CHAPTER 7

ANNEXES

7.1 CASE STUDIES

Case 1 – Mali Jatropha Electrification

Initiative Name	*Small-scale Jatropha plantation for Rural Electrification of Garalo Commune*
Location	*Garalo Commune, capital of Garalo, Mali, West Africa*
Initiation Date and Duration	*1 August 2006 (36 months)*
Funder(s)	*AMADER, MFC, FACT Foundation (Fuels from Agriculture for Communal Technology), Stichting het Groene Woudt (SHGW)*
Project Initiator	*Mali Folkecenter (MFC)*
Overall Budget	*$756 000*
Output	*300 kW (3 units 100 kW) Electrical*
Area of Land	*Potential of 10.000 ha out of which over 600 ha currently cultivated*
Beneficiaries	*More than 300 farmers (326), 247 electricity subscribers currently With a potential for more than 10 000 inhabitants including social services and income generation activities*

Background and Context

Mali is among the poorest countries in the world, and characterised by uneven income distribution. The country is facing a huge energy bill due to rises in world oil prices while at the same time, the main export of the country, cotton, is hindered by subsidies allocated by Northern countries, particularly the USA, to their own cotton farmers. The macro situation is impacting on poor communities who are facing increased energy costs and decreased income due to low cotton prices. A large number of farmers have given up cotton production and, as a result, have no more or very little cash income from agricultural activities.

In Mali, 99 % of the rural population lacks modern energy services such as electricity and LPG. It is becoming increasingly clear that improvement of living conditions of the rural population cannot be based only on service provision from the state and para-statal budget and initiatives. The Garalo project is aimed at addressing these challenges at a community level. If proved successful the pilots will be scaled up given the huge land potential. The population of the commune (administrative sub-division made up of several villages) where the pilot is taking place is approximately 19 800 inhabitants and is composed of different ethnic communities.

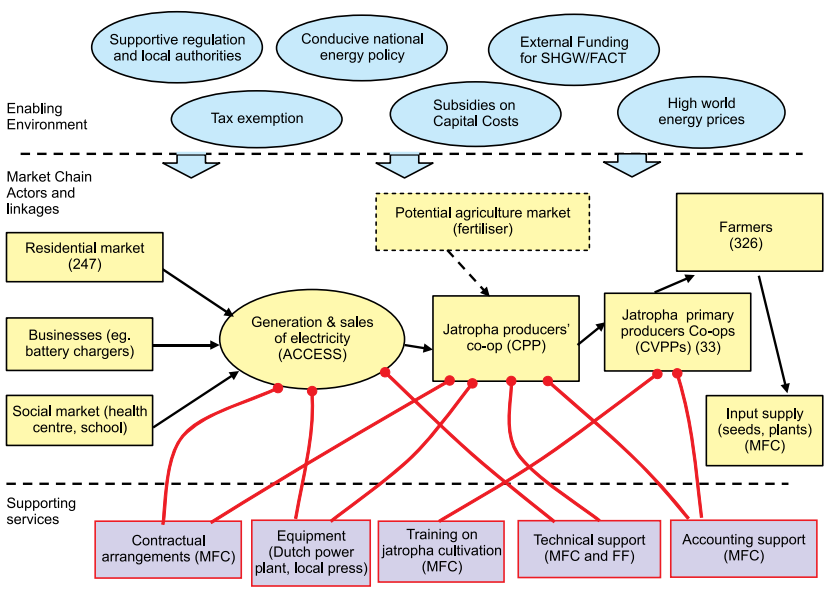
The energy component of the Garalo project has been largely funded by a grant from AMADER- a para-statal company in charge of rural electrification- and an international

non-governmental organisation, the FACT foundation. When the project was initiated, there was little information on the use of biofuel and its impact on engines. There was also a lack of knowledge about engines designed to work only with pure vegetable oil. Despite these constraints the Garalo project gave priority to biofuel development and more specifically to Jatropha, chiefly because this is a model in which village natural resources (land and Jatropha) are processed and used locally, contributing thus to energy security and increasing the added value for local communities.

A series of other key reasons explain the choice of Jatropha development for electricity generation. Mali is the most experienced West African country in this field. With the support of GTZ, Mali carried out several pilot projects during the beginning of the 90s including equipment testing. However world oil prices were relatively low, as a result the cost effectiveness was a key factor in phasing out the energy component of the Jatropha programme. The dramatic increase of oil prices, particularly after 2005, and the biofuels investment world wide by large companies were instrumental in the re-development of Jatropha programmes in Mali which received a strong political support from the government. There are also other factors such as the environmental impact (possibility to use the residues as an organic fertiliser, soil protection, contribution to reducing greenhouse gas emissions etc.), economic impact (less inputs required e.g. fertiliser, water compared with other crops) and the low impact on food security. The inter-cropping model (Jatropha in association with crops for food) which is being largely used contributes to limiting the negative impact on food security.

The Initiative Market Map

With respect to the **Enabling Environment**, the national energy policy strongly supports development of Jatropha for energy end uses. Local Authorities are playing an important role particularly thanks to their power to enact municipal by-laws.



The Jatropha supply chain is being developed by two main institutions: The Garalo Jatropha Producers' Co-operative (CPP) and the power company ACCESS. Jatropha farmers are at the heart of the business model supplying biofuel to the hybrid power plant. The CPP deals at the level of the "commune" with all issues regarding Jatropha seeds, production and sale of pure vegetable oil as well the residues (oil cake) as a fertilizer. In order to operate efficiently in all the villages, farmers, with the support of Local Authorities, have set up Jatropha producers village committees (CVPP) to deal with the key activities at the village level for instance seeds collection and transport to the co-operative. Out of a forecast of 10 000 ha of Jatropha, 600 ha, involving 326 rural families are already under cultivation. Many plantations are on land previously allocated to cotton. Farmers have opted for the inter-cropping production mode to ensure food security at least at the village level. The residues of Jatropha seed processing can be used as a fertilizer. It is also envisaged to make an energy use of the oil cake to produce biogas.

The private power company ACCESS is responsible for generation and electricity sales. ACCESS has a capacity of 300 kW with a distribution network of approximately 13 km with the prospect for an extension of 3 additional kilometres. Currently 247 households are connected to the micro grid after a payment of $30 as a contribution to the connection costs. As for electricity consumption, there are two broad tariffs categories. Subscribers with 50, 150 and 300 W are paying a monthly lump sum for their electricity consumption which is respectively $5, $12 and $24. In addition there is a modest monthly contribution for street lighting which is 0.07 cents, 0.16 cents and 0.30 cents according to the power. Other subscribers with higher power and theoretically higher purchasing power, are billed according to their metered consumption at a tariff of 38 cents/kWh. In addition, they have also to pay fixed charges and higher contribution to street lighting (see appendix). It is worth mentioning that the first 100 kWh are exempted from the VAT payment. The tariff' structure is largely due to AMADER which is providing a large grant (approximately $379 750) and is concerned by the power plant sustainability. Despite these relatively high prices, the recovery of the bills is over 90 % which demonstrates the willingness to pay for modern energy services. Customers who do not settle their bill on time were offered the option to delay the payment till their financial situation improves. Currently ACCESS has been able to recover almost 100 % of the recurrent costs.

In terms of **Supporting Services**, apart from its coordination and mediation function, Mali Folkecenter (MFC) has been supporting the Jatropha committees by setting up nurseries and distributing Jatropha plants through the village committees (CVPP), training etc. This is a crucial technical and financial input to the farmers. For the follow-up and evaluation, FACT foundation is providing its services to MFC. Other supporting services include the hybrid power plant equipment provided by a Dutch company and the locally manufactured press.

Relationships between the actors in the Market Map

To encourage ownership of the Jatropha production system by the rural communities, the social and business model was developed with strong involvement of the local

	Small-scale Farmers	ACESS	AMADER	FACT	SGHW	MFC	CVPP	Co-op (CPP)
Small-scale Farmers:								
ACCESS	**Fair** - commercial, informal							
AMADER	None	**Good** - Financial, formal						
FACT	None	None	None					
SGHW	None	None	None	None				
MFC	**Good** - Technical, informal	**Good** - Subsidiary, formal	**Good** - Financial	**Good** - Financial, technical, formal	**Good** - Financial (subsidy)/ formal			
CVPP	**Good** - formal : information	None	None	None	None	**Good –** informal, information		
Producers' co-op (CPP)	**Good** - commercial, formal	**Good** - commercial, formal	None	None	None	**Good**, financial formal		

authorities. For instance given the competition regarding Jatropha seeds, local authorities have prohibited their sales outside the commune to secure a sustainable supply for the hybrid power plant. Currently the supply at national level is very low compared with demand. A by-law was passed to ensure that local production is entirely devoted to the power plant. Jatropha production village committees were set up in 33 villages including 30 in the commune of Garalo and the three others are in another commune (Sibirila) close to Garalo. A co-operative of producers (CPP) encompassing all the villages has been set up for the purchase, commercialisation and processing of the Jatropha seeds by a co-operative owned press. The co-operative is also responsible for the distribution to its members of the revenues generated by these activities on average twice a year. The agreed current price is currently 9.8 cents per kg which should allow both a reasonable margin for the farmers and a competitive selling price of Jatropha oil. The seeds will be processed by the co-operative and sold to ACCESS. There is not yet an agreed price as oil production is marginal given the time it takes between plantation and seeds production. ACCESS, the power company, is a MFC subsidiary with a commercial status, thus management and procedures (accounting, VAT, etc) are completely different from MFC which has NGO status. MFC and Fact Foundation are providing technical support to the power plant operator ACCESS and to the Jatropha producers' co-operative.

Balance of Rights, Responsibilities and Revenues of Actors

The whole model is based on the land ownership of small-scale farmers and the availability and status of the land. Even if the quantities cultivated remain modest,

	Rights	Responsibilities	Revenues
Small farmers	- Use of land for farming or usufructuary rights in some cases - Sales of Jatropha seeds	- "Caretakers" of the land - Plantation, Jatropha seeds collection and delivery to the co-operative	- Cash from selling Jatropha seeds to CPP - Income from other farm products generated from intercropping system (Peanut, Fonio, etc.)
Jatropha production village committees (CVPP)	- Collect seeds at village level and deliver to the co-operative (CPP)	- Seeds collection storage and delivery to the co-operative in Garalo.	- Income from selling seeds to the Pressing co-operative (CPP)
Co-operative of Jatropha producers (CPP)	- Buy the seeds from the farmers (CVPP)	- Press the seeds and sell the oil to the power company (ACCESS)	- Income from Jatropha oil and potential income from seed cake selling
AMADER (Rural electrification agency)	- Promotion of Rural electrification in Mali	- Ensuring that subsidy is used according to regulation	- Grant from World Bank, other donors and State
ACCESS (Power company)	- Electricity sales	- Electricity production and distribution	- AMADER's subsidy - Electricity sales
Electricity consumer association (ECA)	- Interact with ACCESS and local authorities	- Look after electricity subscribers	- None
MFC	- None	- Project follow-up and quality control	- Grants, project implementation

the Jatropha plantation growth rate is fast both at national level and in this commune. This is mainly due to the prospects raised by some large foreign companies, as well private entrepreneurs, to buy and process the seeds to produce biofuels either for the local market and/or for exports. As a result, there is a significant demand from many farmers to plant Jatropha, collect and process seeds for energy purposes. The main socio-cultural constraint is the status of the farmers and the land. Some have only the right to cultivate (usufructuary or tenants for life) either collectively or individually but they are not fully-fledged owners. As long as the usufructuary only grows non perennial short rotation plantations, the possible conflict between owners and usufructuaries is low because the investment is made on a short-term period. However, the plantation of trees is an investment over several decades. In Mali, according to customary law, it is considered that land planted with trees definitively belongs to the person or community who planted the trees. This explains the opposition of landowners to authorize migrants to plant trees including Jatropha as they may lose their landlord status.

The co-operative (CPP) is responsible for all the technical, commercial and financial issues in the supply chain from the raw material (Jatropha seeds) to processing to obtain biofuel. Currently, co-operative members are benefiting from guaranteed although fixed prices for seed production. In a region with little opportunities for cash generation, this is an important economic and social safety net. In the unlikely event of a sharp fall of oil prices and diesel oil, the farmers might encounter some difficulties to sell their seeds. On

the other hand, an increase of oil prices may give some margin for the co-operative to negotiate higher prices with the power plant's owner.

The other key issue regarding rights is related to independent power producers, such as ACCESS, which now have the right to produce, transport and sell electricity. In order to limit the monopolistic situation of ACCESS, an Electricity Consumer Association (ECA) was set up to look after the rights of the consumers and acts as an interface between the consumers and ACCESS. Although ECA does not have a legal status, it is recognised, de facto, by local authorities and attends the meetings to discuss the tariffs alongside with the key stakeholders, particularly local authorities, AMADER and ACCESS. It is AMADER's responsibility to ensure that the subsidies are being used efficiently and according to the procedures, including tariffs, by the recipients.

Analysis of Livelihoods Outcomes

In terms of human capital, farmers have access to new knowledge regarding the Jatropha supply chain, including the technical aspects of production and commercialisation. Farmers have been trained on how to maintain and harvest their fields and they now have a fair understanding of the whole process from Jatropha growing to electricity services delivered to households, social services and income generating activities. In terms of job creation, this initiative has made it possible for a series of small businesses based on electricity such as repairs of electrical goods and tyres, shops, connection of houses, etc. to emerge.

With respect to **natural capital**, land use is the noticeable and important change. In the Jatropha supply chain, farmers have discovered alternative options to cotton plantations. To some extent this new opportunity increases the value of the land. Furthermore, irrigation is not necessary for Jatropha plantations. There is an initial water demand for the nurseries but the quantities are small.

In villages, **social capital** is an important asset. In Garalo, the whole supply chain is located within the village, which has contributed to strengthening social capital. Setting up a co-operative has allowed farmers to strengthen their relationships under a new formal status which increases their rights to get better income from their main asset (land). The Electricity Consumer Association is a powerful tool regarding the rights and obligations of consumers and also a vehicle to reinforce social relationships. Access to modern energy services has also contributed to increasing social activities (music, dance etc) and security thanks to street lighting.

With regard to **physical capital**, this is one of the few integrated projects dealing with agriculture and energy infrastructure at this scale. As such, the project has made a substantial contribution to the physical capital of the village. Garalo, like more than 90% of the villages in Mali, was not electrified. As a result, social services were of poor quality and there was little prospect of new income generation activities. Electricity is rightly considered by all villagers as an entry point to modernity and a means for a better livelihood. An additional key infrastructure component is the mechanical press and the associated institutions and services to process Jatropha seeds.

Increasing **financial capital** is a key component of this initiative as it allows the generation of new cash flows to rural farmers which dried up with the cotton crisis. The

farmers have now a secure local market and a guaranteed cash income. It has also been noted that new income-generating activities have developed related to electricity usage and a decrease in the selling prices of some basic products in rural areas has occurred. The other indirect financial impact is at the macro level where the substitution of diesel oil with renewable energy generated locally will reduce fossil fuels imports, although with the scale still small as yet, the impact at national level is negligible.

Overall Conclusions

This is a fairly large-scale and complex pilot project and the substantial subsidy by AMADER was therefore crucial to its implementation. The hybrid power plant is designed to run on pure vegetable oil (PVO) and diesel. Successful trials were carried out to test Jatropha oil as a fuel to power the plant. It is envisaged that 5% of PVO will supply the plant in 2009 which will increase rapidly over the next years to reach almost 100% by 2013. So far only 326ha are being planted using inter-cropping out of a target of 10 000ha. However, electricity is already available to villagers and the key conditions (hybrid power plant installed, tariffs structure designed by key stakeholders, support from national and local authorities etc.) seem to be in place for almost total transition to Jatropha oil for electricity generation.

