



COMPETENCE PLATFORM ON ENERGY CROPS AND AGROFORESTRY SYSTEMS FOR ARID AND SEMI-ARID ECOSYSTEMS IN AFRICA (COMPETE)

COUNTRY STATUS ON ENERGY CROPS AND AGROFORESTRY IN ARID AND SEMI-ARID AREAS

(CASE OF TANZANIA)

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PRESENTATION OUTLINE



- Introduction
- Tanzania- Location
- Tanzania -Selected Indicators
- Energy Status
- Ecological Zones of Tanzania
- Arid and Semi-arid Areas (ASA) of Tanzania
- Livelihood in Arid and Semi-Arid Areas
- Agriculture situation
- Potential Energy Crops
- Modern Biofuel Development Efforts
- Agro-forestry situation
- Forms of Agro-forestry in ASA
- Case of MFP (potential bio-fuel powered) Project at Engaruka Juu Village in semi-arid area.

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INTRODUCTION

Map of Tanzania

- This presentation provides brief overview of country status on energy crops and agro-forestry in Arid and Semi-arid Areas (ASA) of Tanzania.
- The country has total land area of 93.8 million hectares (Mha). Potential area for rain fed crop production is 55.2 (Mha) of which 10.8Mha are in use for crop production, the rest, 44.4 Mha are available for crop production.



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TANZANIA-LOCATION

- **Location:** Between 1° and 12°S and 30° and 41°E between three great lakes - Victoria (north), Tanganyika (west) and Nyasa (south west) in the Western Rift Valley and the Indian Ocean (east) in East Africa.
- **Altitude:** Between the summit of Mount Kilimanjaro 5,950 m. above sea level and the floor of Lake Tanganyika 358 m. below sea level.



Mt Kilimanjaro (5,950 m above sea level)



Lake Tanganyika-Gombe Shore (358 m below sea level)

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TANZANIA-SELECTED INDICATORS

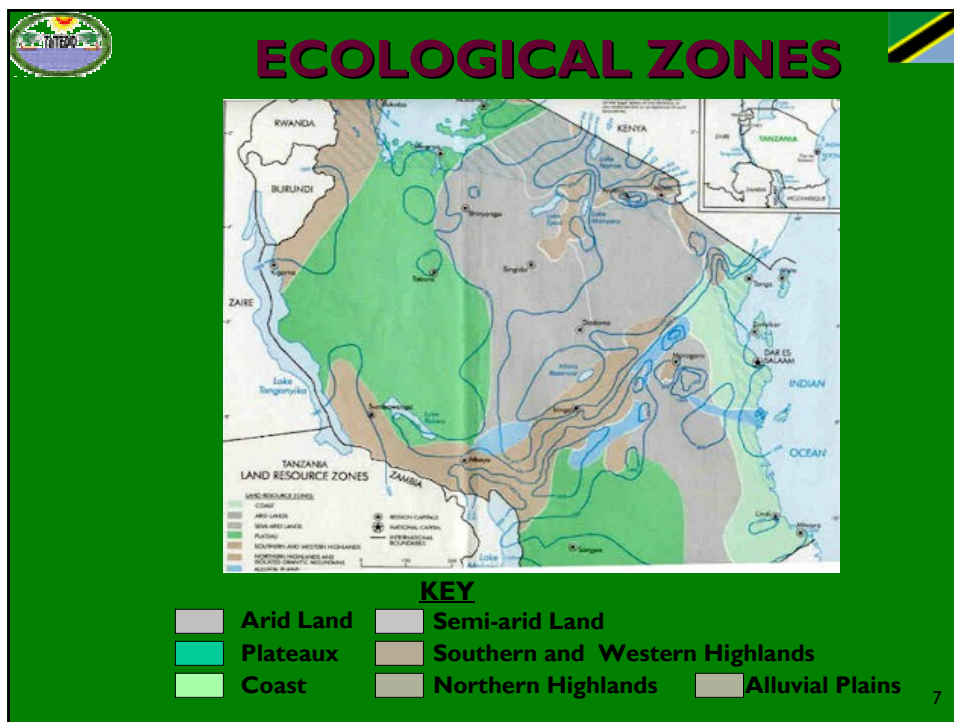
- **Country Size:** Covers an area of about 945,087 sq. km.
- **Population:** Estimated at 34.6 million (with annual growth rate of about 2.1%). About 70% of the total population lives in rural areas.
- **Economy:** GDP (2005) amounted to USD 10.5 billion. Economy depends on agriculture, Minerals and tourism.
- **Economic growth** is around 6.8% (2006) picked up from sales and retail trade, substantial industrial investment and an increase in minerals, led by gold and tourism.
- **Industries:** Mostly for processing of agricultural products and production of light consumer goods.

