Overall Conclusion

The project continues to evolve over time with weaker elements being addressed and improvements made. The saplings require a period of 4 to 5 years time to provide sufficient yield. However the saplings are yet to arrive at maturing stage and therefore the additional seeds are at present procured from the external market. Strategies are being deployed to undertake plantation to ensure constant and sufficient supply and of seeds in future. The likely technical sustainability of the project can be gauged from the fact that to date the operation of the power plant has been totally reliable without even one day of downtime in 18 months (from April 2007 to date) of running. The level of interest and feeling of ownership have been increasing steadily, not only among the VEC members, but also among the community. The villagers now feel the benefits of electricity in their lives and this drives them to work towards sustained management of the initiative.

The project is also working towards briquetting the jatropha press cake and its possible sale as fuel in nearby towns which would help in reducing the electricity tariff. Efforts are also underway to establish small business plans for the VEC and SHG groups which would open additional source of income.

The initiative establishes the idea of rural electrification through active community participation. The promotion of small scale village energy generation helps to boost the village economy by providing alternative livelihood opportunities. It also helps accessing clean and affordable energy source and maintaining the energy security of the rural community.

Case 9 - Biodiesel based Water pumping program in rural Tribal villages of Orissa

Initiative Name	Carbon-Neutral Biodiesel-fuelled Energy System (CNBFES) Project
Location	Mohuda, Berhampur, ORISSA, India
Initiation date and Duration	February 2004 and 5 years
Project Initiator	The Gram Vikas- CTxGreEn Biodiesel Project was initiated in February 2004 in Orissa with funding won from the World Bank Development marketplace (DM2003) competition
Overall Budget	US$ 230 300
Energy output	20 litres of Biodiesel produced that pump 285 000 litres of water per month in a 3.5 HP engine.
Area of Land Under Cultivation	5 Acres
Beneficiaries	52 Households of 3 Tribal villages. , Biodiesel based water pumping program in Tribal households.

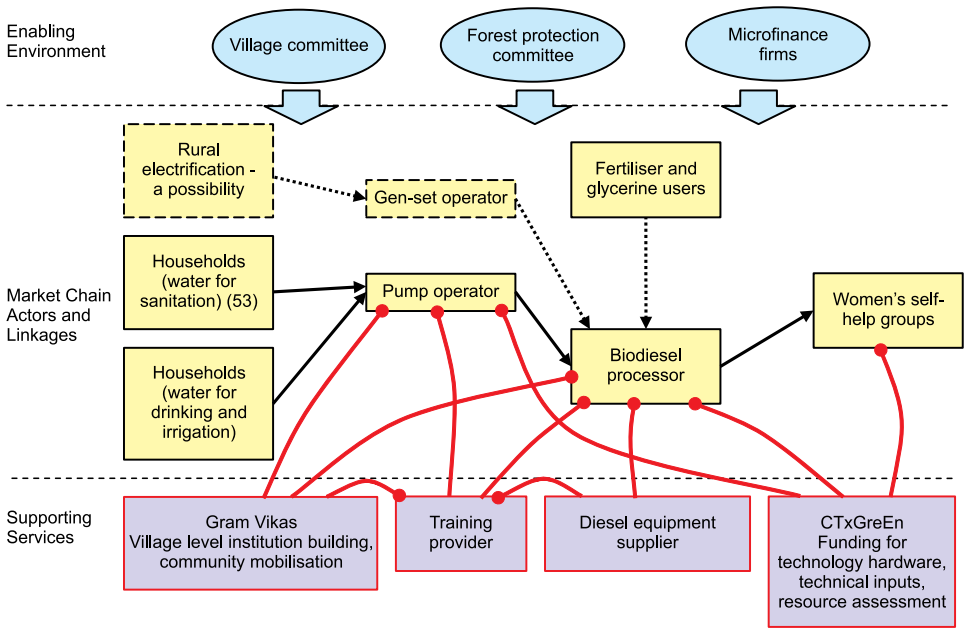
Introduction

Orissa occupies 4.87% of the total geographical area of India. The state occupies an important place in the country having a high concentration of Scheduled Tribe (ST) and Scheduled Caste (SC) populations. These are the groupings of Indian population explicitly recognised by the Constitution of India. Some Scheduled Caste groups are also called Dalits and some Scheduled tribes are Adivasis. Both Scheduled Tribe and Scheduled Caste constitute nearly 38.66% of the total State Population (ST: 22.13% and SC: 16.53% as per 2001 Census). The biodiesel-based water pumping project is being implemented in the remote and tribal belts of two neighbouring Ganjam and Gajapati districts of Orissa. Agriculture is the main source of livelihood in Gajapati district. Gajapati is sparsely populated (120 people per km2) and has steep hilly mountainous areas, which are poorly connected and offer a difficult existence for the communities living there. 50% of the population of 0.5 million in Gajapati district are Tribal1. The tribal population in Ganjam district is less than 20%. The biodiesel project, a collaborative venture between the Canada based CTxGreEn and Gram Vikas is in the most remote and non-grid villages of Ganjam and Gajapati districts. CTxGreEn is a Canadian team of technical experts dedicated to promote community based clean and green energy technologies. Gram Vikas is a voluntary organisation that has been working since 1979 to bring about sustainable improvement in the quality of life of poor and marginalised rural communities - mostly in Orissa through Rural Health and

Environment Programme (RHEP) and as a part of Integrated Tribal Development Programme (ITDP). Part of their mission is the provision of safe drinking water and sanitation, creation of adequate rural infrastructure and capacitating the natural as well as human resources for secure livelihoods. Gram Vikas initiated biodiesel based water pumping primarily for sanitation in 4 villages, and later on extended into critical irrigation of crops. The Mohuda pilot plant and training Center was established in May-June 2004. A biodiesel production unit was installed in Kinchlingi in November 2004 in Gajapati

district. The second initiative took shape in the twin villages of Kandhabanta-Talataila of Ganjam in December 2004 and the third in Tumba of Gajapati district.

The Initiative Market Map



The objective of the initiative was to provide water and sanitation services through a bio-energy system that eventually led to regeneration of land resources and improved livelihood opportunities. Most of the project villages belong to the Sauras, an indigenous shifting agriculture (locally called Bogodo) dependent community. Most of the villagers are marginal farmers with land holding ranging from 0.5 to 2 Acres. Villagers, mostly women, had been walked long distances and spend many hours to hand-pump household water each day. The present initiative is small-scale, biodiesel-fuelled equipments that allowed electricity production for water pumping and lighting. The biodiesel production unit uses the local underutilised seeds of *Pongamia pinñata, Madhuca indiaca* from Forest *and Guizotia abyssinica* (Niger) as feedstock. Alcohol (Methanol or Ethanol) and Lye (Sodium or Potassium Hydroxide) are used to convert vegetable seeds to biodiesel. These reagents are purchased in the open market. Niger is an indigenous oil seed crop widely adapted to varied soil conditions. It is commonly grown in India on poor soils or infertile hilly slopes. Villagers cultivate the community and fallow lands in and around the village to grow Niger seeds. Afterwards Agricultural bunds and kitchen gardens are also brought under plantation to supply adequate oil seed.

