

# Bioenergy Value Chains in Namibia: Opportunities and Challenges for Rural Development and Food Security

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## Abstract

This paper elaborates on the potentials and risks of bioenergy production in Namibia and the institutions and policies shaping them. Existing and emerging value chains based on the conversion of *Jatropha curcas* into straight vegetable oil and biodiesel and of woody shrubs (bush) into charcoal, pellets, and woodgas are analysed in terms of their viability and impacts on rural development and food security. We argue that bioenergy value chains can have large positive impacts, but these depend on the specific value chain configuration and institutional and policy environment. The paper identifies gaps in the institutional and policy framework and proposes solutions for improvement around the policy areas of food security, agriculture, labour, land, output markets and value chain coordination.

Keywords: bioenergy, Namibia, rural development, food security, institutions

## 1 Introduction

Bioenergy production has attracted enormous attention worldwide over the last years, particularly liquid biofuels for transport.<sup>1</sup> Sub-Saharan Africa (SSA) has so far been affected mainly passively through higher food prices by the global expansion of modern bioenergy, while only participating marginally in its production. However, studies show a vast production potential for biofuels in several African countries (e.g. Faaji 2008, Fischer 2009). Many attempts are under way to realize this potential, yet mostly at an experimental or very early commercial stage. Many problems arise, some of which are generic, some typically shaped by the African context, and some unique to specific sites. Given that modern bioenergy production (especially that of liquid biofuels) is still a marginal phenomenon in SSA, there is yet little consolidated knowledge on the various potential effects for the producing countries.

The introduction of bioenergy value chains in a developing country can lead to very diverse effects both at the macro and micro level, depending on feedstocks, shape of value chains, modes of production and actors involved. Energy markets are very large, and so are some bioenergy business models. This explains why effects of bioenergy production on rural areas can be significant.

This paper takes Namibia as a case study to foster the understanding about the feasibility of modern bioenergy value chains, their potential effects on rural development and food security, and the factors affecting both. Namibia is regarded to have considerable potential for bioenergy production. The two most promising bioenergy pathways are the conversion of invasive woody shrubs (bush) into bioenergy (charcoal, woodgas for electrification and woodfuel briquettes) and *Jatropha curcas* cultivation for producing straight vegetable oil (SVO) and biodiesel. The government is still hesitant to either fully promote bioenergy value chains through policies and supporting mechanisms or to block it. This attitude is explained by the potentially large effects on local and national food security and rural development,

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<sup>1</sup> Bioenergy is the final product derived from biomass whereas biofuel is the energy carrier. Adopting the FAO definition, biofuel also includes biogas and solid materials (such as fuel wood, charcoal and wood pellets) (FAO 2008). Fuel wood is the most common form of energy in Africa, providing 80 percent to total energy consumption. When referring to modern bioenergy, we exclude fuel wood.

including ecological aspects which are concerns of many SSA countries, but also by the inertia of government towards innovative, complex sub-sectors which require coordinated action on several grounds and by several ministries.

This paper aims at answering the question how bioenergy production in Namibia affects food security and rural development and which factors shape its viability. In additions, it envisages identifying changes in policies and institutions to support and regulate bioenergy production, to realize its opportunities and minimize its risks.

## **2 Conceptual Framework and Empirical Approach**

For analysing the effects of new productive activities with significant use of natural resources on rural development such as bioenergy production, various objectives and limitations have to be brought into balance. Given that poverty largely remains a rural phenomenon in SSA, the need for increasing labour-intensive activities is widely acknowledged (see, World Bank 2008), which should be as far as possible competitive and not require government subsidies. A key question for agricultural and rural development is whether and how agricultural growth and nature conservation can be brought into balance (Vosti and Reardon 1997). Rural development is therefore a systemic and normative concept of sustainability of rural areas incorporating different goals (competitive agricultural growth, natural conservation, poverty reduction, social development) that need to be balanced in order to enhance livelihoods in rural areas. While in the longer term, these different dimensions of rural development probably complement each other they might compete in the short-term. In consequence, a comprehensive assessment of bioenergy value chains requires looking at different areas of rural development, including political, socio-economic and environmental effects.

Food security is a key policy issue of most SSA countries (including Namibia) and therefore of high importance when discussing bioenergy policies, particularly after the 2008 food price crisis. Given the low agricultural production and high food import dependency of Namibia as well as of many other SSA countries, the effects of bioenergy production on food security render particular relevance. As rural development, food security is a multidimensional issue, too, including food availability, access, stability and utilization (FAO 1996). Such a wide concept prevents from looking at food security only as a problem of (local) food production when introducing a land-using activity such as bioenergy production, but forces to also assess food markets, prices, transfers etc.

The effects of bioenergy production on rural development and food security are determined by factors within and outside the value chain. Factors affecting a chain's viability and the distributional effects within the value chain are the costs and institutional arrangements of production and processing, the local and national institutional environment, the bargaining power of the involved actors etc. (see, Kaplinsky and Morris 2001, Eaton and Meijerink 2007). Some important effects of a value chain lie outside the chain boundaries (e.g. effects on food markets, water, wildlife, tourism), many of which are indispensable to understand the (potential) impacts of bioenergy on rural development and food security. These are also influenced by a variety of policies and institutions on various levels (see, Williamson 2000).