In order to reduce oil dependence and the huge deficit of its balance of trade, the national energy policy in Mali promotes renewables and particularly Jatropha. Such a policy has contributed to securing the subsidy for the power plant. The involvement and commitment of local authorities was an important step towards increasing the economic impact of the project. The NGO MFC also played an important role from initial fundraising till the implementation of the power plant and follow-up work. The MFC leadership in this project and the consultation process with the stakeholders- particularly the farmers- may be considered a good practice model for other similar initiatives. A strategic decision initiated by MFC in consultation with the key stakeholders was that the development of Jatropha should improve the livelihood of the village population and increase the financial capacity of local communities, particularly the farmers. The Jatropha project was therefore conceived to provide cash income to the farmers given that cotton revenues had significantly decreased. The huge interest expressed by farmers who are not already part of the scheme and the national demand for Jatropha oil are good indicators for scaling-up the project.

Case 2 – Senegal Chardust Briquettes

Initiative Name	*Charcoal Dust Collection and household fuel production in Saint Louis, Senegal*
Location	*Saint Louis City, Senegal, West Africa*
Initiation Date and Duration	*April 2007 - end December 2008 (current project). Support by PERACOD for second phase likely*
Funder(s)	*Senegal-Germany Co-operation Programme to promote rural electrification and household energy (PERACOD-GTZ- Ministry of Energy and Mines)*
Project Initiator	*PERACOD and BRADES (Bureau de Recherche Action pour le Développement Solidaire)*
Overall Budget	*US$20 000*
Output	*Charcoal briquettes from charcoal dust for domestic cooking. Current average annual production 20 000 kg and rising*
Key Mechanisms	*Supply contracts to secure charcoal dust collection with charcoal retailers*
Implementor	*BRADES company : Bureau de Recherche / Action pour le Développement Solidaire*
Beneficiaries	*26 charcoal retailers/wholesalers, 14 char-briquettes retailers, Charcoal dust collectors, several thousands households in Saint-Louis*

Background and Context

In Senegal, charcoal and wood consumption are important causes of deforestation. In Saint-Louis, North Senegal, as well as in other large cities, securing energy supply for cooking has become increasingly difficult. This is because the reduction of quotas for biomass energy production, and the diminution of forest areas devoted to it, along with the high cost of transport, high LPG prices and shortages, have coincided with reduced purchasing power of low income people due to rising inflation.

Among the 18 420 households of Saint-Louis, with a population of approximately 160 000 inhabitants (Regional Service of National Forestry Commission of Saint-Louis, 2005), the majority use charcoal as a main fuel with an average daily consumption of two to three kilograms per household. Decades ago the department of forests banned charcoal exploitation in 'at risk' forest areas, which increased the incentive to develop alternative energies. This measure was accompanied with important subsidies allocated to LPG that benefited those on middle and high incomes.

However, an increase in world oil prices has constrained Senegal to gradually phase out the subsidy. The charcoal supply in Saint-Louis is marked by a strong seasonal variation between the dry season (November to April) and the wet season (May to October), caused by difficulties of carbonisation during this latter period.

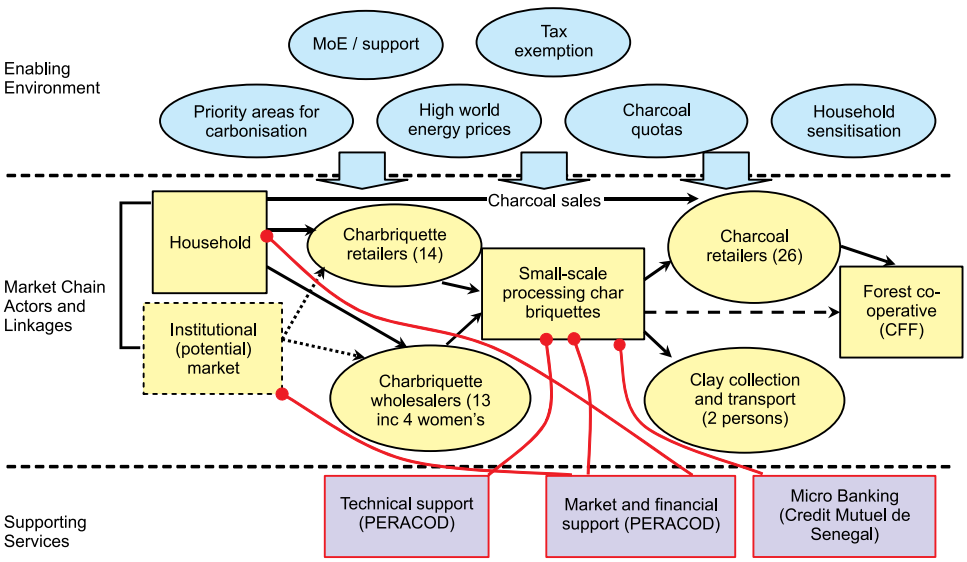
Only the areas of Kolda and Tambacounda, hundreds of kilometres from Saint-Louis city, are authorised to produce charcoal, resulting in increased transportation cost and reduced supply, Saint-Louis has experienced increasing selling prices for charcoal (€ 0.31 per kg in Saint-Louis in 2006 against € 0.38 per kg in 2007).

This situation offers improved prospects for the penetration and scaling up of local renewable alternative solutions, such as recycling low-value charcoal dust. There is a significant potential resource of charcoal residues in the many existing charcoal yards and

storage areas in Saint-Louis. This new fuel could replace approximately 28% of the annual charcoal consumption in the city (PERACOD data).

To expand the range of available cooking fuels, a Public Private Partnership (PPP) was established between the PERACOD programme, the BRADES private Company (Bureau de Recherche/Action pour le Développement Solidaire) and CFF (Co-opérative Forestière du Fleuve). The objective of this partnership is to process bio-residues available in the 'charcoal stockyards' of Saint-Louis into charcoal briquettes (known as char-briquettes). After a feasibility study carried out in 2006 on the potential of charcoal dust, PERACOD supported BRADES Company to install a Production and Marketing unit of char-briquettes in the town of Saint-Louis in November 2007 through the public private partnership (PPP).

The Initiative Market Map



With respect to the **Enabling Environment**, Senegal is a country benefiting from a favourable political and institutional environment regarding the development and implementation of new initiatives aimed at forest protection and greenhouse gas mitigations. Private sector and the civil society (mainly NGOs) usually have good working relationships with central authorities (the Ministry of Energy in this case). PERACOD is, in this case, a partnership between the Ministry of Energy and GTZ.

PERACOD played a leading role in initiating and coordinating the process to involve key stakeholders in the project, in particular the micro-banking system, the Ministry of Energy and the company in charge of developing and managing the project. The department of water and forests have been supporting and following the initiative very closely. Such support gives added credibility to the exploitation and commercialisation of this new household fuel. Unlike other fuels, it is currently, de facto, exempted from taxes.

The **market chain actors** shows the flow of revenues from the final consumers (currently limited to households in Saint-Louis city) via the processors of the raw material suppliers, to the forest co-operatives. In this case the raw materials comprise charcoal dust and clay, used as a binder. However there is also an emerging institutional market, particularly restaurants that are shown with a dashed line. It is worth mentioning that charcoal retailers who are supplying chardust as a raw material to BRADES are also selling charcoal to households and businesses as their main source of income.

With respect to the **Supporting Services**, the funding by the private micro-banking sector (Crédit Mutuel du Sénégal - CMS) as well as PERACOD and regulation incentives provided by the Ministry of Environment were instrumental in starting up the business, run by the family-owned private company BRADES which benefitted from two sources of funding:

- The PERACOD programme: € 15 267 (10 000 000FCFA) (Reinforcement of production capacity and equipment purchase).
- Mutual credit of Senegal (Crédit Mutuel du Senegal CMS): € 3053 (2 000 000FCFA) (furniture and technical equipment purchase and availability of working capital).
- BRADES must pay back monthly instalments to CMS over a two-year period from November 2007.

Relationships between the actors in the Market Map

	MoE (Department for Water and Forests)	BRADES	PERACOD	CMS	Forest co-operatives (CFF)	Char Briquette Retailers/ Wholesalers	Charcoal Retailers
MoE (Department for Water and Forests)							
BRADES	**Good -** Institutional, informal						
PERACOD	**Good -** Institutional, formal	**Good -** Technical, financial, formal					
CMS	None	**Fair -** Financial, formal	**Fair -** Informal/ formal				
Forest co-operatives (CFF)	**Fair -** Regulation (quotas), formal	**Good –** information, formal	None	None			
Char Briquette Retailers / Wholesalers	None	**Good –** commercial, Formal	**Fair -** Information, informal	None	None		
Charcoal retailers	None	Good - Financial, formal	**Fair -** Information, informal	None	**Fair -** commercial, formal	None	

The char-briquetting process was initiated by PERACOD who signed a partnership agreement with BRADES providing the latter with funding for at least 50% of the costs. This agreement was for a total of € 947, equally split between the two partners and designated for equipment (briquetting, drying, tools etc.). In the agreement, BRADES was committed to provide the premises, install the equipment, and commercialise the final

product. In addition, BRADES was to serve as an experimental platform for PERACOD, and share all technical and financial information. This agreement led to the commencement of activities and ensured that the partner had the necessary technical and managerial skills to develop the new business.

The second agreement was in the framework of a Public Private Partnership (PPP), in which PERACOD provided additional funding. BRADES benefited also from a loan from the Mutual Credit Bank of Senegal. The relationships between the forest co-operative (CFF), BRADES and PERACOD were mainly about identifying which charcoal retailers would be supplying the charcoal dust.

The supply of charcoal residues is currently secured through procurement agreements with charcoal retailers. In total 26 contracts were signed over an 8 month period. Two people directly employed by BRADES provide the supply of clay. This is also the case for char-briquette retailers and wholesalers (women's groupings and individuals) who are directly employed by BRADES.

The forest co-operative (CFF) helped in identifying which charcoal retailers would supply the charcoal dust. In Senegal, charcoal is a highly regulated business in which charcoal co-operatives are important stakeholders. In the case of Saint-Louis, charcoal retailers are supplied by the forest co-operative. BRADES is currently considering the possibility of getting its charcoal dust supply directly from the co-operative. Such an option may reduce the costs of collection and, as a result, reduce the price of charcoal dust.

Balance of Rights, Responsibilities and Revenues of Market Actors

	Rights	Responsibilities	Revenues
Ministry of Energy/ Department of Water and Forests	Regulation framework & Fiscal policy (tax exemption in this case), charcoal quotas allocation. Quotas allocation for charcoal making	Ensure that exemption is efficient and properly used.	State budget Taxation on biomass supply chain
BRADES	Collection, and processing of charcoal residues; contract loans	Char-briquette production and commercialisation, loan reimbursement	Income from char-briquette sales
PERACOD	Initiation of charcoal residues project	Follow-up of BRADES charcoal residues project	Grant from Germany and Senegal
Mutual credit of Senegal (CMS)	Credit provider	Monitor credit	Profit margin on credit
Forest river co-operative (CFF)	Wood exploitation and charcoal making	Market supply at reasonable price	Income from charcoal and potential for charcoal residues
Women groupings/ retailers (GIE)	Buy char-briquettes	Sale of Charcoal Briquettes	Income for char-briquettes sales
Charcoal retailers	Business with charcoal and residues	Buy and sell charcoal and residues	Income for charcoal and chardust sales

With respect to **rights**, the Ministry of Energy and Mines is empowered to develop an incentive regulation framework to reach its policy objectives. For instance, quota allocation for charcoal making is the **responsibility** of the Ministry of the Environment. It is the responsibility of the Ministry of Energy to ensure the adequate supply of the market. As a public institution, the revenues of the Ministry of Energy come from the state budget. Wood energy taxation including fines (wood cutting permits, charcoal making, transport) is another source of direct income for the Department of Water and Forests.

Within the biomass supply chain, forest co-operatives have the right to produce charcoal through quotas allocated by the forest administration. However due to the lack of control, production often exceeds the quotas, contributing to deforestation. This may explain, in some instances, the situations leading to conflicts that have arisen between the forest administration and the professional and non-professional actors (e.g. illegal charcoal makers). The forest co-operative revenues are mainly derived from the sale of charcoal to wholesalers, and to a lesser extent to households, small businesses and institutions.

BRADES, retailers (women's groups) and wholesalers are the key beneficiaries of this initiative. As a registered company, it has the right to produce and commercialise char-briquettes. Currently BRADES' main revenues are derived from this commercialisation.

PERACOD and the Ministry of Energy played a key role in marketing the product, particularly its acceptability and affordability (through tax exemption) by the households in Saint-Louis city.

Potential conflicts between charcoal retailers and char-briquettes manufacturers are not excluded although the risk is marginal given the size of charcoal demand. Other potential conflicts of interest might involve blacksmiths who are currently buying small amounts of chardust for their businesses. However, even though we assume a substantial increase in chardust prices, the impact will be low, given the fact that chardust accounts for a small percentage of their running costs.

Regarding the **revenues**, the purchase cost of good quality residues (larger diameters) varies from 6 cents to 9 cents per kg according to the sites and the relationship between supply and demand, which makes an average of approximately 8 cents per kg, plus transport costs. Clay is collected near the premises at the backwater of Khor. The cost of its extraction and transport is approximately 1.5 cents per kg and this is carried out by two people with an average wage of € 3.8 per day.

The final product is packaged using recycled paper before being put on sale. The cost of packaging is roughly two cents per bag and 3.25 cents after accounting for labour costs. Two women are daily employed especially for this task, producing on average 20 bags per person per hr. The company sells char-briquettes to 13 wholesalers, out of which four are women's groups, as well as to 14 retailers. The retail price is 19 cents per kg whereas the wholesale price is 15 cents per kg. This compares with a retail price of 30 to 38 cents per kg for normal charcoal sold in the town, depending on the season. Over a period of eight months (November 2007 to June 2008) about 18 000 kg were produced and approximately 15 000 kg commercialised. This gives a turnover of around € 2 850, based on retail prices

that could be considered as significant in the context of Saint-Louis city, which is marked by a high level of unemployment.

Analysis of Livelihoods Outcomes

Regarding **human capital**, the technology transfer of the rotor press has contributed to increased knowledge in the recycling of previously low-value residues. The involvement of vulnerable people in business activities strengthens their livelihoods. The family company which was created (BRADES) operating in the biomass sector has become a reference for other entrepreneurs.

In developing countries **social capital** is an important asset that allows marginalised people to cope with a harsh economic environment. The establishment of a family company and the involvement and reinforcement of women's groups and retailers are instrumental in strengthening the social capital. The new professional relationships, and trust developed, contribute to strengthening social networks. For instance, women's groups are commercialising the char-briquettes.

With regard to **natural capital**, recycling low value energy residues is contributing to forest protection by decreasing the extraction rate from natural forests which are already under a great deal of pressure. Furthermore, BRADES is allocating 10% of its profits to reforestation programmes carried out in the lower reaches of the Senegal River valley. Charcoal dust recycling is certainly contributing to the cleanliness of the local environment, and impacting on the health of surrounding communities as well as retailers, thereby reducing by the household expenses devoted to health care. However, further investigations are necessary to assess more thoroughly the environmental impact from a health perspective.

Physical capital comprises the basic infrastructure and goods needed to support livelihoods. A more sustainable supply of affordable energy services, thanks to the recycling of charcoal dust, is helping poor people to cope better with meeting their basic energy needs. Furthermore, the penetration of a new technology in this region (the rotor press) is a significant contribution to increasing the efficiency of the charcoal chain, contributing to poverty alleviation and reduction of environmental damage.

With respect to financial capital, there is an increase in income through job creation (8 regular workers currently and 16 in prospect); creation of income-generating activities for the char-briquettes retailers (14 employed in total) and increase in revenues for charcoal retailers.

