected by lack of work force	Increases due to kitchen/restaurant on the farm
	Access	Limited by low wages and, if applicable, by restriction of lending from shops by Labour Act	Limited by low wages and, if applicable, by restriction of lending from shops by Labour Act	Increases due to more cash income
	Stability	Dependance on farmer's service Seasonality of work	Dependance on farmer's service Seasonality of work	No significant changes expected

Source: Authors' compilation (2009)

Figure 8: Bush-to-Energy Impact Chain



Source: Authors' compilation (2009)

6 JATROPHA-TO-BIODIESEL VALUE CHAIN AND POTENTIAL IMPACTS ON PRO-POOR RURAL DEVELOPMENT AND FOOD SECURITY

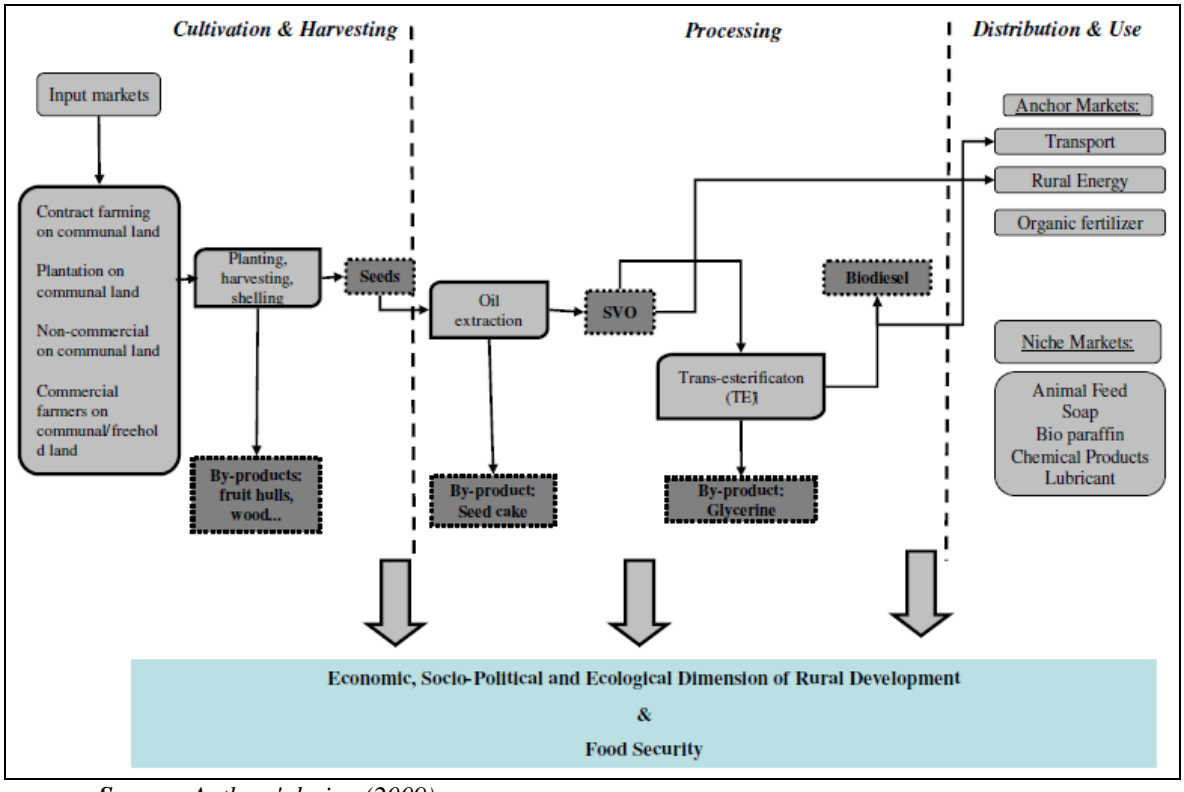
6.1 Background

This chapter describes the basic value chain and potential impacts of Jatropha-to-Bioenergy. In the subsequent sections, different ways of organizing potential value chains in Namibia are assessed regarding their effects on food security and rural development.

Jatropha is a small oil-bearing tree that originates from Central America but can nowadays be found throughout the developing world (Henning 2000), 3). In recent years, Jatropha has received a lot of attention for its agronomic characteristics, making it a promising bioenergy crop for developing countries. The high oil content (25 to 35 per cent) of Jatropha seeds allows producing biodiesel and straight vegetable oil (SVO) for transport, lighting, cooking or mechanization (Jongschaap, Corré et al. 2007), 25). At the same time, Jatropha is often attributed with less fierce competition for resources with food production and less negative ecological effects than conventional energy crops. This and the plant's various by-products can contribute to rural livelihoods.

Figure 9 shows a basic value chain of Jatropha starting with its cultivation and harvesting, through processing to distribution of its end- and by-products. Again, there are various development impacts, positive and negative, arising from the value chain. The next chapters will analyze these effects in the context of different modes of value chain organization.

Figure 9: Jatropha Value Chain and Development Impacts



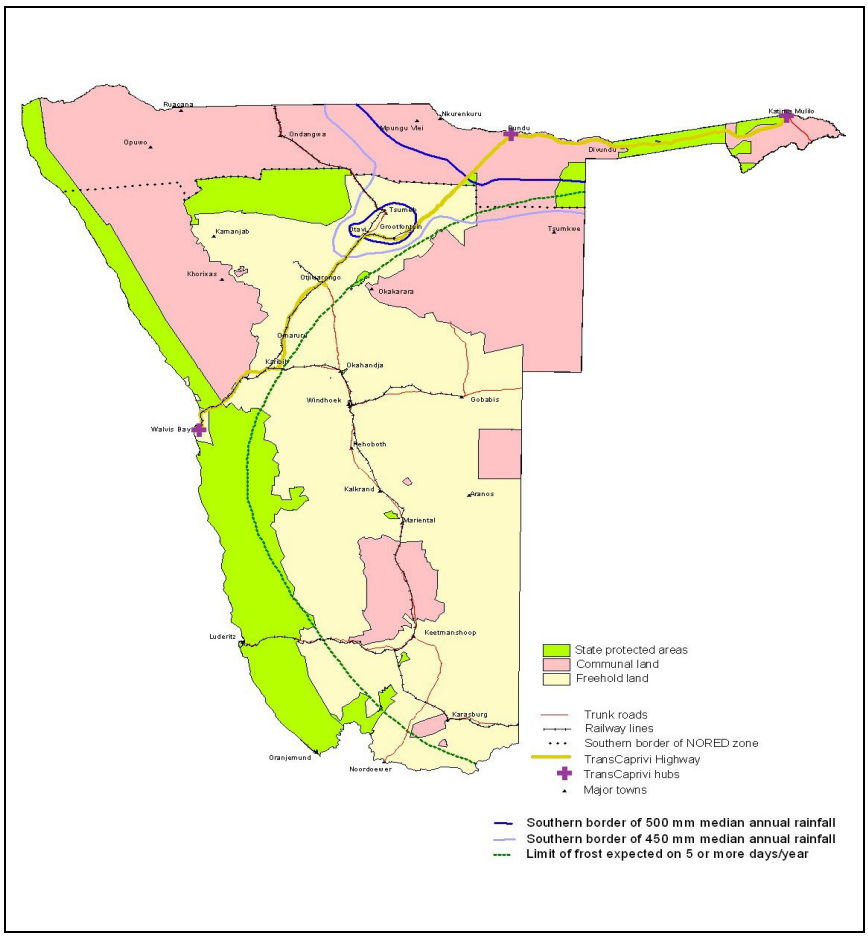
Source: *Authors' design (2009)*

Cultivation & Harvesting

Jatropha is often considered a low input crop that requires little water, nutrients and labour, making it a suitable crop for arid and semi-arid regions. In various countries the plant has been promoted to conserve soil and water on marginal, degraded land (cf. (Wiesenhuetter 2003) for Cabo Verde). However, doubts have come up in recent years regarding how far these assumptions can be extended to situations in which Jatropha is planted to produce high oil yielding seeds (Jongschaap, Corré et al. 2007), Int. Polytechnic).

Whereas Jatropha was found to survive in regions with as little as 250 mm annual rainfall (cf. (Wiesenhuetter 2003), 2), 450-600 mm rainfall per year is necessary for it to have reasonable production yields (Henning 2003), 6). Since food security considerations in Namibia advise the use of scarce water resources only for food crop production, suitable conditions in Namibia for Jatropha cultivation can only be found under dry-land in the communal areas of Kavango and Caprivi, as well as in the commercial farm region of the Maize triangle (Interim Bioenergy Committee 2006), 26 figure 10). Annual oil seed crops such as sunflower, however, require irrigation and are thus not opted for within a biodiesel industry of Namibia (ibid.). Since Jatropha is very susceptible to frost, at least in its initial growth phase, cultivation appears to have only limited potential in the Maize Triangle (Int. Commercial Farmer).

Figure 10: Map - Rainfall and Frost Borders in Namibia



Source: (Interim Bio-Energy Committee 2006)

Figure 10 shows also that most of the production would take place on communal land and only to some extent on freehold land (Maize Triangle).

As a perennial crop, Jatropha is said to require less nutrients and thus less fertiliser than annual crops once they have reached their full heights. Nonetheless, chemical or organic fertilisers strongly enhance crop growth (Jongschaap, Corré et al. 2007). Besides, Jatropha in Namibia was also found to be susceptible to crop pests such as the Golden Flea Beetle making it necessary to apply organic or chemical pesticides (Int. Polytechnic).

Supposedly, toxicity of the plant and its fruits protects Jatropha from browsing animals. Thus, when planted as hedges Jatropha can protect food production as already practiced in some regions of Caprivi and Kavango for a long time (Int. MTCT). Wild animals, however, were found to brows young Jatropha trees in the Maize Triangle (Int. Commercial Farmer).

One concern regarding Jatropha is the risk of it being invasive, i.e. of invading and out competing other species once introduced outside its natural habitat (Interim Bio-Energy Committee 2006), 41). Whereas invasiveness of other oil crops such as castor beans is apparently proven for other countries (Int. NBRC), there have not been any indications so far of Jatropha being invasive in Namibia. Single plants in Caprivi and Kavango were found to have existed already for a long time without having spread around (Int. Polytechnic). In other countries however, such as Australia and South Africa, Jatropha has reportedly been declared invasive (Interim Bio-Energy Committee 2006), 41).

Low labour requirements can make it possible to integrate Jatropha plants into existing production systems without neglecting food production. However, especially in the first years and during harvesting, labour input is quite substantial (setting-up nursery, preparing land, weeding and applying fertilizer) in order to reach well yielding Jatropha seeds (Jongschaap, Corré et al. 2007), 23). After 3-5 years under dryland conditions Jatropha is expected to reach its full production potential, respectively earlier when fertilizer and irrigation is applied (Metzler 2006), 11). Mechanical harvesting methods are not available, consequently Jatropha harvesting has to be done manually. In addition, even on an individual tree ripe seeds are often produced at different times throughout the year.

When cultivation is done on a larger scale (plantation model) to benefit from economies of scale, wages for hired labour are important cost drivers. Alternatively, Jatropha can be planted by smallholders on their own land that employ family labour (contract farming model). Here, opportunity costs of labour are usually lower. However, there might be risks of reduced capacities for food crop production when labour and land is scarce. Integrating Jatropha and food crop production through intercropping can overcome this problem and even increase food production (Int. Namib Bioenergy Ltd.).

Reliable information on potential yields and market prices are important to assess the viability and income potentials of Jatropha cultivation. In literature, however, a very large range of yield figures is found, varying from 0.6 t/ha up to 15 t/ha (Int. Polytechnic). Besides, reliable data for yields under marginal land or sub-optimal conditions do not yet exist (Jongschaap, Corré et al. 2007). Seed yields depend on a number of factors such as plant variety, soil conditions and agricultural practices. Whereas one investor currently performs research on different Jatropha varieties (section Plantation Model), there is little public research in Namibia to find most suitable seed varieties under different soil conditions and agricultural practices for smallholder farmers (Int. Polytechnic). Since no market for Jatropha seeds as biodiesel input exists so far in Namibia, there is a lack of information on potential seed prices. Eventually, the prices will be related to the prices paid for biodiesel minus the costs and profit margins of subsequent processing stages (Int. Namib Bioenergy Ltd.). Current prices paid for Jatropha seeds to set up nurseries are mostly higher than future

seed prices for oil extraction (Int. Polytechnic).

Processing

The processing stage comprises two major steps. During oil extraction SVO is produced which can be consumed locally for mechanization (powering stationary diesel engines), lighting, and cooking purposes. Also, it can be fed into a second processing stage called trans-esterification converting it into biodiesel. Oil extraction can be done with a variety of machines which differ in their scale of operation, i.e. the amount of seeds processed in a given time and the efficiency of extraction. Low scale presses can be used for village purposes with an efficiency of about 60 per cent whereas mechanized extractors or extraction based on organic solvents have efficiencies of up to 100 per cent (Interim Bio-Energy Committee 2006), 39; (Jongschaap, Corré et al. 2007), 22). With an reported oil content ranging between 25 and 35 per cent and hand presses extracting 60 to 80 per cent of the oil, four to six kilograms of seeds would be required to produce one liter of oil (cfa. (Henning 2000), 4, Metzler 2006). Given the range of reported yields above, this results in 0.2 to 5 tons of oil per ha (Int. Polytechnic).

Trans-esterification usually takes place in centralized plants where SVO is converted into Fatty Acid Methyl Esther (FAME), i.e. biodiesel. Methanol, a highly toxic and flammable chemical and a catalyst is added to SVO (Heller 1996), 22). Jatropha oil then first separates into three free fatty acids and glycerin, and in a second step combines with methanol, rendering FAME ((GTZ 2007), 18). Biodiesel can then be sold to the national or international transport fuel market, whereas the by-products enter various other markets. Additionally, carbon credits might be sold within the CDM (Clean Development Mechanism) or voluntary carbon markets.

The profitability at this stage depends on the conventional diesel price as well as biodiesel production costs. The FAME plant size exerts strong influence on unit costs due to economies of scale. According to the Interim Bio-Energy Committee (Interim Bio-Energy Committee 2006), 51) a small (on-farm use) FAME plant requiring 200 ha of Jatropha plantation leads to 84 US-cents/liter of production cost. Medium-sized FAME plants with 20,000 ha of plantation produces at 62 US-cents/liter.[8] Thus, both plant sizes would be economically profitable with conventional diesel prices at US$60-70, whereas at prices below US$50 a small plant would be unprofitable (Interim Bio-Energy Committee 2006), 52).

Distribution & Use

A commercially viable Jatropha industry depends largely on the existence of key output markets and the ability of the producers to meet the demand. Currently, Jatropha cultivation is neither directly done on farms or locally, nor on large-scale cultivations on a commercial basis addressing national or international markets.

Nonetheless, two different potential output markets are the transport fuel market and the rural energy market, resembling two different basic production choices. For either one there are potential additional uses stemming from the by-products such as soap production or seed cake market. A special market is provided by the CDM and will be explained below.

[8] Additionally, if seedcake is sold biodiesel prices would be 69 (small plant) and 52 (medium plant) US-cents/liter.

Transport Sector

In general, both SVO and biodiesel can be used to replace diesel fuel in engines. Although there are different methods for using SVO in diesel engines for transportation, there has not been much research on its use in the transport sector (GTZ/TERI 2005), 4; (Takavarashara 2005), 32). Problems with SVO's high viscosity and flash point lead to incomplete combustion (GTZ 2005), 17-18). In India, however, successful trials of public transport service providers with blends of ten per cent SVO were reported (GTZ/TERI 2005), 4).

Biodiesel, on the other hand, can be used in diesel engines as blends in any proportion or without blending. Blending can be easily done by pouring conventional fuel and biodiesel (splash blending) together in the tank (Interim Bio-Energy Committee 2006). As engine manufacturers warranties are mostly valid up to a blending of five per cent (B5) - although increasingly up to B20 – the potential market size can be derived by assuming five per cent of all fuel consumption to be supplied with biodiesel (Takavarashara 2005), 37). At a total diesel consumption in 2005 of 454 million liters mineral diesel, the wholesale market would therefore be 22.7 million liters per year.

Rural Electrification

SVO can be used directly in rural diesel generators to produce off-grid electricity. According to the Interim Bio-Energy Committee (Interim Bio-Energy Committee 2006), 31), approximately 9 MW of diesel generator capacity exists across farms and at Katima Mulilo, the capital of the Caprivi Region, as well as several at sites in the Kavango and Caprivi Regions. In addition, Jatropha oil can also be used for lighting (Henning 2000), 12), cooking and heating and thus as replacement for paraffin which 70 per cent of Namibians currently use for this purpose (Metzler 2006), 11).