The significant aspect of the project is the use of non-edible oil to produce biodiesel in decentralised manner catering the energy need of rural poor people without affecting food production. It also discourages large-scale monoculture and endorses a stronger village economy. Biodiesel is produced through the process of transesterification in a

pedal powered reactor. The machines installed are for grinding oil seeds, pressing oil from seeds and getting biodiesel from the oil. Recently a Mafuta Mali Oil press from Kenya was included in the biodiesel technology package with minor adaptations to suit the range of Indian seeds. The press is hand operated while the grinder and biodiesel reactors are pedal operated. The local community uses the by-products, such as pressed oil cake and glycerine, as natural fertilizers and cattle/poultry feed. Biodiesel, thus produced can be stored easily and used as and when required in the regular pump or generator sets. The machinery set up runs by the volunteering method in the form of Sweat Equity (Sweat equity is the term assigned for the monetary value of labour work contributed and is equivalent to the opportunity cost). Each household provides a volunteer every month to run the unit. A base amount is fixed for each household for contribution to biodiesel production, production and collection of feedstock and chemicals as sweat equity. This method was developed as the community has limited liquidity to pay tariff for water. On a bi-monthly or weekly basis the reactor produces five litres to 20 litres of fuel in batches consuming 20kg and 80kg seeds per batch respectively. Kinchlingi village needs 11-13 litres of Biodiesel every month, which can be produced in 2-3 batches.

Relationships between Market Actors

	Equipment Supplier	Biodiesel Processors	Pump Operators	Microfina-nce Firms	Woman Self Help Groups	Forest Protection committee	Gram Vikas/ CTXGreen
Equipment Supplier							
Biodiesel Processors							
Pump Operators	**Good** Formal	**Good** Formal					
Microfinance firms	**Good** Formal	Financial	Financial				
Woman Self Help Groups	Formal	**Good** Formal	**Good** Financial	**Good** Formal			
Forest Protection Committee	**Good** Informal	**Good** Informal	**Good** Informal	**Good** Informal			
Gram Vikas/ CTXGreen	**Good** Technical Formal	**Good** Technical Formal	**Good** Technical Formal	**Good** Financial	**Good** Technical Formal	**Good** Formal	

Women's self help groups act as savings and credit organisations, with support from microfinance firms, which generate additional income. The self-help groups are trained to play an active roll in all aspects of seed collection, processing and fuel use. A core team of staff members was created to support the operational training at village level and to train the maintenance personnel. The demonstration and laboratory unit of Gram Vikas functions as the nucleus of Training and capacity building. Biodiesel recipes have been developed at the Mohuda pilot plant for Niger (*Abyssinca guizotia*) and Mahua (*Madhuca indica*), and training programmes are ongoing for dissemination to the village units. Work continues on standardising these recipes and developing others for

Karanja (*Pongamia pinnata*), Kusuma (*Schleichira oleosa*), castor (*Ricinus communis*), Neem (Azadirachta indica) and local varieties of Jatropha. The laboratory established at Mohuda carries out regular evaluation of the biodiesel produced in the village to ensure world biodiesel standards.

CTxGreEn anchors the funding for the technology hardware, and also for the resource assessment part where as Gram Vikas takes care of the institutional fostering and community mobilisation aspect.

Balance of Rights, Responsibilities and Revenues of Market Actors

Actors' 3Rs'	Rights	Responsibilities	Revenues
Forest Protection committee	- Forest usage rights through Forest Protection committee. - Legislate on forest usage and development	- Protection of the forest resources from Fire, Illicit cutting and poaching.	- Subsistence from the selling of Non Timber Forest Products.
Village Committee	- Decision making in resource management.	- Formulating Regulations for water supply and sanitation. - Monitoring and Evaluation of the project processes.	- Village funds from RHEP. - Tariff from Electricity usage and Water services. - Project contributions from funding agencies.
Biodiesel Processors	- Ensured supply of oil seeds.	- Equipment up keeping,	- Income from the sell of oil cake and Glycerin.
Pump Operators	- Right to the vegetable oil.	- Maintenance of the equipment.	- Subsistence from the operation.
Microfinance Firms	- Right to take appropriate actions under deferred repayments and similar other conditions. - Right in taking decision to fund a group or not.	- Providing the finance in time for the purchase of Alcohol, wash room construction and seeds purchase	- Financial relationship with Self help groups,
Woman Self Help Groups	- Right to the water and other by products. - Equal involvement in the decision making process.	- Procurement and Collection of oil Seeds - Cultivation of Niger seeds - Construction of the wash rooms and its maintenance - "Caretakers" of the land and natural resources.	- Savings and credits from the initiative. - Income from farm products
Gram Vikas/ CTxGreEn	- Formulating strategies as per the need during project implementation - Access to the Village energy committee registers, log books and project accounts. - Decision on the fiscal matters.	- Village level Institution building - Community mobilisation - Rural energy planning by survey, Forest Survey with the Community Forest Management group. - Information Dissemination, Training - Funding for the Technology hardware. - Technical inputs, Resource Assessment. - Setting up baseline on the target species that can be used as biodiesel feed stock. - Livelihood Analysis, Monitoring at watershed level - Promoting small scale enterprises on the byproducts like Glycerin for soap making	- None from the Project.

Use of methanol and ethanol in the production of biodiesel attracts the excise law that forbids any activity dealing with intoxicants under the legal and regulatory framework. The excise laws *per se* do not recognize the production of biodiesel from the perspective of alcohol. The use of absolute alcohol or rectified spirit (RS) / denaturated spirit (DS) in the production of biodiesel for the bona fide consumption of tribal village community in Scheduled areas is emerging as a policy imperative[6].

The raw material used is sourced from the forest. Access and use of Non Timber Forest Products (NTFP) used are subjected to the influence of The Orissa Timber and Other Forest Produce Rules, 1980, State Policy Resolution of Government of Orissa, Forest and Environment Department and Orissa Gram Panchayats (Minor Forest Produce Administration) Rules 20027. The current policy environment is favourable for the initiative. Around 68 forest species have been deregulated and hence are exempted from Transit permit requirements. But the state reserves the power to alter the list of regulated forest species. This is a critical concern for the forest produce based rural energy set up. So it is imperative to seek a formal notification from the state government ensuring protection from such state of affairs.

Analysis of Livelihoods Outcomes

Nutrient recycling is complete as the locally grown crop seeds and oil cake as green manure.

Human capital: The project prepared well trained rural bare-foot technicians capable of handling and maintaining the equipments. Knowledge transfer to improve the Niger yield and procurement and collection of healthy forest seeds were also carried out.

Natural capital: Water availability through irrigation supports improved agricultural productivity. Slash and burn agriculture (Bogodo) is being substituted by multi crop organic agronomic practices. A seed bank has been established to preserve precious germplasm and enabling sharing of local knowledge among villagers.