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ENERGY STATUS

- Rich in Energy resources (biomass, coal, hydro, natural gas, solar etc.) but its population has low access to modern energy services.
- Energy consumption pattern, 90 percent from solid biofuels (charcoal and firewood), 8 percent from petroleum products, 1 percent electricity and others 1 percent.
- Characterized by low per capita consumption of modern energy
- Low electricity consumption, annual per capita 100 kWh.
- 80 percent of energy is consumed in rural areas.
- Solid biofuels consumption is on the increase in absolute terms.

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ECOLOGICAL ZONES (SEVEN ZONES)				
Zones	Sub- Zone and Area	Altitude	Rainfall (mm/yr)	
I.COAST	North Tanga (except Lushoto) Coast and Dar es Salaam South: Eastern Lindi and Mtwara,	Under 300m	North bimodal 750 – 1200mm South: bimodal, 800 – 1200mm	
II. ARID	North: Serengeti, Ngorongoro Parks, part of Maasai land Maasai Steppe Tarangire Park, Mkomazi Reserve, Pangani and Eastern Dodoma	North 1300 – 1800 South: 500 – 1500m	North: Unimodal, unreliable, 500 – 600m South: unimodal and unreliable, 400 – 600mm	
III. SEMI ARID LANDS	Central Dodoma, Singida, N. Iringa, some of Arusha, Shinyanga South-western: Morogoro (except Kilombero & Wami Basins and Uluguru Mts.) Also Lindi and Mtwara	Central: 1000 – 1500m Southern: 200 – 600m	Central: Unimodal and unreliable 500-800mm Southern: unimodal, 600 – 800mm	
IV. PLATEUX	Western: Tabora, Rukwa (North and Centre), Mbeya North), Kigoma, part of Mara. Southern: Ruvuma and Southern Morogoro.	800 – 1500m	Western: unimodal, 800- 100 mm Southern: Unimodal, very reliable, 900 – 1300mm	
V. SOUTHERN & WESTERN HIGHLANDS	Southern: Abroad ridge from N. Morogoro to N. Lake Nyasa, covering part of Iringa, Mbeya South-western: Ufipa plateau in Sumbawanga. Western: Along the shore of L. Tanganyika in Kigoma and Kagera	Southern: 1200 – 1500m South-western: 1400 – 2300m Western: 1000 – 1800m	Southern: unimodal, reliable, local rain shadows, 800 – 1400mm South-western: Unimodal reliable 800 – 1000mm Western: Bimodal 1000 – 2000-mm	
VI. NOTHERN HIGHLANDS	Northern: foot of Mt. Kilimanjaro and Mt. Meru, Eastern Rift to L. Eyasi. Granitic Mts: Uluguru Mts in Morogoro, Pare Mts in Kilimanjaro, and Usambara Mts. In Tanga, Tarime highlands in Mara.	Northern: 1000 – 2500m Granitics 1000 – 2000	Northern: Bimodal, varies widely: 1000 – 2000 mm Granitic Mts. Bimodal and very reliable 1000 – 2000mm	
VII. ALLUVIAL PLAINS	K – Kilombero (Morogoro) R – Rufiji (Coast) U – Usungu (Mbeya) W – Wami (Morogoro).		K – Unimodal very reliable 900 – 1300 R – Unimodal, often inadequate 800 – 1200mm U – Unimodal, 500 – 800 W – Unimodal 600 – 1800mm	



