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**Kavango Biofuel Project:  
Plantations of *Jatropha curcas*  
Environmental Impact Assessment**

**EXECUTIVE SUMMARY**

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## 1 INTRODUCTION

Prime Investment (Pty) Ltd is a Namibian registered company represented by Mr Gustav de Waal and his consultant Mr Johann Breytenbach. This company proposes to involve local communities in establishing plantations of the tree *Jatropha curcas* in northern Kavango, Namibia. This tree produces oil seeds, from which biodiesel and other by-products are made. The project is to be funded by Prime Investment who in turn is financed by Kavango Bioenergy Ltd in the United Kingdom. Prime Investment proposes the project as a business venture and not as an aid or upliftment programme.

A factory will be established near Rundu to extract the oil from the seed. A second factory, probably at Walvis Bay, is proposed to manufacture biodiesel from the oil. The factories will be the subject of separate Environmental Impact Assessments in due course.

Colin Christian & Associates CC was contracted to conduct the Environmental Impact Assessment for the establishment of plantations of *Jatropha curcas* in the study area.

The project area is a 10km wide strip of land along the Namibian section of the Okavango River – from Katwitwi to Divundu (refer Figure 1 in the EIA report.) The project seeks to qualify for carbon credits in terms of the Kyoto Protocol. Therefore, only land that was cleared before 31 December 1990 will be used – as shown in Figure 2.

J. Breytenbach has been conducting research on *Jatropha*, in Kavango, since February 2006.

## 2 BACKGROUND TO BIO-OIL ENERGY IN NAMIBIA

### 2.1 The Kyoto Protocol & Clean Development Mechanism

The Kyoto Protocol, through the Clean Development Mechanism (CDM), aims to reduce emissions of greenhouse gases which are implicated in global warming, and to remove carbon from the atmosphere. Namibia is a signatory to the Kyoto Protocol.

The production of renewable fuel sources can play a role in achieving these aims. Projects that remove carbon from the atmosphere can qualify for carbon credits – subject to strictly audited procedures. Carbon credits can be sold on the international market and can contribute significantly to the income stream for a project that is producing biofuels.

One of the key conditions for such a project to qualify for carbon credits is that the land to be used must have been cleared before 31 December 1990.

Under the CDM the window of opportunity for a project to obtain carbon credits exists until 2012. Thereafter the United Nations CDM programme will re assess the effectiveness of this mechanism. An extension may be considered but it cannot be relied on at this stage.

The Kyoto Protocol requires that certain structures be set up within the Government of a project's home country before a project can be awarded carbon credits. For example, the required Designated National Authority (DNA) will be established within the Ministry of Environment & Tourism in Namibia.

## 2.2 The (Namibian) National Bio-Oil Energy Roadmap

The Namibian Agronomic Board commissioned a study of the potential for a bio-oil energy production in Namibia. This study established that *Jatropha curcas* is the most suitable crop for a bio-fuel industry in Namibia (NAB, 2006). It is suited to the growing conditions in Kavango. At least 63,000 hectares would be needed to make a bio-diesel industry viable here.

The report also considered a number of important issues, including appropriate technology, the potential use of communal land, the advantages of bio-diesel, and a potential market in Namibia of some 22.7 million litres / year. It also considered risks to the bio-fuel industry and the potential for this alien plant to become invasive.

Some differences of approach between the Roadmap and the proposal by Prime Investment are evident with regard to the relative difficulty and desirability of qualifying for carbon credits through primary production, the appropriate scale of operations, and various models for primary production of *Jatropha* seed.

## 3 THE PROJECT PROPOSAL

The plantations will be grown on the Kalahari sands which cover most of the study area. Floodplains, omuramba (ephemeral drainages), and seasonally inundated grasslands are not suitable for this tree, which requires well-drained soils.

The tree, *Jatropha curcas* originates from South and Central America, but it has been grown for centuries in India and Africa. A little has been grown in northern Kavango for some 40 years around homesteads. It is also cultivated in Botswana. The plant is extremely hardy and resists most plant pests and diseases. Literature sources vary widely in the yields of seed that have been claimed elsewhere. Yields have not been accurately established for Kavango.