Overall Conclusions

At this stage, this pilot is very promising, with sales of 15 000kg between November '07 and June '08 with a significant monthly growth, (from less than 500kg in November '07, to 2 000kg in June '08). A crucial test in the coming years will be the extent to which the initiative scales up, and whether it continues to enhance the livelihoods of poor people, and the environment as it has done so far. The key lessons and conclusions that emerge are as follows.

The support of the local authorities (informal authorisation to collect and transport charcoal residues) as well PERACOD and micro financing (Mutual Credit of Senegal) were crucial in the development and sustainability of this initiative.

Although this is still a small business, the jobs generated (management, collection, processing, commercialisation) contribute a great deal to improving livelihoods, creating additional value and income opportunities from a previously unused resource.

Results of acceptability tests of charcoal briquettes carried out for households and businesses (restaurants, dyers etc) show that there is good acceptability and a potential market for these briquettes. This has been reflected in the growth of char-briquettes production. Improvements can be made regarding ash removal and, to a lesser extent, smoke emissions. This is an area which must be considered in scaling-up strategies.

BRADES is not yet a completely autonomous company because the market is not yet well established, and there is still PERACOD's technical support, which is currently being phased out. Nevertheless, the development of a Public Private Partnership between BRADES and PERACOD is a sound step towards the technical and financial self-sufficiency of this company and the emergence of new similar companies.

Development of the market will certainly lead to a price increase of charcoal dust, which is the main raw material for the briquettes. Such an evolution needs to be anticipated by increasing productivity and by the utilisation of very low value wastes such as charcoal dust fines that are currently barely used. Indeed, currently only thick charcoal residues are being processed. Blacksmiths already use this category of residues, although given their volumes, there is not yet competition between the two market segments. The utilisation of very low value residues (fines) will increase the overall efficiency of the whole supply chain.

The involvement of the Ministry of Energy and PERACOD will remain, over the short term, crucial to promote this initiative, particularly the marketing component and access to financial capital for new investments. Experiences in other countries shows that substantial market gain for a product needs to be accompanied by a well-targeted marketing campaign that is often beyond the financial means of the producers. However once this has been achieved, cases have proved that business viability can continue long after the government support ends.

Case 3 – Senegal Typha Charcoal

Initiative Name	*Transforming pest invasive species (Typha Australis) into marketable charcoal in Senegal*
Location	*Saint Louis Region, Senegal, West Africa*
Initiation Date and Duration	*2003 until end December 2008 (first phase). Support for second phase very likely.*
Funder(s)	*PERACOD: Programme to Promote Rural Electrification and Household Energy Supply*
Project Initiator	*PERACOD, PREDAS (Regional Programme to Promote Household and Alternative Energy in the Sahel), Tiabakh rural community*
Overall Budget	*US$ 1 950*
Output	*Typha briquette: daily output of 1 carbonisation unit = 120 kg, recorded production from 18 May 08 to 23 June 08 = 1 315.5 kg*
Area of Land	*Estimated green biomass potential 120 to 150 tonnes/ha* *GIS estimate for 40km = 7 000 ha and 3 million tonnes of green biomass*
Beneficiaries	*Young people producers' groupings of four people of Thiabakh rural community, approximately 200 women involved in promotion.*

Background and Context

Wood and charcoal account for 60% of the energy supply of Senegal and nearly 85% of household energy consumption. In July 2002, PREDAS organised a workshop to share the results of the "Study on the Development of Typha for Energy Usage". A key outcome of the workshop was the possibility to transform Typha Australis, a fast growing invasive river reed species, into briquettes for household cooking after agglomeration and carbonisation (agglo-briquetting). Unless the plant is uprooted, the re growth rate is extremely high.

Throughout the delta and along the shallow stretches of the Senegal River, millions of tons of Typha biomass could be harvested every year. A 2003 satellite estimate over 40 km from the Diama dam on the Senegal river shows that there is a potential of 3 millions tons which can generate 519 000 tonnes of dry biomass. There is currently a sharp deficit in biomass supply in Saint Louis region which is supplied from Kolda and Tambacounda forests. These two zones are authorised to produce charcoal, however they are located respectively 785 km and 609 km away from St Louis city. As a result of the increased transportation cost and reduced supply, St Louis has been experiencing increasing selling prices of charcoal (€0.31 per kg in 2006 increased to €0.38 per kg in 2007).

In October 2003, following the very encouraging preliminary tests carried out in Mali on production and use of Typha briquettes, PERACOD decided to set up a pilot unit. In January 2005, a joint mission of PREDAS and PERACOD experts in Mali, confirmed the reliability of the technology as well as the quality of the final product.

Between the end of 2004 and the end of 2006, the Saint-Louis office developed a carbonisation "Pilot Unit" in Ross Béthio in the premises of SAED (Delta Management and Exploitation Company).

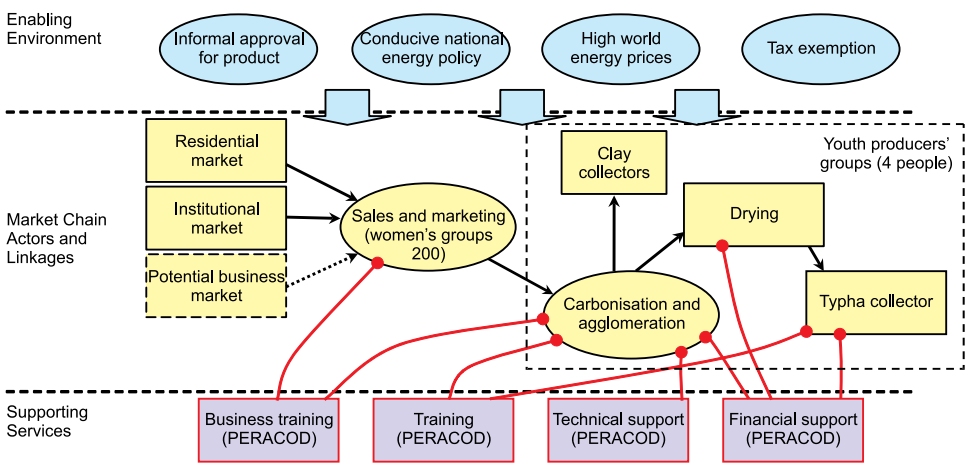
Tests were carried out based on the carbonisation technology known as "Three drums", as well as a compacting process for briquette manufacturing known as "Press Rotor" technology. The results of the technical and acceptability tests among households, confirmed

the relevance of the PERACOD strategy regarding the utilisation of low value biomass residues (Typha, rice husks, cotton stems, millet etc.) to produce quality household fuels.

The site of this initiative was selected on the basis of environmental, economic and social criteria, in particular: (i) the growth of Typha and its density must be of sufficient quantity to ensure the cost-effectiveness of the business, (ii) the site must be close to a city to facilitate the Typha marketing and commercialisation (lower transport costs). On this basis, the project was set up in the village of Thiabakh, 12 km away from the Richard Toll commune (administrative division). Access to Richard Toll is facilitated by tracks maintained by the Sugar Company of Senegal which operates in this area. Due to the absence of housing, the producer's grouping installed their own premises using Typha which is also a good building material.

With respect to the **Enabling Environment**, Senegal benefits from a favourable political and institutional environment regarding the development and implementation of new initiatives aimed at forest protection and greenhouse gas mitigations. For instance, Senegal was one of the first African countries to set up an Agency to deal with rural electrification and prioritise renewable energy. Local authorities have welcomed the Typha australis initiative and actively participated in the product launch. Furthermore, the president of the rural "commune" (administrative division) and the village representative (customary authority) have legally approved the business developed by the producers' grouping of Tiabakh rural community.

The Initiative Market Map



With respect to the **Market Chain Actors**, the producer's grouping on one hand and commercialisation by women's groups on the other hand are the two key players. The producers' grouping is formed by four young people from the Tiabakh rural community. The grouping is in charge of the whole process from Typha collection, drying, and processing using the rotor press technology to obtain the final product.

Typha is manually harvested using sickles. On average the yield is 250kg per person per hour which is approximately 1 500 kg of fresh Typha per day based on 6 hours per day. Harvesting is a very demanding job. This is the reason for which from a situation where initially there were three local producers' groupings, there is only one still currently involved. Currently the company in charge of the management of the delta (SAED) has contracted a large company (Fougerolles) to clear the irrigation canals. The possibility of using this Typha was considered by the project. However it appeared that this option would not be worthwhile, as the Typha would have been uprooted and accompanied with mud which makes the operation complex and more time consuming than current practice. In Mali, where a similar project is being carried out, mechanisation is being considered (harvesters' boat); however the investment is high. Such an option could be introduced for production on a much larger scale.

Because it is cheaper to transport the final product to the consumer rather than the unprocessed Typha, the agglobriquetting unit has been installed near the site. On average, it takes 5 to 10 days to dry the Typha. The daily production of a plant equipped with 4 carbonisation kilns and 2 agglomeration units (rotor press technology) is 120 kg of briquettes allowing the creation of 4 jobs for a total investment of approximately US$ 1300 including small equipment (tools etc.) and the drying area. Commercialisation is carried out through a women's grouping. About 200 women are involved in selling and/or promoting the Typha charcoal.

The project benefited from subsidised **Supporting Services**. PERACOD provided 90% of the total investment and the youth grouping the remaining 10%. Two types of trainings were provided. The business training over a 4-day period was provided by a financial institution FEPRODES. PERACOD provided the technical training involving all the steps of the production chain (collection, drying, processing).

Relationships between Market Actors

	Youth producers' grouping	Women's groupings	PERACOD	Local authorities	Ministry of Energy
Youth producers' grouping					
Women's grouping	**Good** – commercial, formal				
PERACOD	**Good** – financial, technical, formal	**Good** – information, informal			
Local authorities	**Good –** legal, formal	None	**Good** - Informal		
Ministry of Energy	**Good** – information, informal	None	**Good** - information, informal	**Good** - information, informal	

The producers' grouping is the key player and as such it is at the centre of all the relationships. Local authorities and the representative of the village have formally recognised the producers' grouping and its activity which provides all the facilities to operate in this area.

To ensure efficient marketing and commercialisation of the product, a protocol was set up between the producer's grouping of Thiabakh rural community and the women grouping Federation of Thiabakh which involves 625 women. Such a large number of women provide a good basis for the sales. In West Africa women are in charge of cooking and also buying or collecting household fuels. Depending on the season, two to three women are in charge of this activity however the profits benefit the whole federation of women.

The relationships between PERACOD and the producer's grouping are regulated by contractual arrangements such as partnership protocols. According to the protocol, the equipment and the final product (Typha briquette) belong to the producers as long as they comply with the terms of the agreement. Initially, protocols were signed with three groupings based around Richard Toll which is the main town. The partnership between PERACOD and the producers' grouping is primarily focused on the technical (e.g. training) logistic as well financial and institutional support (investment subsidy, relationships with local authorities and Ministry of Energy etc.). For instance, there is no regulation regarding the development of *Typha Australis*. PERACOD has been providing its support for a better visibility of the producers and to facilitate their activities within the area. As an example, the National Forestry Commission inspection of Saint Louis is informed of all the activities carried out by the producers' grouping and is closely following the project.

Balance of Rights, Responsibilities and Revenues of Market Actors

	Rights	Responsibilities	Revenues
Youth producers' grouping	- Typha harvesting (informal right)	- Production of Typha briquettes - Compliance with protocols	- Cash from selling Typha briquettes
Womens' marketing groupings	- None	- Commercialisation of Typha briquettes	- Income from selling Typha briquettes
PERACOD	- To promote household energy alternatives	- Follow up of protocol with producers and project monitoring	- Grant from Germany and Senegal
Local authorities	- Enact by laws, recognition of the producer's groupings	- None	- State budget
Ministry of Energy	- Regulation framework	- Adequate supply of the energy market	- State budget

The business is based on harvesting and processing *Typha australis* which is currently a free natural resource. In terms of **Rights** the younth producers' grouping of Tiabakh community are benefiting from their informal right to collect and transform this resource. Given its huge potential and its nuisance, it is very likely that it will remain free for the coming years, if not decades. This assumption means that despite the hardship, there seem to be good prospects to make a livelihood out of this business.

Local authorities have many rights in their geographical zone particularly with the decentralisation laws which have given more power to local authorities. Local authorities have legally endorsed this project by a formal recognition of the producers' grouping.

In terms of **Responsibilities**, it is the responsibility of the grouping to supply an alternative household product and that of the women's groupings to deal with commercialisation.

Regarding the **Revenues**, given the constraints during the wet season (difficulties drying Typha and briquettes), the optimal production period is limited to 8 months. Over this period, 23 tonnes of Typha briquettes can be produced which gives an annual turnover of approximately US$ 4 500 based on selling price of 19.4 cents per kg. Recent records show that over a 3 month period (23 March to 23 June 2008) 2 300 kg were sold at a selling price of 19.4 cents per kg which gives a total income of US$ 544 which may provide a reasonable profit given the fact that the main raw material is completely free of charge. However detailed calculations are needed to work out more precisely the profit margin generated by this business.

Typha charcoal is sold by the producers to the women's groupings at 19.4 cents/kg and the selling price to the final consumers is 24.3 cents/kg. Two to three women are fully involved in commercialisation and 200 women in promoting the charcoal Typha. Compared with char-briquettes, the wholesale and retail prices are the same in order to avoid any market distortions. Assuming the whole production is commercialised by women's groupings, according to the production records between 23rd March and 23rd June 2008, the sales were 2800 kg which gives a maximum profit of US$ 140. Given the potential market, the profit may increase dramatically in the near future. Furthermore this income for women grouping is quite important as it is re-invested into social and income generating activities.

Analysis of Livelihoods Outcomes

In terms of **human capital**, producer's groupings are having access to new knowledge regarding the Typha supply chain. This includes harvesting the natural resource, carbonisation and briquetting. Furthermore training was provided on management and business issues. The business is very labour intensive particularly for Typha harvesting. In the case of successful scaling-up, there are therefore real prospects for the creation of a large number of jobs even when harvesting is mechanised

Physical capital comprises the basic infrastructure and producer goods needed to support livelihoods. With regard to households, they gain a household fuel alternative to meet their basic energy needs from a renewable local energy source. Furthermore, the processing equipment put in place by the project forms the physical tools required to turn the Typha resource into a marketable product likely to improve the livelihood of poor people.

At this stage, **financial capital** gains are limited given the fact that the project is still at an early stage. However, given the huge potential in the area and also in two neighbouring countries (Mali and Mauritania), there are good prospects to generate important local revenues from this business, all the more that the initial investment for small-scale units is low (about 1 000€).

The **social capital** in West Africa is an important asset which allows marginalised people to cope with harsh economic environment. This is also the case in this region of North Senegal. The project has allowed young people to develop social networks not only within their village but also with the important federation of women's groupings, as well as local authorities.

Natural capital is the most important component of this project with a serious impact on the livelihood of poor people. Indeed Typha Australis is an invading plant of the family of the reeds, which colonizes the flooding zones of the Senegal and Niger rivers with serious consequences on the human activities and the ecosystem (fishing, access to water, health, irrigation). The widespread prevalence of Typha has become a threat to the environment, obstructing animals' access to water, encouraging the proliferation of weaverbirds, and increasing the incidence of bilharzias and malaria in the population. It is estimated that Typha constitutes a potential threat for about 100 000 hectares of irrigated land in the delta and the low valley of the Senegal river. However this plant is also an opportunity to develop on a large scale a new local household fuel which will contribute a great deal to reducing the pressure on natural forests which are currently supplying the bulk of household fuels in Senegal. It is worth mentioning that similar projects are being developed in Mali, while Mauritania is exploring the feasibility of a pilot project.

Overall Conclusions

Five main conclusions can be drawn from this pilot project implemented in St Louis, Senegal, and also in Mali.

