

Plan of Operations:

Developing a modification kit for Chinese diesel engines in Mozambique

This workpackage is part of the **FACT pilot project: Jatropha Oil for Local Development in Mozambique**

Budget labeled as **Tech Team** in Workplan 2008

Last modification: 29 May 2008

1 General

Introduction

As explained in the Workplan 2008, section 4: *Challenges and adjustments proposed*:
"From the first survey of diesel engines in Quirimbas park, it followed that a variety of engines are being used. After finalizing the full survey, it will be investigated whether a standardized modification kit for diesels can be found (or developed) in 2008. This would include a period of test trials, before existing diesels will be modified (which is now planned for in 2009). This test and research component for identifying or developing a kit was not foreseen for in the original workplan and budget."

Detailed adjustment in Annex II:

Act. 2: Local Market development

Adjustment: To investigate if a general applicable modification kit for diesels can be made available or developed. This investigation was not planned for in the original workplan. From the preliminary survey of diesel engines in Quirimbas park (by Arrakis) , it followed that a variety of engines is being used. Once the full survey has been finalized, it will be investigated whether a standardized modification kit for diesels can be found (or developed) in 2008.

This step must have been completed before existing diesels can be modified. The modification, which was planned for 2008, and thus has to be postponed to 2009.

Activities planned: To define a work package for this activity in cooperation with GAIA and subcontract it to experts.

Budget planned: amount reserved: € 16000. If testing will be needed, GAIA is willing to contribute approx. € 5000,-.

Sources of funding:

- (1) from uncommitted amount (2007);
- (2) € 7000 from Act 2: Market development;
- (3) € 9000 from Act 5 Develop large proposals.

Consequences for original budget:

The budget for activity 5 will be reduced by € 9000 (equivalent to 26%).

This is compensated for by extra contributions of GAIA in writing of large proposals.

1.2 Target:

To develop a simple modification kit to modify the DI Chinese diesel engines of various makes as used in region Bilibiza in the JatroMoz project.

The diesels should be able, after modification, to run trouble free on PPO of sufficient quality from Jatropha, for long periods of time, without having to do major cleaning or maintenance, such as cleaning of injectors or pistons etc.

The kit should be simple enough to be applied by engine-amateur technicians like me, with basic tools.

In addition, attention should be paid to controlling the exhaust emissions, since these diesels are often operated by people nearby, e.g. with maize milling.

1.3 Period: 2008

1.4 Available budget: Euro 16,000. (as part of the JatroMoz project, in approved workplan 2008)

1.5 Plan of approach:

To assign a development team: potential candidates (based on experience):
Ger Groeneveld; Niels Ansoe, Sander de Waal.

They will get the task to develop the modification kit.

Secondly one of the diesels (or one newly bought diesel) needs to be modified with the kit and tested for at least 500 hrs, running on PPO.

Potential candidates to do this:

1. Ger Groeneveld, in NL, but also the other two could be asked if they could do that.
2. Prof Naveen Kumar at Delhi College of Engineering, who has built up a testing unit and is testing a Kirloskar diesel at present for GAIA-Movement.
3. Brendon Evans in Chimoio Mozambique, who is a Caterpillar technician as well and is pressing cotton oil.
4. Students at Tue, at the engine department of prof. de Goede

Selection of the candidate will be on experience and price.

Any modification needed after or during the duration tests need to be designed by the team, and the test should be repeated, until satisfactory results have been obtained.

2 Detailing

2.1 Re: the DI Chinese diesel engines of various makes as used in region Bilibiza in the JatroMoz project

Diesel surveys

- Execute a survey on existing diesels, being used in the project area, that could be modified to run on Jatro PPO. Diesels with the grain millers and schools and private people at the villages near the FC's
- A preliminary survey has been done by JdJ Nov 2007, Quisanga + Bilibiza (4 engines).. See ANNEX I: Report: Diesels observed, etc.
- Survey of the remaining 10 diesels to be finished by ADPP Bilibiza team before end April 2008 using a sheet developed by Niels Anso, adapted and translated by Christian Fenger.
- Survey of diesels in the new provinces, Itoculo, Macuse Niassa, by ADPP, before?

2.2 Investigate required modifications.

- Literature survey on endurance tests (longer than 500 hrs) done with comparable diesels as in the project, with good quality PPO and minor modifications, e.g. alone the heating up of the oil to reduce the viscosity. Subcontracted 0.5 days to Thijs Adriaans of Ingenia. Report in Dutch.