By combining a value chain with a qualitative impact analysis, we analyse the (potential) impact channels of various bioenergy value chains and elaborate on institutions (from national to local level) that influence the viability and the development effects. The findings rely on qualitative data collected during a 3 months field research between February and May 2009 in the capital of Namibia and various rural regions. Selection of interviewees followed the value chain logic (actors at different levels along the chains) as well as a stakeholder logic (for instance, policy and administrative responsibilities for institutions affecting

the value chain, such as labour or environment). About 130 semi-structured interviews with experts and stakeholders were conducted, including representatives from ministries and decentralised bureaucracies, parastatal organization, private sector investors, NGOs, commercial farmers and group discussions with smallholder farmers and wood/farm workers. With regard to the new value chains (Jatropha and bush), the sample covers most major actors (except small-scale farmers and wood workers which we sampled according to availability).

Obtained information was cross-checked with other sources and interviews. A computer program for qualitative data analysis, called atlas.ti ([www.atlasti.com](http://www.atlasti.com)), was used. Most quantitative information was derived from literature. Where triangulation did not yield clarification or consensus, a conflict of interest, perception or an information gap is stated.

### **3 The Rural Development Challenges and Bioenergy Potential in Namibia**

Namibia is classified as a middle-income country and envisions becoming a highly urbanized knowledge society by 2030 (NPC 2004). While agriculture still contributes about 5-6 percent to GDP, the agricultural base is considered too weak to offer a sustainable basis for long-term prosperity (Namibia has the driest climate in southern Africa with an average rainfall of 270 mm). On the other hand, Namibia faces the immediate challenge of an enormous income inequality, which is one of the highest in the world (World Bank 2008). Poverty is highly concentrated in the rural areas (particularly in the communal areas in the north) where it reaches 50 percent with unemployment of 45 percent (NPC 2008, Schmidt 2009). Urban development, tourism and mining activities, the major pillars of Namibia's development, do not provide sufficient jobs, or require skills which only few rural poor have. Enhancing rural incomes, at least in the short and medium term, is thus necessary for poverty reduction. As in most African countries, agriculture plays an important role in combating poverty. It is the largest employer in Namibia, supporting, directly or indirectly, 70 percent of the population. While half of Namibia's population lives in the communal areas north of the veterinary fence<sup>2</sup>, this region only contributes 24 percent to national agricultural production (Mendelsohn 2006, SEEN 2008). The communal areas are dominated by agro-pastoral subsistence farmers with average cropping plots of 1-4 hectare and low external inputs (Mendelsohn 2006). The low agricultural performance in the north and lack of alternative employment is one of the key causes for poverty and food insecurity (cf. UNDP 2004, NPC 2008).

Many other rural poor (several ten thousands) are workers on commercial farms south of the veterinary fence. They are residents or temporary migrants from the communal areas. According to a study by the Labour Resource and Research Institute (LaRRI) (Karamata 2006), less than 40 percent of farm workers are actually registered as members of the social security scheme and most lack knowledge of the existence of labour unions, while only half of all farm owners have implemented the official minimum wage regulation.

Food insecurity is less a matter of inadequate food availability but rather insufficient access to food of the rural poor. Most rural households cannot meet their basic food needs through subsistence farming but rely on food purchases for a considerable time of the year (NPC 2006). Only large (white) farmers in the northern commercial area (the so-called maize triangle), some government-owned medium size irrigation schemes, and larger black farmers in the communal areas produce staples for the market. Irrigation is necessary for high crop productivity. 50 percent of the food is imported, while temporary food import restrictions (for maize, some vegetables and recently for millet) assure the viability of domestic com-

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<sup>2</sup> This fence exists since the late 19th century and was initially constructed to prevent the rinderpest from invading the southern zones. At the same time, it delineated the border between private and communal land, white and black land ownership, as well as free migration and settlement for black people.

mercial food production. Food markets appear to be in general well developed, reliable and with relatively low price variability, but food supply stress exists locally during sporadic periods of inundation in some northern areas. A particular situation prevails in the commercial farm areas where markets are lacking because of low population density.

A key constraint to enhancing agricultural productivity is the unequal and insecure land tenure system. Land is divided along the veterinary fence into ‘commercial’ farmland with freehold tenure, communal areas without freehold property in the north, and state land which is mostly embedded in the communal areas (Odendaal 2006, SEEN 2008). Lack of land ownership in the north hinders accumulation of larger farm areas, restricts access to credit through lack of collateral, causes insecurity of investments for instance for irrigation or feeder road construction and maintenance, and creates problems of common resource management.

Another major problem of northern Namibia closely linked to bioenergy is the severe bush encroachment problem which degraded around 26 million ha of woodland savannas (de Klerk 2004). This has severely limited the grazing potential for cattle and sheep affecting 65,000 households in communal areas and 6,283 commercial farmers and their employees. About 35,000 wage labourers working on commercial livestock farms are affected by bush encroachment. Bush encroachment causes an economic loss of more than N\$700 million annually (about 1 percent of agricultural GDP) (Hager et al. 2008), while also reducing biodiversity, water-use efficiency etc. Reducing encroachment is a government objective (ibid.).

Bioenergy production can take place in all of the areas described above, on crop land as well as in drier areas not suitable for staple food production. However, *Jatropha* and bush-to-energy are not envisioned within the same context:

- *Jatropha* was identified by the National Biofuel Roadmap of 2006 as key feedstock of a domestic biodiesel industry for export and to serve a yet to be established national market (Interim Bioenergy Committee 2006). Major production was envisaged in the maize triangle and in the communal areas. Other biofuels were not excluded nor highlighted.
- Converting bush into biomass energy on a larger scale has been recognized in the context of reducing rural poverty and the invader bush problem at the same time (SADC 2006). The energy potential was calculated by Leinonen (2007) at 40.8 TWh (Terra Watt hours) per year, which by far exceeds Namibia’s total energy need (12.6 in 1999).