- Local natural resources are an important asset and can be tapped on a large scale. In most villages where adequate training is provided, human resources are available and the impact of capacity building contributes to improving directly or indirectly the livelihoods of poor people
- Local authorities and ministries in charge have supported the initiatives on the basis of the economic and environmental potential offered. This support has been instrumental in enabling the initiative to take root.
- Very often lack of technical knowledge and financial capital are major constraints. The lack of financial capital is associated with reluctance to take risks. Indeed for poor people, financial assets are very limited and the conventional banking system is not tailored to deal with their needs. Access to financial capital through traditional mechanisms is often very expensive and not adapted to productive investments. Government or aid support can unlock this barrier if properly targeted and supported by training and other types of stimulus and support.
- External initial support, particularly regarding project feasibility, coordination, mobilisation of initial capital and capacity building seems to be necessary to promote new initiatives.
- The sustainability of this project and its scaling up remain an important challenge. There is indeed a large natural potential. Precisely because of the size of the potential and the hardship to manually harvest sufficient quantities to reach an economically viable quantity, other technologies options do need to be explored.

Case 4 – Tanzania Sisal Biogas

Initiative Name	*Katani Ltd SISO Project and Cleaner Integral Utilisation of Sisal Waste for Biogas and Biofertiliser*
Location	*- SISO Project located on all 5 estates owned by Katani, all within 150km of Tanga City, Tanga Region,* *- Cleaner Integral Utilisation of Sisal Waste for Biogas and Bio-Fertiliser located at Hale Estate.*
Initiation Date and Duration	*- SISO Project initiated 1999, 9 years duration* *- Cleaner Integral Utilisation of Sisal Waste for Biogas and Biofertiliser subsequently initiated 2005, 4 years duration*
Funder(s)	*- SISO Project: Katani Ltd (Private Company), no external funding.* *- Cleaner Integral Utilisation of Sisal Waste for Biogas and Biofertiliser: CFC, UNIDO, Tanzanian Government, Katani Ltd.*
Project Initiator	*- Both projects initiated by Katani Ltd and Tanzania Sisal Board.*
Overall Budget (if available)	*- SISO Project: Predominantly financed by Katani Ltd and farmers* *- Cleaner Integral Utilisation of Sisal Waste for Biogas $1 503 312*
Output	*Production of sisal, with sisal waste used to power the biogas plant at Hale, which has an output of 150kW. The biogas plant is to be replicated on all estates, to produce 6MW of electricity.*
Area of Land	*By end of 2007, 4 500 ha planted with sisal with total land allocation of 12 000 ha.*
Beneficiaries	*- SISO Project: 2000 Families – Income and electricity through local grids Though not yet beneficiaries it is intended that local communities, outside the SISO scheme, will benefit from the provision of low cost access to energy in the future.*

Background and Context

Lying on the Coast of Tanzania, bordering Kenya, Tanga Region has a population of around 1.7million, with a growth rate in population from 1998-2002 of 1.8% and a population density of 60 persons per square kilometre. The population of Tanga Region has been increasing since 1957, and as a result of high population density, forests have become endangered and wood scarce. The increasing need for income and food is not matched by increased economic development or food production.

Sisal is the most important cash crop, used to produce yarns, ropes, carpets, clothing and composites, and sold to the domestic and international markets. Since 1999 Katani Ltd, a sisal growing company, has developed a system of smallholder and out-grower sisal farming, on land owned by the company and in the surrounding areas. Katani has developed the first biogas plant in the world to convert sisal biomass to biogas. This is used to run electricity generators which power production machinery, with excess electricity supplied to out-growers/smallholders homes, schools and hospitals.

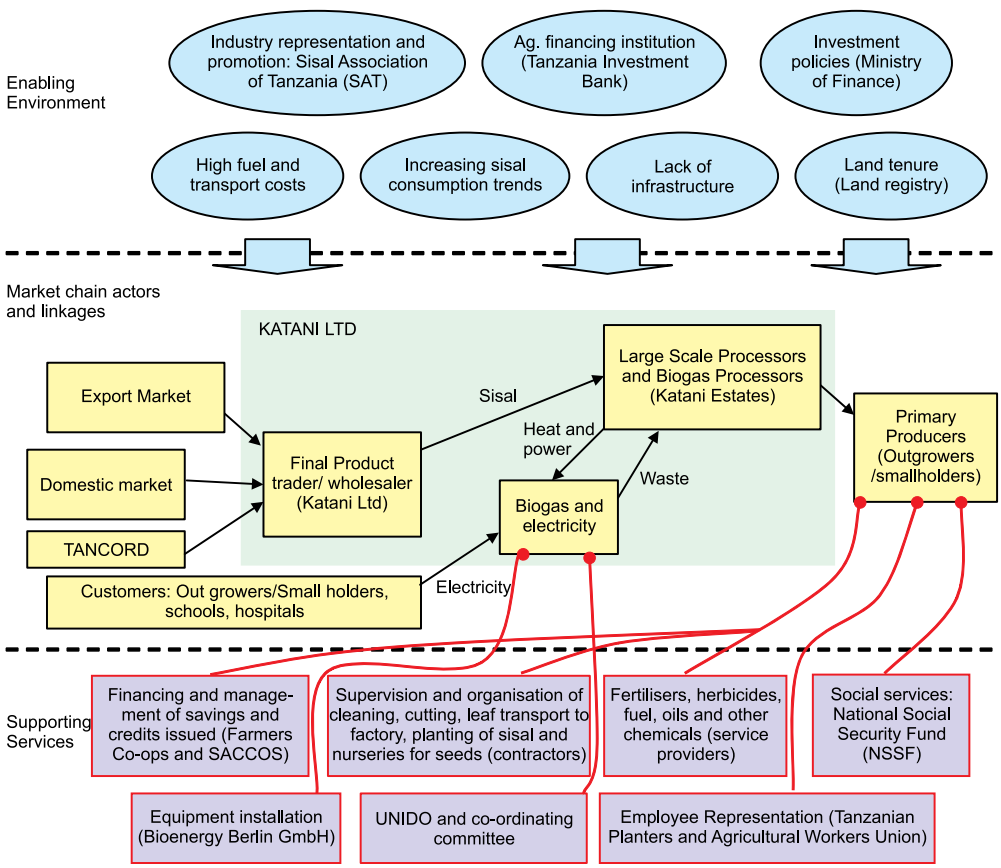
Organic fertiliser is produced as a by-product, process heat is used for drying fibre and could be used to dry paper made from sisal pulp. Using current production methods, only 4% of the actual plant is recovered as fibre. The residue was either burnt, producing carbon dioxide, or rotted naturally, producing methane. The use of sisal waste for bio-energy is thus environmentally beneficial. Converting the waste to biogas increases the profit to farmers, since 80% of the plant mass is suitable for biogas production.

Investment for a biogas project came from The Common Fund for Commodities (UN Body) US$ 927 712; UNIDO US$ 225 600; and the Tanzanian Government US$ 350 000, during phase one of the pilot plant. Ongoing financing is received from government and external agencies. The project is managed by UNIDO and a 16-member coordinating committee with representation from the FAO, CFC, UNIDO, TSB, Katani Limited, the Sisal Association of Tanzania (SAT) and relevant government ministries. The biogas project is profitable and Katani Ltd plans to provide local access to low cost bioenergy via a system of mini grids from their biogas plants. Funds are being sought to undertake the work and plans are under development.

Planting and harvesting takes place all year so there is no element of seasonality to earnings. The farmers are paid monthly, and they are guaranteed a market for their product. There is little vulnerability to environmental shocks since sisal is so drought resistant and sisal provides an income even if food crops fail, thereby increasing financial security.

The planned Phase 2 of the biogas project involves a scale up from 150 kW to 300 kW, requiring US$ 472 026 in funds. Phase 3, in 2009, involves developing biogas for vehicles and piping fuel to households, which will cost US$ 100 000. Nine other commercial-scale plants will be established at the other nine factories owned by the company, each with the capacity to produce 1MW of electricity. This will give Katani an overall output of 10 Megawatts of electricity with a similar amount of process heat.

The Initiative Market Map



With respect to the **enabling environment**, an increase in consumption of fibre locally and in regional markets is critical to the success of the programme. Land taxes, taxes on labour, and taxes on production need to be reduced to encourage farmers to expand their holdings. Investment funds for investment in agriculture in Tanzania are still hard to access; only firms with foreign connections have been able to get all the financing they require, and that from overseas. Farmers on their own cannot afford to venture into adopting new technologies. Transport costs locally are very high due to fuel costs. At present a financing window for agriculture has been opened at the Tanzania Investment Bank. Regarding gender, Katani provides women with the chance to engage in economic activities.

Relationships between Market Actors.

	Katani Ltd	Out growers/ Small holders	Farmers Co-ops and SACCOS	TSB	TANCORD	SAT	NSSF	TPAWU	UNIDO & CFC
Katani Ltd									
Out growers/ Small holders	**Good**, formal, Technical, Service & Financial								
Farmers Co-ops and SACCOS	**Good**, formal, negotiating relationship	**Good**, formal, power building & supportive							
Tanzania Sisal Board (TSB)	**Good**, Formal, Regulatory, advisory, supportive & representative	None	**Good**, Formal, Regulatory, advisory, supportive & representative						
TANCORD	**Good**, Formal, Financial & Market	None							
Sisal Association of Tanzania (SAT)	**Good**, Formal, Representative & Promotional	None	None						
National Social Security Fund(NSSF)	**Good**, Formal	**Good**, Formal, Financial& Service	**Good**, Formal, Financial & Service	None	None	None			
Tanzanian Planters and Agricultural Workers Union	**Good**, Formal & Regulatory	**Good**, Informal, Supportive & Service	**Good**, Informal, Supportive & Service	None	None	None	None		
UNIDO and Coordinating Committee	**Good**, Formal, Financial, Support & Knowledge Sharing	None	None	None	None	None	None	None	

Katani Ltd assists the farmers in forming registered community-based operations and accessing loans, and, grants to pay for services; and facilitates the repayment of loans to financiers. In 2006 Katani Ltd mobilised US$ 1.2 million in loans for farmers and is presently negotiating a further US$ 3.3 million. The firm has set up the Mkonge Umoja Savings and Credit Co-operative Society with a capital of around US$ 500 000. Katani are assisting farmers in strengthening community based organisations so that they provide the full range of production and delivery of services. To date there have been no breakdowns in stakeholder relationships and no apparent barriers to progress.

Training programmes and study tours to biogas production facilities in China were organised to enable staff at Katani to gain valuable experience in the operation and maintenance of medium-scale biogas energy systems. The biogas is produced with the waste derived from

the Sisal decortication plant. The stored biogas is used to run two 150 kW electricity generators for a rated total electricity output of 300 kW, with an intended output of 500 kW by the end of 2009. The electricity is used mainly within the decortication plant and some of the excess is supplied to the domestic quarters within the estate. The excess biogas can also be distributed to surrounding communities to cover cooking and lighting requirements.

Balance of Rights, Responsibilities and Revenues of Market Actors

Actors\'3Rs'	Rights	Responsibilities	Revenues
Katani Ltd (including Estate Management, Mkonge Energy Systems Ltd and Central Workshop Ltd)	- Guaranteed purchase of all sisal grown by small holders & out-growers.	- Out-grower / small holder extension services and training - Running electricity generators which power production machinery, - Providing excess electricity generated from biogas to homes, schools and hospitals. - Management of sisal operation, from growing through to marketing and sales - Strengthening CBOs to provide services	- Income from selling Sisal and potential income from sale of bioenergy to the national grid in the future. - Savings through use of biogas instead of bought fuel. - 6 MW of electricity will make substantial fuel savings once installed
Out-growers/ Small holders	- Use of land for sisal production. - Guaranteed revenue from sale of sisal leaves to Katani	- Production of sisal meeting quality control standards. - Maintenance of the land - Planting of sisal crop Adherence to terms of land lease.	- Income from sale of sisal leaves - Income from sale of food grown alongside sisal
Farmers Co-Operatives	Negotiating a fair price for farmers	- Representing interests of small holders/out growers. - Management of savings and credits issued, and financing of farmer operations.	
Tanzanian Sisal Board (TSB)	Regulation/ development of sisal industry	Regulation, development and Promotion	
TANCORD		Purchase of sisal fibre from estates Production of various sisal goods	Income from sisal products
Sisal Association of Tanzania	Operate under act of parliament	Representation and promotion of mutual intercessions with government	
National Social Security Fund (NSSF)	Operate under act of parliament	Provision of social services	
Tanzanian Planters & Agr. Workers Union		Out-grower/smallholder and employee representation	
UNIDO and the Common Fund for Commodities	Promotion of sustainable development via industrial development	- Managed the Project on Product and Market Development for Sisal and Henequen Products through the Project Coordinating Committee - Management and Coordination of Cleaner Integral Utilisation of Sisal Waste for Biogas and Biofertiliser project. Provision of investment, knowledge and support	- International donor countries

Out-growers and smallholders sub-lease land from Katani, upon which they produce sisal under contract for sale to Katani Ltd. Katani Ltd provide a guaranteed market for the sisal, providing income throughout the year. Food security is assured through intercropping and continued growth of food on traditional land in the village, reducing the likelihood of any food versus fuel conflict. Both out growers and Katani Ltd are linked to the Sisal Value Chain which includes the international market; they are therefore at risk from changes in international markets and finance. Katani has overall responsibility for production and sale of sisal.

Katani Estates pay primary producers US$ 370 per tonne of fibre while they get US$ 850 per tonne covering processing costs and Katani Limited gets US$ 85 per tonne. The revenues continue throughout the year. Katani buys farm inputs and sells the sisal through well established marketing channels world-wide. Katani receives the revenue from these sales. All other providers of services for Katani are under contractual arrangements and receive income for work carried out. The Sisal Association of Tanzania, NSSF and TSB are bodies established by Acts of Parliament.

Analysis of Livelihoods Outcomes

Human Capital: There has been an 80% increase in the number of children attending school and access to health care has improved. Katani provides energy for schools and hospitals, improving access to education, communications and healthcare.

The introduction of the sisal programme typically gives rise to increased yields for crops grown alongside it, e.g. an increase in maize yields when grown alongside sisal from 400 kg per hectare, the average for Tanga Region prior to the programme, to 1 200 kg per hectare after the programme was noted in a UNIDO and CFC report (2006).

Access to biogas reduces health problems associated with the use of wood for cooking.

Physical Capital: Out growers and smallholders are building better houses and buying bicycles, mobile phones and better clothes. They can access electricity and cleaner drinking water. Electricity is used to provide lighting for work in non-daylight hours, and to run small scale industries, which can subsequently increase incomes.

Financial Capital: The SISO project has led directly to the creation of rural employment for both men and women, with increased levels of income resulting from sisal production, related increased output of food per hectare and related reduced food production costs. Higher standards of living alongside increased levels of employment have reduced the rates of migration from rural to urban areas.

Natural Capital: The use of sisal waste for bioenergy is an environmentally beneficial procedure, reducing methane emissions from waste which would previously have been left to rot and CO^2 emissions from waste burned in the field. Carbon dioxide emissions have gone down as fossil fuel burning is reduced. The biogas process yields biological fertiliser which when applied to the fields reduces the need for chemical fertiliser. Access to biogas/electricity for cooking heat for smallholders/out-growers reduces the pressure on forest resources.

Social Capital: The formation of farmers groups and co-operatives by smallholders and out-growers has increased social capital. Greater household income and access to communications may extend the scope for participation in external activities

Overall conclusions

It is felt that the Siso scheme has maximised its potential to support local livelihoods. Farmers are now forming Savings and Co-operative Societies to be able to raise capital for financing their operations. It is difficult to assess the impact of the Cleaner Integral Utilisation of Sisal Waste for Biogas and Biofertiliser since only phase one has been completed. It appears however, that, by following the Katani model, there is significant potential, to produce large quantities of bioenergy in a socially and environmentally sustainable fashion in order to reduce poverty.

