JATROPHA VILLAGE POWER IN GARALO MALI
A NEW DIMENSION FOR PEOPLE, PLANET AND PROFIT ACTIONS

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ABSTRACT: The project is to setup and run an integrated village electricity production and distribution system that is fuelled with bio-oil from Jatropha plantations around the village, on designated land. The systems also include the seed to oil conversion press and filtration installations. The installed capacity of the electric power system is 300 KW and this serves 400 connections of which most are village household connections. Productive uses are a crucial aspect of the project, with local small enterprises and community services included, such as metal workshops, carpenters workshops, boutiques, cold stores, restaurants, school lighting, health post lighting etc. This means the electricity available will not just provide high quality residential services, but will stimulate the local economy. It will also put more disposable income in the pockets of the local people who will grow and sell the Jatropha seed for the project, increasing purchasing power of the families in and around the village. In total 10.000 people are expected to benefit from this system. In this paper an analysis will be given on the project, why it has been funded and is being considered a template for many similar projects. The project has started in September 2006 and the installation will be completed at the beginning of summer 2007. A long period of preparation was necessary to obtain sufficient financial means. Fortunately, these were found. This project can be seen as a first step of this Dutch Foundation to a large scale, decentralised electrification of Mali.
Keywords: developing countries, biofuels, electricity production.

1 THE PROJECT DESCRIPTION

1.1 Background/problem definition

Mali is among the poorest countries in the world, with 65% of its land area desert or semi desert and with a highly unequal distribution of income. Mali is land locked with low opportunities for export.

Figure 1: Start of project in Garalo (Mali), September 2006

In Mali 99 % of the rural population lacks energy services. A sound economic basis, respecting the environment, is the only way rural people can escape from the poverty cycle. For this to happen energy is needed, as energy can increase productivity and generate added value to the agricultural produce, and thereby increase income.

1.2 Justification

There is a strong demand from the villagers for electricity as it can drive water pumps for irrigation, agricultural processing equipment, cool vegetables, lighting and refrigeration for small shops and restaurants etc.

Village power using diesel generator mini-grids is the least cost option for most villages. The supply of diesel fuel however is not always easy to get, and since Mali imports diesel it is costly. In general the electricity costs of diesel systems are dominated by the direct fuel costs!

Jatropha is well known in Mali as it is used for protective hedges and erosion control lines. As the source for oil, it has preference, because Jatropha:

- grows well on marginal soils
- requires modest inputs (no irrigation, little labor)
- does not compete with local food production
- has a soil restoring effect and is already used in erosion control and for hedging.
- press cake can be used as an organic fertilizer
- oil can be used to replace diesel in engines

This use of Jatropha oil as a fuel for diesel engines, without the need to be converted to bio-diesel (which has higher process energy), is what makes it so strategically important for countries in Africa. Generator sets are commercially available with built-on conversion equipment, ready to run on bio-oil. Use of Jatropha for rural electrification can:

- be a sustainable solution to the local people's electricity generation needs
- make people independent of fossil fuels
- help generate income by allowing cheaper electricity production
- generate additional income for farmers and women's groups through the production of Jatropha seeds

In the first years it allows the use of intercropping with other (oil producing) crops. It is also used for traditional soap making by women.

On the micro economic scale money spent on fuel stays in the villages to stimulate the local economy and

provide sustainable livelihoods and on the macro economic scale it reduces imports of increasingly expensive fossil fuels. Thus it is also good for Mali as a nation as it saves hard earned foreign currency needs.

1.3 Policy relevance

In Mali, with the advocacy and lobbying work of the MFC, awareness amongst policy makers in the government is raised on the opportunity of use of Jatropha in Rural Electrification. Since the government has already given rural electrification with diesel systems priority, it is now time to seize the opportunity for Jatropha and other oil plant species. The project fits well to existing policy documents such as the Strategic Document for Poverty Reduction and the National Renewable Energy Strategy.

1.4 The project objectives

The aims is to reduce poverty of the village population and improve in greening the planet by concretely setting up and operating village electricity with Jatropha fuelled generator systems for 10.000 people in the Commune of Garalo, Mali [1].

Geographic target area of project is concentrating production of oil plants, pressing and electricity generation and consumption in one single area. The village chosen for the project is Garalo, the municipal capital of Garalo Commune.