*Jatropha* and bush-to-energy, if established at a large scale, have the potential to affect poverty and food security in the northern regions (Kavango, Caprivi and the Owambo regions) as small scale farmers, livestock holders, permanent farm workers or migrants for both farm work or for bush clearing.

#### **4 Elements of Viability and Development Impacts of Bush Value Chains**

There are three main bioenergy pathways in Namibia that use bush as basic feedstock – charcoal, woodgas (for electricity generation), and woodfuel briquettes. Only the charcoal value chain is already commercially viable and widespread. The others are at an experimental stage: woodfuel briquettes are produced but not (yet) at commercially viable scale by a NGO; a pilot woodgas facility was to be established in autumn 2009 by a joint venture of a NGO and a private actor. In consequence, most information below is based on charcoal production. All three value chains reveal similar characteristics on the production and initial processing stage which are the most important ones for rural development and food security. In particular, they have in common the legal regulation, the mix of production goals for bush clearing, and the very laborious activities around harvesting of bush.

Bush-to-energy activities in Namibia generally pursue at least two out of the following three goals in parallel: selling the energy, clearing land for creating or increasing livestock carrying capacity, and improving the ecological conditions of the land. For each of the purposes, different species and sizes of bushes and trees are cut or left on the field, different optimal bush densities are envisioned, different post-clearance treatments used, and different activities, remuneration schedules and supervision tasks result. In general, the law restricts total bush clearing and requires certain species to be protected. Under Namibia's Forestry Act, a permit for debushing land is needed when exceeding 15 ha. The multiple-goal nature of debushing makes analysing the viability of bush-to-energy activities very complex.

In the prevailing charcoal business, farmers or specialised charcoal producers employ teams of mainly male charcoal workers who manually chop and burn the trees and bushes to charcoal in mobile kilns. Small farms employ 5 to 10 wood workers, while larger charcoal producers use additional land from neighbouring farms (mostly against a fee) to employ up to several 100 charcoal workers. Some communal farmers are also engaged in charcoal production, either as income diversification strategy or main source of income.

Labour and transport costs have been mentioned to be the main cost components and supervision of charcoal workers is seen as a major problem. Commercial farmers often do not like to employ many strangers on their land as they fear insecurity, illegal actions such as poaching, fires and theft. The Namibian Charcoal Producers Association agreed with labour unions to pay 40 percent of the selling price to the labourers (around 350-400N\$ per ton). As stated by commercial farmers, workers can produce between 2 and 4 tons of charcoal per month, which results in an earning of 700-1400 N\$/month, clearly above minimum salaries. However, performance varies considerably among workers, working conditions are very hard, and in the first months repayment of initial credits for working material can absorb a substantial portion of the remuneration. Many workers therefore abandon the job already after few weeks. Charcoal workers are self-employed contractors and therefore not covered under the Labour Act as farm workers. Contracts are usually oral agreements and make the worker responsible for the own social security. Charcoal areas are remote; villages with commercial activities or social services can be dozens to hundreds of km away, making workers highly dependent on farmers. Food from the farmer's shop, medical expenses and, in some cases transport are other expenses often deducted from the wage.

Other bush-to-energy value chains differ only slightly in debushing activities, which can, however, constitute important differences in labour costs. Charcoal production from invader bush for example, needs 4.5 times more labour than when simply clearing land (de Klerk 2004). While for charcoal producers smaller bushes and branches are less attractive, for wood chips and woodgas producers this may be different, depending on total product, quality and energy yield. However, the most important differences in bush harvesting are not due to the end product but to the combination of objectives that are pursued (see above).

Large differences between bush-to-energy value chains exist in transformation and marketing the final products. Charcoal production has the key advantage of reducing the weight of the energy carrier at the production site, and both road transport to South Africa as well as combined road and sea transport to Europe of the final product are not prohibitive. Charcoal is sold to retailers, mainly for export (Europe and South Africa) but also for national sales. Of the few domestic retailers Jumbo Charcoal is the biggest, buying about a quarter of total production. As others, they use the Forest Stewardship Council (FSC) standards for most of their production to secure overseas markets. A ton sold for 800-1,100N\$ (80-110 €) over the last years compared to domestic prices of 850N\$.

In the cases of the other two bush-to-energy value chains, more bulky products have to be

transported – in the case of woodgas (electricity) only over a shorter distance to the gasifier, which has to be linked to a (local) electricity network; in the case of woodfuel briquettes only volume is reduced, not weight. Transport costs vary considerably according to (off) road and useable vehicle type. Commercial experiences are still few, but it is clear that transport costs can be prohibitive. This, on its part, limits the size of a factory or gazifier and therefore handicaps economies of scale. Also, the demand and prices for the innovative products are yet not clearly established: Woodchips are marketed under a special NGO conservation label, creating especially high prices which may not be achievable for “ordinary” successors. Electricity can be fed into the national grid - this market has been institutionally opened but the price up to now is not subsidised. This may change, as the recent feed-in policy of South Africa indicates (see below).

While bush-to-energy value chains are partly operational, there are several challenges constraining their viability. Labour is the most sensitive issue. Unions recently demanded a remuneration of 700N\$ per ton of charcoal for workers which, according to commercial farmers, would make production unprofitable. An even more fundamental risk seen by commercial farmers is the position of the Ministry of Labour (MoL) towards self-contracting, claiming that wood workers need to be treated as workers under the Labour Act. Charcoal producers, however, insist on more flexible contracts to provide sufficient incentives for wood workers given the difficulties of labour supervision. They criticise that political negotiators and unions do not have sufficient knowledge of the charcoal business realities. Unions', namely the Namibian Farm Workers' Union (NFWU), lack capacity to reach out to the people. Negotiations between the charcoal producers association, unions and government representatives are going on for years without any agreement so far. A Woodland Management Council (WMC) is foreseen as discussion forum, but only exists in an interim form with low prospects of becoming fully operational soon. All these challenges cause many commercial farmers to choose labour-saving methods (de Klerk 2004). Finally, in the communal areas, given the land tenure system trees are merely cut down as income generating activity instead of strategically restoring rangeland. This is also linked to the problem of market access for communal products, especially to FSC markets as investment and verification costs are high.