Key factors affecting the sustainability of the SISO project include rising costs of electricity, labour, fuel and oils, cost of building materials and of foodstuffs which small holders/out growers do not grow. By using the by-products of sisal production to generate energy, the industry will make itself more competitive in the global market.

Key factors affecting the sustainability of the Biogas project include the availability of financing and cost of labour and building materials.

Providing access to low cost energy is hampered by the monopoly of Tanzania Electrical Supply Company, and related costs of transmission lines and transformers, although recent Energy and Water Utilities Regulatory Authority (EWURA) legislation on small power projects favours renewable energy suppliers. The high cost of tanks (80% of investment cost) and a lack of infrastructure to enable biomethane to be used for vehicles and households also act as barriers to the success of the biogas project.

Crucial success factors for both projects are that the production of sisal and biogas from sisal waste following this model are both environmentally and socially sustainable. As an emerging market, the opportunities for investment and development in sisal are significant. Research shows that there is huge market potential, of the order of millions of tonnes worldwide, for sisal. The sisal industry has witnessed an upward trend, with national production in Tanzania up 84.5% from 20 000 tons in 1997 to 36 900 in 2007, and momentum is continuing to gather.

Case 5 – Tanzania Palm Oil

Initiative Name	*FELISA ('Farming for Energy for better Livelihoods in Southern Africa' / 'Kilimo cha Nishati') Company Ltd.*
Location	*Kigoma, Kigoma Region, Tanzania*
Initiation Date and Duration	*Incorporated: April 2005* *Start of field operations: November 2005*
Funder(s)	*Private company*
Project Initiator	*Hamimu Hongo (Tanzanian) and Stefan De Keyser (Belgian)*
Overall Budget	*US$ 836 000*
Output	*Crude palm oil (CPO); Biodiesel*
Area of Land	*100 hectares planted* *4 250 hectares now owned for expansion*
Beneficiaries	*FELISA has yet to begin large-scale production of CPO or biodiesel. 990 farmers have received seedlings, and a large number of individuals who currently farm palm oil trees are potential suppliers to FELISA and therefore—along with their households and the employees of the company—are beneficiaries as suppliers of an emerging market.*

Background and Context

FELISA Ltd is based in Kigoma town on the shores of Lake Tanganyika in western Tanzania. The company cultivates oil palm trees (*Elaeis guineensis*) and processes fresh fruit bunches (FFB) to produce crude palm oil (CPO), an edible oil used for cooking, cosmetics and pharmaceuticals. FELISA is presently 100% self-financing, funded by equity contributions from 24 (majority Belgian) shareholders.

FELISA has a 100 hectare oil palm plantation 75km from Kigoma town. They have recently obtained another 4 258 hectares of land 150km from Kigoma, where they plan to also plant oil palm. A first crop of seedlings was planted in December 2005, and a second in January 2007. Oil palm trees take four to five years to mature to fruition, and the production of CPO is planned to begin in 2009. FELISA also aims to purchase FFB from local small-scale farmers as part of a proposed outgrower scheme. They calculate that a total of 500 hectares under local cultivation will meet demand once their own plantations bear fruit.

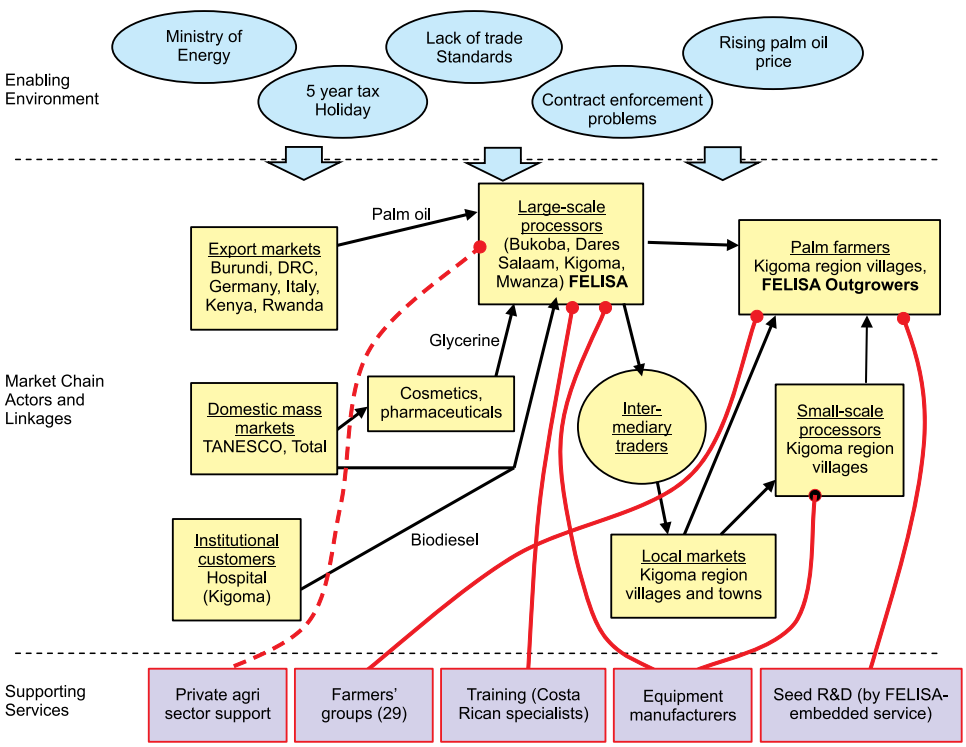
An influx of refugees from conflicts in Burundi and the Democratic Republic of Congo has placed great pressure in the Kigoma area, but this trend is now reducing with repatriations. The refugee camps absorbed many natural resources regionally, as evidenced in mass deforestation for firewood and a large reduction of water. Investment in western Tanzania, especially Kigoma region, is low, and there is sparse allocation of funds in the agricultural sector. Many people in the region are subsistence farmers and, according to FELISA, do not notice economic shocks as profoundly as those with stronger ties to the wider economy.

Crops are harvested and planted during the rainy seasons of October-January and March-June, and prices decline during these times of peak production. During off-peak periods farmers owning palm oil harvest the few ripe FFB and prune and weed. Between January-February farmers harvest maize and plant fast crops, such as beans and sunflower. The planting of palm oil trees takes place at the onset of the rainy season because the oil

palm requires much water. Although malaria is present all year, infection rates increase during these wet periods.

The company's initial strategic choice was to grow and process palm oil for biodiesel production for the domestic market, targeting the national utility TANESCO back-up generators and possible transport fuel blending markets. However with the world market price of CPO having risen sharply, from $0.25litre in 2005 (when their first planting took place) to a high of US$1.35) in 2008, FELISA are considering additional non-energy market options.

The Initiative Market Map



The market map below is currently in an emerging state and FELISA are still considering which market segments to target. The map illustrates the various existing market options that FELISA will be joining and developing further.

With respect to the Enabling Environment, FELISA have sought to influence the Ministry of Energy's biofuel policy so that they and other domestic biodiesel producers can operate in a known environment when negotiating with foreign buyers. One call is for a policy that stipulates the blending ratio between biodiesel and fossil diesel used in Tanzania. Ideally this policy would also ensure that a certain percentage of biodiesel is produced internally. Primary producers and processors have not made similar efforts to engage with the policymaking process. Contract enforcement issues have not affected

any Kigoma-based actors, nor have bodies that monitor trade standards. There are reported cases of product adulteration, with incidents of waste water being added to CPO (apparently by middlemen who, in one case, paid farmers to bring waste water to be added to the oil). The effect has been that some buyers avoid Kigoma and now purchase instead in Mbeya. While FELISA has not experienced corruption, employees recognise that any process that involves government officials can run the risk of delay due to institutional bureaucracy which may impact on the timely accessing of services. In registering their new land, for example, FELISA had to wait close to an entire year for the process to be completed. This is due to the fact that only one person is authorised to make declarations about land and their services are in high demand. FELISA currently enjoys a five year tax holiday, along with a capital goods import duty exemption. Local farmers, however, are frequently levied to pay various taxes, including a tax for goods going to market. Accessing loans or grants for agricultural and agri-related industries is difficult. Banks in particular perceive the sector to be high-risk, and rarely provide loans, especially for perennial crops. FELISA have recently applied to Private Agricultural Sector Support for assistance in obtaining a loan and, if successful, this should have positive knock-on effects for primary producers working with FELISA.

Of the Supporting Services, inputs and finance are sourced by FELISA themselves. All linkages are created and maintained by FELISA's own efforts, although they have benefited from some outside influences, in particular training received from specialists from Costa Rica. Research relating to market information is self-initiated, and lessons are learnt within the company from their exposure to the domestic and international production markets. FELISA's proposed outgrower scheme, for example, bears some resemblance to the agreement between Prokon, a German private company in Rukwa that sources its Jatropha from local farmers in the region. The Ministry of Agriculture sends investors interested in palm oil production to FELISA, and one of the Directors is regularly invited to present at international conferences. FELISA regard themselves as a learning institution.

Relationships between Market Actors

	Palm Farmers	FELISA	Small-scale Processors	Intermediary Traders	Farmers' Groups
Palm Farmers					
FELISA	**Good**, Formal, Technical, Commercial				
Small-scale Processors	**Fair**, Informal Commercial	**Fair**, Informal Competitive			
Intermediary Traders	**Poor**, Informal Commercial	**Fair**, Informal Competitive	**Fair**, Informal Commercial		
Farmers' Groups	**Good**, Formal Technical, Commercial	**Fair**, Informal, Technical, Commercial	**Fair**, Informal, Commercial	**Poor**, Informal, Commercial	

Before the emergence of FELISA relationships between market actors were purely commercial, with palm farmers existing in a state of dependency on a few buyers who dictated prices and offered no other support. In Simbo village, some 18km from Kigoma, for example, palm farmers have calculated that there are many risks in processing their crop themselves, and the profit margin from their few drums of oil is small. The disadvantage of allowing others to process their crop, however, is that the farmers do not retain ownership of by-products such as kernel cake which can also be sold.

FELISA wants to support palm farmers by offering technical support in farming methods through conducting extension services together with the government. A rural development policy exists, but it is not always implemented. FELISA's solution is to introduce an outgrower scheme based on demonstration plots where an extension officer will train small-scale suppliers on modern oil palm production and provide palm farmers with high yield hybrid seedlings. In the long run they hope to help palm farmers establish their own processing plants. The intended result is to improve the quality of FFB that farmers bring to FELISA, thereby helping meet demand. Palm farmers are under no obligation to sell only to FELISA, and the price is negotiable; although there would be a contractual agreement that binds the farmer to supply a certain amount of a crop at a specified quality over a given period of time.

Farmers' groups share information on farming methods and markets. They provide an opportunity to FELISA, to engage with many farmers at once, and a channel for lobbying decision makers in favour of FELISA's planned actions. The largest group is *Wabango*, who have their own savings co-operative, and a leadership committee who have conducted a palm oil study tour in Malaysia. *Wabango* have expressed an interest in selling their oil directly to FELISA, but price negotiations are yet to be finalised. FELISA are distributing hybrid seedlings to 29 farmers' groups (about 990 farmers) in Kigoma region, and to date they have given away 10 000 seedlings. The value of hybrid seedlings is slowly being realised and Care International and Red Cross are asking FELISA to supply them. FELISA employ around 60 people for weeding on their farm, and they employ permanent nursery staff.

Balance of Rights, Responsibilities and Revenues of Market Actors

Farmers find out the local market price by asking those returning from the market. Daily markets occur in some villages where between ten and twenty local sellers walk or cycle with the FFB or, more usually, the CPO that they wish to sell. Bulk buyers come from towns such as Bukoba, Mwanza, Kasulu, and Tabora and, as outsiders, are not well known by the sellers. The bulk buyers purchase CPO from the market or from local machines in the villages and use their own vehicles to take away the CPO. They do not provide any support to the producers, and are variously described as 'ordinary traders', 'middlemen' or 'profiteers'. Other buyers—often Tanzanian Indians, or those working for them—work directly for businesses that produce edible oil, pharmaceuticals or cosmetics, such as the Dar es Salaam-based Mohammed Enterprises, or VOil from Mwanza. Those producing margarine and soap come to the markets themselves, as do fish fryers from Mwanza,

Actors\'3Rs'	Rights	Responsibilities	Revenues
Small-scale palm farmers	- Use of land for farming	- "Caretakers" of the land and natural resources - Production of FFB at price and quality requirements	- Subsistence from farm land - Income from oil palm trees and remaining farm products
FELISA	- Farmers' CPO (where contract is in place)	- Outgrower training - Biodiesel processing - Pay and conditions to employees - Fair contracts to farmers	- Income from selling CPO and biodiesel
Small Scale Processors	- Use of by-products (if agreed with supplier)	- Connection to local markets - Responsible disposal of 'waste'	- Income from processing - Income from by-products (if agreed with supplier)
Intermediary traders	- None	- Connection to larger markets in Dar es Salaam	- Income from selling CPO
Farmers' Groups	- Joint action - (Individual members') use of land for farming	- Negotiating with buyers - Disseminating best practice - Representing members' interests	- Members' fees - Income from selling CPO

Bukoba and Nguruka (near Tabora) who purchase the oil for frying their fish for sale. Small quantities of CPO are also sold for household consumption.

Impact on Livelihoods Assets

The full impact of FELISA cannot yet be assessed since the company has yet to begin production at scale of either CPO or biodiesel. Nevertheless, comments can be made in relation to the types of livelihood capital.

Human capital: In some villages (men report that) women and men do all tasks together, although this was not always observed to be the case. It is more often the case that women collect firewood and water. Soap-making tends to be done by men, whereas the production of oil can be carried out by either men or women. Technology is basic and usage minimal. Information on farm inputs, methods and equipments is accessible, but the problem of how to access better technologies and how to access the Mwanza and Dar es Salaam markets remains. The CPO market in Tanzania is described by one informant as 'disorganised' and 'unsophisticated', with farmers having a low awareness of how to move beyond their present (usually quite limited) market contacts. Human capital does look set to rise, however, as more farmers are trained under the outgrower scheme.

Natural capital: Land ownership is either private or rental. There are few areas where oil palm trees can be harvested freely by anyone, and there is no evidence of conflict over the trees. FELISA plan to intercrop between the oil palm trees for the first two years from planting on their new plantation, but after this period monoculture will be practised as the rooting system and high canopy prevents other plants from growing well. Oil palm requires a lot of water, so thrives in the lowlands, especially in riverine areas, and where the soil is irrigated. While there is a risk in the large new plantation that water supplying nearby areas under cultivation is reduced, waste water and biomass that remains after oil

extraction is to be channelled into a tank, fermented, and used to produce compost for reintroduction into the oil palm tree plantations. The process is also to be used to produce biogas for cooking, heating and the production of electricity on-site.

Social: Some farmers have wealthy relatives who they can rely on if their financial situation becomes difficult, although assistance with small amounts of money occurs at the local level.

Physical: Firewood and charcoal—the popularly used forms of energy— are generally affordable. Biomass from oil palm trees that are used as a source of energy is free but is not clean. Locally, much of the remaining biomass from the oil palm tree is used in construction. Fronds are stripped and the stem used for roofing, building fences, and for firewood. The leaves are used for brooms, and the crown bunch is dried and used for firewood. The fibre is used for kindling, and in the manufacture of hardboard in Iringa and Mbeya regions. The growing apex of the trunk is tapped to obtain a sweet juice that is fermented to make '*marovu*' palm wine.