Social capital: The community mobilisation work yielded dividends in terms of a work force that made the project work successfully. Establishment of Village committees and women-centred self-help groups brought much needed self sustainability strength. Cross-learning and knowledge exchanges helped in sharing and documenting of tribal experiences on seed/fruit collection, storage, and processing of seeds.

Physical capital: The biodiesel pump set and gen-set have been commissioned and installed in the village. The full operational water tank in every project village becomes the testament of successful convergence of a simple eco-friendly technique with community participation.

Financial capital: Biodiesel from non-edible oil seeds when implemented in decentralised manner leads to stronger village level economies. It minimizes cash out flow and creates more jobs in the neighbourhood. Optimum use of land and water resources ensures food and fuel production in tandem without disturbing the ecosystem linkages. Micro finance linkages to the project strengthened financial affairs and might be a lucrative option for green investors and Carbon Trading.

CTxGreEn foresees potential in producing alcohol (Methanol/Ethanol) locally using underutilised fruits through the up gradation of traditional tribal alcohol manufacturing technique that will make the initiative cost effective.

Overall Conclusions

For the villager, the best technology is one that produces the fuel easily, which is stored for use as and when required, has the lowest capital investment, maximizes local value addition, minimizes cash outflow from the village economy and restores the natural resources sustainably7. This project has many implications that extends into wide-scale rural electrification, biodiesel-fuelled gen-sets, farm tools, battery-banks and battery-powered LED lighting. Promotion of micro-enterprises for making glycerine based soap is a near fulfilled target. There are several challenges that delimit large-scale implementation. Fragile village level institutions, vested political interest, the absence of strong local level governance (like Panchayat) are some of institutional challenges. Existing complex legal enforcement in accessing Non Timber Forest Products and excise laws debars promotion of village level energy generation. There is a paradigm shift necessary in the state policy to enable and encourage such small scale energy vis-à-vis livelihood self sufficiency initiatives. Land tenure rights are poorly established in the backdrop of fragmented communal land holdings. Often distress selling of oil seeds for instant cash is observed among poverty stricken tribal people, and the influence of money lenders cannot be ruled out. The local oil mills are in direct competition for the raw materials. The project has established the technical feasibility, promises sustainability and also reiterated that when used as a community tool for productive livelihoods, there will be enough fuel in addition to sufficient food.

Case 10 - Sri Lanka Spice Drying

Initiative Name	*Bio-energy dryer for spice drying in rural Sri Lanka*
Location	*Kandy, Sri Lanka, South Asia Region*
Initiation Date and Duration	*2005 to date*
Funder(s)	*National Agribusiness Council, UNDP/GEF, USAID, Regional Economic Advancement Project, Matale*
Project Initiator	*Alliance for Appropriate Technology Exchange (AfATE), Kandy*
Overall Budget	*$ 5 460 received from UNDP and National Agribusiness Council,*
Output	*Depending on the size, the burner consumes 4 -8 kg of wood pieces per hour producing 15-33 kW of heat. Dryers come in 3 different sizes, with the capacities to dry 220 kg – 400 kg of green pepper in one batch during 12 -18 hrs.*
Area of Land	*Not applicable*
Beneficiaries	A total of 19 dryers are in operation and 5 more are under construction. These dryers are mostly being used by spice growers in Kandy district. The Small Spice Growers Association was formed by the dryer users (mainly 5) and has 52 members in clusters and additional 25 farmers also bring their spice to the society.

Background and Context

Nestling off the southern tip of India, Sri Lanka is home to around 20 million people and boast the highest per capita income in South Asia ($4 264). For nearly two decades, the island was scarred by a bitter civil war arising out of ethnic tensions. A ceasefire was signed in 2002, but it was undermined by regular clashes between government troops and Tamil rebels, and in January 2008 it expired.

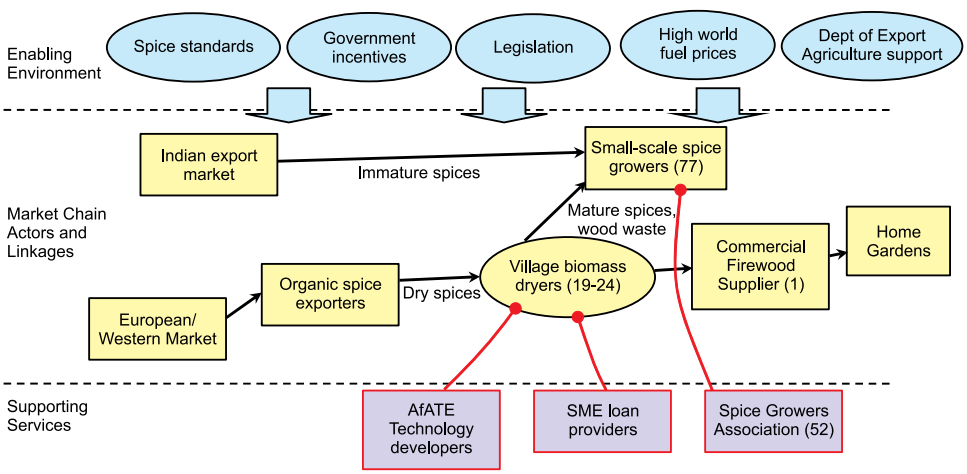
The Government of Sri Lanka's Energy Policy outlines specific targets and milestones for developing and managing the energy sector in the country. Specifically, new initiatives are included to expand the delivery of affordable energy services to a larger share of the population, to improve energy sector planning, management and regulation, and to establish biomass as a significant source of commercial energy.

Occupying an important place in the path of major sea routes, Sri Lanka is one of the world's leading producers and exporters of spices. While the country's most prominent export might be tea, historically the most important has been spices such as Cloves, Cardamom, Pepper, Nutmeg, Mace, Ginger and Cinnamon which have been grown, processed and exported on a large scale dating back to antiquity. Spice processing is a fine art of preserving the product while keeping its aroma and colour intact. Spices have to be dried at suitable conditions to avoid fungi attacks and mixing with impurities. Moreover, the quality of dried spices is a vital factor in the export market. The Department of Export Agriculture speculates that the stringent quality requirements would harm Sri Lanka's export potential drastically in the future if current practices of spice production are not improved. Application of proper drying technologies is key to this improvement but has yet to be achieved. This is not down to a lack of technologies per se, but because of a mismatch with the needs and

requirements of the majority of farmers. The prices, capacities, and operation costs of existing dryers (such as oil or gas fired dryers) do not match the production volumes or the affordability of farmers.

In order to address the need for an appropriate spice dryer for rural communities in Sri Lanka, the Alliance for Appropriate Technology Exchange (AfATE) developed and patented an innovative wood-fired dryer in 2005-06. This has been constructed after a year of research and development work undertaken by the AfATE and University of Ruhuna with financial support from the UNDP and National Agribusiness Council. It has since been distributed as a commercial dryer, popular among medium to large scale spice producers and enterprises.