#### *Potential Development Impacts of Bush-to-Energy Value Chains*

The additional income for wood workers could be a key contribution of bush value chains to poverty alleviation. This again might reduce poverty in the sending regions through remittances. The above mentioned LaRRI study (Karamata 2006) found, for example, that farm workers sent 22 percent of their wages home. Interviews with wood workers have confirmed this pattern. Small scale communal farmers might directly earn income from selling bush or charcoal, while regaining rangeland for livestock production could secure employment and income of farm workers and lead to more employment in processing and distribution.

Risks for wood and farm workers derive from the wage security, side conditions and high dependency on the employing farmer as sole provider of cash income, food and other goods. Informal and mostly seasonal arrangements do not secure workers with cash income throughout the year. More mechanised bush harvesting techniques are discussed which would increase demand for skilled labour, enhance labour productivity, better payments and working conditions but reduce demand for unskilled labour. This could have severe consequences for the extremely poor lacking alternative income opportunities.

The additional income could enhance food security given the high expenditure shares of households for food items (NPC 2006, Karamata 2006). Food security is also determined by in-kind payments to which farmers are obliged under the Labour Act. However, workers often become indebted from borrowing at farmers' shops. Prices were said to be higher than at

markets due to transport costs and profit-making objectives of the farmer. Increased carrying capacities in the commercial and communal areas can also enhance national meat availability and increases food security for communal farmers. Higher incomes might lead to positive socio-political effects in terms of spending on health and education, while negative health risks might be due to harsh working conditions without proper use of protective clothing and little control by the labour inspectorates. Formal labour arrangements would provide workers with benefits from Namibia's social security system.

There are positive environmental impacts of well-managed debushing. Reducing bush encroachment is said to positively impact on water tables by reducing evapotranspiration of trees, which in a drought prone country like Namibia is important for agriculture and livestock keeping as well as drinking water. The entire scope of the ecological impact depends, however, on the type of bush removal (see above). The goal usually is to thin out bush infested areas and not completely remove it (JPC 2008). The biodiversity is expected to be positively affected, but depends on the extent of bush control measures (de Klerk 2004). Debushing permits issued by the Department of Forestry (DoF) only regulate protection of endangered species while more extensive sustainable harvesting is only ensured in FSC production. In any case, effective control of regulation may not always be warranted, even though in Namibia the rule of the law is certainly better than in most other SSA countries. If bush harvesting is done with the (co-) objective of rangeland recovery, an additional assertion that ecological requirements are met exists since totally open areas are not in the long-term interest of farmers. Effects on GHG emissions are yet unclear: harvesting invader bush immediately releases carbon but reduces emissions if replacing fossil fuel use elsewhere.

## **5 Viability and Development Impacts of Jatropha Value Chains**

Under the ecological conditions of Namibia, *Jatropha curcas* was identified as most suitable biofuel crop to grow in the north east (Interim Bioenergy Committee 2006). In recent years, *Jatropha* has received a lot of attention throughout developing countries, and particularly in SSA, as a highly promising bioenergy crop. As a shrub yielding seeds with high oil content, *Jatropha* is promoted for the production of straight vegetable oil (SVO) and biodiesel for the use in transport, lighting, cooking or mechanization (GTZ 2007). It is often referred to as low-input crop requiring little water, nutrients and labour. This would make it suitable for arid and semi-arid regions avoiding competition with food production and less negative ecological effects than conventional energy crops. However, doubts have come up in recent years concerning the validity of these assumptions when high yields are to be achieved (Jongschaap et al. 2007). Also secured yield data under different growing conditions are not (yet) available in Namibia, at least publicly. Investors calculated that yields of 3-5 t/ha would be sufficient to make production viable without even valorising by-products. For large biodiesel processing units, requiring a minimum of 20,000 ha of plantations, biodiesel production cost was estimated to be at 0.62US\$/litre (Interim Bioenergy Committee 2006).

Potentially, three models of *Jatropha* production can be distinguished in Namibia: small scale village production of SVO, medium size commercial farmers, and large scale projects. None of the models is already fully operational. The biofuel roadmap of 2006 was mainly driven by commercial farmers. Seeds were imported from India and widely distributed, others experimented with local strains. However, subsequent trials by some farmers were unsuccessful, particularly due to frost and other natural calamities (e.g. problems with pests).

Nowadays, hope for *Jatropha* in Namibia rests on sites further north in the communal areas, where frost does not pose a threat, rainfall is higher and (temporary) irrigation easier feasible. Kavango and Caprivi are the most important regions; apart from the river banks and two

main roads these provinces are very sparsely used. Local communal farmers were hardly active in *Jatropha* production independently, but investors pushed for large to very large projects (between 20,000 and 300,000 ha). Known investors include MAN, Lev Leviev Biofuels (LLB) and Caparo Investment (cf. Etango 2008, EnviroDynamics 2009). Two types of project are targeted: a) *Jatropha* on own large pieces of land, and b) through contract farming (outgrower) arrangements in which the company provides services, input and know-how to the smallholder with agreement to buy the crops (Mendelsohn and Obeid 2007).