Expected main results of the project are:

- 10 000 people benefit from clean electricity services supplied by viable village electricity service company including 300 kW generating capacity & 400 connections; electricity plan for next 5 years extension developed;
- 1000 ha village plantations of Jatropha and other oil producing plants are established, covering the village electricity needs for production of technical quality Jatropha oil (composing pressing, sedimentation and filtration equipment) and all levels of people trained to carry out the dedicated tasks and functions in the system;
- Environmental benefits with CO2 emission reductions of 9 000 tonne/annum (135 000 over the project life of 15 years) and protection of soil against erosion to combat deforestation & desertification.

1.5 Target groups

The target groups or beneficiaries of the project are multiple: farmers, small entrepreneurs, social services like schools and hospitals, all benefit from the electricity. Garalo is a crossroads and hence has a lively high street with many small businesses including wood and metal workshops, providing services to people in the village and those passing through. The population is engaged mainly in agriculture (mostly millet, sorghum and rice, as well as cotton for income generation), raising cattle, and fishing. There are approximately 100 enterprises, small businesses & shops in the village, as well as local government buildings, schools and clinics,

The population of the village is well organised, with dynamic local leadership. The population support the project, as do the authorities (the local municipality mayor and his staff) and all parties have expressed commitment to the project and their readiness and willingness to pay for electricity if available.

2 RISKS ASSESSMENT

2.1 Introduction

A profound risk assessment was taken on as one of the preconditions of financing of the project. Hereunder the insights on risks are summarized on 3 levels.

2.2 Project level

For the project to be viable, the political climate in Mali must be supportive. Considering the high level of International interest, the Government of Mali's promotion of biofuel and the importance of the project as a concrete example of Jatropha for rural development and electricity supply, even if AMADER(Malian Agency for Rural Electrification) does not fund the project, it is expected that other resources could be identified and mobilised by MFC & FACT.

2.3 Project objective level

The project objective is to reduce poverty of the village population and improve in greening the planet by concretely setting up and operating village electricity with Jatropha fuelled generator systems for 10.000 people in 30 villages in the Commune of Garalo, Mali.
The assumptions at objective level are that for the project to be viable, it is essential that Jatropha oil can be produced at a lower cost than the diesel price. However, significant reductions in petroleum product prices are extremely unlikely. No economic forecasters are currently predicting price drops, in fact there is a consensus that with continued instability and insecurity in fossil fuel producing zones, prices are only likely to increase, thus increasing the advantage of the project.

2.4 Project output level

Main result 1: *10.000 people benefit from electricity services supplied by viable village electricity service company including 300 kW generating capacity & 400 connections; electricity plan for next 5 years extension developed*

Assumptions at main result 1 level are that successful supply of electricity in Garalo will be a stimulus to the economy of Garalo village itself by facilitating many income generating activities which would otherwise be impossible, and will also improve conditions for the many people passing through and doing business there. Therefore the figure of 10 000 beneficiaries is a realistic target, which should be attainable by the project.

Main result 2: *1000 ha village plantations of Jatropha and other oil producing plants are established, covering the village electricity needs for production of technical quality Jatropha oil (composing pressing, sedimentation and filtration equipment) and all levels of people trained to carry out the dedicated tasks and functions in the system*

Assumption/s at main result 2 level are that there is a small risk associated with the Jatropha plantation that there may be climatic conditions which effect the development of the young plants e.g. severe drought. However, this risk will be mitigated by the experience of MFC in Mali of planting Jatropha as well as capitalising on international experience via FACT Foundation.

Concerning the availability of land for the plantation, Garalo is a large municipality, and has a lot of unused and marginal land area. The municipality and the village have agreed to provide MFC with 10 000 ha for plantation of Jatropha for use in productive activities.

Main result 3: *Environmental benefits with CO2 emission reductions of 9000 tonne/annum (135.000 over the project life of 15 years) and protection of soil against erosion to combat deforestation & desertification*

Assumption/s at main result 3 level are that Jatropha has proven capacity to protect soils and to mitigate CO2 emissions. Therefore the assumption involved in this main result is essentially the same as that for main result 2, i.e. that the plantations will be successful, and will last for a significant period (in any case average lifetime of a Jatropha plant is around 40-50 years, much longer than the length of the project).

3 CURRENT UPDATE

3.1 Equipment/material

By the middle of March the Generator sets (3 x 100 kW capacity) will have been produced and shipped to the Netherlands to be adapted and completed to a system that only needs to be connected with the grid. In the Netherlands the system will also be tested. In May the systems will be installed by the supplier in the power house (currently under construction) and connected to the grid, which is currently being installed.

Figure 2: 100kW genset of type to be installed in Garalo.