The Initiative Market Map



With the introduction of the biomass dryer by AfATE to village-level dryer operators, an opportunity for small-scale spice growers to diversify their client base and obtain higher prices for their products has been created. Previously, small scale growers were only selling immature spices direct to the Indian export market for quick income. Immature spices are picked from the plant early on, can be cultivated much more quickly but achieve a lower market price for the growers. Immature spices are used for resin extraction and exported to India. As spice growing areas are located in wet zones prone to intermittent rains, the final product is usually of low quality. Growers are therefore unable to fetch high prices or access more lucrative markets. Mature spices which require a longer growing period and drying can fetch premium prices on the European and Western export markets. The biomass dryer helps growers and processors to achieve this objective. Spice growers sell mature spices direct to village dryer operators who then dry and sell on the spices to European and Western markets via spice export companies. A total of 19 dryers are in operation and 5 more are under construction. These dryers are mostly being used by spice growers in Kandy district.

One of the main advantages of the wood-burning AfATE dryer is the availability of processed firewood locally. There is one commercial supplier in the area who was

supplying cut and dried Gliricidia to a grid connected dendro power plant with a capacity of 1MW in the Central province- the only power plant of its kind in the country. The commercial supplier buys Gliricidia sticks from home growers, cuts and dries the sticks and then sells them on to the power plant. However, the power plant has been out of operation in recent times and the commercial supplier and small scale growers have lost income. The AfATE biomass dryers have now re-invigorated this supply chain. The commercial fire wood supplier has linked up with a Spice Growers Association, buying from home garden growers and is supplying fuel wood to village biomass dryers. The commercial supplier now has two casual employees to help meet increased workload.

It is interesting to note that fuel wood can be grown alongside pepper. Pepper is grown on a tree (usually on Gliricidia) and the branches of the support tree are pruned after harvesting. If not used for any productive use, these branches create extra burden for farmers, as they have to use paid labour to remove them from the plantation. Now, however, spice growers can sell these branches as fuel wood to biomass dryer operators and obtain additional financial income.

Relationships between Market Actors

	Small-scale spice growers	Commercial firewood supplier	Village biomass dryer operators	Home gardens	AfATE	Spice Growers Association
Small-scale spice growers						
Commercial firewood supplier	None					
Village biomass dryer operators	**Good** - informal, financial	**Average** - informal, financial				
Home gardens	None	**Good** - informal, financial	None			
AfATE	None	None	**Good** - informal, technical and financial	None		
Spice Growers Association	**Good** - informal, organisational	**Good** - informal	**Good** - financial	None	None	

The small scale spice growers have an informal relationship with the biomass dryer operators to whom they sell both spices and fuelwood.

The relationship betwen the commercial firewood seller and the village biomass dryer operators is not formal, but satisfactory and improving. Even though drier operators have the option of collecting firewood from their own plantations and through the small scale spice suppliers, the operators prefer the convenience of directly sourcing processed firewood

ready to use. Furthermore, given that firewood requires a large amount of storage space and protection from insect attacks (termites etc.), biomass dryer operators are now proposing arrangements for the firewood supplier to store products on their behalf and deliver as required to the various dryer locations. Though this arrangement is not in operation at the moment, at least one dryer operator is very interested in this arrangement.

The relationship between AfATE and the dryer operators is strong though it is not formal. Frequent visits by AfATE to monitor the machinery and providing technical help as necessary has developed confidence among users and has helped in generating more sales. Further, close and continuous monitoring has helped AfATE to design dryers of better quality and performance and to make them more user friendly.

AfATE does not provide any financial assistance to the buyers. Department of Export Agriculture provides financial assistance up to Rs. 100 000, depending on the capacity of the dryer, to the buyers to purchase (or recover the cost if the dryers are already purchased) the dryers. About 4 of them have already received this assistance, while several others have made applications. The buyers also approach banks or other financial institutions on their own. The higher prices the drier operators get for quality spices helps them to meet their financial obligations towards purchasing the dryer.

The spice growers association, pays the small producers a higher price when they purchase raw spices from small producers. The raw spices purchased from the small producers are dried using the dryer and the is sent to export market by the spice growers association.

Balance of Rights, Responsibilities and Revenues of Market Actors

Actors/ 3 R's	Rights	Responsibilities	Revenues
Small scale spice growers	- Grow spices - Land rights (they own the lands)	- Sell quality raw spices to dryer operators	- Sales of spices to biomass dryer operators and the Indian export market
Commercial firewood seller	- Collecting firewood from the village - Chipping and drying of firewood - Selling firewood chips	- Provide quality firewood on time at an affordable price	- Income from selling firewood chips
Village biomass dryers	- Drying spices for farmers	- Maintain the quality of final products	- Service charges from farmers
AfATE	- Manufacturing dryers	- Making the dryer cost effective	- Selling dryers to village dryer operators
Home gardens	- Collecting firewood from their gardens	- Collect firewood from villagers on pre-agreed dates on agreed price	- Income from firewood sales
Spice Growers Association	- Organize spice chain actors	- Lobbying for issues related to sector - Looking for better markets	- Membership fees
Department of Export Agriculture	- Limited regulation of export by sector	- Promote spice products to export markets	- Central Government funds

The Spice Growers Association has been a key player in promoting the quality of spices and assisting members to look for better markets. The Association was formed by the dryer users and has 52 members in clusters. An additional 25 farmers also bring their spice to the society. As a group, spice growers have increased bargaining power when approaching financial institutions to access credit facilities. This way, financial barriers presently encountered by individual processors in acquiring equipment are somewhat mitigated.

The Department of Export Agriculture plays an important role in promoting products in the export market but it does not have all the regulatory powers necessary to regulate the industry. Distortions are created in the market by certain traders paying high prices for immature pepper. Therefore, farmers tend to sell the produce early for quick cash, without waiting for another few weeks for spices to mature when they would fetch a higher price.

The firewood supplier buys Gliricidia sticks from the growers at $ 0.0091 per kg cut at their home gardens with approximately 60% moisture content or at $ 0.0136 per kg at the supplier's property. Dried and cut fuel wood (of 18-20% moisture) is sold at $ 0.05 per kg. The supplier uses a small machine to cut the sticks to the desired size (3 -4 inches, or 3 feet sticks), but does not use any other energy source to dry them. After cutting into pieces the sticks are left in a covered area to avoid getting wet due to rain and allowed to dry naturally. At present, the commercial fuelwood supplier is able to sell all the fuelwood he can obtain.

AfATE does not play a significant role in initiation of the fuel wood supplier's business, but whenever the dryer users seek assistance from AfATE the organisation directs them to the fuel wood supplier. AfATE is an NGO.

Analysis of Livelihoods Outcomes

In terms of **human capital,** biomass dryer operators now have knowledge of and access to a new technology which is fuel efficient and lowers costs of production. This new technology is subject to further research and development thanks to AfATE's engagement with dryer operators. Demand for dryers are now coming in from other similar industries.

The Spice Growers Association is the key **social capital**. The biomass dryer has improved the reputation of the Association as a good quality producer among European markets.

The dryer is the most important additional **physical capital** this project has brought to the small scale growers as it enables them to process their produce in a shorter time period than the conventional way, ensuring better quality, also reduce wastage. Since no fossil fuel is used for drying in this way, the dryer is environmentally friendly.