In both types of large *Jatropha* production, major difficulties were met in obtaining land or securing production by outgrowers. Three investors based their model on outgrower models. The most promising project aimed at contracting 8,000-13,000 farmers in Kavango to plant *Jatropha* on 70,000-130,000 ha of land deforested prior to 1990 to capture carbon credits through the CDM mechanism (Christian 2006). Given the long time for *Jatropha* to mature the investors subsidised farmers with food and cash during this time. A farmers' association was established holding shares in two companies for feedstock production and processing. These shares were scheduled to increase to 100 and 49 per cent respectively after 2014.

Of the large-scale *Jatropha* projects studied, none had yet reached a larger level of production, while several seemed to have already stopped their activities. A major obstacle encountered related to problems surrounding land-use planning processes and legal problems of the communal land tenure system. In one of the projects, land promised to the investor was already gazetted by another ministry for alternative use in livestock production a couple of years ago. This right had not been used and expired, but after the discovery degazetting took a lot of time. Violations of the Communal Land Act were reported as investors consulted on traditional authorities but these did not consult their communities sufficiently. In the contract farming model, where acquisition of land was not an issue, uncertainties regarding the legal claims between farmers and investors for carbon credits from *Jatropha* trees arouse: The investor demanded long-term leaseholds by the farmers to assure ownership of trees, while communities and the government feared loss of long-term land access or rights of farmers.<sup>3</sup>

The lack of a clear government position on *Jatropha* had further created uncertainties and risks for long-term investment decisions. One factor mentioned was the fear of invasiveness and toxicity, although *Jatropha* had existed in the north of the country for a long time and a thorough EIA (though financed by investors) had found no negative signs. Communities and regional governments insisted on proofs of technical viability before dedicating own land. Doubts in the viability of the projects and in investor objectives were fuelled by the lack of reference *Jatropha* projects elsewhere in Africa and the failures of past cash crop initiatives (e.g. cotton and sugar). Other constraints mentioned were the high labour input needed due to lack of mechanization technologies, uncertain benefits from by-products (e.g. cake for fertiliser, animal feed, gas-to-electricity, CDM markets) due to lack of industry-scale technologies and not yet established markets.

#### *Potential Development Impacts of Jatropha Value Chains*

The research conducted on *Jatropha* value chains in Namibia shows that effects differ widely according to how value chains are organised. Most obvious are the potential economic gains for the regions. Massive employment generation potentials of large *Jatropha* schemes in regions characterized by high unemployment rates can be considered as highly relevant (Mendelsohn and Obeid 2007, Mitchell 2009). The enormous increase of cash circulation in the regions and project investments (building roads, pump stations, pipelines, factories for processing) could lead to further growth and employment effects.

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<sup>3</sup> Customary rights are already recognized by law in Namibia, while converting such land into private leaseholds might lead to farmers losing their lands once unable to pay lease fee to the Government (e.g. in case of project failure).

On the other hand, projects of such a size increase the exposure of the regions to project failure and new market risks. The paramount risk is the overall project failure leaving the communities with huge open lands or *Jatropha* fields. Even if these areas are hardly used for other purposes (almost complete absence of water in the earmarked areas makes even livestock rearing difficult), the new structures are long-term and costly to reverse. Another key point lies in the contractual modalities between companies and smallholders, and mechanisms ensuring that these are respected by both parties. Here, the communities face the risk that a company exploits its monopoly position and not fully complies with promises made.

Positive socio-political effects might come from improved education and health status due to increased household spending and promised social investments of the company. The availability of formal wage employment might reduce prevailing youth problems, as expressed by communities, though also fear of increased alcoholism was expressed by traditional authorities (see also Mitchell 2009). Further potential for conflicts lies in an increased number of work-migrants from neighbouring countries. Projects of such size attract influential persons and pressure groups that take position for personal and/or common interests. On the other hand, minorities and vulnerable groups such as small ethnic groups, women collecting non-timber forest products, migrant livestock herders and others risk to be overseen or unheard and their rights not or under-compensated. During some negotiations over communal lands, problems within the communities could already be observed. Traditional authorities are under extreme pressure, never having experienced a similar run on their land and not having knowledge, experience or capacities to deal with such large projects. The Government seems to fear the psychological and political effect of project failure, having already experienced such industrial failures elsewhere. Extremely high expectations, unclear land rights, delegated negotiation power, rivalling ethnic groups, bad communication infrastructure and habits, long procedures and government anxieties combine to a politically and socially explosive mix. Even the successful establishment of such large projects will create certain problems, since not all parties will benefit in equal terms, not all politically influential persons will be satisfied, and effects such as alcoholism or migration effects are difficult to manage.

The potential effects on food security of the *Jatropha* models appear to be positive in general through increases of income and, thus, food access without jeopardising food availability, due to the facts that a) subsistence and food crop production is already widely insufficient, that b) people are already largely depending on relatively well-functioning food markets (see above), and that c) high unemployment and lack of job in rural areas is main cause of food insecurity. The effect on household food production within the contract farming models depends on household- or community-level effects. Generally, the scarce resource for *Jatropha* cultivation is labour (and water if irrigation is - temporarily - needed), not land. Of course, large project failure could annihilate or even aggravate the food security situation given the huge number of people which would increasingly rely on income for *Jatropha*.