The large scale nursery with the production of 400.000 plants is being established. 125.000 plants are already there.

Figure 3: Jatropha seedlings at the project nursery

Figure 4: Water pump to provide water for nursery

Figure 5: Water trough in nursery

Additionally to figure 4 and 5; water is used only for the nursery, not for general irrigation of the Jatropha fields. A test field for some new plant R&D will be made with small separate funding. In this new accessions or varieties (eg. CABO VERDE, Ghana Valley view Ghana, Brazil-Torres) will be planted.

The storage, presses and filtering and generator set buildings have been designed and construction will start soon.

ACCESS has a 15 year concession to provide electricity to Garalo, granted by AMADER. A village Jatropha cooperative (Bagani) has been established and this cooperative will manage the business of the Jatropha nursery, planting and production of seed for pressing.

3.2 Innovations

The project although recently started has already led to innovations or new thinking. We can highlight a number of examples:

- Marine generator technology
- Large scale nursery and seed selection and propagation
- Capacity building at various levels to have local competence in all aspects (Jatropha technology transfer)
- Real grassroots participation of the target population in the cooperative and through Jatropha seed production on their land (which provides economic benefits), with support from the municipal authorities

3.3 Marine generator technology for bio-oil village power in Garalo, Mali

In its efforts to find reliable, tested and affordable equipment for village power for Mali, FACT and MFC Nyetaa (Mali-Folkecenter) have come across a technology that is expected to do the job. It is based on simple, well established and well tested, marine diesel generator technology.

Since the funding of the MFC Garalo village Jatropha based village power, MFC Nyetaa and FACT have been searching the market for a 300 kW generator system that can run on straight vegetable oil from the Jatropha plantations in the Garalo village, Mali. MFC Nyetaa and FACT have been familiar with the conversion of smaller units (3 to 60 kW), but now the issue was on bigger units: 3 of 100 kW each. Various companies in Germany, France and Denmark and some other countries were requested to make an offer by the MFC. Offers included one and dual tank systems using standard diesel engines of well-known brands. However, costs of these sets were much higher than anticipated, based on the extrapolation of smaller engines unit costs. Also in quite some offers guarantee conditions were not favourable, making us doubt if the suppliers had real trust in their equipment sturdiness over time.

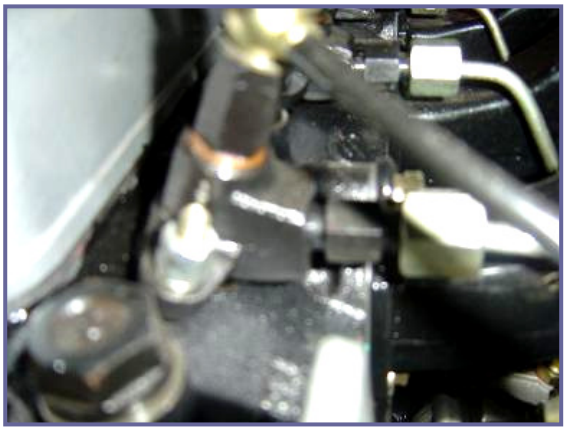

Figure 6: Injectors of biofuelled generator engine

So, finally we resorted to a supplier in the Netherlands who had supplied FACT smaller diesel engines for demonstration purpose. The company manager, who has a long experience operating ship engines and generator sets, took on the challenge to offer a complete turnkey solution for Garalo.

With his background in marine generator sets and understanding the characteristics of vegetable oils, he concluded that the marine generators would be the most sturdy and proven technology for the purpose of village power. Reasons for this are that marine generators:

- can use all type of more heavy oils like fuel oil: they are easily adapted to a specific oil type using different injectors. As such this is standard practise for such engines.
- Have a long lifetime (much higher than that of transport purpose diesel sets) as they work day and night on the ship.
- are robust as breakdowns on the sea have big consequences.
- have a high level of certification as required by insurance companies, if they are to provide insurance of the engines to run at sea

In short, the conditions to be met for isolated operation in a village are quite similar to those of a ship. So the message is that marine generator sets with their sturdy technology might provide affordable solutions.

The offer of this supplier appears to be attractive and is based on a marine Deutz Stamford generator set and comes with a good package of guarantees and financing.

3.5 Large nursery and seed selection

While Jatropha in Mali used to be planted as stakes for erosion control or for field hedges, the MFC has already done testing with direct seeding for more than 2 years now. The results of this were promising, but large variation in yield amongst plants resulted, leading to, in effect, a loss of effective acreage. In order to prevent this from happening in the future plantations, seeds are now selected on weight and size, and germination rate. Next also new accessions and varieties are tested next to the nursery in Garalo. Also the propagation with stakes is being improved. Only from good mother plants stakes are taken. A mother tree garden will also be established so to be a basis for new planting material.