The proposed project activities are: -

- Identify lands cleared prior to 1990 in detail. Prime Investments aims at 70,000 – 130,000 hectares. However, inspection of satellite images by Mendelsohn & el Obeid (2007) indicates that only some 65,000 ha was cleared before 1990.
- Register lands and leaseholds with the Ministry of Lands and Resettlement.
- Establish five nurseries, one in each community area, starting in 2007.
- Establish a fleet of tractors and drivers.
- Establish plantations from 2007 to 2009.
- Construct storage facilities for the seed.
- Construct a factory near Rundu to extract the oil and produce seed cake.
- Construct a factory (probably at Walvis Bay) to manufacture bio-diesel and by-products.

**The Holding Company**, Prime Investment, will establish three companies as follows.

**The Farming Company** will be responsible for the production of seed. Prime Investment will pay all the costs of establishing the plantations. The farmers will use their own land and labour to plant and tend the plantations. Each farmer will be assisted to register a long lease with the Ministry of Lands and Resettlement to ensure greater security of tenure. All participating farmers will be members of the elected Kavango *Jatropha* Farmers Association (KJFA), which will represent them.

Prime Investment will hold 60% of the shares in this company, while the farmers through the KJFA will hold 40%. Participating farmers will receive dividends from the Farming Company as well as the income from the sale of their seed. Each farmer will receive a subsidy until the value of his/her sales exceeds the value of the subsidy. The value of carbon credits received by the project will be retained by Prime Investment and used to recoup their investment. Then in 2014, the full value of the carbon credits earned will be paid over to the Farming Company. Individual farmers will benefit from this through their shareholding in the Farming Company.

After 2014 the shareholding will change. Prime Investment will relinquish its share in the Farming Company, while the KJFA will hold 100%. Thus the farmers will effectively own the Farming Company and receive dividends in accordance with their shareholding.

Of the 24,000 rural families in Kavango, an estimated 8,000 to 13,000 families could participate in growing the trees. Participation will be entirely voluntary, subject to a farmer having rights to land that was cleared before 1990.

**The Industrial Company** will own the factories that extract the oil and manufacture biodiesel, seed cake and other by-products. Initially, Prime Investment will hold 60% of the shares, while the KJFA will hold 40%.

After 2014, the shareholding will change. Prime Investment will retain 51% of the shares, while the KJFA will hold 49%. Thus the farmers, as members of the KJFA, will continue to receive dividends in the Industrial Company as well as the Farming Company.

**The Tractor Company** will operate some 600 – 800 tractors to transport plants and materials for establishing plantations and the seed to the factory. Prime Investment will provide financial assistance to people who want to purchase and operate tractors. Operators will then charge for the transport they provide. Each owner will be responsible to maintain his/her own tractor, with technical assistance and facilities provided.

#### **4 PUBLIC PARTICIPATION PROGRAMME**

A comprehensive public participation programme was carried out in Namibia to inform the public and to hear any issues and concerns that should be investigated in the EIA. This involved advertisements, seven public / community meetings, minutes, interviews, a public information document and correspondence. Interested and affected parties were registered and a list is contained in an appendix to the EIA. Consultations were also carried out with the authorities and key organisations in Botswana.

The findings of this programme in Namibia and Botswana, together with specialist studies, were used to influence the scope of the EIA study.

A summary of all the issues, concerns and queries was made in the EIA report.

## 5 DESCRIPTION OF THE BIO-PHYSICAL ENVIRONMENT

Details of the project environment are presented, and possible constraints posed by the environment are considered in Section 3 of the EIA.

The climate is suitable but planting may be limited to the rainy season. Rainfall is highly variable, but *Jatropha* can survive with as little as 250mm in a given year, once established. In dry years it will produce less seed. The sandy, low nutrient, well drained Kalahari sand is suitable. Floodplains, omuramba, and seasonally inundated grasslands are not suitable.

Global climate change is predicted to result in increased temperatures and decreased rainfall in the study area. According to some projections, the dunes that are now covered in vegetation could be mobilized by 2040 in Kavango. Climate change will affect all agricultural activities in the future but the timeframes are uncertain.

The plantations will be restricted to fields that were cleared before 1990, a fact that will minimize the impacts on natural vegetation. Nevertheless, some natural regeneration has occurred in fields that have been left abandoned for some years. A specialist botanical study was conducted by Strohbach (2007). Plants that are worthy of conservation can be found in hedgerows and old fields, and some individual large trees are still standing in cultivated lands.