Environmental effects from *Jatropha* production vary substantially between the different models, too. The plantation models would unavoidably lead to widespread loss of biodiversity through debushing activities and monocropping. Although the investors promised to make provisions for intercropping and maintain natural vegetation and wildlife corridors in their plans, these efforts only reduce the negative ecological impacts of a plantation. Also, irrigation changes the natural water cycle, and fertilizers and pesticides may pollute water and soils. As to the greenhouse gas emissions, plantations would reduce the stored carbon in natural vegetation while capturing carbon through *Jatropha* plantings. In contrast, contract farming schemes in Kavango partly focus on land already cleared before 1990 and degraded, so that no carbon sink is lost and instead tree growth is fostered and soils rehabilitated. While no evidence of *Jatropha*'s invasiveness in Namibia exists, lacking experiences on

large scale and with imported strains makes it difficult to assess this. Especially, contract farming with many independent producers makes control of seed distribution difficult.

## 6 Key Institutional Challenges for Bioenergy Value Chains in Namibia

Whether opportunities of bioenergy production materialize and threats are minimized depend on various institutions and policies which we have classified into seven policy areas: food security, rural development, agriculture, land, labour, environment, and output markets; in addition, on policy coordination. In each area institutional challenges for bioenergy production exist, since policies are missing or not functioning well to shape bioenergy production. While these challenges are valid for many rural activities, modern bioenergy animates these as the first massive wave of investments in the communal areas of Namibia in recent years.

### *Food Security*

A straightforward and comprehensive attitude and policy towards a clear food security concept and strategy is probably the most important policy area for large-scale bioenergy production. The government is not conclusive in this regard which has repercussions for biofuel development. As argued, the inability of many households to meet basic food needs by subsistence farming is a key factor of food insecurity. The government's Vision 2030 focuses on food security and not food self-sufficiency (NPC 2004). While past initiative officially tried to foster productivity in subsistence agriculture, the government acknowledged in the latest National Development Plan (NDP) that these measures failed: *"the lesson is that subsistence agriculture is not an appropriate means to reduce poverty in Namibia"* (NPC 2008, 21). In consequence, NDP 3 recommends reaching food security by diversifying and improving household agricultural production and incomes (ibid.). However, a recent explicit food policy does not exist.

Few government initiatives were implemented to achieve this strategy (most prominently a general minimum pension scheme), and many of those in the agricultural sector seem to be incoherent with the Vision 2030 concept of food security. Large-scale irrigated food production was subsidised for black empowerment and local employment (Grimm and Werner 2005), national food self sufficiency was followed by supporting maize production which is essentially a crop of commercial farmers. It is only recently that millet, the typical product of small farmers in the communal areas, was included into the scheme. Most of the poor are net food buyers and therefore do not necessarily benefit from these measures but might even suffer from higher prices.

A similar incoherence is observed with regard to bioenergy. There are still many officials who emphasise a supposed conflict of biofuels with food production while neglecting the opportunities for diversification strategies away from subsistence farming through own cash-crop production or employment. The inclusion of food production in all *Jatropha* business models is to a large extent a tribute to this attitude of government. Even if this reservation may be understandable for large plantations which are also under scrutiny for other reasons, such reservation is much less reasonable for *Jatropha* under outgrower schemes, and even unjustified for bush-to-energy. Still, the official support for these technologies is very low.

The incoherence in the government's position towards food security and food self-sufficiency and lack of a coherent food security strategy must be clarified. Agricultural investments require security of government's position regarding cash crop production and their role for food security. Coming up with a national food security policy as announced in the latest strategic plan of the Ministry of Agriculture, Water and Forestry (MAWF) would be a good sign. Food security strategies must be targeted towards different groups, such as over-

coming market failures in remote areas, assigning roles for agriculture in food security, and clarifying the role of cash crops (particularly in communal areas), especially of bioenergy production. The role of rural non-farm employment, essentially tourism which is an important though much less labour intensive activity and of migration must also be included. This shows that food security and rural development strategies must be closely linked.

### *Rural Development*

The role of bioenergy 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. Bioenergy production as a form of commercial agriculture is one potential land-use besides others and needs to be assessed in this context.

Adhering to the long-term goal of becoming an industrialized knowledge-based society, a fundamental transformation of the country's economic structure is necessary, keeping only mining, tourism and probably extensive livestock in rural areas. Whether a highly productive modern agriculture and forestry sector (including for bioenergy) should complement this modernisation depends particularly on the importance attributed to food self-sufficiency (see *food security* above), the importance attached to producing transport energy within the country (see *output markets* below), the value assigned to nature conservation (see *environment* below) and the time required to transform the rural economy. Migration (see *labour* below) will have to play a key role in transforming rural areas.

However, in the short- and medium-term agriculture has to play a very important role in overcoming rural food insecurity and poverty as it is by far the largest employer. The economic benefits from tourism and wildlife seem to be rather limited for most households as came out of discussions with local communities. Agriculture including bioenergy, livestock or forestry can be more productive uses with higher impacts on food security and rural employment but also more negative environmental effects. Conflicts and trade-offs also 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. A key challenge is thus to reach the long-term objectives without neglecting short- to mid-term problems. It seems to be unclear which immediate and mid-term strategies for the rural areas Namibia opts for in order to reach the goals set in its long-term vision. 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. Without a clear strategy, this state of the play will not yield any satisfying outcome.

### *Agricultural support*

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 knowledge, credit, inputs, services and output markets. Interviews showed that there are general weaknesses of support to small-scale farmers through the research and extension system, and for bioenergy options in particular. Even for larger farmers and investors there are limits to own efforts. This hinders the introduction of new crops, such as *Jatropha*, or of sustainable technologies, for instance FSC charcoal production. A different approach, represented by the *Jatropha* outgrower schemes, focuses on integrating small-scale farmers into value chains coordinated by large private companies. Whereas this approach helps to overcome various market failures and brings potential benefits to communities the risks involved still require government interventions.