By-products: Seedcake and Soap

The seedcake resulting as by-product during oil-extraction is toxic and can thus only be used as animal feedcake after detoxification. Detoxification, however, has been proved successful only on laboratory scale, and costs involved in fulfilling quality requirements would make it difficult to achieve profitability (Jongschaap, Corré et al. 2007), 15). The press cake, on the other hand, can be used as organic, nitrogen-rich fertilizer. Under low-input conditions using seedcake in Jatropha production might be advisable to avoid fertility loss when the seeds are harvested and withdraw nutrients (Jongschaap et al., 2007: 16).[9]

Soap can also be produced from SVO by mixing it with water and soda (Heller 1996), 20; (Heller 1996; Henning 2000), 10; (Hesselbach 2001), 12). The Interim Bio-Energy Committee (Interim Bio-Energy Committee 2006), 29) highlights soap production as a suitable activity especially for micro-enterprises or households to sell on local markets where imported soaps can be very costly.

6.2 Jatropha-to-Biodiesel Business Models

Jatropha projects in Namibia have started along with the Bio-oil Roadmap (Interim Bio-

[9] Jongschaap et al., however, mention that using the nutrients from the seedcake is only possible at higher production levels. For small farms with weak soils conventional fertilizer use might thus be unavoidable.

Energy Committee 2006) presented to the GRN. Trials have taken place in the Maize Triangle by commercial farmers (Commercial Farmer Model). Large foreign and national investors have tried to go into contract farming (Contract Farming) or tried to acquire large pieces of land to grow Jatropha (Plantation Model). Also, plans exist to implement Jatropha schemes within communities for local use (Community Model).

The subsequent chapters present four different business models for the production, processing and use of Jatropha. It is useful to look at each model individually since different ways of organizing the value chains bring along different effects and different institutional challenges.

The models differ according to their scale of operation, i.e. either large-scale (Plantation and Contract Farming model) versus small-scale (Community and Commercial Farmer Model) as well as according to the ownership structure of land, i.e. community ownership (Community and Outgrower Model) versus investor ownership (Plantation). The fourth model, the Commercial Farmers model is something in between, it is not as large as a plantation but has the potential for large scale processing if integrated into a cooperative structure. Additionally, it is comprised by farmer and farm worker arrangements like the plantation model.

Figure 11: Jatropha Business Models in Namibia

		Scale of operation	
		Small-scale	**Large-scale**
Land ownership	**Community owned**	Community model	Contract farming
	Investor owned		Plantation
	Commercial farmer owned	Commercial Farmer Model	

Source: Author's design (2009)

6.2.1 Plantation Model

6.2.1.1 Description of Model

In the Plantation Model in Namibia, an investor leases an ample piece of communal land to grow Jatropha on a large scale. The investor employs farm workers for cultivation, harvesting and processing. Jatropha-oil or biodiesel and by-products are sold on the national and/or international market.

Several projects of this business models have been started in Namibia in the recent past. MAN tried to set up a plantation in Kavango (and a contract farming scheme in Caprivi) but stopped their activities. Currently, two investors want to establish plantations in Namibia: Lev Leviev Biofuels (LLB) and Caparo Investment. Both enterprises selected the Caprivi region for their activities. The groups these companies belong to do not focus on agriculture as their core business. The Lev Leviev Group operates in the Namibian and Angolan

diamond industry and Caparo Group Ltd. is a worldwide manufacturing company with business interests predominantly in the manufacturing of steel, automotive and general engineering products (Etango 2008), (EnviroDynamics 2009).

LLB's first step was to obtain a 5-year-leasehold from the town council of Katima Mulilo to set up a test farm. The purpose of this farm is to detect which varieties of Castor-oil plants, Jatropha, and food crops are most suitable for the Caprivi region. LLB built up a pump station near the Zambezi River and irrigates all plants, including Jatropha. In the second step, the company approached communities in order to get a leasehold for communal land. The company is still busy with both tasks and is hence still in its pilot phase. The size of land LLB is supposedly seeking to cultivate ranges between 20,000 and 300,000 ha. Depending on potential revenues, the company will decide which crops to focus on. For the future plantation, mechanized harvesting is favoured over more labour intensive methods. (Etango 2008), Int. Caparo Investment).

Caparo is also still in a planning phase. In the first step, this company wants to obtain a leasehold over ca. 150,000 ha on which to grow Jatropha and food crops. Initially, ten per cent of the area was envisaged for food crops. This allotment was increased to over 40 per cent in the recent past. 25,000 ha of land are planned to be irrigated with water extracted from the Zambezi River whereas Jatropha will primarily be planted on the non-irrigated land. 2,000-2,500 skilled and unskilled jobs are promised to be created in the long term. Caparo has had Social and Environmental Impact Assessments conducted and included various positive impacts on the community in their business plans. Currently, the company is trying to obtain leaseholds (Caparo 2009) – Presentation).

Concerning markets, both companies envisage the local market and the neighbouring countries for the food crops. Also, both companies are planning to process Jatropha products in the Caprivi region but cannot yet specify which markets they will sell the Jatopha-oil and biodiesel to. The CDM market is not included in the calculations of the investors so far (ibid.; Int. Caparo; Int. Samicor/LLB).

When looking at the motivation of the Traditional Authorities and communities to participate in this model one has to bear in mind that unemployment and alcoholism are widely spread among the rural youth. Traditional Authorities therefore want the investors to create employment for their families and communities – the Mashi Traditional Authority, for example, was assured 5,000 jobs. Additionally, some communal farmers agreed to the leasehold because they were promised development projects, water pipelines and the debushing of their fields. As some members of the communities affected consider the land negotiated over as 'unused', they do not see a competition over land and welcome the new opportunities offered by investors. Farm workers currently working at the LLB-test farm also mentioned knowledge gain and income diversification as advantages of their employment. (Int. Farm Workers; Int. Ngweze Community; Int. Mafwe TA; Int. Mashi TA) Yet, not everybody in the communities involved supports the plantations – the reasons for this will be pointed out later in this section.

So far, the Government's position towards the Plantation Model seems rather undefined. As mentioned above, Namibia's Government has an expressed interest in creating employment, especially in the rural areas. It is, however, unclear if a plantation is considered the best way to create jobs. Furthermore, the regional government of Caprivi is particularly interested in the investment in food crop production because it wants the region to be self sufficient (Int. Regional Council).

Wheras a National Oil Crops for Energy Committee has been established to coordinate the implementation of the "National Bio-Oil Roadmap" (see chapter 4), this Roadmap has so far

not been adopted as a policy. Various ministries are involved and have mentioned the following issues that currently hamper the development of a biofuel policy in Namibia: food security and land issues and the global debate on biofuels, the question whether Jatropha is to be considered an invasive species as well as local, national political and party political issues (Int. NAB; Int. MAWF; Int. MET). Currently, a moratorium is put on Jatropha production, valid until the newly formed cabinet committee on biofuels (comprised of MME, MAWF and MET) has further investigated environmental and food security aspects of Jatropha (Int. MET).

The Ministry of Environment and Tourism plays a crucial role in Jatropha production in a large Jatropha schemes such as the Plantation and Contract Farming Models: The Department for Environmental Affairs is responsible for reviewing and approving Environmental Impact Assessments for agricultural projects and currently preparing a Strategic Impact Assessment on Jatropha cultivation for Caprivi and Kavango (Int. MET).

6.2.1.2 Obstacles & Potential Impacts

Obstacles

One of the major obstacles in this business model is land tenure. The land promised to the investors was partly already gazetted for community conservancies and for a government initiative for small-scale farmers. Also, the communal land act was in some cases violated when the communities were not included in the decision making process and the negotiations took place only between the investor and the Traditional Authority (Caparo SIA 32-33). Although the area promised to the investors is mainly considered 'unused', not the whole community affected agrees with that categorization because small farmers and herders do feel threatened by the plantations. This already indicates an enormous lack of communication, be it between the Traditional Authorities and their communities or between Traditional Authorities and investors. Additionally, the stakeholders in Caprivi do not know what the Namibian government's opinion regarding Jatropha is. (Mitchell 2009), Int. Mashi TA) This uncertainty about the position of the government makes a long term planning impossible. LLB already had to change their objectives when cultivating of Castor-oil plant was prohibited. Now, the investors wait for a government decision on Jatropha which would require an agreement of the different ministries involved in addition to intensive research. (Int. Samicor/LLB)

Some of the factors mentioned above result in a partial resistance of the community. The communities are not always sufficiently involved in the allocation of communal land. They often feel they lack information on the characteristics of Jatropha, because no example of best practice in- or outside Namibia is shown to them. Some communities have already made bad experiences with other cash crops, such as cotton, and are now worried about the viability of the project and hidden objectives of the investors. The communal farmers are also worried about losing the rights to their land for many decades. (Int. Communal Farmers, Ngweze, Nambwa) Agroclimatic factors such as the Golden Flee Beetle are regarded as a minor problem whereas the floods of the Zambezi River in the beginning of 2009 did bring major problems for the pump stations. (Int. Caparo; Int. Samicor/LLB). Lack of capital due to the Global Economic Crisis also constitutes a problem because it is becoming more difficult for the Namibian enterprises to obtain money from their mother companies.

Impacts

Economic Impact

So far, there is hardly any commercial agriculture, industry or manufacturing in Caprivi. Consequently, the positive impact of the plantation model most often mentioned is the creation of employment and the incentive for the young and/or economically active to stay in Caprivi and not to migrate. (Mitchell 2009),12). Also, the investors promised to improve the agricultural skills of their labourers and invest in the area by e.g. building roads, pump stations and pipelines, as well as factories for the processing of Jatropha seeds. It is also to be expected that taxes will be paid both by the companies and by their workers. (Int. Samicor/LLB; Int. Caparo).

Concerning negative economic impacts, opportunity costs of a plantation have to be considered. If the investors get a leasehold, a large area in the Caprivi can not be used for subsistence or small scale farming, conservancies (tourism) or other activities. Also, people would mainly work on the plantation and reduce other (income generating) activities. What is more, the region is exposed to the risk of project failure. If the investors pull out after a while, the Caprivians are left with the enormous task of restoring the fields. Additionally, one might argue that positive impacts are decreased as the bioenergy generated will not necessarily be used inside Caprivi or even inside Namibia.

Ecological Impact

Although the investors promise to make provisions for intercropping and to include natural vegetation and wildlife in their plans, these efforts can only lessen the negative ecological impacts of a plantation and not create any additional benefit. Especially since the land used for the plantations was partly gazetted for conservancies, the effects on the environment are in any way negative. These effects include a loss of carbon sink through debushing and a decrease of biodiversity through debushing and monocropping. Also, irrigation changes the natural water cycle and fertilizers pollute water and soils. So far, there is no evidence of Jatropha potentially being an invasive species in Namibia, but since there are no experiences with large-scale plantations, the potential for invasiveness needs to be observed. Effects on soil, biodiversity and water resources will also need careful monitoring.

Additionally, as the land available for small scale farmers and herders is reduced by a plantation they would dispose of less grazing area for their cattle. This negatively affects the natural vegetation of areas which already now are considered overgrazed.

Socio-political Impact

Through the increase of cash income, employees of a plantation can, for example, afford school fees for their children and medical care such that education and health are improved. One company even promised free schooling, medical support and investments in the social development of the region. The Traditional Authorities also hope that the alcohol consume of the youth will decrease once they are employed (Mitchell 2009), 9, Int. Mashi TA).

Negative socio-political impacts might result from a complete change of lifestyle and livelihoods of former subsistence farmers. The fact that the initiative comes from outside Namibia makes critics even more sceptical. Conflicts might arise between communities and Traditional Authorities because of the partially intransparent allocation of leaseholds and nepotism. Also, government actors are accused of being connected to the shareholders of the bio-oil projects. Further potential for conflicts lies in fencing off the land for the plantation

and in an increased number of work-migrants from neighbouring countries (Int. MAWF, Int. Ngweze Community).

Impact on Food Security

As mentioned above, food crops are an essential part of the business plans and might even become more important if the market for Jatropha products is weak. This can contribute to food self sufficiency of the region and the country. Also, farm workers and their families have an improved economic access to food through cash income.

On the other hand, food crop production might be decreased if the bio-oil business takes off. In this case, Jatropha and food production would compete for land and especially for labour. It also has to be considered whether the food crops produced are meant for export or for local consumption. Additionally, one must not forget that economic access to food does not help if food markets do not exist.

6.2.2 Contract Farming Model

6.2.2.1 Description

Contract farming refers to "*a system where a central processing or exporting unit purchases the harvests of independent farmers and the terms of the purchase are arranged in advance through contracts*" (Baumann 2000), 7). The terms of the contract vary and usually specify how much produce the contractor will buy and what price will be paid for it. The contractor frequently provides credit, inputs and technical advice.

In Namibia, schemes that fall under the label of contract farming exist mainly in the form of irrigation farms under the Green Scheme and intensive agricultural projects. Private commercial investors are given leaseholds for land suitable for intensive agricultural production in communal areas. A number of smallholders are also allocated land around the core estate of the project which is run by the investor. The investor acts as a service provider to the smallholders and is responsible for overseeing the intial operations of the scheme, advising smallholders, providing input and know-how and assisting with the marketing of the produce on a cost-recovery basis (Mendelsohn 2006); (GTZ 2006).

There are plans and first steps taken to establish contract farming schemes in order to produce bioenergy in Namibia. The proponent of one of these projects is a Namibian registered company called Prime Investment (Pty) Ltd that is financed by South African and UK-based investors. Their project is based on the idea to contract 8,000-13,000 farmers in Kavango to plant Jatropha on 70,000-130,000 ha of land cleared before 1990 along the Namibian section of the Okavango River, covering the surrounding areas of Katwitwi, Rundu and Divundu in order to receive Carbon Credits and sell the seed cake in Europe and bio-diesel in Namibia and neighbouring countries. The seed cake would provide for 19 per cent of income in the project, bio-diesel for 33 per cent and carbon credits for 48 per cent. All three income streams are considered to be needed in order for the project to be economically viable (Christian 2006).

For the project, it is crucial to identify those sites that have been cleared prior to 1990 to claim carbon credits. In Namibia, this can be done using satellite images. Farmers who have

such land at their disposal qualify for participation in the project. Farmers who choose to grow Jatropha are contracted to grow the trees on part of their land (either replacing maize or mahangu cultivation or using fallow lands) with an estimated average size of 10 ha (ibid.). The farmer will thus maintain control over his land but in accordance with the requirements of the Kyoto Protocol he/she may not clear new lands in order to compensate.

The farmer mainly contributes his/her land and labour for planting, maintaining and harvesting to the project. The investor sets up nurseries and provides seedlings, fertiliser, other materials and training for planting. The farmer agrees to sell the harvest from the trees to the investor. The company constructs and operates a factory in Rundu for extracting the oil from the seeds and a factory in Walvis Bay for processing the oil into biodiesel.

Nurseries, tractor services and factories will provide additional employment opportunities, especially for families who do not have access to land cleared before 1990.

As Jatropha trees take several years to mature and those farmers who take care of the plants will probably not be able to grow the same amount of staple crops as before, the investor also subsidises the farmer with food and cash during this time.

In addition, a farmers association is established to represent the interests of farmers. This association will hold shares in the project companies. After 2014, these shares will increase such that the association will hold 100 per cent of the farming company and 49 per cent of the industrial company (Christian 2006).

Box 2: Contract Farming

Another contract farming scheme in Namibia planning to grow Jatropha does not count on carbon credits. At its centre is the commercial vegetable farm Shankara in Kavango. Together with national and foreign investors the operator of the farm founded the company Namib Bioenergy Investments and put up a nursery. The project has not taken any further steps at this point but the idea is to supply small-scale farmers who with seedlings, training and financial assistance for weeding and other inputs. In the first phase, the assistance will be provided as a sponsorship. Once the farmer starts producing yields it will be on a cost-recovery loan base. The farmers grow the Jatropha trees on an inter-cropping basis and use their cattle's manure for fertilizing. They harvest the seeds and sell their yield to the commercial farmer and investors. The seeds are transported to Walvis Bay where they are processed into bio-oil. Both oil and seedcake are exported (Int. Namib Bioenergy Investment)

As described above, farmers in Kavango make a living under difficult conditions due to shortage of fertile soils, lack of inputs and knowhow, poor crop yields, and limited markets for surplus farm production. In addition, there are few other economic opportunities open to rural households. Most rural homes in Kavango are among the poorest in Namibia.

Their main motive to participate in Jatropha projects is therefore the opportunity of an alternative source of cash income. The value of Jatropha incomes is expected to more than compensate for the loss of reduced mahangu farming. Farmers also mentioned the benefit of Jatropha as a perennial tree: they do not need to worry about sowing every year and build up an asset value for future generations. They also expect to benefit from further employment opportunities related to the project (e.g. in the factory) and training in farming and business skill provided by the investor (Int. Communal Farmers; Int. Village Headman; Int. KJFA).