The use of abundantly available fuel wood without risk of deforestation to forests and improved combustion helps to preserve **natural capital**. Since spice and fuel wood plantations can go hand in hand, this is a sustainable way of ensuring quality drying. Since there is always an excess of Gliricidia production in spice gardens, sustainable harvesting can be ensured.

Financial Capital has been increased for all actors in the market chain through improved product quality, as well as increased sales volume. The amount of cash handled by the spice growers and dryer users (they are also growers) has also increased with the usage of dryers.

Overall Conclusions

The AfATE biomass dryer helps small scale farmers to produce higher quality products and access important export markets attracting better prices and increasing financial assets. A chain of firewood supply has been created with the introduction of this intervention. Spice growers are now able to earn additional income from fuel wood grown alongside the spices.

The main successes of this intervention are the close association of the biomass dryer manufacturer (AfATE) with the users of dryers. This has led to improved technology and maintained dryer operators' confidence in the machinery. Furthermore, the emergence of the Spice Growers Association has enabled a collective approach to the sector specific issues at a local level.

Market distortions in the spice market by directing produce to other uses and lack of proper guidance and pricing mechanism in the fuel wood chain are the aspects to be considered for further expansion.

Escalating prices of raw materials for dryer manufacturing (e.g. stainless steel) affect also the affordability of the dryer by the small and medium scale operators/farmers.

Though the firewood is available in abundance, collection and processing involve costs and must provide clear profit margins in order to keep actors motivated. At the same time, pricing cannot be unreasonably high so as to negatively affect processing cost of spices. Therefore, a clear pricing mechanism for fuel wood is required to help safeguard the interests of all stakeholders.

Case 11 - Brazil Ethanol Micro-distilleries

Initiative Name	*PROJECT GAIA BRAZIL - "A model for a community owned and operated microdistillery to fuel cooking stoves in rural areas"*
Location	*Minas Gerais State, Brazil*
Initiation Date and Duration	*Test of fuels: October 2005 to June 2007* *Viability Microdistillery Study: July 2007 to December 2008*
Funders	*Shell Foundation and Dometic AB*
Project Initiator	*Project Gaia*
Overall Budget	*US$122.390,26*
Energy Output	*21 600 litres ethanol per year*
Area of Land	*7.5 hectares for ethanol, 1 hectare for "rapaduras"*
Beneficiaries	*90 families, users of CleanCook stoves*

Background and Context

Project Gaia is part of a global initiative created to promote the use of clean-cooking fuels, using ethanol, aimed at the poorest part of the population. In Brazil, the project aimed to evaluate the acceptance of clean-cooking fuels by domestic users in different urban and rural areas. The project also evaluated practicality, safety and economy.

Brazil has some of the most extensive experience in biofuels worldwide, owing to its National Alcohol Fuels Research Program (PROÁLCOOL) created to stimulate the production of alcohol fuels and reduce dependence on oil derivatives, and also thanks to research programmes run by automobile companies and the sugar industry.

The technology for large scale production of ethanol and the knowledge of small scale production, together with food production (alcohol and milk), attracted the attention of Project Gaia. In spite of the logistics and infrastructure constructed to facilitate access to Liquefied Petroleum *Gas* (*LPG*) – known as cooking gas – many rural communities, mainly in the north and north-east of Brazil, do not have access to LPG and continue using firewood as their main source of fuel. A key factor is the price per cylinder of LPG. From the creation of the Real Plan in 1994 (the government economic stability plan) Brazil had an accumulated inflation of 225.25% and an increase in the price of a 13kg cylinder of LPG of 639.51%. This contributed to the increase in the number of families returning to use firewood as their main source of fuel, reaching 38% in the first quarter of 2007.

The State of Minas Gerais was chosen for this project because of its historical use of firewood for boiling and for producing cachaça – a typical drink made from the fermentation of sugar cane with a 20% production waste. This waste occurs because, during the fermentation process there may be some kind of contamination, and also during the distillation due to the use of copper alembic stills. The resulting co-products can be harmful for human health, so it is common to separate the liquid that is obtained at the beginning and at the end of the distillation process.

In order to assess the acceptability of the CleanCook stove, communities with different profiles were selected, and fuel was supplied at an accessible price. This was necessary because of the high price of ethanol in fuel shops. Local partnerships were also considered. Three communities from the Minas Gerais State were selected: Salinas, in the north of the

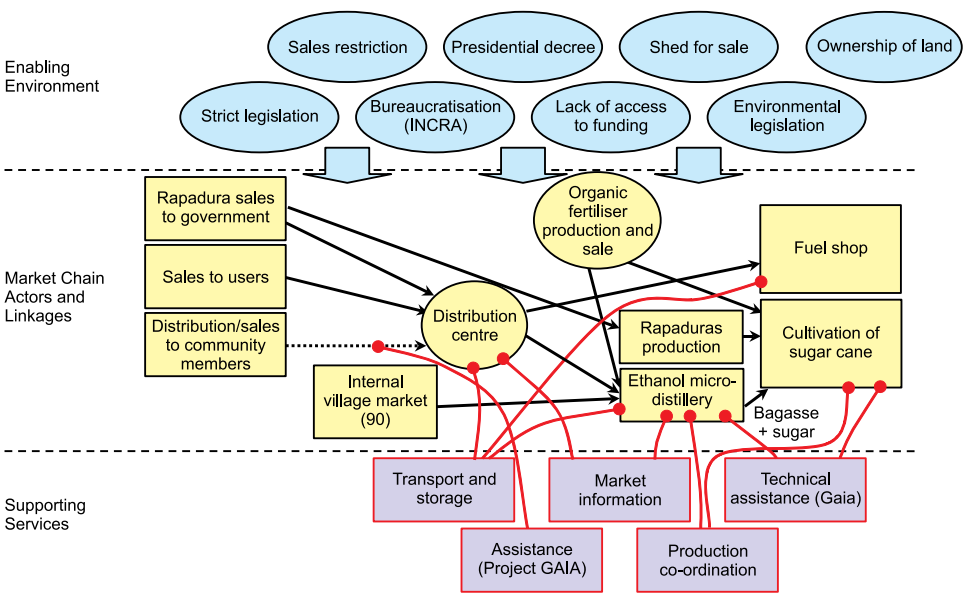
State, Urucania, in the central region (in partnership with the Jaticoba Mill that provided ethanol to families in rural areas), and Betim, in the metropolitan area of the state capital, in the Dom Orione settlement.

During the stove testing phase, until June 2007, Project Gaia received funding from the Shell Foundation and Dometic AB of Sweden, which donated the stoves. Today, Project Gaia uses its own resources, and has reached the dissemination of results phase, spreading information about the tests of the CleanCook stove in order to educate the market to sell stoves to the public.