Financial: The world market price of CPO has risen sharply over the last few years after large producers such as Malaysia, Costa Rica, and Indonesia cut their output to the CPO market in favour of biodiesel production. Prices have risen from US$0.25 per litre in 2005 (when FELISA's first planting took place) to a high of US$1.35 in 2008. At the local market a 20 litre container now sells for around US$ 15.30-20.40. Middlemen make around US$ 2.55 profit, and the price is around US$ 1.70/litre lower if the buyer collects the oil direct from the farmer. Although the entry of FELISA as a substantial buyer holds the potential for farmers to better stabilise their income, the reluctance shown by banks to support farmer loan applications is unlikely to change. Nevertheless, farmers are generally happy as prices are rising. Last year a container was US$ 10; two years ago it sold for around US$ 7.70. Five years ago the price was US$ 4.40 and US$ 1.60 ten years ago. Farmers pay a local village government tax of US$ 0.16 for each twenty-litre container. At the local market the buyer also pays a tax. Local community saving schemes (SACCOS) exist, although many small-scale farmers have limited savings because their existence is subsistence. Any profit is usually reinvested into clearing and tendering farms, paying local labourers to harvest, paying others to draw water and other manual tasks. Remittances rarely reach home in cash. FELISA plans to encourage its suppliers to open bank accounts so that they can deposit to them without marketplace transactions.

Overall Conclusions

Oil palm has a high production potential among the oil crops , at up to 6 000 litres per ha per year. This compares to <3 000l per ha for avocado and coconut, and <2 000lper ha for brazil, macadamia and pecan nuts, and for Jatropha. Oil palm trees are perennial, and are grown by small-scale farmers throughout Kigoma region in western Tanzania. The downside is that palm oil plantations can be water intensive, although FELISA plan to reintroduce waste water onto their farms.

This is a favourable time in Tanzania for growers of palm oil trees and traders in CPO, so to some extent FELISA's decision over whether to supply the biodiesel market

or to stick to supplying the edible oil and cosmetics/pharmaceuticals markets (or to supply both) is one that will not affect their local suppliers since there is demand in both markets. Nevertheless, there is a risk that by producing both CPO and venturing into the biodiesel market FELISA could force up the local price of CPO. FELISA and local partner organisations should remain vigilant about this potential impact and implement mitigating measures to avoid its occurance. One such method could be to use FELISA's own suggestion for FELISA to only purchase medium and large FFB from the smallscale outgrower farmers, leaving smaller FFBs for local processing and consumption. The potential for FELISA to support rural livelihoods does exist, most notably in their proposed outgrower scheme that in exchange for a more reliable source of extra crops to supplement supplies from their plantations promises to offer support from a staff experienced in improved methods for the production and processing of palm oil. The staff are also familiar with the local and international CPO and (to a lesser extent) biodiesel markets. Here FELISA is able to provide another avenue to markets that presently farmers feel they are lacking when dealing only with bulk buyers locally. That said, there is no guarantee with FELISA that the oil (whether CPO or blended biodiesel) will end up in Tanzania

Case 6 – Kenya Afforestation Charcoal

Initiative name	*Community Driven Commercial Afforestation*
Location	*Central Uyoma, Madiany Division, Rarieda District, Nyanza Province, Kenya, East Africa.*
Initiation Date and Duration	*September 2002. Six years by end of September 2008.*
Funder(s)	*Initially Thuiya Enterprises Limited; now Embassy of Finland and the Christian Agricultural and Related Professionals Association (CARPA).*
Project Initiator	*Youth to Youth Action Group and Thuiya Enterprises Ltd.*
Overall support budget	*US$ 15 000 in 2007 and US$ 22 000 in 2008 (this increases annually)*
Energy Output	*100 tonnes of round wood or 30 tonnes of charcoal per hectare – under six years rotation.*
Area of land	*Currently about 200 hectares.*
Beneficiaries	*Farmers from beans and groundnuts - US$ 385 600 over the 6yr cycle; Honey - US$ 5 400 per year from 60 hives. Households, energy saving US$ 20 640p.a. Charcoal transporters, charcoal wholesalers - US$ 214 500 in 6 yrs and retailers US$ 321 400 in 6 yrs, Community based organisations e.g. RAID US$160 per ha from raising seedlings. The total financial benefits for all the key actors are about US $ 2 096 911.*

Background and Context

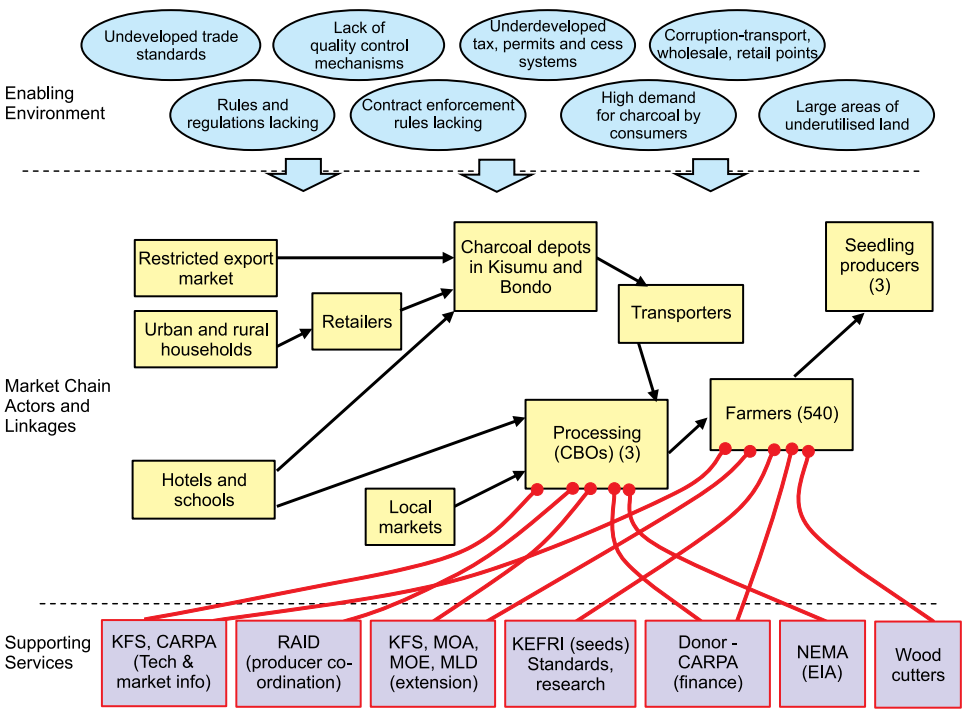
Although potentially renewable, forest resources in Kenya are exploited at a higher rate than their supply is renewed, rendering them non-sustainable in practice. As a result of this exploitation, Kenya's forest resources cover only around 6% of the country's 58.2 million hectares and are estimated to be decreasing by 2% annually. Forest cover is very low compared to the United Nations' globally recommended 10% for ecological stability of the country. In 2002, wood fuel demand and supply in Kenya was estimated to be 32 million tonnes and 16 million tonnes respectively. This is a 50% deficit, drawn from standing wood stocks, leading to deforestation, and environmental degradation. Besides the suffering of women and children who bear the burden of providing household fuel, increased deforestation reduces the forests' carbon sink capacity, contributing to changes in climate and rainfall patterns that interfere with food production and security. Increased water runoff contributes to greater soil erosion and downstream floods.

Firewood is mainly a rural fuel with over 90% of Kenya's rural population dependent on it. Charcoal made from wood, on the other hand, is produced by rural people as a source of income. Charcoal is mainly an urban fuel, with 82% of the urban population using it. Increasing urbanisation of of the population (7.4%) and the subsequent increase in charcoal consumption has lead to an increase in deforestation. In the 1980s and early 1990s, charcoal was mainly obtained from natural woodlands. However, over time, natural forest resources have declined drastically necessitating deliberate intervention to increase resource supply. Worse still, over 99% of the charcoal produced in the country is processed in traditional earth kilns with a 10% conversion efficiency, so for every 100 kilogram of wood, only 10 kilograms of charcoal is obtained, despite there being

technologies with 30% efficiency that can yield three times more charcoal for the same wood.

Although the Lake Victoria basin region is endowed with large tracts of productive land, and other natural resources, national poverty surveys consistently show the districts around the lake to be amongst the poorest in Kenya. Determined to make a difference in this region, the Youth to Youth Action Group, with financial support from Thuiya Enterprises Ltd., initiated the community-driven commercial afforestation project in 2002, in Madiany Division, to enhance the livelihoods of the local communities. The project promotes the growing of *Acacia xhanthophloea* and *Acacia polyacantha* for charcoal. Acacia xhanthophloea, commonly referred to as Naivasha thorn or fever tree (Alii in Luo), is a fast growing acacia species that grows at a rate of 1.0 metre to 1.5 metres per year, thriving at altitudes of 600-2 100 metres above sea level, and ideally suited to near swamps, along rivers or lakesides.

The Initiative Market Map



Through historic neglect and the perceived negative environmental impact, many **Market Actors** in the charcoal value chain do not engage openly in the charcoal industry, although the situation is changing for the better. This project has demonstrated that it is possible to produce and market charcoal sustainably. Currently, there are no formally registered charcoal producers, transporters or marketing institutions around Lake Victoria; the linkages described are in the process of formation. This project is coordinating registration

of charcoal producers within Madiany division. There is limited research on the potential in the industry and project facilitators plan to lobby for more research and establishment of stakeholder associations and linkages.

An **Enabling Environment** is needed as policies and regulatory issues are slowing down emergence of a dynamic charcoal sub-sector. Although not illegal in Kenya, charcoal is treated as semi-illegal because of certain presidential decrees of the 1990s. Charcoal cannot be exported without authority from the Ministry of Forests and Wildlife. Corruption is endemic, especially at the transport stage, and those who want to engage in non-corrupt business shy away from it. Too many actors in the regulatory system – chiefs, police, county council officers etc. leads to confusion in the industry. With no developed standards for charcoal, the same price will be charged for differing weights. Charcoal from lightweight species like cypress, and charcoal from very dense wood, such as Acacias, is sold at the same price. With no law to facilitate enforcement of production, transportation and marketing contracts, the participation of the private sector in contracting charcoal producers is limited. Since only those individuals and communities with secure land tenure can engage in its production, this excludes many landless or young families.

Supporting Services are provided by the Rachar Agroforestry Initiative for Development (RAID), a farmer umbrella Community Based Organisation. The Embassy of Finland and the Christian Agricultural and Related Professionals Association (CARPA) provide technical backstopping, some funding, and resource mobilisation for groups. Moi University and the Kenya Forestry Research Institute (KEFRI) provide leadership in research. The Ministries of Forests and Wildlife were involved through the Kenya Forest Service and the Ministry of Agriculture and Livestock Development provides extension services. The Ministry of Energy was involved in choosing the charcoal processing technology. Transporters provide support services and form part of the market as intermediary traders.

Relationships between Market Actors

Although not fully developed, the relationship among the actors is generally good. This initiative has contributed to the creation of demand-driven research and extension insofar as farmers previously planted trees without sufficient knowledge on spacing, management practices, expected wood yields and efficient charcoal processing technologies. They later requested technical support from KEFRI on these issues. KEFRI is now carrying out trials to determine the appropriate spacing and management regimes for optimal yields. Preliminary results have given general indications on some of the requirements for higher wood and charcoal yields. As indicated in the Table above, most of the relationships are informal. The initiative is working on modalities to formalize the key relationships. Those targeted include training teams of charcoal burners, by developing formal charcoal burning agreements with farmers, developing standards and trade rules. In this initiative, it is only the farmers who planted trees who are allowed to harvest them for charcoal. RAID ensures that this rule is enforced by producing and distributing seedlings to farmers,

	Seeds & Research (KEFRI)	Seedlings Producers (RAID)	Farmers	Wood cutters	Charcoal processors	Charcoal transporters	Charcoal whole-salers & retailers	Local Authority/ Govt	Charcoal users
Seeds & Research (KEFRI)									
Seedlings producers (RAID)	**Fair** - financial, technical								
Farmers	**Good** - technical	**Good** - technical, formal							
Wood cutters (employed by farmers)	None	None	**Good** - financial, informal						
Charcoal Processors	**Good** - technical, Formal.	None	**Good**- financial, informal	None					
Charcoal Transporters	None	None	None	None	**Good** - financial, informal				
Charcoal wholesalers and retailers	None	None	**Fair** - financial, informal	None	None	**Good** - financial, informal			
Local authority/ Government	None	None	None	None	None	**Poor** - regulatory, financial	**Poor** – undefined		
Charcoal consumers	None	None	None	None	None	**Poor** - financial, informal	**Good** - financial, informal	None	

and recording all those who have planted trees. Once produced, any interested buyer can purchase charcoal from the producers, and transport it to any area of their choice. In the near future, RAID is expected to identify and negotiate for better prices on behalf of the farmers. The relationship between farmers & charcoal processors is good. The farmers get a service (charcoal from wood) & the processors get income from the farmers.

Balance of Rights, Responsibilities and Revenues of Actors

Farmers have the **Right** to farm while RAID has the right to produce seedlings. Farmers risk losing their tree crop through drought or floods. RAID guarantees trees for a month, so risks losing seedlings transporting or transplanting. Men usually sign the initial contracts with Thuiya Enterprises Ltd, with their sons rather than wives, claiming insecurity about their wives' permanence. Some women hire and plant their own land.

In terms of **Responsibilities**, production was initially funded by Thuiya Enterprises Ltd. on a contract basis. Two risks emerged: lack of legislation; risk of competition. The new arrangement allows farmers, supported by government, NGOs or through loans, to sell wood for the best price.

Revenues come to farmers from short seasonal crops for the first and second year. In the third to sixth year, they get income from honey, poultry and dairy goats. In the third year, farmers are loaned one beehive for every 500 Acacia trees planted, with an anticipated yield within three months, providing interim income. The farmer repays RAID for the beehive with 2 kg (US$ 6) of honey from every harvest (US$ 24 per year) for three years. Dairy goats and poultry will be introduced in 2009. The money paid to RAID is used as

Actors/3Rs	Rights	Responsibilities	Revenues
KEFRI	-Carry out research on suitable charcoal species	-Generate appropriate technologies. -Provide certified tree seeds	-Income from sale of information and seeds
RAID (CBO)	-Facilitate farmers pooling sales to reduce transaction costs. -Produce seedlings for farmers	-Mobilize / engage small scale farmers -Ensure sufficient seedlings for all the registered farmers.	-Membership fee -Marketing fee -Income selling seedlings
Small scale farmers	-Use of land for farming -Sale of wood products	-Caretakers of land and natural resources	-Income from farm produce including wood products.
Youth/ Women groups (Seedling producers/ Charcoal processors)	-Produce seedlings	-Ensure quality seedlings	-Income from selling seedlings
Wood cutters	-None as casual labourers	-Cutting wood	-Wages from cutting wood
Charcoal processors	-Convert wood into charcoal	-Ensure efficient transformation process	-Wages processing wood into charcoal
Charcoal transporters	-Transport charcoal from the production centre to the urban wholesale market.	-Ensure maintenance of charcoal quality while on transit.	-Income from transporting charcoal
Charcoal traders	-Selling charcoal	-Ensure certified scales and weights	-Income from selling charcoal
Local Authority	-Collect fees for infrastructure use such as cess (tax paid by transporters to Local Authorities for transporting charcoal)	-Ensure availability of selling points e.g. Depots	-Income from cess
Charcoal consumers	-Right to purchase charcoal	-Use energy efficient utilisation technologies	-Income saved from using less charcoal
Forest service	-Provide extension services -License production and transportation of charcoal	-Provide appropriately packaged technical information -Ensure sustainable sourcing of charcoal by issuing certificates after inspection.	- Income from license for production and transportation

a revolving fund for buying more beehives. The youth benefit from raising tree seedlings, women from trading in efficient cooking devices, beans and groundnuts, men are mainly involved in tree planting, management and charcoal processing. Women get firewood from tree tops and smaller branches.

Analysis of the Livelihoods Outcomes

In terms of Human Capital, all participating farmers have acquired new knowledge on tree-husbandry for charcoal, bee-keeping and energy conservation technologies. They

have harvested ~270 tonnes of grain, for food or sold for income. The added knowledge and skills will reduce vulnerability of the community. They have gained a market for products and equable returns for individual actors. The knowledge and skills will remain within the community as a resource, while others can benefit from both the documented research outcomes and study tours.