Traditional Authorities (hompa and headmen) also mentioned the benefits described above as reason for agreeing to the project (Int. Chief, Kavango; Int. Headman, Kavango). TAs will

be involved in confirming claims of using rights to fields that qualify for Jatropha production (and may have lain fallow for a long time).

The government position on Jatropha has already been pointed out in the Plantation Model. Regarding Contract Farming, another important role of the Ministry of Environment and Tourism has to be mentioned: the Department for Environmental Affairs is home to the Designated National Authority which has to approve of the project and certify that all national legal requirements have been met before the project proposal can be submitted to the CDM Executive Board in Bonn.

6.2.2.2 Obstacles & Potential Impacts

A contract farming scheme to produce Jatropha faces a variety of obstacles. Some of those that have already emerged before the project has started are mentioned here.

Land Tenure

As pointed out before, land is a very sensitive issue in Namibia (chapter 4; section Plantation Model). According to the investor, customary use rights of communal farmers on the land where Jatropha is planted should be formalised in the form of long-term leaseholds (Christian 2006). This is meant to prevent conflicts over ownership of trees. Interviews showed that the involved communities as well as the government have reservations against this procedure. The Jatropha Farmers Associations expressed the view that leaseholds will actually make land rights less secure for farmers (Int. KJFA; Int. NJGA). Customary rights are recognized by law already and are mostly undisputed. Converting them into leaseholds threatens the right of the farmer as, in case he/she is not able to pay the lease (e.g. in case of project failure), the land becomes state property. At the same time, it seems that formal registration of communal land is also not possible at this time as Traditional Authorities have expressed their unwillingness to support the registration process (Int. DED, Int. MLR). It is not clear whether the circumstance that Jatropha is planted on unregistered land poses an obstacle to claiming carbon credits (Int. KJFA).

General PoliticalIssues

There is not yet a government position on Jatropha. In addition, there seems to be a general distrust towards activities of people from outside of the community, especially foreigners. The communities and regional government would like to first see that the investor is genuine and committed before dedicating their own land to the project. Local authorities seem to be hesitant in their support as “they have not seen any examples” of functioning Jatropha projects of this kind (Int. MAWF, Int. NDC).

Plant Issues

Another obstacle to the project is that so far there is only little information on Jatropha cultivation in Namibia. Farmers have mentioned insects and wild animals as a threat to young plants (Golden Flea Beetle, grass hoppers, porcupines). The amount of fertilizer and weeding to get good results is not yet clear (Int. Commercial Farmer).

Potential Impacts on three Dimensions of Rural Development

Possible economic impacts on target group

As described above, families and communities participating in a contract farming scheme to produce Jatropha can benefit economically. They diversify their economic basis and are able to generate additional cash income in multiple ways: contracted participant farmers are paid an initial compensation which begins to fall away when the plants start producing seeds and the farmer then receives income from selling the seed to the investor who creates a guaranteed demand/market for the product in the first place. In addition, employment opportunities are created for those who cannot participate in growing Jatropha. They can work in the factory and nurseries or as tractor operators. Opportunities for casual field labour might also increase as Jatropha farmers hire others to help take care of their mahangu fields. Moreover, secondary employment might be generated as consumption expenses of participating farmers rise and demand for maintenance workers etc. increases with project activity.

The contract farming scheme to grow Jatropha thus provides the opportunity to enhance income and improve income security through diversification but the project also poses several challenges and risks that have to be mitigated in order for economic benefits to materialise.

The paramount threat is the failure of the project for example due to either market failure (global price changes), mismanagement or if Jatropha yields turn out to be much lower in Kavango than expected. Capital risks, in this case, will be borne mainly by the investor and not by the individual farmers. So there is no risk for the individual farmer of losing his/her lands or assets due to debts associated with the project (Christian 2006). However, this is not always the case in contract farming schemes. Often the farmers get into debt with the investor for inputs and services provided (Dubois 2008).

If, on the other hand, the project completely fails the farmers are left with the trees on their fields but cannot sell the harvest if there is no other buyer in the region (as is often the case). The farmers then have to remove the trees before they can turn the land to other uses. This can be expected to require a considerable amount of labour and probably also mechanical input. The company has already indicated in this case that they are willing to create a fund to provide for this case (Christian 2006).

Another risk that is born by the farmer is that of crop failure. Poor rainfall or infestations with insects or diseases might result in low yields in the short term. Also, climate change might have an impact on yields in the long term (Christian 2007). These risks also exist for the farmer who grows mahangu and other dry land crops but might be more severe with plants the farmer is less familiar with and that are perennial like Jatropha.

Another key point lies in the contractual modalities that link companies to smallholders, and in mechanisms for ensuring that these are respected by both parties. The company is faced with the risk of the farmer selling outside the contract or diverting some inputs supplied by the company to other purposes, thereby reducing yields available for processing. Farmers and community leaders, on the other hand, expressed their fear that the company may be unreliable or exploit its monopoly position and not fully comply with promises made or abandon the project completely. Pricing systems need to be fair and transparent and independent buyers need be regulated and controlled. It became apparent that communities and Traditional Authorities need support from NGOs or government institutions. These must provide them with reliable and independent information about advantages and disadvantages of the project. They must support them in negotiating terms and prices with the investor and help with dispute resolution (Int. Polytechnic).

Land and Pastures

In this special case, the investor needs to verify that the land farmers offer for Jatropha was indeed cleared before 1990. The project would then assist farmers in having the boundaries of their farm mapped and registered with the Ministry of Lands and Resettlement, with assistance from the Traditional Authorities and Communal Land Board of Kavango. As mentioned above, local and national authorities expressed the concern that this might actually weaken farmers' rights to land. If, on the other hand, no leaseholds or formal registration of land is issued, land disputes might arise. Tenurial uncertainty might cause farmers to be hesitant to take part in a long-term project. Interviews with farmers and Traditional Authorities led to the conclusion that use rights to land are locally well known and mostly undisputed. Disagreements can be resolved through village headmen and land boards (Int. Chief, Kavango; Int. KJFA). However, determining access to land that has lain fallow or been abandoned for a long time can be expected to put additional pressure on capacities of TAs and land boards in Kavango.

Planting Jatropha on a large scale can also result in the loss of some grazing area for cattle and small livestock. This will occur on fallow and abandoned fields but also on currently cultivated fields where animals are generally allowed to browse the leaves and stalks of mahangu after harvest and possibly also as a result of the clearing of woodlands for additional mahangu fields.

Food Security

Not every field envisaged for Jatropha production is fallow land. It can be expected that some farmers who participate in the project will convert part of their mahangu fields into Jatropha cultivation. This potentially means a reduction of food production and food self-sufficiency in Kavango. On the other hand, as mentioned above, most families in Kavango already provide for a large part of their food needs by buying food as most farmers' own yields do not suffice to feed the family. Additional cash income and food subsidies from the Jatropha project can thus play an important role in enhancing food security. This is providing that food markets in Kavango function well and that people actually choose to spend their money on nutritious food. Allowing farmers to use their improved skills in farming techniques and Jatropha seed cake as fertilizer on land set aside for food production as well as the possibility for inter-cropping during the first years can further help to mitigate negative impacts on food security.

Box 3: Opportunity costs of Jatropha production (according to (Mendelsohn and Obeid 2007))

Mahangu yields in Kavango are about 300-330 kg/ha. Mahangu has a value of approximately N$ 3.00-4.00 / kg. Therefore, one hectare will yield a value of N$ 900-N$ 1,320 / year. Averaged over 12 months of the year this amounts to N$ 75-N$ 110 / month. In this particular project, participating farmers are paid N$ 100/ha/month until the value of their seed yield exceeds that amount. The investor provided the following figures indicating the expected yields of seed per hectare and associated incomes to participating farmers from the seventh year onwards: At N$ 0.35/kg and an annual yield of 4,200kg/ha, a farmer could earn N$ 1,470/ha/year. If 65,000 hectares are cultivated, then over N$ 95 million/year could be earned by all the participating farmers in Kavango.

Ecological Impact

Due to little experience with Jatropha cultivation on a large-scale in Southern Africa,

possible ecological impacts are hard to assess. Just as a plantation, a contract farming model requires research on the potential invasiveness of Jatropha as well as on the plant's effects on soil, biodiversity and water resources. A special characteristic of this scheme is the big number of independent producers. This makes seed distribution particularly hard to control.

As opposed to the Plantation Model, Jatropha contract farming schemes in Kavango use land that has already been cleared and been used for agriculture before so that no carbon sink is lost but rather created.

Socio-Political Impact

Additional cash income for farmer families can lead to higher spending on education and health. School fees already make up a large proportion of expenditures. The support of farmers coming together in an association and having representatives to speak for them might also help communities to make themselves heard for other purposes.

On the other hand, it can be expected that a project of this scale will put additional pressure on social and political structures in Kavango. Some of the spending of additional cash income may be undesirable, for example on increased alcohol consumption. HIV/AIDS infection rates may also increase in association with greater economic activity (Colin Christian and Associates CC 2007).

Not all families have access to land cleared before 1990 and the already rich have more land available for Jatropha. Some people will thus benefit from the project more than others.

Increased economic activity might also lead to increasing immigration of Namibians from other regions and foreigners to Kavango and put additional demands on and competition over natural resources (ibid.).

Furthermore, it has been frequently mentioned that in the case of project failure and abandonment of the project by the investor, the willingness of communities to cooperate in projects of this kind will be destroyed for years. It appears that extreme pressure is put on community leaders and TAs who supported the project and, in the case of project failure, 'convinced' people to participate (Int. NDC, Int. MAWF).

6.2.3 Community Model

6.2.3.1 Description

Another model proposed for Jatropha value chains in Namibia follows a decentralized community-based approach. Jatropha seeds, in this model, are not sold to outside markets but rather processed and used locally for providing remote communities with access to energy and improved livelihood activities.

Whereas community models are running successfully in various other Southern African countries (cf. FAO 2009), no such model existed in Namibia nor was on a field trial phase during the time of the research. One university, however, had conducted laboratory research and had plans to go into field trials (see Box 4). Another NGO had started to promote Jatropha among disadvantaged women in the north of Namibia to provide improved livelihood options. During other interviews potentials of such a Community Model for

Namibia were highlighted.

Bioenergy in this model would either be the main output for consumption (for household cooking, mobility and electricity application within a community) or an input for other value chains (e.g. mechanization of irrigation systems to enhance production of food crops). In the latter case, it is important to assess the potentials of the food crop value chain in order to determine the benefits of the Jatropha Community (e.g. output market conditions for vegetables) (FAO 2009), 23).[10]

In both cases Jatropha seeds, once harvested, are sold or provided to a local SME or some community extraction facility to produce SVO. Communities lacking a critical quantity to process alternatively sell their seeds to a mobile oil extractor serving various communities (Int. Polytechnic). The seedcake would be available locally and thus be used as fertilizer for food crop production in the community (ibid.).

Locally extracted oil could thus power generators for pumping water, for grinding, or electricity provision. Alternatively, SVO can be used for improved cooking stoves, lighting or production of alternative products (e.g. soap out of Jatropha oil).[11] In addition, bio-gasification plants were mentioned as a use for Jatropha residuals for a community to produce energy (e.g. Int. Baumann & Meier Workshop CC, Int. MTCT). The Bio-oil Roadmap (2006: 32) further mentions the potential for using Jatropha oil as biodiesel component within a hybrid off-grid system, an option also discussed for the Tsumkwe Off-Grid Electrification project (Int. Solar Age Namibia).

Value Chain Stakeholders

Besides the different local value chain actors (producers, processors and users) a very important role in setting-up and coordinating the value chain is played by an external facilitator (an NGO, academic institution, government institution or private company). The local value chain actors can be expected to lack capital and know-how for initiating a value chain. The external facilitator supports the community through training and in finding capital (Int. Polytechnic, Int. MTCT).

A Community Model requires high start-up investments. Funding organizations, such as donors, governmental organizations or subsidized private companies might help overcoming the financing gap. External facilitators and funding organizations are guided by the potential development outcomes for the community. GRN aims at providing off-grid solutions for regions without grid connection (Interim Bio-Energy Committee 2006), 32). Government support for a community-based initiative is thus conceivable once the model proves successful.

[10] One of the models, run by an NGO, proposed a somewhat different model: women were encouraged to plant Jatropha trees without necessarely using seeds locally but selling them to a different market (Correspondence with Angelica 2009).

[11] Whereas there was no reference so far whether to also produce biodiesel from SVO in this model, it is basically possible.

Box 4: Current Community-Based Jatropha Initiatives in Namibia

Current initiatives include a pilot research project by the Polytechnic of Namibia, the IRES (Integrated Renewable Energy Solutions for the Rural Namibia). Farmers within an off-grid community will be encouraged to plant hedges of Jatropha for local energy provision (Int. Polytechnic). Work is still in a nascent stage, with currently only technical feasibility tests under laboratory conditions and the development of a specific hand-operated press for community use. The next stage of research will focus on the economic viability of the community model and field testing (ibid.). One community in Kavango envisaged for a pilot currently uses a diesel generator to power a water pump for irrigation of a vegetable field (Int. Communal Farmers). Conventional diesel is at present the major cost element of vegetable production (reported to be 60 per cent of the final output price) thus reducing potential benefits to the community. The university in this case would partner with a local institution, the Village Development Committee (VDC), to plant Jatropha for replacing conventional diesel.

Another project, run by an NGO, started to promote Jatropha among women's groups in the North of Namibia to plant Jatropha as fences and enhance rural livelihoods (Int. MTCT). The basic idea was to set up pilots of 5 ha farms from Caprivi to Omusati and produce SVO for community use to pump water, for cooking etc., use the seed cake, enhance food production and processing. Women were mobilized in rural and urban areas of Caprivi and Kavango. (Int. MTCT Caprivi). In Kavango, women were motivated to intercrop Jatropha with their main crops mahangu and beans (Int. Women's Group). A member of the women's group explained that there were up to 1,000 women interested in growing Jatropha (ibid.).

6.2.3.2 Obstacles & Potential Impacts

There can be a variety of development impacts from a community-based Jatropha models since feedstock production, processing and use stay within the community.

Economic Impact and Food Security

As previously mentioned, biodiesel and SVO can be used in generators for communal provision of electricity or as fuel for transportation and machines. For communities without grid connection, locally produced biodiesel or SVO if economically competitive with other energy sources, can contribute to rural energy security by providing a decentralised, reliable and affordable energy supply for agricultural equipment and electrification. On the one hand, wider and more on-demand availability of energy and electricity increases living standards. Also, the time formerly spent on fuelwood collection can now be used for other productive purposes. On the other hand, reliable electricity provision is indispensable for many productive purposes and services for local development (e.g. irrigation through SVO powered water pumps, higher productivity through light and better health) and thereby provides further opportunities for income generation as a second round effect (see Box 5 on experience in Mali below). Additional income for the community can also come from the CDM or optional carbon markets (Interim Bio-Energy Committee 2006).

If the model proves to be technically viable, communities have to build up expertise in processing techniques, management and self-organisation to be able to run the project successfully. Helping to empower the community in this way is a significant advantage of this model over the above mentioned which provide mainly low-skilled employment and little empowerment. (Int. Polytechnic).

Food security can be positively affected when Jatropha residues (seedcake) are used as fertilizer in food production or if water pumps for irrigating food crops are powered with biodiesel or SVO, both improving the food availability and/or access to food (Int. Polytechnic). The food security can, however, also be negatively affected when labour is scarce or land formerly used for staple food production is now used for Jatropha cultivation.

Social/Political Impact

As control over the land and a large share of value addition remain within the community, a high degree of ownership of the community in the project can be expected (Int. MTCT). Participation of the community and incentives for collective actions enhance social capital. Moreover, using Jatropha oil for cooking and light instead of fire wood and kerosene can have positive impacts on health. Enhanced energy availability can further support education and health facilities.

Ecological Impact

Large-scale environmental effects cannot be expected from individual community schemes. On the contrary, experiences from other countries show that replacing traditional energy sources reduces air pollution and deforestation ((FAO 2009)). Carbon emission can be reduced by replacing conventional diesel in stationary engines, depending, however, on the induced land use changes.

Challenges and relevant Institutions

In reference to the literature on community-based models (cf. (Dubois 2008), (FAO 2009) and the research conducted in Namibia, there are two major challenges facing community-based models from a development perspective: economic sustainability at local level and scaling-up to national level. The entire value chain, from production to consumption, is managed within the community. The challenge is then to coordinate these interdependent steps in the context of a target group that lacks capital and know-how.

A crucial problem is the high investment cost (inputs, machines, human capital) for setting-up community-based models, e.g. as a hybrid-system or stand-alone solution. The low purchasing power and size of the target communities would make it unlikely for the community to recover the start-up and running costs by themselves. As a consequence, to become financially viable the investment costs would need to be covered by public funding (Int. VO Consulting). Financing mechanisms from the GRN, however, do not seem to be in place for a Jatropha based off-grid system. The Off-grid Electrification Master Plan (OGEMP 2007), not yet a government policy, focuses only on household solutions, not mini-grid solutions. A feed-in policy as an incentive for pre-grid regions, i.e. regions without access to the national grid within the next years, is however lacking for Kavango and Caprivi (Int. NORED).