Project Gaia Brazil began to study the technology and the feasibility of micro distilleries of ethanol (MDE) in order to promote access to low cost fuel, in addition to promoting the development of communities. Studies were based on existing micro distilleries, and Gaia are working on the implementation of a MDE in the Dom Orione settlement. There are 39 families at the settlement, most produce vegetables, and a small group works on the production of derivatives of sugar cane, and know the ethanol production process from MDE. All families have shown interest in the production of ethanol and can provide a small area for planting sugar cane.

The Initiative Market Map

It is important to mention that in the initial phase of tests of the CleanCook stove, Project Gaia donated the ethanol to the families, (with the exception of Urucania, where ethanol was donated by a sugar and alcohol plant). The price increased progressively until market price was reached, evaluating the buying and selling capacity of the families. Project Gaia was in charge of the distribution of ethanol. Due to the high price of ethanol, many families used the stoves less and this was crucial for the development of market research studies for



MDE. The model shown is in development for the settlement Don Orione in Betim, based on research in a micro distillery unit and also from other studies of Project Gaia.

During the tests with the CleanCook stove, Project Gaia created an ethanol distribution centre. The ethanol was purchased by Project Gaia at the fuel shop (initially, ethanol was purchased at gas stations) and transported to the distribution centre, where it was passed on to families. Families were visited by Project Gaia weekly in order to find out whether they were adapting well to the stove and the fuel, and to determine the benefits for these families.

As for the production of rapadura (a sweet solid product, obtained from the concentration of sugar cane, with high levels of vitamins and minerals), this activity already existed at the settlement Dom Orione in Betim, and Project Gaia offered support to improve the storage and coordinate the planting of sugar cane in order not to interfere with the future production of ethanol (Currently, Project Gaia has about 5 hectares of sugarcane plantations and the new plant will start production in February. 80 hectares of sugar cane can be planted without harming other crops). The rapaduras currently produced are sold to the local government in a program called "Direct Buy" and are donated to local nurseries, to be served as a food supplement for children up to 6 years of age. Considering the production of ethanol, Gaia have projected to provide technical assistance to EMATER - Technical Assistance and Rural Extension Company of the State of Minas Gerais – in the cultivation of sugar cane. Project Gaia will assist in the production of ethanol and help in the coordination of MDE, until they are able to manage the business, from production to final sale.

Relationships between Market Actors

	Stove Users	Posto Combustible	Local Government	Community Members	Ethanol Producers	EMATER	INCRA	Project Gaia
Stove Users								
Posto Combustible	**Good** Formal							
Local Government	None	None						
Community Members	**Good** Informal	**Good** Formal	**Fair** - formal					
Ethanol Producers	**Good** contractual	**Good** Formal	**Fair** - formal	**Good** Informal				
EMATER	None	None	**Good** Contractual	**Good** Contractual	**Good** Contractual			
INCRA	None	None	**Fair** - formal	**Fair** - contractual	**Fair** - formal	**Good** Formal		
Project Gaia	**Good** Contractual	**Good** Contractual	**Good** Formal	**Good** - Formal	**Good** Contractual	**Good** Informal	**Fair** - formal	

During the testing phase of the CleanCook stove, Project Gaia was in charge of all intermediation of the purchase and sale of ethanol at the fuel shop. Stove users seek ethanol at the local distribution centre, coordinated by Project Gaia. The local government's involvement with the project was to put Project Gaia in touch with the communities.

During the implementation phase, the MDE will be installed in an area of common use of the 39 families of the settlement. Currently, most families produce vegetables but have an area for the cultivation of sugar cane. From these, 15% are directly involved in the production of rapaduras, and will be responsible for the production of ethanol, as they are already familiar with the process, and 33% are already planting sugar cane. In addition to the 39 families from this settlement, other families from the area will also receive a CleanCook stove unit, and will have access to purchase ethanol at a reduced price, with a monthly limitation. These families will have a contract with Project Gaia and will be registered in the MDE. As the market for stoves grows in the area, other families will be included in the project through contracts and registration in the MDE. In this set-up the local government will be more closely involved, because this institution is accredited to provide environmental licensing for MDE. They could also provide information on families who have no access to energy, so that they receive the stoves. The Institute of Colonisation and Agrarian Reform (INCRA) will monitor the program as it is the federal agency responsible for settlements, and in spite of being very bureaucratic, it has an interest in the generation of income in the settlements. The Technical Assistance and Rural Extension Company of the State of Minas Gerais (EMATER) is a State Government organisation with an office in the municipality that attends to local demands, offering technical assistance free of charge to small farmers. Project Gaia will facilitate these partnerships in a way that improves relationships and provides information in order to facilitate access to the bioenergy market for other groups of farmers.

Regarding legislation, currently there is only one Presidential Decree from 1981 that authorizes ethanol production in MDE, for vehicular use, but only for the use of co-operative members or associates. In the case of ethanol for domestic use, there is no impediment in sales, but there is also no law regulating the sale. The lack of specific legislation for MDE prevents access to funding, mainly due to restriction of sales, which prevents the creation of a market.

Balance of Rights, Responsibilities and Revenues of Market Actors

The project has brought benefits to families who are stove users, initially for the possibility of using a clean technology, and thus avoiding spending on health problems resulting from domestic air pollution. An attractive aspect for families is the ability to buy ethanol in small quantities (compared to the choice of 13 or 45 kg of LPG), since many of the families have no fixed income. It is also important to consider the direct purchase of MDE at a more affordable price. As for the families of the settlement, they are the owners of the land, and therefore have the autonomy to decide what to grow. They can thus all become suppliers of sugar cane and in addition to being paid for the cane, they will be able to buy ethanol at a lower cost. They can also exchange sugar cane in return for ethanol (*sugarcane bagasse*, which is the waste of the cane after is crushed, is used, among other things, as fuel for boilers), sell it, and even use it on their crops, avoiding spending money on fertilizers.

The group of producers will be paid for the work of production and sale of ethanol, and are also generating work for other families, with the cutting of sugar cane. They also save on energy, using sugar cane bagasse (waste obtained only from the craft production of rapaduras) to feed the boiler, to provide the heat needed for the process. To ensure that the

Actors\'3Rs'	Rights	Responsibilities	Revenues
Stove Users	- Buy ethanol at affordable price	- Proper use of ethanol and stoves	- Buy fuel in small quantities - Savings in fuel purchase - Savings in expenditures, benefitting home income
Community Members	- Possession of land - Right to cultivate - Access to low cost fuel	- Protection of natural resources - Supply sugar cane	- Income of agricultural products - Savings in the acquisition of organic fertilizers - Income from sugar cane
Ethanol Producers	- Utilisation of venue and equipment. - Waste utilisation	- Production of ethanol - Follow safety procedures - Participation in trainings	- Rapaduras sale - Ethanol sale - Sale of derivatives
Local Government	- Information on natural resources preservation	- Environmental licence and permits - To buy Rapaduras	- Taxes from the sale of Rapaduras - Economy with direct sale projects
Federal Government	- Formulation of specific policies	- To facilitate access to markets for small producers	- Taxes - Savings in health expenditures due to a decrease in domestic pollution
EMATER	- Orientation on sugar cane production and rapaduras	- Offer technical assistance without cost	- Dissemination of the project in other regions of Brazil
INCRA	- To guide and supervise use of land	- Guide on access to financial resources - Facilitate legal possession of land	- (Indirect) lowering resources from Agricultural Reform (if families have a higher income, the federal government through the INCRA will be able to reduce the resources needed for these families)
Project Members (Project Gaia and USI)	- Orientation on ethanol production - Distribution of stoves	- Assistance in ethanol production - Open market assistance - Project experience dissemination	- Donor and project funds

purchase of ethanol is for stoves, all users need to be registered eliminating all possibility that the ethanol is diverted for other purposes.