The 200 hectares planted have enhanced Natural Capital, a significant increase in forest cover. The two indigenous tree species are leguminous, fixing nitrogen and improving soil fertility, so the land has higher ecological value without depleting biodiversity. The trees have an impact on the micro-climate, conspicuous during the dry season. Although quantitative data are unavailable, forest cover increases the carbon sink capacity of the area.

Social Capital increases as members interact and build trust with each other and outsiders. RAID is now vertically linked to networks like the Embassy of Finland, CARPA, Kenya Forest Service and other potential supporters. Horizontally, the local network has brought participating groups together. All group members have registered with the Ministry of Social Services and leaders are learning to be strong leaders. Farmers feel increased status, interacting with outsiders, building their own capacity and that of others. They have negotiated with Constituency Development Fund (CDF) officials, for support building an office and attracting support for cotton production.

Physical Capital is increased by the trees themselves, which are used as collateral by farmers e.g. one beehive is given for every 500 trees planted. Energy security has improved in villages and urban centres. The community has bought land for offices. They own six charcoal processing kilns, accessible to all members. Farmers may choose to sell the wood to anyone, but for charcoal, wood harvesting has to be certified by a Forest Service Officer. Seedling for the three tree nursery sites (producing over two million seedlings) have been provided by the Ministry of Forests and Wildlife demonstrating the good working relationship with the government.

Financial capital from the 200 hectares will provide key actors in the chain with an income from charcoal of US$ 1 028 571 after six years. Firewood savings through energy efficient stoves will save US$ 20 640 p.a., fast-growing crops US$ 385 600 p.a., transport services US$ 94 200 p.a., wholesaling of charcoal US$ 214,500 and retailing of charcoal US$ 321 400. Honey will generate US$ 5 400 per year for the 60 hives. The number of hives is expected to rise to 1000 hives earning US$ 90 000 per year. The coordinating CBO, RAID, gets an income of US$160 from the donor for raising seedlings for every hectare of trees planted. To date it has earned US$ 32 000 from tree seedlings. The total financial benefits for all the key actors are about US$ 2 096 911 (charcoal included) in the six-year rotation period. Sustainability of the indicated livelihood outcomes can be attained if the weaker components of the charcoal value chain are strengthened to ensure fairness in distribution of the benefits along the value chain and enhancing the enabling environment.

Overall Conclusions

This project has potential to improve the livelihoods of the rural poor because of the high demand for charcoal. The initiative does not require high capital investments and can be integrated with other enterprises to ensure sustainable access to food and income benefits. The current initiative has not maximised its potential because it is still in its pilot phase and the enabling business environment is not well developed. When fully operational, and the appropriate enabling environment in place, this initiative can maximize its potential in supporting rural livelihoods especially if contractual business arrangements are adopted. This will assure producers of a regular and predictable income and also assure contractors of a steady supply of the product. Despite the presence of the large market, if those farmers who produce charcoal find the business environment is not conducive for them to sell profitably, and are stressed by the current corruption and harassment from the regulators, it is easy for the initiative to collapse. However, if the enabling environment improves, and sufficient investment is provided to reach a threshold level where the initiative expands naturally, then the project will be very successful. Since it is a business enterprise, whose every activity is valued, sustainability is assured provided a market exists.

Case 7 – Ethiopia Ethanol Stoves

Location	*Addis Ababa, Kebribeyah & Awbere, Ethiopia, Capital city & Somali region*
Initiation Date and Duration	*2004, 4 years*
Funders	*Shell Foundation, UNHCR, USEPA, IRC, LWF*
Project Initiator	*Finchaa sugar factory and Ministry of Trade and Industry*
Overall Budget	*973 062 In US$*
Output	-
Area of Land	*N/A*
Beneficiaries	*2650 households in displaced communities and in Addis Ababa who use ethanol for cooking*

Background and Context

Ethiopia has a total of 1.14 million square kilometres and a population of 71.1 million in 2004. It is the ninth largest African country in size and the second most populous. The overall population density is 62 persons per square kilometre. Approximately 16 percent of the country's population resides in urban areas. Ethiopia is one of the poorest countries in the world. This is reflected in low per capita income (US$ 97 in 2003), very poor social indictors, poor output from the productive sectors, poorly developed infrastructure and a degraded environment.

The country's economy is based predominantly on rain-fed subsistence agriculture. Gross Domestic Product (GDP) at market prices in 2003 was US$ 6.7 billion. The agricultural sector contributed 43%, with the manufacturing industry, including small-scale and handicrafts, providing 12 percent and the service sector about 45 percent.

The most widely used fuel for cooking in Addis Ababa is kerosene (42.2%) followed by fuelwood (29.4%). Charcoal, LPG, electricity and residues are used by a much smaller section of city households. The primary cooking stove used in Addis Ababa is the single burner kerosene wick stove. This stove is imported from the Far-East and sells for about US$ 5 The second most important fuel in the city, fuelwood, is used when cooking over an open fire.

As one moves from Addis Ababa to other urban centres, access to modern fuels declines and use of traditional fuels increases, so fewer households use modern energy in the other urban centres. At national level, kerosene is used as the primary cooking fuel by only 14% of urban households compared with 42% in Addis Ababa. Similarly, only 2-3% of households reported using LPG and electricity as their primary cooking fuel at the national urban level compared to 6-7% for Addis Ababa.

In the case of kerosene, the number of users has dropped substantially in both Addis Ababa and other towns between 2000 and 2004. The share of kerosene has declined from 66% to 42% for Addis Ababa and from 22% to 14% at the national urban level. As in Addis Ababa, the reduction of kerosene use is accompanied by an increase of fuelwood use. The recent government policy to remove the kerosene subsidy has aggravated the trend, and the kerosene price rose from US$ 0.57 to US$ 0.86 per litre.

The indoor air pollution (IAP) monitoring carried out by Gaia Association in the homes of Addis Ababa residents that use primarily kerosene, fuelwood and charcoal showed high concentrations of carbon monoxide (CO) and particulate matter (PM) which have been shown to be harmful to health. Household energy scarcity and indoor air pollution are widespread problems in Ethiopia.

In addition to urban homes, Gaia Association has completed cooking energy and indoor air pollution studies in homes in refugee camps in the north (Tigray), west (Gambela) and east (Jijiga) regions. These homes rely entirely on solid biomass fuels. The project has found extremely high levels of pollution in these homes.

Ethiopia established an ethanol manufacturing plant called the Finchaa sugar factory in 1999. Seeking potential markets for the ethanol, Project Gaia was invited to do pilot studies in Addis Ababa households in 2004. Since then, Gaia has been working to promote ethanol as a household energy fuel. In recent years the government of Ethiopia has planned and started to use ethanol for automotive fuel (gasoline) blending. Ethanol distilleries being built by the government have a promising potential to cover ethanol demand from both the household and transport sector. The government placed its plan for ethanol in the Ministry of Mines and Energy's Biofuel Development and Consumption Strategy. According to the plan, the household market will get an adequate share of the ethanol produced.

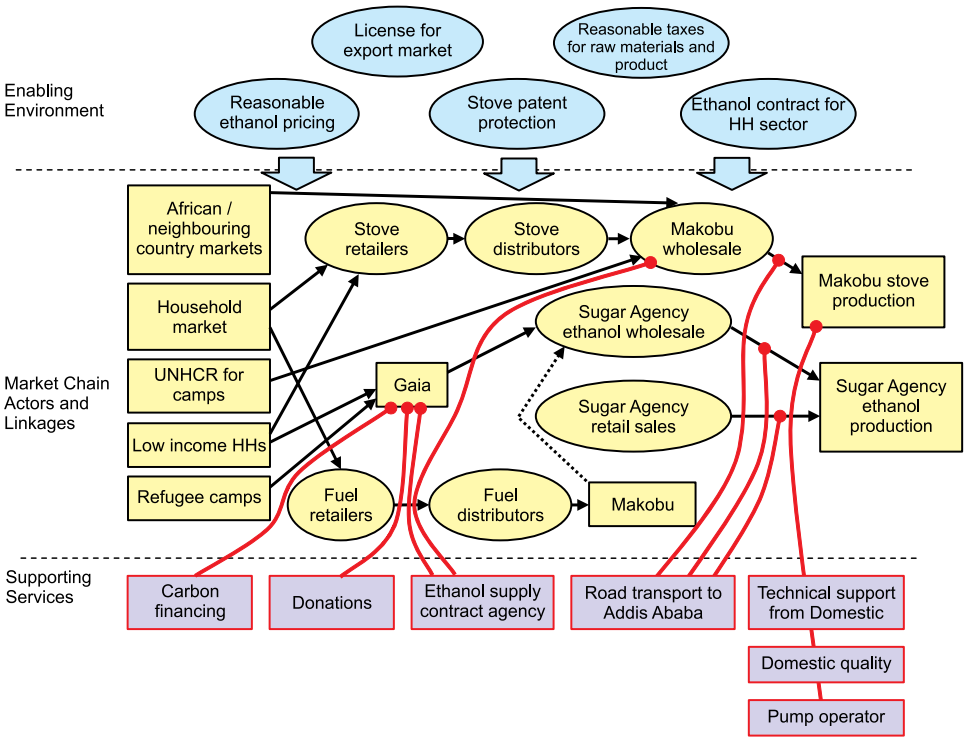
Results of a pilot study have showed that the project households readily accept the new cooking technology (called the 'CleanCook' stove), and ethanol fuel, and that ethanol could effectively substitute for kerosene, for charcoal and for fuel wood use, where the cooking task could be completed with the ethanol stove. Thus, ethanol could provide a new fuel to households, with the potential to mitigate household energy scarcity while increasing stove safety and reducing indoor air pollution.

In 2007, the Gaia Association was formed as an autonomous Ethiopian registered NGO. It began working with a private sector partner to facilitate local manufacture of CleanCook stoves, to reduce the cost of the stove to Ethiopian consumers. Work with the private sector partner is financed by the partner, Makobu Enterprises PLC, and by a 'commercialisation grant' from the United States Environmental Protection Agency (USEPA) under its Partners for Clean Indoor Air (PCIA) programme. This effort is also being assisted by Project Gaia, Inc., a U.S. donor-supported non-profit agency.

The Initiative Market Map

With respect to the enabling environment, the Ethiopian government has determined that locally manufactured ethanol will be used solely within Ethiopia, thus assuring domestic supply. Gaia Association has worked closely with the government and the sugar agency to ensure a reliable supply chain for the fuel.

Ethanol supply at a reasonable price, and realistic taxes on raw materials and goods are an essential part of the enabling environment for the ethanol stove market in Ethiopia. The current 8 million litres ethanol production in the country is not yet enough to cover the



large household market, but the country has a promising ethanol production plan for the coming years through expansion and the construction of new distilleries. According to the Ethiopian Sugar Agency projected annual ethanol production will reach 128 849 000 litres in the next four years from the current 8 million litres. This annual production of ethanol will serve both the households and the transport sectors.

In terms of supporting services, Makobu stove production is supported technically by the original stove manufacturer Dometic AB, a longstanding Swedish company, for consistent product quality. The patent of the stove will be protected so that investments made in stove design and the manufacturing plant will not be jeopardised.

Makobu enterprises has imported and sold stoves for the last five years, and is now starting to produce stoves locally in a custom-built new factory 80Km from Addis Ababa, supported by Dometic. A wholesale outlet in Addis Ababa enables different institutions and retailers to purchase stoves from Makobu wholesale. These include the UNHCR for its refugee camps, and distributors within Ethiopia and in neighbouring countries. Gaia Association purchases stoves from the wholesale market, whilst households in Addis Ababa, and other cities within the country, purchase stoves from retailers and the retailers from the local distributors.

Stoves purchased by Gaia Association will be used for subsidised sales. As ethanol burns very cleanly, Gaia is currently in discussion with carbon financiers about finance to allow the stove to be subsidised for those living in poverty. Low-income households in Ethiopia will get stoves at a subsidised price from Gaia. Gaia subsidy will be covered by carbon finance and donations.

Relationships between Market Actors

	Gaia	Makobu	Dometic AB	Ethiopian Sugar Agency	UNHCR
Gaia					
Makobu	**Excellent -** formal				
Dometic AB	**Excellent -** informal	**Excellent -** formal, technical,			
Ethiopian Sugar Agency	**Excellent -** formal	**Poor -** informal	None		
UNHCR	**Excellent -** formal, financial	None	None	**Excellent -** informal	

Gaia Association has been working with Makobu Enterprises PLC to produce CleanCook stoves in Ethiopia for around five years. The two partners have a bilateral agreement that has helped them to work on establishing a local stove manufacturing plant.

The partners have have a mutual fund from USEPA (United States Environmental Protection Agency) to further the stove production and commercialisation of the stove. Gaia and Makobu are working closely in advocating ethanol for household energy.

Dometic AB is working with both Gaia and Makobu on patent rights, stove redesign for adaptation, and local manufacturing. Gaia has had an excellent relationship with the Ethiopian sugar agency (responsible for production and distribution of ethanol) for the past four years.

Gaia has been contracting ethanol from the sugar agency for pilot studies and projects in the refugee camps. Now Gaia is working to sustain and strengthen this relationship and also to strengthen Makobu's relationship with the agency. Makobu's strong relationship with the agency is necessary to enable Makobu to be a future wholesale ethanol buyer.

Gaia has a formal Implementing Partner relationship with the UNHCR liaison office in Ethiopia to supply CleanCook stoves and ethanol in the refugee camps. UNHCR will continue to buy stoves produced locally, and this will initiate a relationship with Makobu. UNHCR has a very good relationship with the sugar agency, and has greatly assisted Gaia's advocacy of ethanol for household sector.

Balance of Rights, Responsibilities and Revenues of Market Actors

Gaia Association has the responsibility to work towards promoting and allocating ethanol and the ethanol fuelled CleanCook stove for household energy. The Association has promoted its pilot study results in Addis Ababa and the success of the project in refugee camps over the past two years. Makobu Enterprises produces CleanCook stoves and distributes ethanol allocated for household energy, penetrating the market through Gaia Association's promotional work. Gaia Association and Makobu Enterprises have signed an agreement detailing the responsibilities of each entity in achieving their shared goals. Dometic AB will provide technical know-how needed by Makobu to produce CleanCook stoves.

The Ethiopian sugar agency ensures a sufficient amount of ethanol is allocated for the household sector through contracts with Gaia and Makobu. UNHCR is responsible

	Rights	Responsibilities	Revenues
Gaia	-Using ethanol for household in different project sites	-Promoting ethanol for household energy -Advocating to secure ethanol for household energy	-Donations -Carbon financing
Makobu	-CleanCook stove production and selling -Ethanol distributing	- Plant construction for stove manufacturing -Supplying CleanCook stoves and ethanol	- Income from CleanCook stove sales - Income from ethanol distribution -Carbon financing
Dometic AB	-CleanCook stove patent right	-Technical support to Makobu	-Income form patent transfer to Makobu
Ethiopian Sugar Agency	- Selling ethanol	-Ethanol allocation to household sector	-Income from sale of ethanol
UNHCR	-To get supply of CleanCook stoves and ethanol in the refugee camps	-Stove and ethanol purchase for refugee camps from Makobu and Sugar Agency	-Clean and safe energy to the refugees

for buying stoves from Makobu Enterprises through Gaia Association for its Clean and Safe Energy programme in the refugee camps. UNHCR and Gaia Association signed an agreement that has been renewed every year in January starting from 2006 to implement the program in the refugee camps.