THE ARID AND SEMI-ARID AREAS (ASA) OF TANZANIA

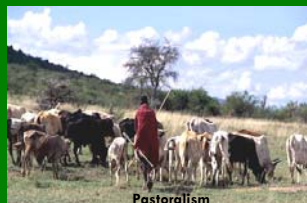
- ASA with mean annual rainfall of between 200-800mm covers between 50% to 75% of the country
- ASA have mean monthly temperature of above 18°C and one rainy season (rarely two rainy seasons).
- Although the mean annual rainfall ranges from 400 to 800 mm, lack of water is a major constraint and much of the ASA are prone to drought.
- Rich in wild animal and plant biodiversity;



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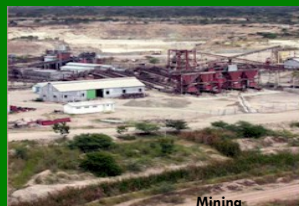
THE ASA CTN...



Pastoralism



Tourism



Mining

- Some ASA areas have beautiful natural sceneries such as rift valley, seasonal rivers, national parks, etc
- ASA are potential for wild life i.e, animals and fruits, mining mostly gold and diamond.
- Poverty, malnutrition, poor access to modern energy, water and health services are some of the major problems facing communities in ASA.

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LIVELIHOOD IN ASA



- Major occupation for people in the ASA includes agriculture, pastoralism and agro pastoralism.
- Also engage in diverse and multiple livelihoods strategies, such as hunting, agricultural intensification, diversification and migration.
- Well off households with irrigation means engage in intensification and high value crops production.
- However, most are involved in subsistence cropping, working as laborers, migrate to seek employment in other areas including urban.

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LIVELIHOODS IN ASA.....



- ASA are associated not only with low and erratic rainfall, but also with poor soils and degraded environments.
- Large tracts of these areas have minimal infrastructural development, impeding people's access to markets, health and educational facilities, safe water and modern energy etc.
- Livelihood coping strategies to unusual shocks in ASA production system include piece-work, petty business, changes in diet, fewer meals, loans from traders, and selling cattle.

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Institutions working in the ASA



Following are selected institutions with activities in ASA. Some Government, private and NGOs institutions are working in these areas, they include among others, the following:

- Natural Forest Resources and Agro-forestry Centre (NAFRAC) (Formally HASHI)
- Hifadhi Ardhi Dodoma (HADO)
- Miradi ya Gesi ya Samadi Dodoma (MIGESEDO)
- Participatory Irrigation Development Project (PIDP)
- Matumizi Bora ya Mali Asili Ididi na Pawaga (MBOMIPA)
- Dodoma Environmental Network (DONET)
- INADES - Formation Tanzania (IFTz)
- Dodoma Beekeepers' Cooperative Society Ltd. (DOBEC)
- Tanzania Traditional Energy Development and Environment Organisation (TaTEDO).

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AGRICULTURE SITUATION



- Agriculture is the main contributor to the economy and accounts for about 46 percent of the GDP.
- Agriculture provides about 40% of exports, and employs about 80% of the work force.
- Agriculture is dominated by smallholder farmers cultivating farm size of between 0.9 and 3.0 hectares.
- About 70 percent of Tanzania's crop area is cultivated by hand, 20 percent by ox plough and 10 percent by tractor.
- The main crops cultivated include coffee, tea, cotton, sisal, tobacco, wheat, maize, rice, beans, and cashew.
- Four classes of vegetative crops in ASA (raw materials) can be used as energy crops
 - Oil seed crops, i.e Jatropha, palm oil
 - Starch crops such as grains, maize and tubers like cassava,
 - Sugar plants such as sugarcane, sweet sorghum, etc,
 - Cellulose plants (agriculture and forest residues)

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POTENTIAL ENERGY CROPS



Oil Seed Crops

- Oilseeds plants (crops) include both industrial (castor seeds) and edible oilseeds (sunflowers, groundnuts, cashew-nut, sesame, cottonseeds, palm seed and soya beans).
- Of oil producing tree species, some have been evaluated and found that *Jatropha curcus* and *Pongamia pinnata* are suitable for biofuel.