On the other hand, the Community Model requires know-how and participation of all actors involved in the value chain. Whereas extensive external support is necessary at least at early stages, participation of local communities is important to create sustainability. Research in Namibia has shown the importance of a clear vision and viable project proposal as well as of communication between community and external support. A lack of these factors makes success unlikely. In some cases, an NGO had promised to distribute seeds which never reached the communities, in other cases the communities sold the Jatropha trees after receiving them from the NGO without planting any trees themselves.

Box 5: Examples of a Community Biofuel Development Scheme - Jatropha Biofuel in Malian Villages

Mali is among the poorest countries in the world with a highly unequal income distribution. The country is land-locked and 65 per cent of the land area is desertic or semi-desertic; 99 per cent of the rural population lack energy services and show a a strong demand for electricity to pump water for irrigation, to operate agricultural processing equipment, for chilling of vegetables, for lighting and refrigeration services in small shops and restaurants.

Jatropha is well known in Mali where it is used for protective hedges and erosion control lines. Women also use it for traditional soap. A 15-year development project makes use of this knowledge on the plant. It aims at reducing poverty of the population the Garalo-village and at setting up Jatropha-fuelled electricity generators for 10,000 people in the community. 1,000 ha plantations of Jatropha (and other oil-producing plants) are implemented to cover the electricity and capacity building for the community is organized. Environmental benefits include CO2 emission savings of 9,000 tons per year over the project life as well as protection of soil against erosion to combat deforestation and desertification.

In the village of Tiécourabougou, the Malian NGO Mali-Folkcenter Nyeeta (MFC) launched the idea of "energy service centers" built around Jatropha. Some 20 hectares of plantations grow seeds for producing Jatropha oil; which is used as oil to power activities like millet grinding and batter charging. Villages around a 20-kilometer radius also benefit from these services. The money spent on locally-grown fuel stays in the community to stimulate the local economy; on a macro-economic level, this implies a reduction of the country's expenses on imported fossil fuels, saving hard-earned foreign currency reserves. (UN-Energy, 2007; (Dubois 2008)

To achieve results comparable to those of larger schemes "significant scaling-up is necessary" (Dubois 2008) (see CBEND-problem for Bush). For this purpose, there needs to be a significant potential for Jatropha based-community schemes throughout Namibia. Whereas small solar-home systems are applicable for localities with low population densities, larger off-grid solutions require a certain population size and density as well as productive activity (Roedern 2007), 41). Besides, sufficient potential for feedstock production must exist (Dubois 2008), 22). The Bio-oil Roadmap (Interim Bio-Energy Committee 2006) identified several potential sites for off-grid solutions based on Jatropha, i.e. "approximately 9 MW of diesel generator capacity already spread across farms and at Katima Mulilo" and additional "sites in the Kavango and Caprivi Regions for off-grid power generation development". Further potential for pre-grid regions as a component of "hybrid systems to deliver off-grid power, and potentially sell electricity into the grid at peak times" are mentioned (ibid., 32). Actual information and data on potential mini-grid sites however seem to be lacking (OGEMP 2007), 21).

6.2.4 Commercial Farmer Model

6.2.4.1 Description

Another potential way of organizing the Jatropha value chains involves commercial farmers planting Jatropha on their own land to subsequently use the Jatropha seeds on-farm or sell them to off-grid generators or other markets (Interim Bio-Energy Committee 2006).

The Bio-oil Roadmap (ibid.) estimates a potential of 500 commercial farms in Namibia to plant on average between 5 and 10 ha, on freehold and communal land. At the time of research, trial plots existed already under freehold land in the Maize Triangle. Apart from that, extensive areas in Kavango and Caprivi have been assigned for small-scale commercial farming units (2,500 ha farms) primarily for livestock use. It is apparently also considered to integrate Jatropha as a cash crop into those farming systems (Int. Communal Farmer, Int. MLR).

Some of the commercial farmers in Namibia belong to the early adopters of Jatropha seeds. One interviewed farmer had started to grow Jatropha for on-farm use, i.e. to replace conventional diesel in tractors with Jatropha oil (Int. Commercial Farmer). Other farmers in the Maize Triangle started to plant Jatropha on a trial basis to eventually sell it on the domestic market or to potential buyers abroad (Correspondence with German Farmer 2009). The currently largest plots exists in Kavango at a government farm producing mainly food crops under irrigation. 14,000 Jatropha trees were planted with seed production already occurring in the first year (Int. Commercial Farmer).

6.2.4.2 Obstacles & Potential Impacts

Potential Development Impacts

In comparison to large-scale plantations or contract farming schemes, the direct development effects of this scheme on income generation for farmers and farm labourers can be assumed to be rather limited. Besides, commercial farmers have low capability to tap into global capital markets and output markets, and therefore have less capacity to develop a processing industry domestically by themselves. However, forming Jatropha processing co-operatives with other Jatropha growers might secure reasonable processing economies of scale (Interim Bio-Energy Committee 2006), 45).

However, commercial farmers can play an important role in developing a biodiesel industry by introducing and diffusing innovations (new crops) like Jatropha (Int. NDC). They are less risk avers than small-scale farmers and relatively independent in their decisions (small-scale farmers depend on decision of Traditional Authorities), at least when producing under freehold land conditions.

Providing incentives for those farmers to plant Jatropha as trials can result in a public good if the research results are accessible to the wider economy (positive externalities). Thereby government research and decision-making can be supported saving further government resources. Besides, some risks for late adapters might be eliminated. (ibid.). The Commercial Farmer Model can thus play an important role in applied research and innovation dissemination. The Ministry of Agriculture Water and Forestry (MAWF) is the key institution to set the right incentives and regulations.

Apart from that, growing Jatropha on commercial farm land could help create a critical mass of Jatropha seeds for setting up processing industries (ibid.). Potential processing industries or co-operatives might therefore also provide extension services to commercial farmers (Interim Bio-Energy Committee 2006), 45)

On the contrary to foreign investors, commercial farmer schemes seem to have the advantage of their familiarity with the local terrain as well as a higher potential to be controlled due to their Namibian citizenship. The risk of moral hazard is thus reduced.

Obstacles & Institutions

Despite the potential development effects and less external dependence for cultivation, some obstacles were reported to be responsible for this model not yet taking off.

Frost-sensitivity: Farmers had underestimated the frost-sensitivity of young Jatropha trees. As the Maize Triangle experienced relatively cold winters in the last years the Jatropha trees suffered severely in their first year at one farm visited and did not reach a sufficient strength to protect them from frost (Int. Commercial Farmer). However, as one farmer mentioned, frost in the Maize Triangle is mainly a problem in the valleys, not at farms located in higher altitude regions (Int. Commercial Farmer).

Destruction by animals: Contesting earlier believes of the plants' toxicity, wild animals were found to have eaten young Jatropha trees not yet developing their toxicity (Int. Commercial Farmer). Besides, problems with insects and termites destroying the Jatropha plants were reported (Int. Commercial Farmer)

A further aspect mentioned in the commercial farm land, was the labour costs involved in harvesting the trees due to the lack of appropriate mechanical harvesting devices.

Whereas large scale investor schemes have the advantage of being able to create production and markets simultaneously (see section 6.2), commercial farmers depend on on-farm utilization or on external markets (which still do not exist). For other crops, such as sunflowers, the national co-operative AGRA sells seeds to commercial farmers and provides also a guaranteed market (Int. Communal Farmer) which, however, does not exist so far for Jatropha.

Jatropha cultivation in communal areas, if done by small-scale commercial farming units, (chapter 4) could face problems regarding leaseholds. From the interviews it was not clear whether small-scale commercial farmers would be allowed to receive permissions to grow Jatropha.

6.3 Comparison of Jatropha Models

Here, we follow the same procedure as in Section 5.3 (Comparison of bush models). First, Table 5 below summarizes and compares the findings of the anaylsis of the four Jatropha business models. Just as in the case of bush, the table contrasts the models according to their effects on the three dimensions of rural development (economic, socio-political, ecological) as well as food security. Each dimension was further specified including only the most important and visible effects.

Figure 12 below shows the Jatropha-to-bioenergy impact chain. Again, not the whole graphic will be spelled out, but only one example showing how to read it:

Production and harvesting of Jatropha can be done either by investors, communal or commercial farmers. The decision whether to go for a scheme involving Jatropha is based on whether the producer considers this to be (economically, ecologically, etc.) viable. A number of institutions and institutional arrangements have an effect on the viability of this undertaking, for instance Government and Traditional Authorities, labour regulations, land tenure rights, among others. If the producer decides to embark on a Jatropha scheme, then the economic, socio-political and environmental impacts are also shaped by institutions and institutional arrangements. Once more, power relations, the food market, labour regulations, available output markets, social structures, environmental regulations etc., determine the impacts of a given Jatropha value chain on rural development and food security.

Table 5: Comparison of Jatropha-to-energy business models

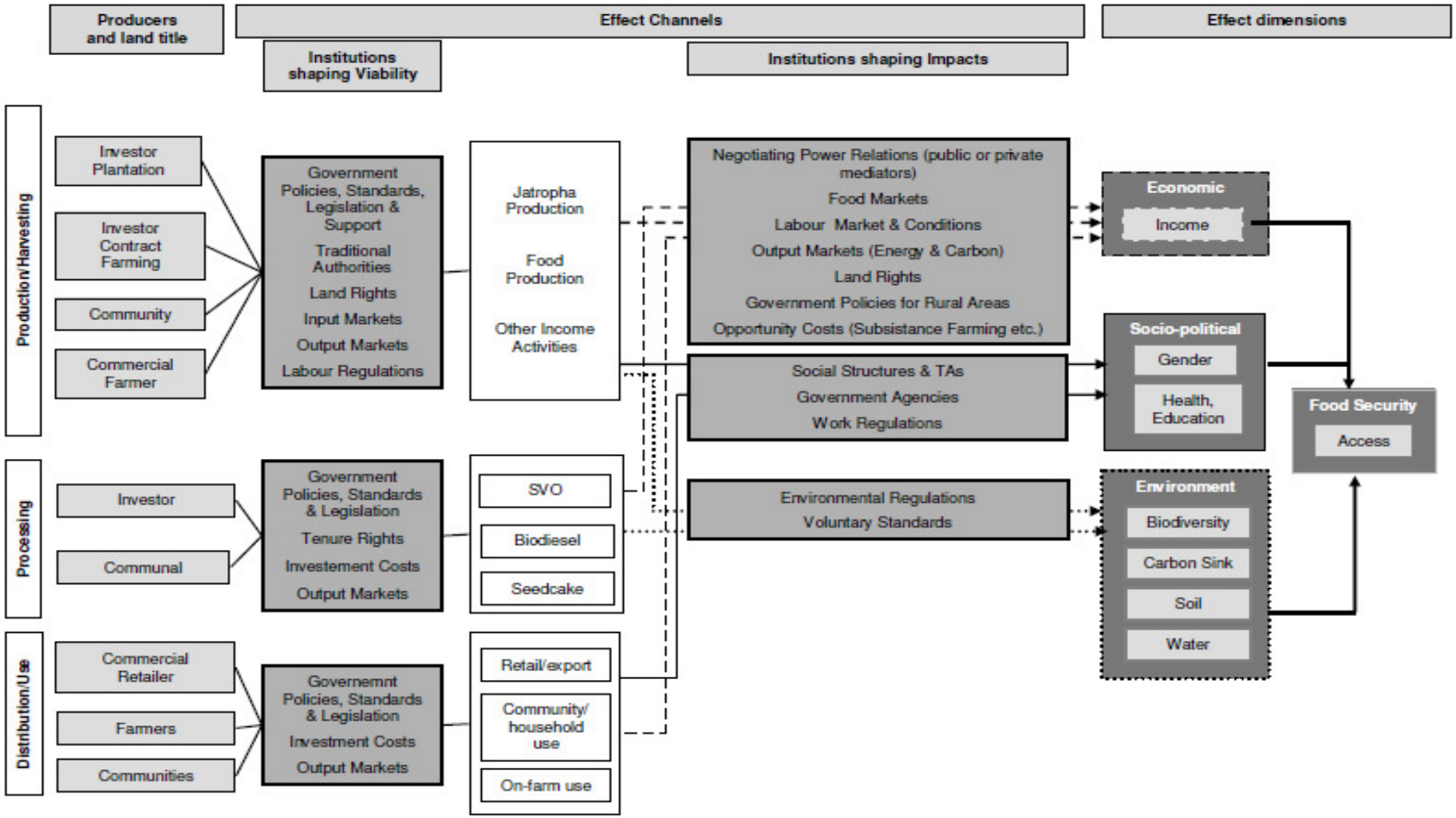
Impact	Specification	Plantation	Contract Farming	Community Model	Commercial Farmer Model
Economic	Income	Lots of unskilled wage labour in production and processing (permanent and seasonal) (1,000-15,000) Some skilled labour in production and processing Remittances to neighbouring regions & countries	Cash income from subsidies and selling seeds (8,000-13,000 families in Kavango) Wage labour in factories, nurseries etc. Potential share of community in production company	Long-term upgrade of livelihoods (access to energy, productivity increases) for selected communities	Wage income for additionally employed farm workers? (Direct effects of this model on target groups can be expected to be minimal)
	Opportunity Costs	Subsistence farming (heavy competition for labour) Alternative land-uses (conservancies, livestock, small-scale commercial farming, forestry)	Subsistence farming (some competition for labour and land) Pasture (former fallow and mahangu land used for Jatropha plantation not usable for grazing anymore)	Conventional crop cultivation (e.g. mahangu) (little competition for labour and land if Jatropha planted as hedges)	Commercial food production? (Some competition for labour, land and capital)
	Spill-overs & Trickle-down	Potential productivity increase from know-how & access to inputs Increased employment on subsistence farms Higher purchasing power	Potential productivity increase from know-how & access to inputs (use of seedcake as fertilizer or/and purchase) Increased employment on subsistence farms Higher purchasing power	Potential productivity increase from know-how & access to inputs	Contribution to R&D Innovation diffusion to late adopters (small-scale farmers)
	Land	Loss of customary ownership/control for community (long-term leaseholds for investors)	Farmers keep customary ownership of land but conflicts may arise due to conflicting claims	Customary ownership remains within community	Cultivation on freehold or long-term lease
	Special Risks	Risk of project failure: Market uncertainty (conventional fuel price, biofuel policies), harvest uncertainties High costs of project failure (recovery of cultivated land and	Risk of project failure: Market uncertainty (conventional fuel price, biofuel policies, future of CDM), harvest uncertainties, conflict about land rights High costs of project failure (land	High costs of setting-up & coordinating scheme High costs of scaling-up	No significant changes expected

		unemployment of wage labourer, market failure)	must be immediately restored for alternative uses)		
Socio-political	Health & Education	Reduced (youth) unemployment Increased expenditures on education and health Reduced/Increased alcoholism?	Increased expenditures on education and health Reduced/Increased alcoholism?	Energy for education and health facilities	Know-how transfer to resettlement farmers and farm workers on new crops?
	Social Structure & Power Relations	Conflicts between TAs and communities High dependency on investors (low negotiation power of workers) Changing gender relations depending on employment policies Risk of long-term loss of confidence in external projects in case of failure or conflict	High dependency on investors (low negotiation power of farmers) Potential self-organization of communities Risk of long-term loss of confidence in external projects in case of failure or conflict	Self-organization and empowerment of communities	No significant changes expected
Ecological	Biodiversity	Debushing of natural vegetation Monoculture with high threat to biodiversity Risk of invasiveness?	Risk to biodiversity if quasi-monoculture Difficult controlling of seed spread (high risk if invasive)	Reduced deforestation if Jatropha planted as hedges and oil is used to replace fire wood	Small risk to biodiversity if invasive
	Water	Intensive irrigation Pollution through fertilizer	some irrigation	some second-round irrigation	No significant changes expected
	Soil	Pollution through fertilizer	Restoration of degraded soils?	Restoration of degraded soils?	No significant changes expected
	Carbon Sink	Initial loss of carbon sink through debushing Possible replacement of conventional fuels	Carbon capture if planted on already cleared land Possible replacement of conventional fuels	Carbon capture if planted on already cleared land Possible replacement of conventional fuels	Possible replacement of conventional fuels
Food security	Availability	Net-effect depends highly on food markets and food production on plantation	Net-effect depends highly on food markets	Second-round effects from increased productivity	No significant changes expected

	Access	Increased cash-income Decrease of household self-sufficiency	Increased cash-income Decrease/Increase of household self-sufficiency (intercropping?)	Increased cash-income (from second-round effects)	No significant changes expected
	Stability	Cash-income partially seasonal Depending on stability of food markets	Depending on stability of food markets	Depending on stability of food markets	No significant changes expected

Source: authors' design (2009)

Figure 12: Jatropha-to-Energy Impact Chain



Source: authors' design (2009)

7 SYNTHESIS

So far, the existing bioenergy landscape in Namibia has been depicted, partly already hinting at problem areas inherent in existing value and impact chains and business models. Recalling the methodology section, the role of institutions in framing and guiding the development of a bioenergy sector was deemed important. They determine the rules of the game, give incentives and disincentives, and are, at least partially, in a position to regulate the dimensions of development affects caused by a given bioenergy initiative.