Most of the *Jatropha* plantations will be made on cleared land that was formerly Kalahari woodland. Beyond about 5 – 10 km from the river there are vast expanses of the original Kalahari woodland, which will not be planted to *Jatropha*. Fire is a concern in much of Kavango but the project area is least affected because so much is cleared.

A much smaller portion of the project area was originally riverine woodland – which comprised a narrow strip along the edge of the Okavango River floodplains. Remnants of this forest remain only in small pockets along the river, and larger stretches only in the vicinity of Andara, near Divundu. The remnants of this riverine woodland are of particular conservation concern as they contain various species of conservation importance even on old cleared fields. For this and other ecological reasons, the EIA recommends that a buffer zone 200m wide, measured from the landward edge of the floodplain, should be kept free from *Jatropha curcas*.

A specialist study on the fauna (amphibians, reptiles and mammals) was conducted by Griffin (2007). There is little concern about fauna because of the degree of pre-existing disturbance. Wetland species should be unaffected, provided there is no pollution. Species that live on old cleared lands may experience reduced food supply in *Jatropha* plantations. Any toxins in the soil may affect burrowing species of frogs. One frog species is rare but widespread in Namibia and its population would not be threatened by the project. All faunal species are widespread and their population status would not be affected by the project.

A specialist study on birds was conducted by Brown (2007). Although some bird species will be displaced by plantations, there should be no significant impact on the population status of any species of bird in Namibia. None of Namibia's fourteen endemic bird species occurs in the study area.

It is considered unlikely that any species of fauna or bird would become a pest in the *Jatropha* plantations.

Aquatic habitats and wetlands in the Okavango River are extremely important ecologically, and fish are an important component in the diet of many people. Potential threats to aquatic habitats are fertilizers, insecticides, and any pollution from a factory. Seeds could get into the river and may be toxic to fish if eaten. These impacts must be prevented. The recommended

200m buffer zone will help to minimize these threats, and further controls will need to be considered to prevent pollution in the separate EIA for the factory.

In the areas further from the river, groundwater represents a potential resource for establishing plantations. However, the yields are low and recharge is as unreliable as the rainfall. The Department of Geohydrology discourages the use of groundwater for crop cultivation.

## **6 DESCRIPTION OF THE SOCIO-ECONOMIC ENVIRONMENT**

A detailed socio-economic study was undertaken by Mendelsohn & el Obeid (2007) for this EIA. Various methods used included a review of available literature, statistics from the Namibian Government Bureau of Statistics, recent population and housing censuses and income and expenditure surveys. Fieldwork was undertaken, interviews were conducted and satellite images were analysed.

An estimated 16,000 rural households are found in the 10km strip that comprises the study area. Rapid population growth has placed pressure on the natural resources (soil, wood, fish, and grazing) such that the traditional lifestyle is becoming increasingly unsustainable.

Based on their recent and previous studies in the region, Mendelsohn & el Obeid (2007) made a number of important observations which dispel popular misconceptions about the socio-economic conditions in the area: -

- Kavango households differ widely in overall wealth due to access to cash incomes, available land, livestock holding etc. Notably, those households with access to off-farm incomes also cultivate the most land and keep the most livestock.
- For most households, crop cultivation is unable to provide sufficient food for the household's needs. Most people rely on cash incomes as they are not self-sufficient in food production. Mahangu production may vary in value from N\$300 to N\$1,200 / hectare / year.
- The food production potential of Kavango is still very low. Many of the irrigation schemes are not economically viable.
- Concern has been expressed that cash crops would jeopardize the production of food, and therefore further reduce food self sufficiency. In fact, local people invest very little in agriculture because output is so low and unreliable. They already depend on cash incomes to provide for most of their nutritional needs. The 1994 and 2004 Income and Expenditure Surveys showed that consumption of non-food goods rose from 37% to 63% during that period. These figures (and others) clearly indicate that the economy of rural Kavango is no longer simply a subsistence economy but an emerging cash economy, even though most people are still relatively poor.
- With regard to impacts on food production - of the roughly 65,000 ha cleared lands that are potentially available for the project, approximately 75% is lying fallow or abandoned, with only 25% currently being cultivated. Therefore 75% of the available cleared land could be planted to *Jatropha* without any impact on food production.