The federal and municipal governments are responsible for the licensing and environmental guidance on the correct use of natural resources, and also for legislation on the production and sale of ethanol to facilitate access to markets. In addition to gaining from tax collection, they also benefit from savings on public spending on health problems related to domestic pollution. EMATER and INCRA, which are government agencies for technical assistance and guidance on the correct use of cultivable land and agricultural production, can reduce the transfer of resources, since families are involved in a profitable activity, and can help other groups interested in MDE.

Project Gaia maintains its social objective of promoting access to clean-burning stoves, and assisting in access to ethanol, therefore it has a responsibility to help families in the production of ethanol and access to markets. When the generation of income comes from ethanol, Project Gaia can allocate its resources to other projects, and it is also known for facilitating the search for new financial partners

Analysis of Livelihoods Outcomes

Regarding the use of the CleanCook stove, families consider several advantages compared to traditional wood-fired stoves and ovens using LPG gas. The issue of safety and speed

were the most prominent, with the stove providing both a reduction of risk from leaks and a time saving on average 20 minutes per day in the kitchen. The stove was also considered economical, and easy to handle and clean.

It is important to note the issue of facilitating access to ethanol for families. The results obtained on the MDE were based on studies of production units from the State of Minas Gerais and on two studies on the implementation of MDE at the Settlement Dom Orione in Betim.

Regarding the advantages and benefits of a micro distillery, the communities involved have seen positive change, with the use of clean fuel in their homes, and the benefits arising from environmental and health issues as well as the diversification of production (sugarcane can be produced along with other crops). This would be mainly an activity for rural areas, to help promote the increase of family income through the cultivation of sugar cane and production and sale of ethanol, and generate a reverse rural exodus, by giving people the opportunity to generate income in their own lands and bringing farmers back to the countryside. It is important to mention that the production of ethanol through the sugar cane is one of the few activities in rural areas where the waste is used in the production and can also be processed into sub-products that will generate extra income for families

Overall Conclusions

Besides promoting access to a clean burning stove and improving air quality in homes, Project Gaia has focused on spreading and replicating the micro distillery model to other countries, to facilitate access to ethanol. Biomass energy can be replicated in tropical countries due to climate conditions and the possibility of using other crops such as the mandioca, sweet-potato and Sorghum sacarino.

It is important to mention that this is not a monoculture of sugar cane associated with the production of food. This is a production chain of sugar cane, in this case, in addition to ethanol and the production of rapadura, which is a high energy food supplement. With the sub-products such as bagasse from sugar cane and vinhoto, as well as food for cattle, which will improve the production of milk and meat, high quality fertiliser can be produced, which results in increased production of food, and also sugar cane.

Considering the Brazilian reality, where thousands of farmers have left their lands as they do not represent a means of survival, living in precarious conditions in big cities resulting in an evident social exclusion, this project could promote a return to the countryside, creating favorable conditions to bring people back to the countryside, increasing their self-esteem and strengthening their livelihoods. More than just a simple project to generate energy, this is considered to be a "self-development" project as it promotes "self-sustainability" in energy and income increase through the sale of sub-products, facilitating the promotion to food access, either through the associated production of rapadura and dairy cattle, or the use of sub-products such as food for cattle and other organic fertilizer for crops.

It is worth highlighting that planting sugar cane for the production of ethanol in micro-distilleries, through co-operatives or associations, is an advantage for rural farmers, and will not generate conflict in the daily activities of communities.

Case 12 – Guatemala Jatropha Biodiesel

Initiative Name	*Biofuels for Rural Development, Guatemala*
Location	*Chiquimula and Cuyotenango on the southern coast and western dry-zone of Guatemala*
Initiation date and duration	*Started January 2008, first stage of financing will end in 2009. The project has a minimum life of 5 years to take it to full performance.*
Funder(s)	*Started with USAID support*
Project Initiator	*TechnoServe*
Overall Budget	*$250 000*
Energy Output	*An estimate of 1900 litres per ha is contemplated. One 200ha cluster will produce 380 000 litres of oil per year.*
Area under cultivation	*170 ha in Cuyotenango, with a plan to grow to 560 ha.*
Beneficiaries	*150 families in Cuyotenango, totalling 963 beneficiaries, and 8 villages in Chiquimula benefiting 193 families*

Background and Context

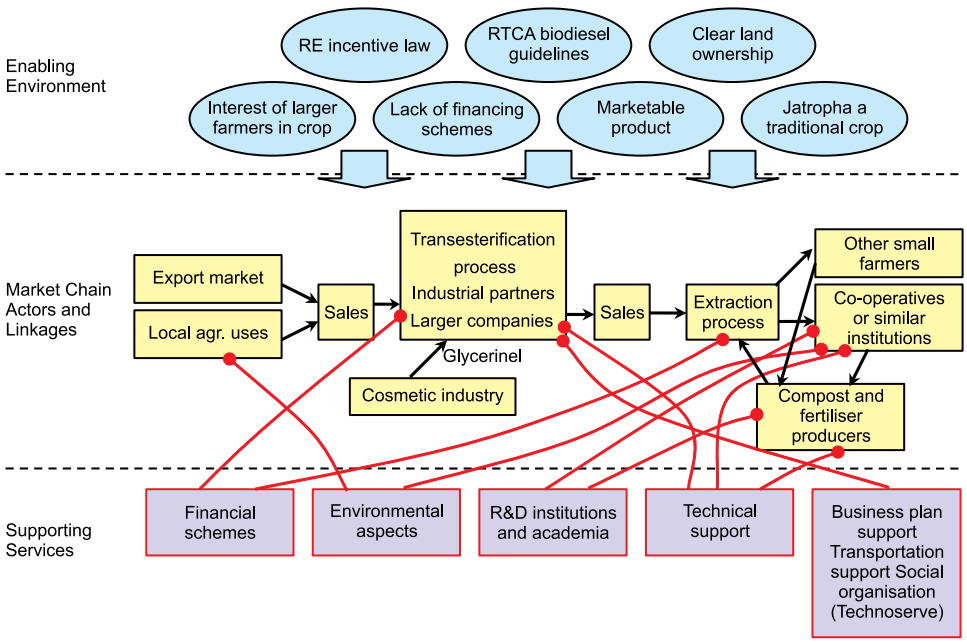
Guatemala is highly dependent on fossil fuels. In 2007, 4 200 million litres of diesel were imported for national consumption. At the same time, the Ministry of Agriculture has identified more than 600 000 hectares of unproductive land – mostly deforested or depleted soil from repeated corn crops – that is suitable for the biofuel crop Jatropha, incorporating small owners and rural population. If all this idle land was used, it is estimated that the country has the capacity to substitute 80% of the imported diesel.