As stated in our research question, this study wants to find out what Namibia can do so as to make bioenergy production support pro-poor rural development and food security. Eight key areas were identified through which influence can be exerted, all of them based on the obstacles and problems encountered while analyzing the different business models. These key areas represent institutional challenges for the country, and are, therefore, leverage points where force can be applied by 'agents of change' (i.e. institutions) to make impacts of bioenergy production positive for Namibia.

After summarizing the eight problem areas below, recommendations will be given as to what Namibia can do to make sure that bioenergy value chains impact positively on rural development and food security.

7.1 Food Security

As mentioned in chapter 4, food availability is not a problem in Namibia at national level because the country produces and imports sufficient food commodities. However, many households cannot afford to buy enough food and are not able to meet their basic food needs by subsistence farming. An aggravating factor is that Namibia is frequented by droughts and floods which result in regular governmental food aid for a large part of the population.[12]

Vision 2030 recommends focussing on food security and not food self-sufficiency – meaning that every Namibian should have enough to eat whether or not food crops are produced by him/herself or even inside the country. The Vision stresses the trade-off between increased agricultural production and environment protection. It puts a particular emphasis on the need of saving scarce resources such as water (NPC 2004), 145). NDP 2 tried to reach the goals set by the Vision by fostering the productivity in subsistence agriculture which involves the broad mass of the population. This, however, did not prove to be successful such that NDP 3 states*: "the lesson is that subsistence agriculture is not an appropriate means to reduce poverty in Namibia"* (NPC 2008), 21). In consequence, NDP 3 recommends to expand the livelihoods of rural communities and to reach food security by diversifying and improving their agricultural production (ibid., 221).

In recent years government support initiatives did not explicitly focus on subsistence / communal farmers (section agriculture). The Namibian Government subsidizes large-scale irrigated food production in form of the Green Schemes (chapter 4) with the objective of black empowerment, national food security and local employment (Grimm and Werner 2005). These Schemes promise a high potential for national food production through irrigation. However, they rarely fulfil this objective and offer very limited employment

[12] In 2003, a drought year, one third of the Nambian population was in need of humanitarian food assistance (NDP 3, 21)

effects for the rural poor and food insecure. Government also built up several silos in the northern regions in order to create a market for local grain producers and a storage for food aid (AZ online 2008). Moreover, white maize, wheat and mahangu were gazetted as 'controlled crops'. This means that import and export barriers as well as floor prices were established for all three crops. Additionally, a market is guaranteed for mahangu ((NAB 2009). However, most of the country's poor are net food buyers. Consequently, they do not necessarily benefit from these measures and, in the worst case, suffer from higher prices.

The initiatives taken by the Namibian Government show a certain incoherence with the Vision 2030 objective of focussing on food security and not food self sufficiency. A strong tendency towards the wish of "Namibia being able to feed itself" could also be noticed in many interviews conducted during the research phase. One major reason often sited was the global food crisis and the resulting fear of depending on international food markets.

As biofuels have a difficult standing when it comes to enhanced food production, the Namibian government does not seem to support this kind of agricultural activities. Yet, there are big differences between the bush and the Jatropha value chains:

If invader bush is removed, grazing area is restored and, consequently, an increased number of cattle contributes to national food security and food self sufficiency. At the same time, the cash income for migrant labourers improves their economic access to food – an effect passed on to the communal areas through remittances. The positive effects depend to a large extent on wages, food stores and markets as well as on the opportunity costs for former subsistence farmers.

Concerning Jatropha, the international debate on 'food vs. fuel' enters Namibia. The Jatropha business models cited above offer strategies of diversifying from subsistence farming through own cash-crop production or employment. Yet, the potentially improved access to food is overshadowed by a competition on land, labour, water and capital. This seems to cause an enormous scepticism of the Namibian government towards cash crops, especially if they serve for biofuel production. At the same time, food production is included in all of the business models – in some cases possibly in order to please the government.

The major problem is that it is unclear if Namibia wants food security or food self sufficiency – the country does not have a food security strategy. If Namibia opts for food self sufficiency, clear guidelines for entrepreneurs and investors are necessary. At the moment, decision making processes are not transparent. It is not clear if cash crop production is wanted at all and if it is obligatory to combine it with food crops.

If Namibia opts for food security as stated in Vision 2030, a decision on the role of agriculture is crucial. The agricultural sector is an important employer in the rural areas but it is not clear if investment in this sector, and especially in cash crop production, is wanted. The competition with nature conservation as underlined in the Vision might play an important role in the decision making process. However, tourism is only one employer in the northern regions and there are not many other sources of cash income. A high dependence of the population on governmental food aid might continue if high unemployment rates prevail.

7.2 Rural Development

The role that bioenergy can play in rural development in Namibia highly depends on the goals and strategies that the country sets for developing its rural areas and how it manages to integrate bioenergy production.

Key national development objectives of Namibia mentioned in chapter 4 include the reduction of poverty and food insecurity. 67 per cent of the Namibian population and 85 per cent of the poor live in rural areas (NPC 2008), 222). This shows the high importance of the rural areas when it comes to poverty reduction and development. Looking at the long term, Namibia aims at becoming an industrialized knowledge-based society. This requires a fundamental transformation of the country's economic structure with the objectives of a mainly urban population, a highly productive agricultural sector and at the same time a sustainable use of natural resources (NPC 2004), 153). A key challenge is thus to reach the long-term objectives without neglecting short- to mid-term problems, such as unemployment, food insecurity and nature conservation.

Agriculture plays a very important role in overcoming food insecurity and rural poverty as it is the largest employer in rural areas (chapter 4). At the same time, the livelihoods of the rural poor depend to a great extent on the quality of the natural resource base requiring an integrated approach of reducing rural poverty and conserving nature (Grimm and Werner 2005), 2; (NPC 2004). It seems to be fairly unclear which immediate and mid-term strategies (e.g. food security strategy) for the rural areas, including its population and land use, Namibia opts for in order to reach the goals set in Vision 2030 and especially which role agriculture will have to play. Depending on which strategy Namibia embarks on, the implications for bioenergy production can be very different since trade-offs between different land uses exist.

Main economic uses of natural resources in the northern regions besides agriculture are livestock, forestry and nature conservation. Hence, bioenergy production as a form of commercial agriculture is a potential land-use besides many others and needs to be assessed in the context of these alternative uses and their comparative impact on rural development objectives.[13]

The biggest and most controversial competition for land in Namibia exists between productive land uses and nature conservation. Preserving natural habitats is a rural development goal in its own right. It also provides income to local communities from tourism and wildlife, but benefits from these sources for communities seem to have been rather limited so far as reported in various interviews with communities. Alternatively, agriculture, livestock or forestry can be more productive land uses with higher effects for food security and rural employment. There are, however, more negative effects for the environment involved which depend on the specific kind of productive use. Achieving the objective of employment creation without neglecting the environment thus requires a balancing of activities for nature conservation as well as its productive uses through agriculture. An integrated approach is needed including local population in long-term planning. However, so far such an integrated and inclusive land-use planning is lacking for the rural areas (section land). At the moment, perceptions among different stakeholders on preferable uses for land in Caprivi and Kavango range from leaving the natural resource 'untouched' to large-scale intensive agriculture. Inter-ministerial coordination does not seem to exist (e.g. the case of double-gazetting the same land in Caprivi for cattle farming through MAWF and natural conservancies through MET).

Apart from that, conflicts exist between different agricultural uses of the rural areas, i.e. use for livestock versus agriculture, small-scale versus large-scale agriculture and food-crop production versus cash-crop production, such as bioenergy. The answer for this, as explained

[13] An extensive comparison of the various land use options, however, exceeds the capacities of this study

in the last section, highly depends on the role agriculture should play within food security and employment objectives. However, GRN so far does not clearly express its preferences.

Finally, migration plays an important role as a strategy for fighting rural poverty in the short-term and as a pre-requisite for achieving Namibia's long-term vision of becoming an urban society. Regarding bioenergy value chains, however, people migrate to rural areas. One pull factor could be the Jatropha plantations involving wage labour. Another pull-factor is the bioenergy production in commercial areas, setting incentives for migration from the communal areas to work as wood-workers, as already practiced in the bush-to-energy value chains. Designing strategies for migration by creating the right incentives and regulations for more and better employment in the Maize Triangle of migrant workers receives importance (section labour).

7.3 Agriculture

Whether a potential bioenergy industry proves to be viable and produces the results needed to address food security and rural poverty, depends on various agricultural institutions that set incentives for actors and provide access to input and output markets.

As previously explained, poverty and food insecurity in rural areas are major challenges. Due to agro-climatic constraints (e.g. low soil fertility and rainfall), a lack of inputs and long distances from larger markets, communal farmers are often left with low productivity and too small land holdings in order to become food self-sufficient or to commercialize and build up capital (Mendelsohn 2006). At the same time, lack of employment alternatives to agriculture exacerbates rural poverty in the communal areas (NPC 2008), 110). [14]

Strategies for the rural poor to overcome these challenges include increasing productivity within the existing subsistence oriented farming system, diversifying through rural commercial activities (own cash-crop production, working on plantations or non-farm jobs) or migrating (to urban centres or other rural areas, e.g. as wood workers in debushing). Previous initiatives to introduce cash-crops in the communal areas (i.e. sugar and cotton) did not prove viable due to market problems, lack of domestic processing, high transport costs and low world market prices (Int. NDC). Jatropha cultivation, on the other hand, could be more successful as large export markets already exist (section output markets) and foreign investors are there to build up local processing. However, their high potentials for employment and food security might come along with risks to the country explained in chapter 6, depending on the different Jatropha schemes. Whereas large-scale plantation or contract farming models require less government resources, they possibly involve higher risks by creating dependencies. Bush-to-Energy value chains, on the other hand, could promote rural-rural migration to improve livelihoods of the rural poor.

Direct Support to Small-Scale Farming Systems

Direct support to small-scale farming systems include productivity enhancement measures and access to markets by trying to overcome various market failures separately. Access to financial capital is central for small-scale communal farmers to either increase the yield on

[14] There is an Export Processing Zone (EPZ) in Katima Mulilo (Caprivi Region), as an incentive for processing industries, but which is apparently only used for beer exports to surrounding countries without creating much value addition and employment (Int. MTCT Katima). Besides, the largest energy consumer in Caprivi Region is a bakery (Int. NORED).

existing fields or for the expansion of their land. Most credit policies that require conventional collateral such as land, houses or other fixed capital do not take into account the reality of small communal farmers with customary land rights and little other assets (section land).[15] Many are thus trapped in a vicious circle. Especially the lack of capital to acquire inputs such as fertiliser, irrigation and other equipment was named as a main obstacle for agricultural development in Caprivi and Kavango (Int. MAWF Katima Mulilo). Another challenge for developing financial markets in rural areas is the problem of long distances combined with a lack of good infrastructure. Lending and repaying is thus more costly and difficult than in urban areas. (Int. Agribank Windhoek). Whereas micro-finance usually fills in this gap as it does not require traditional forms of collateral, there is a lack of micro-finance schemes in Kavango and Caprivi. Renewable energy technologies are mainly funded through the Solar Revolving Fund (SRF), however, merely for solar systems not covering decentralized energy systems based on Jatropha. The CDM mechanism for small-scale renewable energy projects might provide a financing option for sustainable agricultural projects, which requires the building up of new capacities within the MAWF to support this kind of projects.

Apart from financing, the access to knowledge of agricultural practices, suitable crop options and markets is a condition for productivity enhancements and commercialization. Interviews showed that there is a lack of support for small-scale farmers through the extension system and governmental research. Currently, the various agricultural support areas of extension, research and training do not seem to be integrated very well, as to various key informants. This hinders the introduction of new crops, such as Jatropha, to small farmers.

Linking Small-Farmers to Large Companies

A different approach focuses on integrating small-scale farmers and/or rural unemployed into value chains coordinated by large private companies (FDIs or domestic investments). Whereas this approach helps to overcome various market failures simultaneously and brings many potential benefits to communities, as previously explained, there are high risks involved (e.g. environmental damage, risk of total project failures, crop failures and moral hazard behaviour). Bad experiences Namibia made with FDIs in the past seem to have led to a rather hesitant and suspicious attitude.[16]

Large-scale investments in Jatropha do not yet exist, mainly due to the obstacles explained in chapter 6, i.e. communication problems between investor and communities, lack of transparency of government decision-making and general uncertainties attached to the lack of legal land rights. All of this leads to uncertainties for the investor and at the same time to the fear of moral hazard behaviour on both sides. A major problem thus seems to be the lack of an appropriate mediation body between investors, the government and communities that incorporates Namibia's development priorities, support decision-making of the communities and is aware of the requirements to attract FDIs in rural areas. The challenge is to reduce domestic risks for the investor by creating transparency and certainty and at the same time help the community to make sure that risks to rural areas are also minimized as well as promised benefits materialise. The creation of trust funds, as they are found in the mining

[15] Major development on farms are often financed by off-farm income, thus off-farm income becoming a major determinant of farm size (Mendelsohn 2006, 16).

[16] The prominent case of the Malayian textile producer Ramatex left Namibia after five years apparently leaving large environmental damage behind. In the agricultural sector an Indian investment planned to establish a cotton ginery in Rundu (Kavango) never materilized (Int. EC)

sector, to cover for the risk of project failure and environmental damage have been proposed as a solution to this problem (discussion during investor presentation). Moreover, attracting FDIs does not reduce the need for extension services. Additional support from extension service tailored to the new crops can help farming communities to build up the capacity in managing the crop themselves and becoming more independent from the investor.

The research pointed to another weakness within Namibia's agricultural sector: the process of introducing new crops and agro value chains, in this case bioenergy. Since bioenergy value chains span across various sectors, setting up entire industries requires cooperation between different ministries and agencies (section policy-coordination). For the case of bioenergy this seems to be lacking. What regards the role of the agricultural ministry, a central problem encountered during the research is that there seems to be a lack of processes regarding handling new crops, such as Jatropha (cf. Int. Samicor/LLB). Industry development requires clarity and transparency for investments to be secure. Thus, timely decision-making on crops (regarding environmental effects) is required to avoid misplaced investments and influences of individuals (politicians or pressure groups). Currently, there is no institutionalized process to declare new crops invasive or environmentally harmless (Int. NBRC). Besides that, information on yield potentials and requirements for new crops, such as Jatropha, as a decision support for small-farmers currently does not exist. Innovation adoption requires research by government or combined inititatives with private actors. In the case of Jatropha, commercial farmers, as explained in chapter 6, can play an important role in introducing new crops.

A key role in this is played by the MAWF, which however is not operating in a vacuum, but needs to integrate the interests of various stakeholders together to maximize social gains. Regarding large-scale investments such as bioenergy it is important to consider the long-term effects. Especially in the case of crops with little experiences from other countries on a large scale, starting small might be an appropriate solution until most negative effects are known. On the other side, to harness the potentials of FDIs, there is a required scale of operation for investments to be profitable (Interim Bio-Energy Committee 2006).

Support Measures for Migrants to Commercial Areas

The agricultural support regarding the Bush-to-Energy value chains differs widely from the support necessary for communal farmers. The role of commercial Bush-to-Energy farmers for pro-poor rural development is mainly through the effects on migrant workers, national food production (livestock) and environmental effects of debushing (chapter 5).

On the one hand, the economic effects of contracting migrant workers can be increased if debushing is done in a labour intensive way. The agricultural support measures have to be designed to support labour intensive methods but at the same time create incentives for labour enhancements, such as the subsidized debushing loan schemes of Agribank. One potential to increase the economic effects to rural areas is by designing micro-finance schemes that enhance the efficiency of remittances. Another problem relates to the meat market, the major output once areas are debushed. The use of chemicals to spray against encroachment bushes might create the fear of negative health effects for consumers. In Namibia, this potential threat for the commercial farming sector is apparently not taken into consideration (Int. Agricultural Expert). Thus, there is a need to set incentives to reduce ecological harmful effects of farming practices (herbicide use).