## 7 LEGAL & POLICY REQUIREMENTS

Envirolex Namibia (2007) compiled a register of legal and policy requirements with which the project must comply. Compliance with Namibian legislation is necessary not only to meet Namibia's own requirements but also to satisfy the requirements of the Kyoto Protocol.

The Protocol also requires the establishment of certain bodies, e.g. the Designated National Authority, within Government in order to ensure that projects that apply for carbon credits must first comply with the relevant country's laws and policies.

## 8 ASSESSMENT CRITERIA

The potential environmental impacts were assessed in terms of a number of criteria that are internationally recognized in the practice of Environmental Impact Assessments. These are: -

- The *nature* of the impact (how an activity will affect the environment, or be constrained by some aspect of the environment),
- Possible *mitigation* measures to reduce adverse impacts (or enhance positive impacts),
- The geographical *extent* of the impact,
- The *duration* of impact,
- The *intensity* (or magnitude) of the impact,
- The *probability* that the impact may occur,
- The *confidence* that can be placed in the assessment, given the level of information available, and
- The **significance** of the impact **for a decision about the environmental acceptability of the project**. Significance could be either negative or positive (i.e. a beneficial impact. A low significance means that the impact would not influence a decision about the project. A medium significance means that the impact should influence a decision unless that impact can be mitigated to an acceptable level. A high significance would mean that the impact should affect the decision regardless of any mitigation (or where effective mitigation is not possible).

The identified impacts (and constraints) are assessed in detail in Sections 9 & 10 of the EIA report. A short summary of the impacts and significance ratings is provided below – based on the establishment of some 65,000 - 70,000 ha of plantations of *Jatropha curcas*.

## 9 BIO-PHYSICAL IMPACTS

Environmental Impact or Issue	Significance Rating	Possible Mitigation	Further Investigation or Monitoring Recommended
Climatic constraints and risks, mainly due to drought	<b>Low</b> (although yields will be reduced in drought years)	Plan optimum time for planting	Experiment with planting times.
Climate change: higher temperatures and lower rainfall	<b>Low</b> (within a 10-year timeframe) <b>Medium - high</b> within a 30 or 40-year time span	None	Monitor climate. Establish weather stations.

Air pollution from burning Jatropha waste	<b>Low</b>	Avoid burning waste	Monitor and report health issues. Education.
Air pollution from biodiesel is less than from mineral diesel	<b>Low</b> , but beneficial.	Replace mineral diesel with biodiesel as much as possible	-
Risk to plantations by fire	<b>Low</b>	Hoeing and small fire breaks	Monitor plantation maintenance.
Constraints imposed by soils prone to waterlogging	<b>Low</b> (for the project) ( <b>High</b> for the unsuitable, wet soils - floodplains, omuramba and seasonally wet grasslands)	Avoid soils prone to periodic waterlogging	Prevent planting in unsuitable conditions
Impacts on soils	<b>Medium</b> (beneficial)	Encourage use of waste plant material for improving soil	Monitor and assess changes in soil fertility etc.
Potential for enhancement by intercropping	<b>Medium</b> (beneficial)	Encourage intercropping	Experiment with different crops - probably not grains
Management of Jatropha waste	<b>Low</b>	Avoid burning. Encourage mulching.	-
Water abstraction from the Okavango River	<b>Low</b>	Plant during the rainy season. Use 'Terracottem'	None for this project.
Rain water / soil water used by trees	<b>Low</b>	None	None
Impacts of pests on Jatropha	<b>Low</b>	Avoid importing pests in seed.	Monitor plantations for infestation.
Water quality in the Okavango River	No impact from silt. <b>Low</b> significance from fertilisers. <b>Medium</b> for pesticides - reduced to <b>low</b> if effectively mitigated	Manage applications of fertilizers and pesticides carefully. Avoid persistent pesticides. 200m buffer zone.	Periodic water quality monitoring
Impacts on groundwater resources due to abstraction	<b>Low</b> for the project as a whole. <b>Unknown</b> but potentially <b>high</b> in the case of using groundwater	-	Assess sustainable yield for each borehole
Impacts on groundwater quality	<b>Unknown</b>	No persistent pesticides	Groundwater quality monitoring
Impacts on natural vegetation within fields cleared before 1990	<b>Medium</b> , reduced to <b>low</b> if the recommendations are effectively implemented.	200m buffer zone. Leave large trees. Leave hedgerows.	Investigate soil conditions on palm veld.
Potential for invasiveness	<b>Medium</b> significance	Refer to section 9.16	Monitor. Eradicate escapees
Impacts on wild fauna	<b>Low</b> – the areas are already very degraded.	None	Investigate unusual deaths
Potential animal pests	<b>Low</b> – due to the toxicity of Jatropha	None	-
Impacts on wild birds	<b>Low</b> – the areas are already very degraded	None	Investigate unusual deaths
Potential bird pests	<b>Low</b> – due to the toxicity of Jatropha	None	-
Impacts on aquatic fauna, especially fish	<b>Unknown</b>	200m buffer zone. Avoid insecticides.	Test fish with seeds.