A central problem encountered was the lack of procedures for handling new crops, such as *Jatropha*. There is no institutionalized process to declare new crops invasive or otherwise

environmentally harmful. Once accepted, information on yield potentials and requirements as a decision support for small-farmers as well as investors does not exist. Although international investors may have enough funds to conduct such research on their own, it requires a lot of time before gaining clarity which makes governments highly depend on information from investors. This has vast negative consequences: since a certain scale of operation is often required for investments to be profitable, investors feel squeezed between the wish to test small scale and the fear that in the meantime others grab the land that they would require to scale up. This squeeze urges them to try to occupy very large pieces of land without being sure whether they really want or can use it. The land is occupied for years, if it is not denied due to fears around the risks of large investments.

### *Labour*

One of the biggest challenges for both viability and socio-economic impact of bioenergy relates to wage issues, labour regulations and their implementation. At the same time, labour conditions in unskilled jobs and informal employment in the agricultural sector pose social, regulatory and enforcement challenges. 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 concerning, among others, social security regulations, the prohibition of labour hire companies, accommodation, food provision, minimum remuneration, hours of work, leave, termination of employment and health and safety. Negotiations between stakeholders are complicated by Namibia's recent Apartheid experiences making the treatment of employees and workers an especially sensitive issue. While international human rights standards grant every employed person the right to decent working conditions, it might jeopardize economic viability.

The Government plays a double role by creating favourable economic conditions for employers and by protecting the interest of the employees. The analysis of the special situation of the different bioenergy value chains has shown that attention is needed to responsibly satisfy that role. While the Namibian labour legislation is trying to offer special protection to farm workers in the rural areas, it does not sufficiently account for the different types of work requirements and arrangements (e.g. seasonality, piece work, foreign labourers, size and formality of enterprises, special situation of remote areas) that exist in bioenergy production. Problems of implementation and supervision in rural areas increase the difficult situation of appropriate labour legislation. Due to the nature of their work and the farmer's economic and social situation, wood workers 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 workers as well as wood enterprises are left in a grey area which is not conducive to investments. Thus, there is need to adjust labour legislation to the special situation of bioenergy production. Communication channels for the unemployed and informal sectors needs to be build up in order to make their concerns heard when formulating labour policies. In addition, policies should set the right incentives for investors employ labour intensive methods in the short term, such as the subsidized debushing loan schemes of Agribank if labour-intensive methods are used. A strategic plan for long-term employment goals would be useful and coordination with relevant education and training institutions to increase skilled labour supply in the long term.

### *Land*

Land tenure is a central issue for the implementation and impacts of bioenergy investments, but, in general, extremely sensitive in Namibia. Challenges have been widely discussed in literature and reports (e.g. Mendelsohn 2008, LAC 2005, Fuller 2006). Lack of access to credit linked to the lack of collateral value of leasehold and communal land continues to be a

limiting factor and reason for low agricultural productivity. An additional problem in communal areas is the ‘tragedy of the commons’ (Hardin 1968). Most farmers graze their cattle on land to which they have no exclusive rights and from which they cannot exclude other. Thus, communal farmers not only lack capital for investment, but can neither be sure to benefit from their efforts. In commercial areas, on the other hand, farmers face the problem of being uncertain about which farms might be expropriated for redistribution as areas earmarked for resettling formerly disadvantaged people are not clearly defined and there is recurrent political debate as to how to accelerate land redistribution. This uncertainty reduces incentives for freehold farmers to invest in their land. The resulting lack of debushing even poses a threat to the success of the entire land reform as it leaves less productive land available for redistribution.

Another problem for bioenergy production is the lack of an integrated and participatory approach to land and water use planning, and to reconciling needs of different users including nature (see *environment* below). This has slowed down the implementation of bioenergy projects considerably. The Ministry of Land and Resettlement (MLR) as decision-maker of last resort in the land allocation process is waiting for decisions of the line ministries. The lack of coherent and foresighted land-use planning also puts enormous pressure on the local level decision-makers. Traditional Authorities (TAs) and Communal Land Boards (CLB) are faced with multiple requests for unprecedented amounts of land and must act as mediators between different interests in the same areas. The TAs not only lack technical capacities for administering formal land allocation processes, such as trained clerical staff and equipment (Mendelsohn 2008) but also the expertise. Funding and equipment of CLB is inadequate, too, which is reflected in a shortage of human and material resources for activities (see, GTZ 2004). Conflicts between TAs and CLBs, lack of capacities and policies leave room for exploitation of land allocation processes for personal and political agendas, often causing denial of formal land registration. Political affiliations, border disputes and settlements onto land of another community led to social unrest and TAs to object land registrations.

### *Environment*

Environmental aspects of bioenergy are regulated by policies with specific environmental focus and policies regulating activities potentially affect the environment (de Klerk 2004). Namibia’s Ministry of Environment (MET) shares the task of dealing and coordinating environmental affairs with other ministries such as the MAWF. Protection of the environment and natural resource conservation are goals in their own right but compete with productive uses of resources. Similarly, preserving biodiversity can lead to destruction of carbon sinks.

Although the Environmental Management Act of 2007 is not yet fully in place, it is generally expected that all investment projects must undertake 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. Furthermore, EIAs are conducted for single projects only. There is fear that the accumulated impact of many investment projects will be overlooked, and the Act provides for Strategic Impact Assessment (SIAs) which attempt to tackle this problem. However, SIA hasn’t been applied to bioenergy issues yet. 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. Enforcement of environmental regulations is a challenge not only for bioenergy production.