7.4 Labour

One of the Namibia's biggest challenges, as described in chapter 4, are the extremely high levels of unemployment in rural areas and high income disparities. In addition, labour conditions of unskilled jobs and informal employment in the agricultural sector pose social, regulatory and enforcement challenges. The Namibian Government has an expressed interest in supporting the establishment of labour intensive industries. At the same time, the long term goal is to transform the country into a knowledge-based economy with a high-skilled labour force. The Labour Act (Act No. 11 of 2007) (GRN 2007) regulates the rights and duties of employers and employees in Namibia. The Act provides for enhanced protection and rights of employees. These rights concern, among others, social security regulations, the prohibition of labour hire companies[17], food shops (no more than 1/3 of wage as credit), accommodation (provision of adequate accommodation if on agricultural land, also for dependants), minimum remuneration, hours of work, leave, termination of employment and health and safety. Negotiations between stakeholders are complicated by Namibia's recent Apartheid experiences which make the treatment of employees and workers an especially sensitive issue.

As most bioenergy business models depend on the availability of unskilled labour for farm work, the policy framework and legal conditions are particularly relevant. In turn, an upcoming bioenergy industry can potentially work as a catalyst to help solve long existing problems.

Economic Viability vs. decent Working Conditions

The general dilemma with labour regulation is the following: Under international human rights standards, every employed person is entitled to decent working conditions that do not endanger his/her wellbeing. At the same time, guaranteeing decent working conditions is often associated with additional economic costs that jeopardize the economic viability of the enterprise. It is, however, also acknowledged that safe and economically attractive working conditions promote commitment of the employees and have therefore positive repercussion on production output. The Government has a double role: In its policies it has to accommodate its interest in creating favourable economic conditions for employers and its responsibility to protect the interest and well being of the employees. In Namibia, as it is a developing country, the use of cheap labour has particular relevance: Unemployment rates are high and most unemployed are unskilled. From a global perspective, cheap labour can be considered as a comparative advantage for foreign investments.

Namibian labour legislation is trying to offer special protection to farm workers in the rural areas. It is designed to account for their extremely low level of education and high poverty level, the remoteness of commercial farms and their limited access to food and other goods and services. However, it does not account for the different types of work requirements and arrangements (e.g. seasonality, piece work, foreign labourers) that exist in the farming sector and that are relevant for bioenergy production.[18] Due to the nature of their work and the farmer's economic and social situation, wood workers, for example, do not enjoy formal protection under the Labour Act. Because of little flexibility in the legal provisions, a lack of agreement between the stakeholders and little knowledge of the other's situation, wood

[17] Some provision of the Act (namely Section 128 concerning the prohibition of labour hire companies) are legally challenged. The decision of the Supreme Court is pending.

[18] There are currently exeptions for some businesses like hotels and the building sector.

workers are left in a grey area.

Concerning differences in economic size of the enterprises, it is much more difficult for a small scale communal farmer to abide by labour legislation than it would be for a big commercial farmer or an investor. Informal labour often results from the economic need to by-pass strict labour regulations (not excluding the fact that this also happens arbitrarily). Or, as is often the case in rural labour arrangements between small farmers, informal employment is a coping strategy. In Namibia's communal areas, family or community members are often employed on a casual basis to help with the work on the field (weeding, ploughing). These arrangements are relevant for contract farming schemes and for any small scale farmer who wants to employ casual labour on his/her field. Regulating those informal arrangements would not be in the interest of the employer. It is most likely that the employer would not have the financial and administrative capacity to comply with labour regulations. It is also not in the short term interest of the employee as we can assume that the creation of additional income through casual labour makes him/her better off than before.

Control and Enforcement of Labour Legislation

Even if labour legislation did take into account the realities of labour in the agricultural sector, control and enforcement are decisive for their effectiveness. In its current state, the Ministry of Labour does not have sufficient personnel and financial capacities to implement the Labour Act and to carry out adequate labour inspections (Int. Expert; MLSW Annual Report 2007). Complaint mechanisms exist but the majority of farm and wood workers do not have the means to make use of them. Also, labour unions, who could act as arbitrators and representatives are not strongly active in the rural areas. Hence, the farm worker or wood worker remains at the mercy of the farmer. If breaches of the labour law are noted by the respective authorities, there is a mechanism in place to make farmers comply (Int. Experts). The scope of those mechanisms is, however, limited (cf. MLSW Annual Report 2007).

Bridging Short and Long Term Employment Goals

While in the short term Namibia wants to promote labour intensive value chains to create employment for its abundance of unskilled labour, the long term vision is a knowledge-based economy and large scale agricultural production. In the short term, income and employment policies thus need to set the right incentives for investors *and* the potential employee. At the same time, it needs to work hand in hand with relevant education and training institutions in order to make sure the right supply of skilled labour is secured in the long term. Also, even if Namibia strives for a knowledge-based economy, the need for unskilled labour will not disappear (though lessen). Here, labour migration policies play a big role. If, in the long run, work force from outside the country is to substitute in-country work force, adequate migration and work permit regulation have to be developed.

As described in chapter 4, there is an abundance of unemployed unskilled young people in the rural areas. However, there seems to be no national policy that addresses this problem. NDP 3, mentions the improvement of education and income diversification in rural areas but implementation lacks behind (see (NPC 2008), 114).[19]

[19] Currently, the strategy is to empower them through the organisation of youth groups and develop their skills in horticulture, as well as develop a life skill training curricular.

7.5 Land

Bioenergy production in Namibia can, as we have seen above, bring many positive impacts for Namibia's rural development and food security, as well as risks and challenges. Land tenure plays a crucial role when trying to ensure that benefits materialise and that risks and disadvantages are minimized.

Land tenure issues impact on bioenergy projects in two different ways. Insecurities in land rights might prevent investors from implementing the project. No additional benefits can occur for the community in this case at all. On the other hand, land rights and the allocation process play a role in shaping the impacts an implemented project has for rural development and food security.

Land is a sensitive issue in Namibia. In chapter 4, current land reform efforts were described. Challenges to these efforts have been widely discussed in literature and reports (Mendelsohn 2008); (LAC 2005); (Fuller 2006); (Werner 2003) and others). This paragraph will focus on those challenges Namibian local and national government institutions face if they want to ensure that land tenure helps to maximize positive impacts of bioenergy projects.

General Problems with Land Rights and Reform

It is the aim of the Namibian land reform to *"contribute to the alleviation of poverty in Namibia by empowering more citizens with land or access to land, and by providing beneficiaries with the necessary attributes to use the land to generate a sustainable and meaningful livelihood."* (Ministry of Lands and Resettlement 2007), vii) As indicated above, lack of access to inputs continues to be a limiting factor and reason for low productivity for both resettlement and communal farmers. One reason behind this is land tenure. Commercial banks have indicated that neither communal land rights nor the 99-year leasehold obtained by resettlement farmers suffice in themselves as collateral for credit (Int. Standard Bank; Int. Agribank). Several Agribank schemes cannot fully compensate for this, and neither does Agribank itself recognize communal land titles as collateral (Int. Agribank).

In communal areas farmers additionally face the 'problem of the commons'. Most farmers graze their cattle on land they have no exclusive rights to and from the use of which they cannot exclude others by putting up fences. Thus, communal farmers not only lack capital for investment in land (such as debushing or fencing), but can neither be sure to benefit from their efforts fully and, thus, also lack the incentive for investing or managing areas sustainably (Int. NAB, Int. UNAM).

In commercial areas, on the other hand, farmers face the problem of being uncertain about which farms might be expropriated as areas earmarked for resettlement are not clearly defined (BON 2008; Int. Commercial Farmer; Int. NAB). While this uncertainty reduces incentives for freehold farmers to invest in their land, resettlement farmers lack access to capital for it. As a result, few farmers in communal and commercial areas are willing or able to allocate resources to clearing their land from invader bush in a sustainable way. What is more, this lack of debushing poses a threat to the success of the land reform as a whole as it leaves less productive land available for redistribution.

Coherence of Policies

The need for a coherent strategy for the development of rural areas has been explained above. A crucial aspect of this strategy has to do with accommodating alternative and sometimes conflicting objectives for using limited land resources. Debates on possible uses

for land are surrounded by controversial and sensitive topics: the question of food self-suffiency for Namibia, the future of small-scale farmers and communal land tenure, and the protection of wild-life habitats. Accommodating these different interests has not so much to do with land rights in itself but is a question of setting political and social goals for the country across different departments. However, the lack of such a land use planning seems to have slowed down the implementation of bioenergy projects in Kavango and Caprivi considerably. The MLR as decision maker of last resort in the land allocation process is waiting for line ministries to come to terms on the above mentioned issues (Int. MLR, Int. MME).[20] As for now, it remains undecided which areas are possibly available for cash crop and/or biofuel production and which are earmarked exclusively for nature conservation or food production (in the case of Caprivi and Kavango not only for local consumption but to feed the nation).

Capacities and Transparency in Land Allocation

This lack of coherent and foresighted land use planning puts enormous pressure on decision-makers in land allocation on the local level. Traditional Authorities and Communal Land Boards are faced with multiple requests for unprecedented amounts of land and must act as mediators between different interests in the same areas.

For these challenging tasks, TAs in Kavango and Caprivi not only lack the technical capacities for administering formal land allocation processes, such as trained clerical staff and equipment (Mendelsohn 2008) but also the expertise. The majority of land rights that TAs allocate are customary use rights for residential and subsistence farming purposes. Rights are granted on the basis of the level of relatedness and familiarity of the person to the community, on personal character and the need to avoid future disputes.[21] Other factors like the availability of water and pastures are usually not considered when applications are assessed. Knowledge on other forms of use rights, like leaseholds, is also limited within TAs (ibid.).

Funding and equipment of Communal Land Boards is also inadequate which is reflected in a shortage of human and material resources and budget for activities. Skills and knowledge are also poor (GTZ 2004). What is more, there is a polarisation between CLB and TAs. Some TAs feel that Land Board members are disrespectful and inexperienced and are possibly a threat to the authority of the TAs (Mendelsohn 2008).

Secondly, conflicts, lack of capacities and policies leave room for exploitation of land allocation processes for personal and political agendas. Formal registration of rights is already denied for political reasons. Political affiliations, border disputes and encroachments by one community onto land held by another community have led TAs to object to registration while technical issues are given as reason for the objections (Int. MLR Rundu; (Mendelsohn 2008). During the land administration processes for Jatropha projects in Kavango and Caprivi lack of transparency led to conflicts as land was allocated that had already been gazetted for different projects. Middlemen promised land they had no rights to, and local headmen and communities were not sufficiently included in the decision-making

[20] Different ministries have demarcated the same area in Caprivi as 'under-used', a conservancy (MET), for small-scale commercial farming (MAWF) and for mining (MME). At the same time, local farmers use it for grazing and traditional authorities are approached by investors with request for leaseholds for biofuel production.

[21] Immigrants from other regions need to present letters of introduction from their tribal chiefs and seek the consent from the chief of area where he wishes to occupy land. Also, someone intending to use a piece of land for business purposes must discuss the matter with the chief and seek authorisation from all levels of TA.

process (Int. Chief, Kavango; Int. Nambwa community).

7.6 Environment

As shown in chapter 5 and 6, bioenergy production can have positive and negative environmental impacts. Environmental aspects are regulated by policies that have a specific environmental focus as well as policies regulating activities that have potential effects on the environment. Amongst those policies, the most relevant are the Environmental Management Act, the National Agricultural Policy, the Drought Policy and Strategy, the Soil Conservation Act, the National Land Policy, the Land Reform Acts, the Namibia Forestry Strategic Plan, the Namibia Forest Development Policy and the Namibia Forest Act (see (de Klerk 2004). Namibia's MET shares the task of dealing and coordinating environmental affairs with other ministries such as the MAWF, which also the Directorate of Forestry belongs to.

Reconciliation of Conflicting Interests

As already mentioned above, protection of the environment and natural resource conservation are goals in their own right but compete with productive uses of resources. Similarily, preserving (or increasing) biodiversity and climatic concerns conflict with the destruction of carbon sinks. These ambivalent interests might hamper the advancement of bioenergy production.

Although the Environmental Management Act of 2007 is not yet fully in place, it is generally expected that all investment projects must undertake an Environmental Impact Assessments (EIAs). Environmentalists argue, however, that the actual power of EIAs to decide on the realisation of a project is low compared to other pecuniary interests. The major problem is that the agency contracted to do the EIA is financed by the investor that has, of course, an interest in positive results. Hence, there is a risk of not fully independent research and results. Furthermore, EIAs are conducted for single projects only. Although the Act imposes Strategic Impact Assessment (SIAs) which attempt to tackle this problem, the fear is that the accumulated impact of many investment projects will be overlooked. The major obstacles comprise lack of administrative capacity and political will as well as the time lag between project initiation and the reaction of environmental protection measures.[22]

It can be expected that the debate and new international regulations on climate change will have an impact on Namibia in two ways: First, the potential use of the CDM will become an increasing economically interesting way of financing new value chains in the bioenergy sector. Second, access to donor funding will more and more depend on whether a certain project complies with international climate change mitigation requirements. Currently, policies and political discourse hardly account for these topics. While Jatropha projects generally consider CDM as a financing option, combating bush has not yet discovered this tool. Here, introducing the sustainability concept for bush harvesting into national guidelines could be one way to mitigate climatic effects. So far, debushing permits issued by the DoF only regulate the protection of endangered species. Only FSC production ensures sustainable harvesting.

Accounting for environmental degradation caused by productive land use often has negative economic impacts on the local communities. Wildlife conservation in Namibia's North, for

[22] SIA are conducted by state agencies and not by the investor (MET 2008)

example, has shown that human-wildlife conflicts can cause serious misapprehension of nature conservation by the local communities. Acceptance of resource management and conservation is, however, the key to the effectiveness and sustainability of economic development of a region without compromising its natural resources.

Knowledge management

Connected to the previous issue is knowledge generation, distribution and management. The issue is particularly relevant for new bioenergy value chains. Generally, research is a precondition for informed decision making. In Namibia, scientific research (of universities and other research bodies) on environmental aspects of agricultural land use seems to be disconnected from practitioners such as the agricultural extension service. Also, the capacities of government agencies such as the MAWF are too weak to embark on research in new fields like bioenergy production. While knowledge generation in the case of larger investment projects is required through the EIA, the pertinent question is what happens with this kind information. There seems to be little management and use of such documents, not to mention public information and access.

Enforcement of regulations

Enforcement of regulations is a challenge not only for bioenergy production. It is important in as much as the introduction of a new value chain carries usually more and unknown risks than controlling existing ones. Permits in the case of bush harvesting are issued before the harvesting starts. Control of actual debushing procedures is extremely low due to capacity and legal constraints (Int. DoF). Similarly, in the case of Jatropha, an EIA might evaluate and envision probable impacts, but the monitoring, control and action of the project once it is operational is not regulated.

Possible options to mitigate negative environmental impacts of bioenergy production in Namibia include the following points. In order to reconcile conflicting interests, transparency in decision making, investment plans and policy making as well as long term planning are necessary. This includes consultation with all stakeholders. Also, strengthening institutional capacities is vital in order to (1) carry out SIAs and (2) create monitoring, control and information systems for existing environmental legislation.

7.7 Bioenergy Output Markets

The implicit assumption when declaring bioenergy output markets an institutional challenge is that it is possible for Namibia to influence these markets through policies. Output markets, here, refer both to the national and international market for Jatropha (nuts, SVO/biodiesel, seedcake, and other by-products) and bush products (charcoal, briquettes, electricity). Three problem areas related to output markets are discussed below.

Domestic Market

First, although NDP 3 (NPC 2008), 54) states that the envisaged outcome in the renewable energy sub-sector is an *"increased renewable energy use with increased economic and environmental benefits"*, policies supporting this development are not in place. The domestic market has huge potential for renewable energy, given both its dependency on energy imports and need for further rural electrification, however no targets for renewable energy production or feed-in quantities exist. Also, the Energy Policy White Paper (MME 1998),

43) does not mention concrete targets for renewable energies in Namibia, but merely states that the *"government committed itself to promoting the use of renewable sources of energy wherever this is technically feasible and economically viable"*. Though these avowals of interest in renewable energies are indeed laudable, they do not compensate for the lack of tangible goals and therewith hamper the development of a broad domestic output market. Especially considering Namibia's abundant renewable energy resources, particularly bush in this case, this seems a forgone opportunity.

Second, if Namibia decided to actively support bioenergy production and value chains to cater for the domestic electricity market, price and tariff-related initiatives would play an important role. Generally, as it stands now, highly subsidized conventional diesel prices in Namibia have negative effects on the viability of renewable energy solutions (Int. Solar Age Namibia). For on-grid electricity feed-in, various Namibian experts agree that feed-in tariffs are too low at the moment to make such undertakings economically viable (ibid.; Int. Jumbo Charcoal/CSA). If prices paid by the Namibian government were to be increased, cheap electricity imports from RSA would outcompete domestic production. On the other hand, though, the ECB (Int.) opines that also South African prices for Namibia will rise in the future, given Namibia's increasing demand and RSA's inability to meet it.