Jatropha Plant- a potential source of biodiesel

- Jatropha curcus* found to be the most suitable for biodiesel production.
- Jatropha* is drought resistant plant and can be grown in marginal ASA lands, farmers' field boundaries, fallow lands on farmers' holdings as agro forestry along with agricultural crops, public lands along tracks, highways, etc.

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Oil-Producing plants found in Tanzania which could be source of biofuel



Crop	Production 2000 tons/year	% Oil content	Favourable climatic conditions	Regions grown
Coconut	370	65		Tanga, Coast,
Cottonseeds	210	18	Tropics, Sub-tropics and Temperate climates.	Tabora, Mwanza, Shinyanga, Mara, Kagera, Tanga, Morogoro, Singida, Lake zone
Groundnuts		45 - 55	Tropics, Sub-tropics and Temperate climates.	Dodoma,
Palm oil	60	43 - 51	Tropics & Sub-tropics.	Tanga, Dar es salaam, coast.
Sunflower seeds		25 - >85	Tropics, Sub-tropics & Temperate climates.	
Copra		45 - 75	Costal hot temperature	Coastal areas.
Kapok		25	At the Coast and along coastal areas.	Korogwe, Mombasa, Tanga, Coast, Morogoro & Shinyanga
Cashew nuts	123	46 - 47		Lindi, Mtwara, Ruvuma, Dar es salaam, Tanga & Coast
Jatropha	18-58	33 - 60	Tropical & Sub-tropical climates.	Arusha, Bukoba.
Castor bean (<i>Ricinus communis</i>)		20 - 50	Preferring Humus-rich & disturbed ground, (its drought resistant)	Widely spread all over Tanzania.
Pigeon wood (<i>T. Guineensis</i>)			Higher rainfall areas, 0-200m.	Found in riverine forest or forest margins.
Cape mahogany (<i>T. Roka</i>)		55 - 65	Well-drained, rich soils & high ground water areas.	Bukoba, Mwanza, Mbeya & Kilimanjaro.
Margosa seeds (<i>Azadirachta indica</i>)		20 - 45	Pan-tropical in semi-arid & arid regions (withstanding drought). Very dry areas, & poor soils, 1-1,500m.	
African fan palm (<i>Borassus aethiopum</i>)			Less dry areas of tropical Africa. In Tanzania- along the coast and along water courses.	Coastal Regions.
Pearl/Peach oil (<i>Persia vulgaris</i>)		40 - 50		Kilimanjaro, Arusha,

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Potential ethanol Crops



- Sugar, Cellulose and Starch Crops are potential biofuel (Ethanol) source from some ASA areas under irrigation

- Starch based ethanol production- from different crops such as wheat, rice, maize, potatoes, cassava etc, is possible although would compete with food requirements under current production levels.
- Cellulose biomass based ethanol production- from crop residues such as rice straws, bagasse, etc. (sugar industry and large private rice farms etc)



Sugarcane – a potential source of ethanol

- Sugarcane ethanol production in the country can be processed through sugarcane –sugar route. Ethanol could also be extracted from sugarcane sugar molasses route. The route could be developed by sugar companies: KSC,TPC, NSC and KSC.

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MODERN BIOFUELS DEVELOPMENT EFFORTS



Development Efforts

There exist limited efforts on modern Bio fuels (solid, liquid and gaseous) development in the country due to:

- Low awareness on the potential benefits of modern bio fuels.
- Limited knowledge ,experience and capital to invest in modern bio fuels

However, there are increasing efforts by government, private and NGOs institutions to promote modern biofuels in the country.