2.3 Developing modification kit

- Developing simplest, low cost, but reliable diesel modification sets, that are most uniformly applicable, together with experts. Subcontracted to PPO Groeneveld dd 24 May, letter JJ05008, amount ca € 4900,-
- Perform long term test runs of modified diesels with these sets at a suitable place. Jan asks quotations. (also testing in Honduras as part of Gota Verde project maybe?) Negotiations going on with Brendon Evans in Chimoio (29 May)

2.4 Re: PPO of sufficient quality from Jatropha,

Oil quality, handling and storage

- Control of PPO quality (taking the rapeseed standard RK2000) and set up of improvements of quality if necessary (taken 2 kg of Moz. Seeds of Litamande, to press in Holland, and to send sample oil to labs in Germany to test on properties)
- To ask properties of Guatemalan and Tanzanian seeds (see Note on Oil Quality)
- Set up of simplest possible sedimentation and filtering system of the oil, to remove particles, and water as well. Study existing systems used with Diligent Tanzania (earliest April 2008 installed) and in Honduras, delivered by Ger Groeneveld.
- Set up of PPO storage and handling system (to be done by the project leader of the Training Center, who should be a good technician as well.
- Trials with other oils if available, such as coconut and cotton in Itoculo.

2.5 Re: maintenance requirements, such as cleaning of injectors or pistons etc.

Need to be specified during project

2.6 Re: mounting requirements of the kit and basic tools and skills of technicians..

Need to be specified during project

2.7 Re: Duration tests

500 hours duration test programme with Lister DI diesel on PPO.

According to Gert Groeneveld the Fei Dong type of diesels as observed in Bilibiza and Quisanga are copies of the English Petter. He thinks it is quite well possible to run them on 100% PPO with only having the oil at the proper viscosity.

When the surrounding temperature is 20 -23 degrees, it even has not to be heated up.

He has himself various old types of diesels running for longer time on PPO. Amongst them one Lister which has run 350 hours on PPO of old used oil, 50 to 60 hrs on self made bio-diesel for which he has a small plant developed, and only 8 hrs on pyrolysis oil (very bad for the engine). I have asked him a quotation for completing the long term run to 500 hours.

Since that costed only EURO 800, (he did not include his manhours) I have given him the order to do the test.

2.8 Re: Exhaust emissions

2.9 Re: modifications already made by: Ger/Naveen/Manfred

The presently running Lister STD3 with Ger Groeneveld has been modified already;

The system has been modified to operate without electricity available (even no battery) as follows:

- A second tank and a three way hand operated valve, were installed.
- An extra fuel filter, water separator with looking glass; mounted before mechanical suction fuel pump.
- The existing heat exchanger is replaced by a small Stainless Steel one, which is directly mounted to the exhaust manifold. This new SS heat exchanger does not require a fuel pump to pump the oil through it. (the existing one did)
- Removed the existing, electrically driven, pump;
- Mounted an auxiliary pump, suitable for pumping of fuels to a temp. of 80 degrees C.
- Fuel pressure maximally 0.2 bar, suitable for engines up to 60 HP.

The Kirloskar running at DCE with prof Naveen Kumar for the second duration test has been modified with a heating coil around the exhaust to lower the viscosity.

Christain has obtained funding from GVEP for follow up Jatropha project in Zambia and has ordered Kumar to execute second test (Not part of this project budget)

The diesels running on Pongam oil (partly) were modified by Manfred Lehnert (in Auroville India) with a number of measures: pre-heating, changing of injector nozzles, changing ignition time setting, etc. See paper: Production and use of plant oil as a substitute for fossil fuel, Auroville project 2001-2004, Manfred Lehnert.

2.10 Re: Availability of oil/ NL/Mozambique/India/Denmark

In NL there is PPO from Sun flower or Rape seed available

In India Pongam oil and probably also Jatropha oil can be bought.

In Denmark also rapeseed oil can be obtained.

Seeds available for PPO production in Mozambique

Of the first Jatropha planted at end of rainy season in Febr 2007, not much can be expected yet on seed output after the next rainy season, say March 008. Even when seeds are produced the following the third rainy season (March 009) most likely seeds will be bought up by large commercial companies for plantations for a too high price for pressing into PPO.

The resulting price will probably be higher than the existing diesel price of about 1 dollar. (In January 2008 Diligent Tanzania is selling its seeds for \$ 5/kg)

It was foreseen in the pogramme that other seeds might be found , such as cotton seed or copra from coconuts. In Macua there are coconuts, but it needs to be investigated if there is more supply than presently sold for consumption.

Near Itoculo, a company is starting up to press oil from cottonseed. It needs to be investigated if seeds could be bought there or the oil and for what quantities and price.

If oil can be bought, eg in Itoculo from Cottonseed, a press is not urgently needed yet, can come later in the year.

Brendon Evans in Chimoio is pressing cottonseed, which could be obtained from him.