3.6 Social Organisation

A key point for success is that the village power is well embedded in the social structure of the village. The Garalo village already counts with a good functioning water supply system which is run in a sustainable way, both technically and administratively. The payments for the service are collected and cover the operational expenses. The project will build on this background and apply training similarly.

3.7 Jatropha Planting Cooperative

New is also the establishment of a plantation cooperative which will deal with the planting inputs (nursery, seedlings, manure, fertilizer, tools). Planting of Jatrpoha is both done by the community and by the farmers individually. MFC is providing all the training needs

3.8 Village Power Cooperative

Important for sustainability is the ownership issue and the operational responsibility of the system. In the Garalo project the ownership of the system is in hands of the Village power cooperative. This cooperative however assigns the operation and maintenance of the system to a private operator, named ACCESS. The contractual arrangements between the owner and ACCESS are being discussed.

3.9 Training activities and replicability

All the training material by the MFC is also put on paper and other information carriers, such as photo's and video's. This will further the replicability as for new villages all the steps taken by the project are well documented.

4. THE ANALYSIS

The project description was using a PPP like format of the DOEN Foundation. After approval and funding by SHGW, in a later stage also fulfilled DOEN's criteria.

The project was also submitted to AMADER World Bank Funding passing by the modern donor funding and

energy and poverty criteria. It thus was scrutinized by that organisation as well, and found support.

First, the project was submitted to a private funder SHGW with a modern donor agency background based on entrepreneurship, which approved the project and took the first action. Which made the others follow.

We have wondered why donors liked this project over two other projects and found the following points:

1 Simplicity of design: the project activities and technology can be easily explained to the funders the project;
2 Good social and economic (poverty alleviation) effects expected from the project;
3 Concentrated on one location in the chain of sub products like planting bio oil plants, pressing and electricity;
4 No dependency on external factors (buyers outside of the community, or sellers of inputs);
5 Good relation no beneficiaries per unit of investment; cheapest, but reliable alternative in energy supply;
6 Good implementing organisation with background in the topic;
7 Business approach (last P) where the outputs of the farmers are sold to the press and generate some profit, and the electricity sold to the farmers and villagers again (this could also stimulate the local economy as money does not leave the community but can circle around);
8 Replication potential of the project;
9 Stakeholders wish for the project that is well documented;
10 Risk limitation and mitigation
11 Coherence in training, demonstration and dissemination (documentation)
12 Profitability in each sub product (last P)

The funders gave the following evaluation of the project (10 is excellent, 0 is nothing)

Table I: Criteria and evaluation of project by funders.

Positive features	**SHGW**	**DOEN**
Importance of these criteria in general for projects in DC's (0 to 10)		
Simplicity of design: the project activities and technology can be easily explained to the funders the project;	6	8
Good social and economic (poverty alleviation) effects expected from the project;	9	9
Concentrated on one location in the chain of sub products like planting bio oil plants, pressing and electricity;	7	10
No dependency on external factors (buyers outside of the community, or sellers of inputs);	6	9
Good relation no beneficiaries per unit of investment; cheapest, but reliable alternative in energy supply;	9	6
Good implementing organisation with background in the topic;	10	7
Business approach (last P)	8	9
Replication potential of the project;	10	10
Stakeholders wish for the project that is well documented;	7	8
Risk limitation and mitigation	6	7
Coherence in training, demonstration and dissemination (documentation)	10	8
Profitability in each sub product (last P)	7	9

5. CONCLUSIONS

The conclusions of this paper are that this type of project is fitting both the funders criteria which include the Agenda 21 and PPP criteria as well as the energy and poverty criteria of the World Bank. The project is liked very much by both Doen and SHGW for its replication potential.

Apart from that one funder finds the concentration on one location where beneficiaries directly benefit from a system managed by the community, a strong point. DOEN likes the track-record of the organisations involved and values the coherence in training dissemination of this project highly. We also can note differences between the both funders.

Apart from this conclusion on why such a project is found attractive we think that with the implementation of this demonstration project a number of innovations already have come across. It shows again the old wisdom that only by practising, you acquire the knowledge and insight to improve on it!

References

[1] FACT Foundation and Mali Folke Center, Proposal: Jatropha fuelled Rural Electrification of the Commune of Garalo, (2006)