As to bio-energy for off-grid solutions, the MME already identified in its Energy Policy White Paper (MME 1998), 44) that *"rural electrification using the grid is heavily subsidised, while off-grid household electrification using renewable energy is not"*. Although an Off-Grid Rural Electrification Master Plan 2000/2005 is in place and functions as a guiding document, no easily accessible incentive schemes are implemented. What it boils down to, then, is the question whether Namibia wants to go for cheap imported electricity or more expensive locally produced renewable energy, and which of the two would be more conducive for the country's (rural) development and food and energy security.

A third obstacle likely to be encountered when introducing bio-energy (specifically SVO and biodiesell) on the domestic market is the so far lacking technical quality standards. Clear warranty schemes are developed in case of conventional fuels, but if a machine, engine or other device breaks because of the use of SVO and bio-diesel, no clear regulations are in place yet. In addition, the question of who is responsible to monitor quality standards onsite is not answered. This topic is not only relevant in case of Jatropha products, but quality standards also apply to bush-to-energy initiatives, e.g. should IPPs have to follow standards designed by the government, and how are fluctuations of currents to be handled.

International Market

Regarding Namibian bioenergy production destined for the international market, so far only charcoal, briquette fines and Bushblok are being exported. This is partly due to the fact that both the access to buyers interested in other products is limited, and that some products are not even being produced at the moment (e.g. Jatropha oil or electricity from bush). However, even if all of the here described bioenergy products were currently available in Namibia and buyers were in the waiting, the necessary economies of scale to satisfy international market demand would be difficult to reach. Especially small farmers in communal areas often do not find a direct market for their product because they cannot reach the quantities demanded. As is often the case in the charcoal industry, small communal farmers would have to sell to bigger producers, adding to transport costs and consequently decreasing the profit margin. For Jatropha, the major hampering factor for reaching economies of scale is the difficult access to land. Thus, access to inputs is of the outmost importance when trying to reach economies of scale, and it is essentially an issue possible to be regulated by government

policies.

Second, international quality, social and environmental standards can hamper market access. This might not only be through rigorously enforced official regulations (essentially barriers to trade), but also by mere consumer perception. An example of the former would be the new proposal for the EU Directive 2003/30/EC on renewable energy (including biofuels), which states that mandatory blending requirements in the transport sector will be increased to ten per cent until 2020, however adhering to a number of sustainability criteria (e.g. biodiversity and land use impacts, GHG emissions, etc.) (EU 2009). As to the latter, consumer perception, there is a notable trend on western markets to opt for products with 'a social conscience', thus if harsh labour conditions became public it could possibly adversely affect marketing opportunities.

Additional Revenue Possibilities

In the production process of both Jatropha and bush additional revenue could be generated, either through efficient marketing of by-products or by carbon trading, e.g. using CDM or voluntary carbon markets. As to the former, the market for by-products is currently inexistent, of course, since no Jatropha-oil production takes place (bush-to-energy produces no by-products). However, already at this stage looking at those markets with a policy lens can be crucial, considering that some value chains are not feasible when only producing the primary good.

As to the carbon credit market, bioenergy projects in Namibia in theory exhibit vast potential. However, potentials of the carbon market and the procedure to be followed in order to obtain the benefits available seem to not well known or understood, according to various investors interested in the issue. Also, especially in case of bush, it is not quite certain whether going for carbon credits is an option, given that debushing basically destroys a carbon sink. In any case, considering the revenues possible to be obtained from carbon credit schemes, it seems feasible for Namibia to put more efforts into developing this market.

7.8 Policy Coordination

> *"As in the case of any new instrument, where they have an innovative character, their major implementation constraints have to do with policy and institutional weaknesses, such as missing policies or regulations, insecure stakeholders' rights over the resource at stake, unclear and/or anachronistic institutional arrangements, conflicting policy signals lack of information or misinformation, and weak implementation capacities."*
>
> *(Dubois 2008), 1)*

The last institutional challenge to be mentioned is policy coordination. This challenge alludes to the notion that if policies are in place regulating diverse issues, they have to be coordinated in order to be either mutually enhancing or at least not at odds with each other.

As has been mentioned, numerous stakeholders are involved in bioenergy production in Namibia, many of which hold policy making power. Given this situation, policy coordination seems vital in order to guide bioenergy initiatives in the country. In the following, three problem areas hampering policy coordination will be discussed.

Bioenergy as Cross-cutting Issue

First, the fact that bio-energy is a cross-cutting issue makes policy coordination complicated. There is not 'the one' institution in Namibia holding a monopoly on regulating the bio-energy sector. Many Ministries are supposed to play an active role, though it is not completely clear who takes the lead and has the final say in this field. In the case of Jatropha, for instance, a Cabinett Committee was established in 2008 in order to advance the issue, however it seems like the presiding Ministry, the MME, does push the issue sufficiently but chooses to wait for other ministries (MAWF and MET) to come to terms. For bush it looks similar, the Woodland Management Council merely functions as an advisory council to the Minister and is for the most part inactive, though taking charge of debushing control would ideally be within its mandate (Int. DoF). In both cases, no mediator exists facilitating communication between the different stakeholders.

Considering the immediate need for regulations in this field, procedures on ministerial level are generally slow. This could be due to the notion that *"in most cases regulation of Bioenergy can be seen to be in a state of flux as competing interest groups argue over the correct direction for different types of Bioenergy development"* (Practical Action Consulting 2009, 31). However, even though the competing interest groups exist in Namibia, not much arguing is being done.

Second, most likely due to the above 'power vacuum' no bioenergy policy exists in Namibia. Though provisions for renewable energy development are made in Nampower's internal strategy papers, MME's Rural Electrification Masterplan 2000/2005 and Energy Policy White Paper (1998), no national policy exists but only a national commitment (Int. Nampower). The Bio-oil Road Map, though enthusiastically showing ways how to get involved in the emerging bio-economy, was never elevated to the status of a policy.

Once more looking at Jatropha, the Government does not have an official opinion on it, thus impeding or at least severely delaying progress in that area. In fact, though not widely known, a moratorium has been placed on the topic (Int. MET; Int. Directorate of Forestry). Though numerous government officials state that knowledge is insufficient for decision making in case of bio-energy, this general perception is not reflected by initiatives taken to close this information gap. As REEEI (Int.) puts it, *"the challenge with biofuels is that there is a lot of talk and not much action"*. So far, it does not seem to be a strategic issue for the country.

National Policy Framework

In order for policies to be coordinated, they have to exist and be implemented in the first place. The fact that many decision makers mentioned insufficient knowledge to come up with a bioenergy policy is related to the inexistence of other policies. For instance, it is put forth that bioenergy production possibly has a negative impact on food security, but at the same time there is no comprehensive food security policy in place on which a bioenergy policy could build to avert negative impacts. Also, considering that bioenergy is a renewable energy, but no renewable energy policy exists, difficulties regarding the establishment (coordination) of a national energy mix arise. Another practical case in point is the lack of advancement of a policy dealing with bush encroachment. A Rangeland Management Strategy is only *"being developed"* (Int. DoF) leading to the assumption that, so far, little coordination of competing interests has been undertaken.

Support for bioenergy value chain

The third problem area under the headline 'policy coordination' is the insufficient support for bioenergy value chains. Incentives provided for bioenergy production within the existing policies are rather limited when considering the potential inherent in these value chains (of course, since no bioenergy policy is in place yet it is not even clear whether this potential is supposed to be developed at all).

Some farmers claim, for instance, that they would like to productively use bush but do not have access to capital in order to get debushing started. This is matched by Agribank (Int.) stating that they were not able to serve total demand for special debushing loan schemes in 2008. Especially in communal areas access to capital is limited since communal land cannot be used as collateral and micro-finance institutions are all but widely available. If Namibia decided to seriously foster bioenergy value chains, policies regarding access to capital in both commercial and communal areas would need revisiting (see also 'Agricultural Development' and 'Land Tenure')

Furthermore, government extension services are not geared towards supporting bioenergy production, again most likely due to the inexistence of an official bioenergy policy. So far, for instance, no government money can be spend on activities related to Jatropha cultivation, even though *"we* [the MAWF] *would love to include it in the green scheme"* (Int. MAWF, italics added). Interestingly, extension services in the area of food crop production were also not exactly praised when talking to many farmers, leaving room for the assumption that, generally, inefficiencies in the extension system exist. Though AGRA (Int.) has recently set up an 'agricultural advice section' and has about 8000 kg of Jatropha seeds in stock, their services would have to be paid for. So far, no subsidies for their services are in place, however AGRA intends to come up with a scheme for debushing. As a consequence of the above, then, it is crucial that support for bioenergy value chains comes from all sides, which again poses a problem for efficient policy coordination.

8 RECOMMENDATIONS

Food Security

- Conduct country-wide **study on food security** and related factors (self-sufficiency, mode of production, food market properties, transfer programmes such as food packages, income patterns and migration) as announced in the MAFW Strategic Plan 2008/9 – 2012/13 (MAWF not yet published, 35) and continuously monitor **food security status**.

- Design a **national food security policy** as announced in the MAWF Strategic Plan (ibid., 30 and 39):
    - Clarify concept of food security and food self sufficiency at national, regional and household level with due consideration of communal areas and small farmers.
    - Critically assess strategic, political and economic need for food self-sufficiency.
    - Design and implement strategies towards food security for different groups of population. In the case of bioenergy overcome market failures in remote areas that lead to dependencies on a single provider.
    - Assign role for agriculture in food security, i.e. in its functions as food provider as well as source of income.

- On basis of food security strategy, clarify **government position towards cash crops** (in particular in communal areas) and, due to the immediate need of clarification, especially towards cash crops for bioenergy production.
    - Check and harmonize other policies on possible synergies and contradictions: Poverty Reduction Strategy, Agricultural Strategy, Social Security Policy, Energy Policy.
    - Clearly define minimum requirements of large agricultural investors for food security (if any).
    - Promote spill-over effects from cash crop to food crop production.
    - Propagate the strategy widely so as to sensitise all stakeholders and policy makers.

Rural development

- Clarify the role and potential of major land uses in rural areas (agriculture, livestock, forestry and conservation for tourism) for economic, ecological and socio-political development and **assess the role of migration** for rural poverty reduction.

- Derive a **realistic strategy for poverty alleviation and rural development**, including options for income generation versus transfers and migration.
    - Clarify the role of rural areas in the long-term vision, including employment generation (particularly focussing on the youth), food production and nature conservation.
    - Derive strategies to integrate long-term vision and short- to medium-term needs
    - Assign a realistic role for agriculture in rural development, i.e. as a provider of

livelihoods, income and food security, given alternative livelihood sources including migration, and given costs to develop options.

- Clarify the role of bioenergy and cash crops in rural development.

Agricultural development

- Align the **agricultural policy** with food security and rural development priorities and available government resources.

- Clarify the **role of bioenergy feedstock** within agricultural development priorities.
  - Increase information base to assess potentials and threats, by conducting public research on yield potentials and to assess potential environmental risks. Integrate private sector (commercial farmers and private investors) in research and development on bioenergy.
  - Compare bioenergy feedstock to other crop options in the context of rural livelihood challenges and strategies.
  - Decide upon a sequencing of introducing a bioenergy industry, e.g. start out small with governmental trials and small plots of private actors with continuous monitoring before introducing large-scale cultivation.

- Adapt **agricultural support systems** to the needs of the rural poor for each model
  - Improve access to capital for rural poor, e.g. design micro-finance schemes for rural livelihoods, design financing schemes for renewable energy projects, clarify potential of CDM for small-scale applications and design support mechanisms.
  - Improve access to know-how and information (about bioenergy and other crop options for diversification) by improving interplay between extension services, agricultural research and training based on communal farmer needs. Increase especially the capacities of extension services and agriculture.

- Design **a clear strategy for FDIs in rural areas**, especially regarding bioenergy
  - Clarify the potentials and threats of FDIs
  - Design incentives and regulations to reduce social costs, e.g. a trust fund to avoid environmental damages (as in the mining sector).
  - Create a "mediating" body between investors, communities and government to integrate development priorities of the country with investors' needs.

- Improve introduction of **new agro value chains** into the country to increase value addition within the country (recommendation policy coordination)

- Create **incentives to commercial farmers for labour-intensive debushing techniques**, that respect environmental and labour standards

Labour

- Design **labour policies** that take due account of the particularities of the rural economies (seasonality, piece-work wage, remoteness, internal and trans-boundary migration) and carefully balance employment opportunities and job qualities.

- Build up and support sufficient **communication channels** for the unemployed and informal sectors in order to make their concerns heard when formulating labour policies.

- Improve **capacities of existing unions** for them to deal with matters concerning specifically wood workers. This especially concerns their outreach work. Alternatively, support the establishment and functioning of formal representation of certain classes of workers, e.g. wood workers.

- Improve **communication between stakeholders**: workers, unions, employers and government. Operationalise bodies like the Woodland Management Council that can serve as a forum for discussion. Deepen political stakeholders' understanding of realities on the ground in order to shift to debates based on informed arguments.

- Within the Ministry of Labour, improve financial base, quality and quantity of **labour inspections** and channel it to rural areas.

- Prepare **strategic plan for long-term employment goals**. This should include: providing skills for workers to access possible "new" and higher qualified jobs in the emerging bioeconomy and related sectors; bringing training opportunities down to the rural areas; offering relevant university courses for highly qualified employees; facilitate and better control the use of foreign workers.

Land

- Clarify **disadvantages** (lack of access to credit, lack of control/management of the commonages, depletion of natural resources) **and advantages** (safety net for the poor, continuation of traditional leadership) **of communal land rights for rural poor**. Design policies that remedy the disadvantages so as to bridge the gap between economic opportunities of freehold and communal land.

- Design an **inclusive and integrated land and natural resource use policy** that also clarifies the space for bioenergy projects. This should support cross-departmental and inter-agency cooperation at national, regional and local levels so as to ensure transparency in the allocation process and to accelerate decision making and implementation.

- Clarify the **role of Traditional Authorities and Communal Land Boards** with regard to planning and management of natural resources on the local level. Support and invest in capacities at all levels of land administration so as to accelerate land registration processes and help TAs and CLRs to deal with new kinds of request, like large-scale bioenergy projects and international investors. Strengthen **communication and dispute resolution structures** at local level so as to avoid conflicts and enhance legitimacy of decisions with local communities.

- Better **account for economic and ecological principles** in the implementation of the Land Reform. Support sustainable debushing initiatives to increase the quality and

amount of land available for redistribution. Ensure tenure security for existing farmers and support resettlement farmers in a comprehensive way so as to support sustainable land use and natural resource management.

Environment

- Conduct **independent research on environmental issues** of bioenergy value chains such as invasiveness, toxicity, water issues, biodiversity. Introduce **knowledge management systems** to allow informed risk assessment by political decision makers, the public, farmers and investors.

- Design and implement **clear regulations for productive use of natural resources**, such as bioenergy or for nature conservation.

- Ensure **sufficient compensation to rural population** for negative economic effects due to environmental regulation (transfers or benefit sharing arrangements).

- Design **integrated land and water use planning** taking due account of environmental impacts.

- Develop **capacities of local communities** in sustainable resource use planning and implementation.

- **Strengthen forestry and environmental authorities** to implement and enforce regulations as well as to provide permits and authorisation. Enable them to control the application of chemicals (e.g. for debushing) and their effects.

Bioenergy Output Markets

- Draw up a **National Renewable Energy Policy.** Establish targets for production and use of renewable (bio-) energy so as for Namibia to work towards a conventional/renewable energy mix. Targets can, for instance, be reached by minimum feed-in quantities of renewable energy or mandatory blending requirements.

- Design **incentive schemes to achieve economies of scale necessary for reaching national and international markets.** Schemes can include financing/loans, sufficiently high feed-in tariffs, guarantees, tax rebates, support to R&D coordination and to PPP, contact facilitation, legal and contract assistance, subsidies, among others. All of the above should be made as cost-efficient as possible, for instance through declining funding over time, differentiation according to scale of operation, or include own contributions.

- Design **standards for bioenergy products** (e.g. sustainability criteria, technical and quality standards), aligned with international or at least regional standards so as to create trust and respectability. Establish a **monitoring system** to assure implementation of these standards.

- Facilitate **access to carbon markets,** such as CDM and voluntary markets, by developing the necessary institutions and capacities within Namibia. Lobby for rules adjusted to the needs and capacities of developing countries. Ensure access and benefit sharing systems are in place.

Policy Coordination

- **Include Bioenergy in a National Renewable Energy Policy and monitoring system.** Therefore streamline procedures and negotiations and disseminate information effectively to stakeholders. Clearly identify a lead ministry guiding and feeling responsible for implementing the policy.

- Develop **inter-agency knowledge base** in the area of bioenergy. Cooperate with regional bioenergy initiatives in the area of R&D, policies and standards.

- Strengthen or create **mediators that reconcile different** interests and facilitate communication between stakeholders, both at inter-ministerial and local level.