International climate change policies can be expected to have an impact on Namibia’s bioenergy production in two ways: First, CDM will become an increasingly interesting way of

financing new value chains in the bioenergy sector (see below). Second, access to donor funding will more and more depend on project compliances with climate change mitigation requirements. Currently, policies and political discourse hardly account for these topics. Finally, knowledge generation on the environmental aspects of bioenergy production, distribution and management are further key issues when establishing new bioenergy value chains. Capacities of government agencies are rather weak to embark on research in new fields like bioenergy with important systemic and cross-sector implications or to collect, analyse and disseminate existing knowledge.

### *Bioenergy Output Markets*

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 in Namibia. If the country decided to actively support bioenergy 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. For on-grid electricity feed-in, current agreements on feed-in tariffs are considered too low for independent power producers to be lucrative.

Of the bioenergy currently produced in Namibia, so far only charcoal, briquette fines and “bushblok” are being exported. A major market barrier relates to the economies of scale necessary to satisfy international market demand. While small communal charcoal producers need to sell to bigger producers, adding to transport and transaction costs, in the *Jatropha* case the difficult access to land complicates sufficient feedstock supply. Official as well as private quality, social and environmental standards might further hamper international market access (e.g. EU Directive on renewable energy or FSC standards).

In the production process of both *Jatropha* and bush-to-energy, 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 carbon credit market, bioenergy projects in Namibia in theory exhibit vast potentials. However, these potentials and the procedure to be followed are not well known. For bioenergy production to become a viable industry and part of a future energy mix, a national renewable energy policy would be necessary to define targets, quality standards and measures (minimum feed-in quantities, blending requirements or other incentives). It must, however, be clear that poorer countries do not have the economic possibilities to embark on the same type of costly support policies. They must be much smarter and exploit international schemes and comparative advantages.

### *Policy Coordination*

The fact that bioenergy value chains affect various sectors makes policy coordination critical. Clearly, there is insufficient and uncoordinated policy and support for bioenergy value chains. These chains are new and outstanding compared with other more gradually developing agricultural value chains and depend on many factors to become viable. Many ministries are supposed to play an active role in regulating and fostering the bioenergy industry, though it is not clear who takes the lead. In the case of *Jatropha*, for instance, a Cabinet Committee was established in 2008 in order to advance the issue. However, the presiding Ministry, the Ministry of Mines and Energy (MME), does not seem to push the issue sufficiently but rather waits for other ministries (MAWF and MET). The languish Woodland Management Council is an example of coordination failure for bush-to-energy value chains. For both value chains, no mediator exists to facilitate communication between different stakeholders, which holds true for local-level negotiations of project implementation.

Compared to the immediate need for regulations, existing procedures are very slow. Most likely due to the 'power vacuum' and lack of national champions, no bioenergy policy is in place. Though provisions for renewable energy development are made in Nampower's (the public energy utility) internal strategy papers, MME's Rural Electrification Masterplan 2000/2005 and Energy Policy White Paper (1998), no national policy exists but instead only a commitment. The Bio-oil Road Map, though showing ways how to get involved in the emerging biofuel-economy, was never elevated to the status of a policy. Since commercial farmers have lost belief in *Jatropha* in their areas, biofuel policy has lost dynamic. Though numerous government officials have stated that knowledge is insufficient for decision making in case of bioenergy, no initiatives are taken to close information gaps. In order to advance on the issue, a lead ministry responsible for implementing a bioenergy policy is necessary. Inter-ministerial negotiations and information dissemination would need to be enhanced, with a mediating body to reconcile different interest and facilitate communication.

## **7 Conclusions and Recommendations**

The paper has shown that bioenergy production can contribute to rural development and food security in Namibia (especially for the bush-to-energy value chains, small-scale *Jatropha* schemes and contract farming models based on the CDM). The direction and level of impacts of bioenergy production is, however, strongly influenced by the crop choice, the production model envisaged and the functioning of a variety of institutions. Potentials as well as risks can be expected to increase with its scale of production. Sustainability of bioenergy production requires the production models to be economically viable, which apart from charcoal and woodchips production is currently uncertain with all other models. Viability and development impacts depend on a variety of policies and institutions related to food security, rural development, agriculture, environment, labour, land, bioenergy markets, policy coordination which are not yet sufficiently developed in Namibia.

It is a key conclusion and recommendation of this study that the introduction of substantially new value chains, which require innovations and market development at several levels, is very difficult without coherent government support. In the case of larger schemes where investors dispose of important resources and have access to information, innovation generation and markets, this support can be limited to policy clarification and institutional arrangements that do not hinder value chain development and foster constructive negotiations and contractual arrangements. Some strategic research may be very useful to improve negotiation and decision making. Weak actors should be supported more directly to be able to negotiate with stronger partners on a similar level of information, and probably by helping them to organise. In case of smaller bioenergy solutions, more immediate support of generally more resource constrained actors is needed, including capacity development and initial subsidies to acquire know how, organisational structure, economies of scale and markets. Risk considerations must be an important element of any bioenergy value chain assessment, but much more so for large schemes. In case of major uncertainties around bioenergy production it is advisable to start with small realisations and collect experiences for larger projects.

For research, it is important to realise that bioenergy (as well as other agricultural or forestry) value chains in developing countries are extremely diverse and complex and can have considerable externalities of ecologic, economic, social and political nature. Policies, markets and institutions are often inexistent or weak, which can have important repercussions on the viability and the development impacts. Specific arrangements of the bioenergy value chain are decisive for the effects, and size matters not only quantitatively but also qualitatively by changing the type of effects. Too simple research questions and methods do not satisfy the needs policy-makers have regarding bioenergy research in developing countries.

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