- Efforts on, policies, strategies, regulations, research and development on bio fuels are being spearheaded by few institutions.
- Current actors include Govt. Ministries i.e. MEM, MPEE, MAC private sectors KAKUTE Ltd, FELISA, Diligent Ltd, TaTEDO, University of Dar es Salaam, and other stakeholders..

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BIOFUEL DEVELOPMENT EFFORTS...



Policy Issues

- Clear policies, strategies and regulations for modern bio fuels development are still not in place.
- There are no specific targets set for biofuel development and blending in Tanzania.
- A national task force has been formed under the Ministry of Planning and Economic Empowerment to streamline the development of biofuels in Tanzania.
- The Task Force is working on Policies, strategies and regulations for developing modern bio-fuels in Tanzania.



Jatropha in Schools



Sugarcane Farm



Jatropha Farm

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AGRO-FORESTRY SITUATION



- Various agroforestry are practised in Tanzania and have shown encouraging results:
 - Tree planting campaigns have continued from 1960s to-date as part of nation wide reafforestation effort in order to conserve the environment.
 - National initiatives of 1973 introduced agroforestry in the ASA through Hifadhi Ardhi Dodoma(HADO) and Hifadhi Ardhi Shinyanga (HASHI) to control severe land degradation.



Agro-forest farm behind the villagers huts with tree mixed with crops

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AGRO-FORESTRY



- **Tanzania Agricultural Research Program (TARP I & II)** has for years worked in the lake zone to promote agroforestry in the ASA of the western Tanzania.
- **Rangeland management** Implemented as agroforestry approach in the northern and western semi-arid where rangelands are utilized beyond their carrying capacities.
- **Wildlife management:** Apart from community involvement in wildlife management, some projects have introduced improved fuelwood saving stoves to reduce tree demand from the national parks and surrounding villages.

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FORMS OF AGRO-FORESTRY IN THE ASA



- **On-farm Trees** : Farmers in ASA normally grow trees in their farms. Trees grown are for timber, medicines and fruits.
- **Boundary Planting:** Trees (Jatropha) are grown on boundaries in landscapes of the ASA to demarcate farms.
- **Boundary trees** reduce wind speed, water and soil erosion, and improve soil structure and fertility.



On farm trees



Tree seedlings distribution



Energy Crops on the Farm Boundary

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- **Rotational Woodlots:** People in ASA have adopted rotational woodlots. Rotational woodlots have great potential for rehabilitating degraded lands.
- **Improved Fallows:** Soil fertility is a major constraint for agricultural production in the ASA. Trees and herbaceous legume species being promoted in ASA of Tanzania include *Sesbania sesban*, *Gliricidia sepium*, *Acacia angustissima* and *Cajanus cajan*.
- **Ngitiri:** This is traditional fodder banks practised in ASA in Sukumaland for the purpose of provision of fodder, woodfuel, construction materials, and soil restoration.

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CASE OF MFP PROJECT AT ENGARUKA JUU ASA VILLAGE



- Engaruka Juu village is located in ASA. The village was selected in February 2006 for piloting the Multifunctional Platform (MFP) powered by jatropha oil.



- The village is located 60km. from nearest-national electricity grid

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Energy Crops in Engaruka Village

- Main modern energy crop found in the village is Jatropha, in 2005 about 20 tonnes of seeds were harvested.
- Jatropha has been grown in village farms for fencing for more than 30 years.
- Traditional use of Jatropha plant is for hedging, treating fresh wounds and eyes.
- Jatropha seeds are collected and sold to dealers, especially agents working for few emerging biofuel dealers.