- Coordinate the **formulation and implementation of coherent policies around bioenergy value chains**, i.e. food security, rural development, agricultural development, land, labour, environment and energy.

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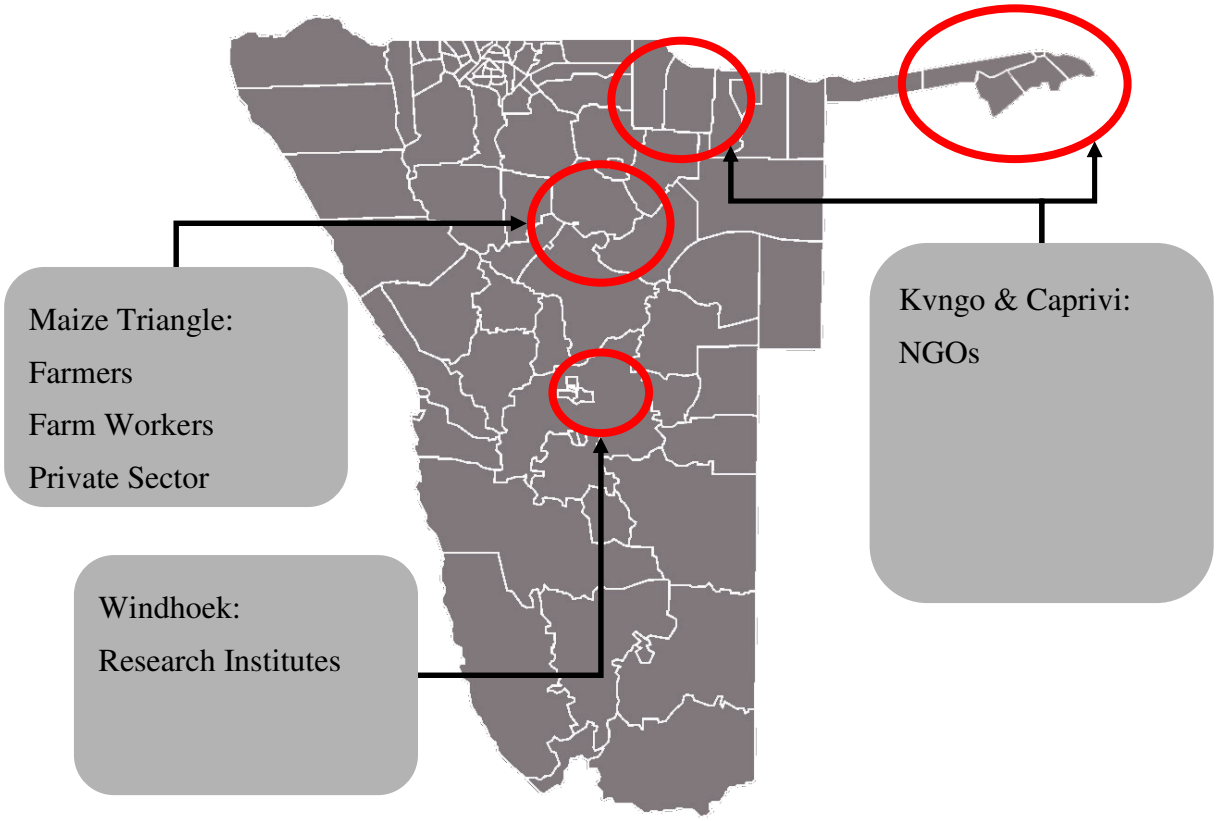
ANNEX

Figure 13: Map Field Trip and Interview Itinerary



The interview itinerary (11 weeks) was as follows:

The first two week were spent in Windhoek to conduct a first round of Interviews with Government institutions, universities and research institutes, as well as NGOs. During the next four weeks we conducted interviews in the Maize Triangle, the Kavango Region and Caprivi Region, speaking to farmers and farm workers, the private and public sector, as well as NGOs. After that, a round of follow up interviews was done in Windhoek (one week). Three weeks were used to reflex, analyse the collected information and draft a preliminary report. Our last week in Namibia was spent in Windhoek again, where we held a workshop together with our local partner organization, DRFN, and the Polytechnic University of Namibia to present our preliminary results. More than 50 stakeholders attended, and every region we visited was represented.

Table 6: Interview Partners and Interview Dates

Organisation	Name	Interview Date
Ministries & Government Institutions in Windhoek		
Namibian Agronomic Board (NAB)	Christof Brock	Feb. 18th, 2009
Ministry of Agriculture, Water and	Marina Coetzee	Feb. 25th, 2009

Forestry (MAWF)		
Ministry of Agriculture, Water and Forestry (MAWF)	Dirk Prinsloo	Feb. 26th, 2009
Ministry of Lands and Resettlement (MLR)	Robert Ridgway	Feb. 26th, 2009
National Planning Commission (NPC)	Olivier Vandenbussche	Feb. 27th, 2009
National Planning Commission (NPC)	Thomas Kroll	Feb. 27th, 2009
Ministry of Finance (MoF)	Dagmar Honsbein	Feb. 28th, 2009
Ministry of Labour (MoL)	Ndili Nghimutiwa	Mar. 30th, 2009
Ministry of Trade and Industry (MTI)	Lucia Radovanovic	Mar. 30th, 2009
Ministry of Trade and Industry (MTI)	Wilbard N. Nashandi	Mar. 30th, 2009
Ministry of Lands and Resettlement (MLR)	Robert Ridgway	Mar. 31st, 2009
Ministry of Lands and Resettlement (MLR)	Maria Kasita	Mar. 31st, 2009
Agribank of Namibia	Hohobeb Masilo	Mar. 31st, 2009
Namibian Development Corporation	Willem A. Kruger	Mar. 31st, 2009
Directorate of Forestry (DoF)	Josef Hailwa	Apr. 1st, 2009
Electricity Control Board (ECB)	Siseho C. Simasiku, Rojas Manyame	Apr. 1st, 2009
Ministry of Mines and Energy (MME)	Noddy Hipangelwa, Nico A. Snyders	Apr. 2nd, 2009
Ministry of Labour (MoL)	Felix Musukubili	Apr. 3rd, 2009
NamPower	David A. Jarrett	Apr. 3rd, 2009
Ministry of Mines and Energy (MME)	Imanuel Nghishangele	Apr. 27th, 2009
Ministry of Environment (MET)	Mr Schikapongo	Apr. 28th, 2009
Ministry of Environment (MET)	Mr. Nghitila	Apr. 28th, 2009
Ministries & Government Institutions in Maize Triangle, Kavango and Caprivi		
Roads Authority, Grootfontein	Nico Cavhura	Mar. 4th, 2009
Kavango Regional Council, Rundu	Hon. Johannes U. Thighuru	Mar. 10th, 2009
Ministry of Agriculture, Water and Forestry (MAWF), Rundu	Berfine M. Antindi	Mar. 11th, 2009
Councilor, Rundu	n.n. guided by John Moremi	Mar. 11th, 2009
Councilor, Ndiyona	Sebastian Karupu	Mar. 11th, 2009
Namibian Agronomic Board (NAB), Katima Mulilo	Hon. Geoffrey J. Chillinda	Mar. 16th, 2009
Agribank of Namibia, Katima Mulilo	Jonathan Mahareno	Mar. 17th, 2009
Communal Land Board (CLB) Katima Mulilo	Yukuta Namasiku	Mar. 18th, 2009
Caprivi Regional Council	Cletius S. Sipapela	Mar. 19th, 2009

Ministry of Agriculture, Water and Forestry (MAWF), Katima Mulilo	Methew Mushabati	Mar. 20th, 2009
Ministry of Land and Resettlement (MLR), Rundu	Alfred Sikope	Mar. 23rd, 2009
Agribank of Namibia, Rundu	Dustin Mungalifa	Mar. 23rd, 2009
Namibian Development Corporation, Rundu	E. M. Likando	Mar. 25th, 2009
Donors and International Organizations in Windhoek		
German Technical Cooperation (GTZ)	Christian Gräfen, Kirsten Probst, Tanja Pickardt	Feb. 23rd, 2009
European Commision (EC)	Claus-Peter Hager	Feb. 24th, 2009
German Financial Cooperation (KfW)	Lydia von Krosigk, Sven Neusinger	Feb. 24th, 2009
German Embassy	Stefan Sckell	Feb. 27th, 2009
Donors and International Organizations in Maize Triangle, Kavango and Caprivi		
German Development Service (DED) / Department of Forestry (DoF)	Wolfgang Hesse	Mar. 23rd, 2009
German Development Service (DED) / Ministry of Land and Resettlement (MLR), Rundu	Sebastian Seitz	Mar. 23rd, 2009
Universities, Research Institutions & NGOs in Windhoek		
University of Namibia (UNAM)	Mutjinde Katjiua	Feb. 19th, 2009
Polytechnic of Namibia (Polytec)	Lamek Mwewa	Feb. 19th, 2009
Desert Research Foundation of Namibia (DRFN)	Robert Schultz	Feb. 20th, 2009
Mukwamahlanga Tukondjeni Community Trust (MTCT)	Angelica Bergmann	Feb. 23rd, 2009
Polytechnic of Namibia (Polytec)	Ibo Zimmermann, Dave Joubert	Feb. 24th, 2009
Institute for Public Policy Research (IPPR)	Matthias Schmidt	Mar. 31st, 2009
National Botanical Research Institute (NBRI)	Gillian Maggs-Kölling, Johan van Eck, Ben Strohbach	Apr. 1st, 2009
World Wildlife Fund (WWF)	L. Chris Weaver	Apr. 1st, 2009
Labour Resource and Research Institute (LaRRI)	Hilma Shindondola-Mote	Apr. 2nd, 2009
Polytechnic of Namibia (Polytec)	Samuel John	Apr. 2nd, 2009
The Renewable Energy and Energy Efficiency Institute (REEEI)	Selma Shitilifa, Lydia Shekupe Mlunga, Kudak-washe Ndhlukula	Apr. 2nd, 2009

Universities, Research Institutions & NGOs in Maize Triangle, Kavango and Caprivi		
Cheetah Conservation Fund (CCF), Otjiwarongo	Bruce Brewer	Mar. 2nd, 2009
Namibian Nature Foundation (NNF), Rundu	Mr. Asser, Mr. Paul	Mar. 9th, 2009
Women's Group, Rundu	Elfriede Calira	Mar. 11th, 2009
Mashare Agricultural and Rural Development Institute, Mashare	Ms. Shipepe	Mar. 12th, 2009
Bagani Research Station, Divundu	Thomas Constanti	Mar. 13th, 2009
Mukwamahlanga Tukondjeni Community Trust (MTCT), Katima Mulilo	Patricia Siska	Mar. 17th, 2009
Integrated Rural Development and Nature Conservation	Mr. Munali	Mar. 18th, 2009
RISE	Clemens Shipanga	Mar. 24th, 2009
Private Sector in Windhoek		
Enviro Dynamics (Workshop)	Carol Steenkamp	Feb. 19th, 2009
Stern Link	Diederik Jankowitz	Feb. 23rd, 2009
SAMICOR / LL Biofuels	Ely Nefussy, Kombadayedu Kapwanga, Alon Vered	Feb. 25th, 2009
Baumann & Meier Workshop CC	Uwe Baumann	Mar. 20th, 2009
Consulting Services Africa (CSA)	Carter Hartz, Danie Nel	Mar. 20th, 2009
Jumbo Charcoal / Consulting Services Africa (CSA)	Ian Galloway	Mar. 20th, 2009
Solar Age Namibia	Conrad Roedern, Marco Simoni	Apr. 2nd, 2009
AGRA Co-operative Ltd.	n.n.	Apr. 3rd, 2009
VO Consulting	Detlof von Oertzen	Apr. 24th, 2009
Private Sector in Maize Triangle, Kavango and Caprivi		
Namib Bioenergy Energy Investment	Terance Spyron	Mar. 12th, 2009
Caparo Investment	Francois Wahl	Mar. 16th, 2009
SAMICOR / LL Biofuels	Alon Vered, Ricky Lilami	Mar. 16th, 2009
SAMICOR / LL Biofuels	Ricky Lilami	Mar. 19th, 2009
Standard Bank Namibia	Devalt Svart	Mar. 20th, 2009
Carbo Namibia (Pty) Ltd.	Hans Steyn	Mar. 25th, 2009
Jumbo Charcoal Okahandja	Brano	Mar. 27th, 2009
Unions & Other Institutions in Windhoek		
National Charcoal Producer Association (phone interview)	Willem Enslin	Feb. 27th, 2009

Namibian National Farmers Union	Laura Imbuwa	Feb. 27th, 2009
Legal Assistance Center	Willem Odendaal	Apr. 2nd, 2009
Namibia Emerging Commercial Farmers Support Program	Bertus Kruger	Apr. 3rd, 2009
Agricultural Employers Association	Giel Schuumbee	Apr. 3rd, 2009
Unions & Other in Institutions Maize Triangle, Kavango and Caprivi		
Central Northern Regional Electricity Distributor (CENORED),	Reimo Bauer	Mar. 2nd, 2009
Kavango Regional Jatropha Growers Association	Mathews M. Mushambe, Ernest Tjembe	Mar. 9th, 2009
Namibian Broadcasting Corporation (NBC), Rundu	Wilfred Njambe	Mar. 10th, 2009
National Jatropha Farmers Association, Rundu	Vincent Likoro	Mar. 10th, 2009
Caprivi Regional Famers Union	Mathias Semy	Mar. 16th, 2009
Caprivi Regional Famers Union	Martha	Mar. 17th, 2009
Namibian Broadcasting Corporation (NBC), Katima Mulilo	Jimmy	Mar. 18th, 2009
Far Northern Regional Electricity Distributor (CENORED), Katima Mulilo	T. Iyambo	Mar. 18th, 2009
Kavango Regional Farmers Union	Reino Aisindi	Mar. 23rd, 2009
Farmers & Farm Workers in Maize Triangle, Kavango and Caprivi		
Commercial Farmer Maize Triangle	Maans Fourie	Mar. 3rd, 2009
Farm Workers Maize Triangle	n.n, Maans Fourie's farm	Mar. 4th, 2009
Commercial Farmer Maize Triangle	Friedel Blume	Mar. 3rd, 2009
Commercial Farmer Maize Triangle	Peter Zensi	Mar. 4th, 2009
Farm Workers Maize Triangle	n.n., Peter Zensi's farm	Mar. 5th, 2009
Commercial Farmer Maize Triangle	Willem Groenewald	Mar. 5th, 2009
Farm Workers Maize Triangle	n.n., Willem Goenwald's farm	Mar. 5th, 2009
Commercial Farmer Kavango	John Moremi	Mar. 9th, 2009
Communal Famer Kavango, Gamboa	Agnes Vikongo	Mar. 11th, 2009
Communal Farmers Kavango, Gamboa	Tadeus Ansik, Oswald Kapungu, Agnes Vikongo	Mar. 11th, 2009
Communal Farmer Kavango, Ndiyona	Valentino	Mar. 11th, 2009
Irrigation Scheme, Shankara	n.n.	Mar. 12th, 2009
Commercial Farmer Shadi Kongoro / Green Scheme	Floris Smith	Mar. 13th, 2009
Farm Workers Shadi Kongoro / Green Scheme	n.n., Floris Smith's farm	Mar. 13th, 2009

Communal Farmers Shankara	Wilhelm, Bartolomeus, Inocentius, Bonifacius, Cornelius	Mar. 13th, 2009
Communal Famers Likoki	n.n.	Mar. 19th, 2009
Affirmative Action Farmer Maize Triangle	n.n.	Mar. 20th, 2009
Commercial Farmer Maize Triangle	Davi Kok	Mar. 25th, 2009
Commercial Farmer Maize Triangle	n.n. (German Farmer)	Mar. 26th, 2009
Affirmative Action Farmer Maize Triangle	Walter	Mar. 26th, 2009
Communal Farmers Maize Triangle	Helmut Keya, Max Katjipi (mechanic?), Albert Hangora, Christofine Rijaro, Sheline Mutjauvikua	Mar. 27th, 2009
Communal Farmers Maize Triangle	Wilson Nglama Kanbii, Theo Kazengurura	Mar. 27th, 2009
Traditional Authorities in Kavango and Caprivi		
Mafwe Traditional Authority	n.n.	Mar. 19th, 2009
Village Headmen, Nambwa	n.n.	Mar. 19th, 2009
Regional Headman, Nambwa	n.n.	Mar. 19th, 2009
Mashi Traditional Authority	n.n.	Mar. 20th, 2009
Area Headman, Ngweze	n.n., Masake J, Mukupi Joseph Mutaya	Mar. 20th, 2009
Ghiriku Traditional Authority	Hon. Chief Kasian Shiyambi	Mar. 24th, 2009
Ambulgo Traditional Authority	Hon. Chief Alfons Kaundu	Mar. 25th, 2009

Source: Authors' design (2009)