Gaia Association has the right to use allocated ethanol for its promotional projects in Addis Ababa and refugee camps so that ethanol and the CleanCook stove is promoted widely. Makobu Enterprises will have the opportunity to produce CleanCook stoves exclusively in Ethiopia and to distribute ethanol allocated to the household sector. Dometic AB will have its patent right for the CleanCook stove protected, while Makobu produce the stove locally. The sugar agency has the right to sell ethanol at a price it determines will enable Ethiopian households to use ethanol for cooking. UNHCR will have the right to get CleanCook stoves and ethanol from the local market for the refugee camps.

Gaia takes the risk in promoting ethanol for household energy and convincing the sugar agency in securing ethanol for household sector. Makobu takes the risk of erecting the plant for the stove manufacturing in a monopoly ethanol market.

Gaia Association and UNHCR are organisations which are not looking for profit; with incomes derived from donations, and carbon financing goes back to project sustainability either in the refugee camps or Addis Ababa. Makobu Enterprises produces stoves and facilitates ethanol distribution; the profit made keeps it in business for sustainable stove production, employment, and ethanol distribution. The Ethiopian sugar agency produces and sells ethanol; the profit made keeps it in business also. Dometic AB gets income from stoves sold by Makobu for a pre-agreed period of time.

As Makobu, Dometic AB and the sugar agency are profit-making companies, they make investments taking the risk of market competitiveness in the existing fuel market of Ethiopia. Gaia also makes investments in stove production, taking the risk of ethanol supply and market competitiveness to realize clean and safe household energy in Ethiopia.

UNHCR takes the least risk, but requires a sustainable reasonable price of ethanol as its only investment is in purchase of ethanol stoves.

Analysis of Livelihoods Outcomes

The project has brought change to the lives of Ethiopians and refugees through creating clean indoor air, stove production jobs, reducing deforestation, new jobs in ethanol distilleries and finally stove and ethanol distribution.

The refugee camps in the Somali region of Ethiopia have already started to value all the benefits of the project. The ethanol distillery at the Finchaa sugar factory has already created job opportunities. Three other new distilleries are in the process of starting up production of ethanol, which will ultimately create many more job opportunities.

When households start to use ethanol in Ethiopia, the country will save foreign currency on kerosene. Stove and ethanol distribution chains will have significant job opportunities for many people. A successful full project scale up of the Gaia/UNHCR project in Kebribeyah refugee camp already demonstrates the project benefits.

Kebribeyah refugee camp is located in the Eastern part of Ethiopia, some 650 km from the capital Addis Ababa, in the Somali region. The UNHCR Kebribeyah Camp, established in 1991, accommodates approximately 17 000 Somali refugees, representing various clans. The UNHCR, who are implementing partners with the Ethiopian government, work together to meet the needs of the refugees. The refugees get a ration of food every month according to their family size, and other needs such as a health facility, schools, housing and recreation centres are being supplied by UNHCR partners.

The refugees were formerly collecting firewood to meet their household energy needs. In some cases, refugees would sell their rations to buy charcoal for cooking. Due to firewood collection from the nearby forests, the area had become deforested, and since mostly women and children collect firewood, they were forced to face physical attacks and in some cases rape while they travelled long distances from their homes. As well as causing deforestation, firewood collection has caused tension between the local and refugee communities about the already scarce firewood in the area.

After completing a pilot study in the camp, Gaia introduced CleanCook stoves and ethanol throughout Kebribeyah camp. The consecutive scale-ups consisted of 1 790 refugee families in Kebribeyah and 800 in the newly-opened Awbere refugee camp.

According to a study conducted by the Ethiopian Rural Energy Development and Promotion Centre, each household in Kebribeyah used on average nearly 400kg of wood every year for cooking. This has been reduced in each of the 1 790 households by 93% after Gaia Association introduced clean burning ethanol stoves.

Women had to travel an average of 8 km to collect firewood before being introduced to the new cooking technology; this has now been reduced by 73%. Conflicts with local people and attacks are also reduced.

Indoor air pollution tests facilitated by Gaia Association under the leadership of University of California, Berkley revealed 94% and 79% reduction in kitchen concentration of Particulate Matter (PM) and Carbon Monoxide (CO) respectively.

Case 8 – India Jatropha Electrification

Initiative Name	*Remote Village Electrification through Biofuels*
Location	*Ranidehra, Kabirdham district, Chattisgarh.*
Initiation date and Duration	*October 2004 – September 2009*
Project Initiator	*Ministry of New and Renewable Energy , British High Commission (BHC) & SDC*
Overall Budget	*$ 88 889 US*
Energy output	*Generating Capacity: 3* 3.5 KVA with 7.5 KVA Back up capacity*
Area of Land Under Cultivation	*44 000 saplings planted along Road side and farm bunds.*
Beneficiaries	*107 households, 535 tribal people belonging to Gond and Baigas Community.*

Introduction

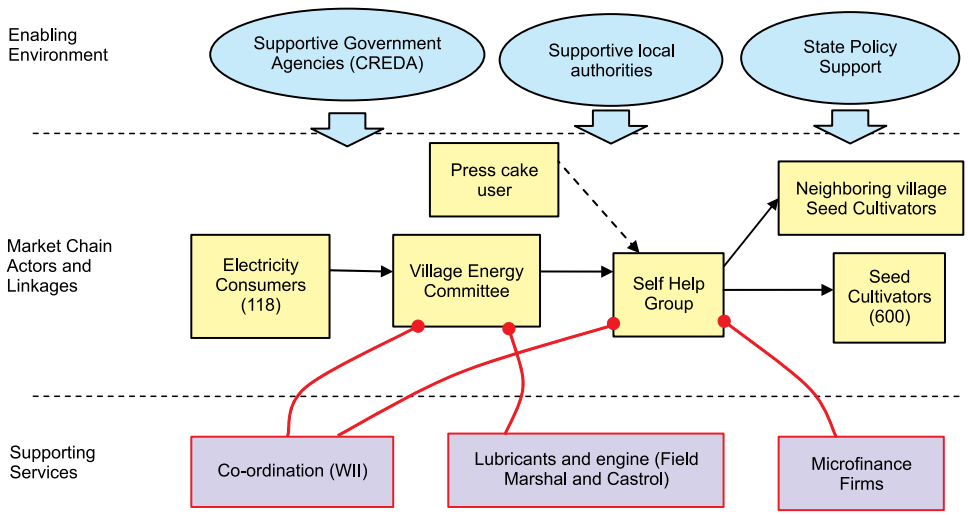
There is a large disparity in the usage of energy in the world and while per capita utilisation of energy is high in developed countries in many developing countries like India the remote rural areas are deprived of any form of energy source. Over 2 billion people around the world do not have access to "modern" forms of energy such as electricity and liquid fuels. In India, the Rural Electricity Supply Technology (REST) mission of the Ministry of Power (MOP) envisages "power for all" by 2012. The mission targets 100% rural electrification but only 43.52% of rural households have access to grid power according to the 2001 census. The electricity supply is also characterised by frequent black outs and erratic voltage levels. Energy supply to urban areas gets prime importance. Use of renewable energy sources could be instrumental in mitigating energy poverty and improving socio-economic conditions of rural people, especially in remote rural villages where extension of the grid is unviable.

However, in spite of various initiatives by the Government, renewable energy technologies are far from mainstreamed. The major barriers include: limited financing to defray high up-front costs associated with developing renewable energy projects; entrepreneurs' unfamiliarity with how to structure commercially viable business; tough competition from subsidised conventional energy sources that lower the market price for electric and thermal power; market penetration costs; and at times, a less than conducive policy environment1. Nevertheless, rural electrification through unconventional energy sources is gaining prominence and needs a coordinated effort among various stakeholders to make it a viable option. A leading effort is the initiative of Winrock International India (WII) to electrify one remote tribal village through the use of biofuel using non edible oil derived from tree borne oil seeds in the state of Chattisgarh.

The objective of this initiative was to demonstrate the technical and financial viability of running diesel generation sets using vegetable oil as fuel in place of conventional diesel to provide electricity in remote villages. The initiative aims to build upon an existing initiative of WII/Ministry of New and Renewable Energy (MNRE) by designing and implementing a replicable model of remote village electrification via biofuels. The project village, Ranidehra is in the Kabirdham district of Chattishgarh. The district is surrounded

by Dindori in the north, Bilaspur and Durg in east, Rajnandgaon in the south and Balaghat in the west. Ranidehra is a predominantly tribal village (Gond and Baigas community) of 110 households. These tribal communities depend on agriculture a s their livelihood. Non Timber Forest Produce (NTFP) trade and wage labor are the alternatives to agriculture. 46% of the population practice subsistence agriculture. The village is underdeveloped owing to its poor connectivity, high tribal population and primitive agriculture practices.

The Initiative Market Map



Recognising the difficulty in energy access of the remote village and to foster self sustainability, WII with the support of MNRE and BHC set out to illustrate the direct use of Jatropha oil for rural electrification. With the assistance from the Kabirdham district Administration, WII selected Ranidehra as the most suitable site to experiment. Field Marshal had provided the necessary equipments and Castrol India supplied the lubricant that enabled the use of conventional diesel engine with some necessary modifications to produce electricity. The project initiation phase had required some serious efforts to convince the local community about the project feasibility. A series of community mobilisation efforts and awareness generation camps resulted in the formation of a Village Energy Committee (VEC) and a women's self help group in the village. VEC had decided to undertake Jatropha plantations in the barren land, private farm bunds, kitchen gardens etc. Successively, 24 000 Jatropha saplings were planted in the first phase and 20 000 in the second. Villagers put together Voluntary labour to plant the saplings and WII granted the sapling costs. The saplings were sourced from the Forest Department. The land for the establishment of power house has been leased to the VEC by the district officials on request from the local panchayat. The power house comprise of an oil extraction section, a power generation room, a rice de-husking chamber, a power distribution room and a

large storage area for Jatropha seeds and food grains. The oil extraction section comprises of an oil expeller and filter press. The power house is strategically located so as to enable equitable power distribution and equidistant transmission line extension to the hamlets and easy accessibility. The power house also serves as the place for village meetings. Active dialogue and negotiation is going on to provide the financial support from microfinance firms who would support the woman self help group in providing the necessary funds to purchase the food crops which are in turn stored in the power house for selling in conducive market situations. The power unit uses 1 tonne of oil seeds per month for 3 hours of domestic and 3.5 hours of street lighting per night. The demand of 1 tonne of seeds for power generation is not currently met through local production from Ranidehra and neighbouring villages. WII provides the necessary funds to purchase seeds from open market to fulfil the total requirement. As the plantation is too young to bear fruit and in some cases thick undergrowth and threat from poisonous snakes has made collection of fruits a daunting task.

The by products, the press cake, is sold in the open market as a domestic fuel and to fuel small scale commercial ventures like brick making etc. CREDA. is testing the possibilities of using the press cake to generate biogas. Use of press cake as green manure is still under scientific scrutiny owing to uncertainty as to its possible toxicity.

Relationships between Market Actors

	Seed Collectors	Self Help Groups	Village Energy Committee	Electricity Users	Equipment and Lubricant	WII
Seed Cultivators						
Self Help Groups	**Good**, Formal Financial					
Village Energy Committee	**Good** Formal	**Good** formal				
Electricity Users	**Good** Formal	**Good** Formal	**Good** Formal			
Equipment and Lubricant Provider	**Good** Informal	**Good** Formal	**Good** Formal	**Good** Informal		
WII	**Good** Formal	**Good** Formal	**Good** Formal	**Good** Formal	**Good** Formal	

The initiative brought a successful partnership between WII, equipment and lubricant provider. The experiments undertaken in WII were directed to use Jatropha oil in conventional diesel engines as fuel instead of converting into Biodiesel. The pilot trials with technical support from PM Diesels (Field Marshal) and Castrol India ltd confirmed the successful utilisation of Jatropha oil directly as fuel. Further, community mobilisation effort by WII established Village Energy committee (VEC) for the proper administration, accountability and accounting of the initiative. VEC is a registered body consisting of 14 members including 6 women. The members are representatives from the local community

and are elected to the committee. Seed collection operation is monitored by VEC while woman self help group assists VEC in seed collection.

The Village Energy Committee (VEC) takes care of all the energy operation activities. Electricity users pay the VEC in cash monthly for energy usage. Rs. 20 ($0.44) per 11 Watt Compact fluorescent light bulb and Rs. 30 ($0.67) per plug point is collected from the villagers. The villagers also benefit from the rice de-husking machine which charges Rs. 25 ($0.55) per 50 kg of Rice where as it costs Rs. 70 ($1.55) for the services of the nearest rice mill in the town.

Balance of Rights, Responsibilities and Revenues of Market Actors

Actors'3 Rs'	Rights	Responsibilities	Revenues
Seed Collectors	- Land rights for cultivation	- "Caretakers" of the land and natural resources	- Subsistence from the seed - Selling of the food crop.
Self-Help Groups	- Involvement in the decision making process - Access to the Electricity on regular payment	- Procurement and collection of seeds and food crops	- Income from selling seeds to the VEC and food crop in the open market - Microfinance transactions
Village Energy Committee (VEC)	- Decision for power connection and disconnection. - Decision on Electricity tariff - Timing of Electricity distribution	- Electricity Bill collection - Conflict resolution among village level stake holders - Providing salary to equipment operators - Attending to complaints & suggestions on power usage	- Electricity tariff - Lending space of power house as temporary storage of food grains. - Income from rice de-husking - Village fund
Electricity Users	- Access to the energy produced	- Using electricity efficiently	- None from project
Equipment and Lubricant Provider	- None towards the project.	- On time delivery of equipments and lubricant - Monitoring the quality of the oil to the optimum standard.	- Selling of the lubricants and machinery
WII	- Choosing the technology - All financial related matters	- Village Institution building - Community mobilisation - Rural energy planning - Information dissemination & Training,	- Grants from donors

The cultivation of the crop is done on private land and also on road sides. The demand and supply of the seeds is currently unsustainable as the production is not adequate to meet the demand. Therefore increasing production, the area of the plantation and improving management are priorities moving forward.

Self-Help Groups appear to supplement and share the responsibilities of VEC well. The financial aspect is managed by WII. To improve the agricultural productivity, WII has also undertaken soil and moisture conservation activities in the village.

Analysis of Livelihoods Outcomes

Financial Capital

The money collected from tariffs and rice de-husking services are deposited in the VEC bank account. This suffices the requirement of money to pay salary for the power plant operators and incidental expenses in maintenance of the power plant. Efforts are going on to use the press cake for briquetting and its safe use in the eateries which would be added income and help to reduce the power tariff. In future, the VEC and the Self Help Groups would be associated with micro finance institutions thus diversifying the income sources. The initiative brought alternative livelihood options to the village. The village depends on Non Timber Forest Produce like Sal (*Shorea robusta*) and Tendu (*Diospyros melanoxylon*) leaf trading on a large scale. Increase in the duration of light helped to selective grading and packaging of the material thus contributing in their income. Now, the farming community can spend more time in agriculture related work. Increased duration of street lighting helped business in the shops as people can venture out into street at night. WII initiative provides an opportunity to utilize the available time in efficient manner which leads to increase in income.

Human capital

The series of trainings and capacity building exercises helped to build local technicians who can maintain and carry out minor repairs in the machinery. Woman folk can finish the house chore like cooking etc. and spent some quality time with family. This also imparted other income generating activities and quality of life improved. The school going children could spend more time reading hence increasing the intellectual capacity. Village meetings are organised regularly and this facilitated dialogue among villagers and possible solution of other issues for village development

Social capital

The community mobilisation effort put together by Winrock yielded increased awareness among the villagers. The community shows immense interest in the project and there is steady increase in ownership feeling towards the project.

Physical capital

The project established a power house in the village and transmission lines. The funds generated through the project would lead to establishment of infrastructure in future. Many villagers have now television sets for entertainment and information.

Natural capital

The soil and moisture conservation works helped to reduce the surface flow and increased periodicity of water availability for Agriculture. Press cake may be used as manure in near future after ruling out possible toxicity to crop thus completing the nutrient cycling.