Villager showing Jatropha Plant in Engaruka

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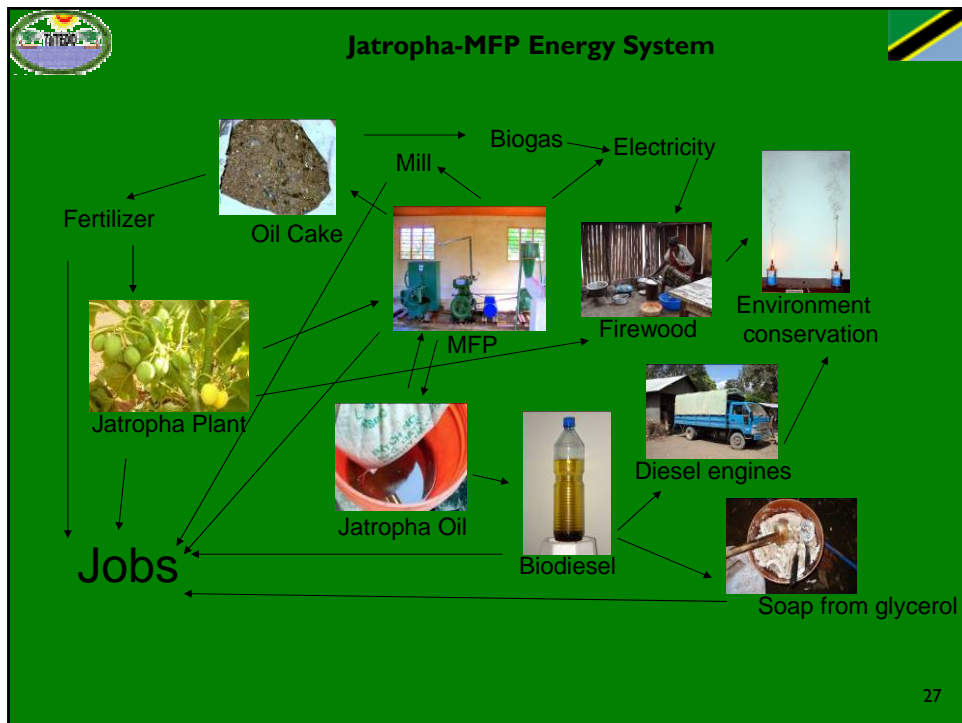
- some women group now manufacture soaps from Jatropha oil,
- There is limited extension services to farmers for cultivation of Jatropha.

MFP PILOT Project (example of modern bio fuel project in ASA)

Project Objectives

- To install two MFPs and associated machineries for oil seed extraction, grain milling, electricity generation and battery charging,
- To bring knowledge and capacity to develop and implement MFPs projects in Tanzania,
- To develop capacity among beneficiaries on the use of MFPs, management and small business development, and
- To demonstrate to policy makers, investors and donors how innovative solutions can provide better energy services and improve rural people's livelihoods

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Participatory Planning with Engaruka Villagers

- TaTEDO conducted PRA and planned with villagers at Engaruka Juu before MFP installation.
- Participatory planning was conducted to ensure that the technology would be technically feasible, socially accepted and economically viable.
- With the Villagers, prepared village modern energy development plan, MFP installation was one of the activities, others were improved stoves, improved baking, trees growing etc.

The image shows a group of villagers, including women and men, sitting in a room, likely participating in a community meeting or planning session. A man in a white shirt is standing and addressing the group.

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THE MFP INSTALLATION IN PROGRESS



TaTEDO and villagers team
Installing MFP Components



Constructing village Mini Grid



Wiring village
house



Testing grain
milling Machine



At last, electricity Light for
the first time in their life!!!

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MFP INSTALLATION OUTCOME

- 27 Houses, 12 Shops, 1 Camp site have access to electricity from the MFP.
- More than 200 People benefited



MFP electricity light at the Camp Site



Electricity in a village Shop

- Potential for many more connections facilitating access to electricity for more than 200 people
- Jatropha oil when available will be the main fuel for powering the MFP engine.

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**THANK YOU FOR
YOUR ATTENTION**

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