Overall the impacts of the project on the bio-physical aspects of the environment are not of major concern. This is due to the fact that the land to be used is already cleared and degraded, with some 75% of the available 65,000 ha having been abandoned for crop cultivation. Key issues requiring management relate to: -

- Potential invasiveness of *Jatropha* (in our opinion it is unlikely to become a threat to biodiversity but opinion is divided),
- Enforcement of a 200m buffer zone from the outside edge of all floodplains and omuramba,
- Safeguarding of wetland and aquatic habitats against any potential pollution.

A few benefits should be optimised – e.g. utilisation of plant waste to improve soil, and experimentation with intercropping in plantations.

## 10 SOCIO-ECONOMIC IMPACTS

Environmental Impact or Issue	Significance Rating	Possible Mitigation	Further Investigation or Monitoring Recommended
Impact on land availability for traditional food crops	<b>Low</b> – food security will increase, though food self sufficiency may decrease.	Use <i>Jatropha</i> waste for composting and fertilising food crops	-
Reduction in labour availability by as much as 27% due to HIV/AIDS	<b>Medium</b> – natural, social and cultural functions continue but are modified.	Education and awareness programme before farmers commit land to <i>Jatropha</i> .	Monitor trends in HIV infection rates to provide early warning of labour shortages
Impact on additional clearing of lands	<b>Low</b> for the proposed project. <b>Medium – high</b> in the case of people outside the constraints of the project, but low if effectively managed by Government.	Conditions in contracts & leases.  Regulation and enforcement by Government.	Strengthen GRN capacity, regulations, and innovative enforcement measures.
Loss of grazing for cattle and goats / impact on livelihood	<b>Low</b> – incomes from <i>Jatropha</i> should more than compensate.	None	-
Economic benefits to Kavango people	<b>High</b> - beneficial	Social programmes to manage a few potential social problems, and to optimise benefits	Ongoing assessment of economic benefits during operations
Risk of farmers losing control of land, or losing money	<b>Low</b> - a farmer will not have to outlay money or offer his land as security	Avoid potentially risky “private” deals with other farmers. Avoid cash loans	Involve traditional authorities and KJFA in confirming rights to land
Potential for increased economic inequalities	<b>Low</b> - inequalities will arise because some people gain wealth while others do not. But nobody would be worse off.	Create preferential non-farming opportunities for those without land.	Promote commerce and secondary industries.
Sustainability issues: Market failure	<b>Low</b> - market failure is very unlikely in the global context	Diversify markets	Monitor trends in the world market

Sustainability issues: Seed production failure	<b>Low – medium.</b> Low probability of crop failure in the short to medium term. (Climate change is likely to increase the risk of crop failure in the long term)	Insuring the crop is proposed.	Maintain detailed, long term production records to establish trends
Sustainability issues: Company failure	<b>Low</b> – The project is a business venture, therefore the company would only invest if they were confident regarding profitability	-	-
Impacts of the no-go option	Negative impact on public perceptions, hopes, aspirations and public morale	-	-
Impacts of project failure after implementation	As above, plus: - Unharvested Jatropha may increase the risk of invasiveness, Likely reduction in income to farmers, and loss of jobs to others	Establish a contingency fund	The onus is on Prime Investment to provide proof of net carbon sequestration
Cultural issues	Wealth generation implies a level of social change, which is already in progress. Communities will have to choose which cultural values they wish to retain		
Impacts of tractors on roads and road safety, ground and water pollution	<b>Low</b> – but mitigation is required	Upgrade gravel to tar roads, Train drivers, Law enforcement, Waste management and recycling of oils	System for reporting bad driving
Impacts on Communal Conservancies, Community Forests and Tourism	No significant impact on conservancies or tourism.  No community forests occur within the study area		
Impacts on human health (toxicity if swallowed)	<b>Low</b> – A few children may get poisoned by the seeds, but medical facilities are available. Fatalities are unlikely if medical treatment is provided promptly	Consider non-toxic varieties. Education in clinics, schools etc. First aid treatment. Dust masks in factory	Ensure good record keeping and reporting in clinics
Impacts on animals and poultry if eaten	<b>Low</b> – but mitigation may be required in the form of fencing with thorn bushes.	Consider non-toxic varieties. Fence off plantations	Record & report any cases of poisoning.
Public perceptions	-	Need for transparency and good information to participants and public	
Impacts Ministries, Regional Council, Traditional Authorities & Rundu Town Council	<b>Medium</b>	Need to develop capacity, commitment and consistency in decision-making	
Monitoring, Enhancement of benefits, Responsibility for negative social impacts	-	Co-operation between Prime Investment & the Authorities	Develop institutional capacity and systems to monitor and control adverse impacts

## 11 FACTORIES

Separate EIAs will be commissioned for the factories at Rundu and Walvis Bay. It is essential that the EIA should feed into the **process of site selection**, as many impacts of industries are best addressed at that stage. The remaining issues need to be dealt with in the design of the process and plant, applying the BATNEEC approach (best available technology not entailing excessive cost).

Several issues were identified for further consideration in the EIAs: -

- Siting the oil extraction factory on already cleared land, preferably away from the river,
- Prevention of soil and water pollution,
- Water resources and water efficiency,
- Air pollution and wind directions,
- Possible power generation, and energy efficiency,
- Transport issues / roads,
- Employment.

## 12 CONCLUSION

The project should perform well in relation to three criteria used in the field of Environmental Economics – efficiency, equity and intergenerational equity (or sustainability).

The project is considered to be **efficient** because it will bring about a net benefit to the Kavango Region of considerable value. It will also benefit Namibia through taxes, foreign exchange savings, and foreign currency earnings.

The project is considered to be **equitable** because it provides good distribution of benefits to local communities, who will control the means of primary production on their own land. The farmers will also have substantial shareholding in the Farming and Industrial Companies and they will benefit from carbon credits. Although some people will be unable to participate in farming because they have no access to land cleared before 1990, nobody should be worse off than they are at present. The project will seek to provide preferential opportunities for those who do not have access to land, for example many people can be tractor operators, employees in nurseries and factories. As the emerging cash economy grows, there will be increased secondary opportunities for commercial development, which will benefit non-participants in the project.

The project also complies with the **intergenerational equity criterion** to a high degree as successful implementation will also benefit future generations.

Certain measures will be required to prevent impacts on natural environments, but provided the recommendations are strictly adhered to any potential degradation of natural resources should be avoidable. Most importantly, controls will be needed with regard to: -

- Strict enforcement of a 200m buffer zone between floodplains and plantations,
- Preventions of clearing of new lands,
- Prevention of pollution in any form,
- Containment of any invasive potential.

Recommendations have also been made in relation to institutional capacity needs within the authorities in order to ensure effective control of potential secondary impacts of the project that will be outside of the developer's control.

The proposed project needs to be seen in the context of pre-existing impacts on the environment. The land to be used is already highly degraded. Population growth in the study area has put considerable pressure on the natural resources, such that traditional lifestyles are no longer sustainable. A shift from a subsistence economy to a cash economy has already begun although most people are still relatively poor. A successful biofuel project would bring substantial economic benefits, which would be well distributed to communities. These benefits should outweigh any negative environmental impacts.

Management of some adverse impacts, both bio-physical and socio-economic will nevertheless require both commitment and co-operation between Prime Investment and Government, with funding by the Company and Government in some cases.