The Biodiesel for Rural Development project has as an objective the improvement of livelihoods for the poor in Guatemala adding an additional crop that produces income, and diversifying crops for soil recuperation. It was developed and is being implemented by TechnoServe, which is a nonprofit economic development organisation with global presence. Its mission is to help entrepreneurial men and women in poor rural areas of the developing world to build businesses that create income, opportunity and economic growth for their families, their communities and their countries.

The project's main idea is to add an additional product to the family economy that would not compete with food items, that would not displace forest land, and that could use marginal land to create an additional income. It will promote the formation of co-operatives of small producers to plant Jatropha and mainly sell the oil to larger processors and eventually to large companies.

The project area was selected because fences are planted with *piñón* (the local name for Jatropha) and the crop is already known and accepted. TechnoServe has worked intensely to transfer knowledge of usage and economic benefits, and coordinating farmers to work in outgrower clusters. To begin, the project involved an industrial partner who purchased the transesterification equipment. For future clusters, the co-operative itself will purchase the extraction equipment and sell the oil. TechnoServe supports preparation of business plans, designed to support small farmers in the vicinity. The ideal area of coverage is of 200 hectares per processing unit.

The Initiative Market Map



Within the main Market Chain, the base organisation proposed will be a co-operative or similar institution which will group small farmers into clusters. Once organised and trained, they can be empowered to access financing to purchase the extraction equipment to sell the oil. The next link is the involvement of an industrial partner who will purchase the transesterification equipment and buy the seeds from small farmers and process the product, because this step needs a high level of quality-control. For the first cluster, the main chain starts with the extraction of oil from Jatropha seeds by the donated equipment; then the small producers have the option to sell the oil or pay the industrial partner for the process and keep the biodiesel for personal use, or sale. The industrial partner will commercialise the product starting in the local agricultural market and after a certain volume is produced, considering exports to nearby countries or selling to a larger company. In new clusters, the total equipment could be acquired by the industrial partner, who will provide support and service to small farmers in the cluster.

The by-products include the seed shells, the seed-cake, and the leftovers of the fruit, which will be used to make fertiliser. The by-product of the transesterification process (glycerin) will be sold to local cosmetics companies.

Within the Enabling Environment there are several positive factors. In the Tax & tariff Regime, the equipment falls into the renewable energy category and is eligible for tax incentives under the Law for Incentives for Electricity Production from Renewable Energy Resources. Another important supporting regime is the Guidelines in Central America for Biodiesel. The biodiesel project is also attractive for environmental purposes

because its use reduces green house emissions from transportation. Because it is a local crop grown in many farms, farmers are interested in the product, mainly due to high costs of diesel, and a new product for the market.

Regarding Supporting Services, TechnoServe and other support institutions are focussed on training, teaching, guiding and supporting the effort of the initiative to reach the poor and improve livelihoods. Additionally the creation of strategic alliances with Universities and research centres with incorporation of larger local producers, as well as private investment, has been crucial.

TechnoServe is providing the transportation in the initial stages of the project's operation, although with small farmers' families close to the plant, transport distances are short and as the project becomes established this service will end.

Because it is a new activity, the banking system is not yet attracted to financing biodiesel projects. However with projects like this one in operation, confidence should grow within banks to provide financial services for such projects. This can be seen as a current negative factor, but with proven experiences, it can change

Relationships between Market Actors

To start the first cluster, the project was able to find a donation to buy the extraction equipment. The industrial partner purchased the transesterification equipment for biodiesel

	Co-operative or similar organisations	Fertiliser preparation groups	Industrial partners	Extraction plant (owned by the co-op)	Transesterification plant (owned by the industrial partner)	TechnoServe
Co-operative or similar organisations						
Fertiliser preparation groups	**Good**. Provision of organic fertilizers at lower prices is attractive					
Industrial partners	**Good** – formal, commericial	**Good**, possible buyers				
Extraction plant (owned by the co-op)	**Good**, service and income to co-op	**Good**, possible buyers	**Good**, possible buyers			
Transesterification plant	**Good**, financial service contractual	n/a	Financial, service, contractual. The industrial partner is responsible for the quality of the product.	Production agreement, contractual. The quality of the final product is responsibility of the industrial partner.		
TechnoServe	**Good** - basic organisation, initial support, training	**Good** - technical support, training	**Good** - technical support in business plans	Training, initial donation in some cases, support in financial process. Oil extraction is simple, and with adequate training, it can be carried out with acceptable quality for the next step.	Technical advisory in business plan. The industrial partner is responsible for quality and an important part of the training in the business plan.	

production, and provided a space in his warehouse to place the extraction equipment owned by the first cluster. In future projects, the industrial partner could purchase both equipments and provide the service and support to small farmers in his cluster.

The project plans to form groups of small farmers organised into co-operatives (or similar organisations) to manage the Jatropha plantations and fences, complemented with an industrial partner who will process the product. Once the crop is ready, recollection of seeds from production locations will be coordinated by a transportation arrangement, for which a small fee is being considered. Once the seeds arrive to the processing unit, oil is extracted, and processed into biodiesel. The seed cake is used to produce fertiliser, to be sold later to interested users.

The importance of the industrial partner is the quality control of production. Later on, when a critical mass of biodiesel is produced, quality will be an important factor for exports, commercialisation at wider levels etc.

The organisations that will be formed pulling together small farmers will grow the plants, collect the fruit, and extract the seeds. They will use shells, fruit and seed-cake to produce fertiliser. The seeds will be transported to the processing plant and payment will be made according to the contract with the industrial partner. The relationship is interdependent and currently has no competition or competing interests.

Balance of Rights, Responsibilities and Revenues

Regarding Rights, the target group is small farmers that received land from the Government. Local industrial partners are interested in biodiesel due to the high cost of fuel, and are coming into the business with investment for planting Jatropha in larger areas, acquiring equipment and bringing the project to a working capacity that will produce revenues for both the poor and well established.

A three pillar strategy was planned with a value chain and selected partners. The first pillar is the small producers organised in co-operatives or similar organisations, and TechnoServe partnered with USAID and AEA (Energy and Environment Agency). The second pillar is research and development and here the partners are Guatemalan universities and private research companies. The third pillar is formed by large scale investors, which will come into play once several clusters are in operation, buying the oil directly from the co-operatives, or through the industrial partners.

In terms of Responsibilities, the small farmers' association and in some cases the industrial partner, plant and collect the Jatropha seeds. The co-operative is responsible for the extraction process and sale of oil. The owner of the transesterification equipment is responsible for quality and commercialisation. The by-products are processed in the communities, using the shells, the left over fruit and the seed-cake to prepare organic fertilizer for local use/sale. TechnoServe has the responsibility to support technical aspects, organisation of the small farmer's communities and the incorporation of industrial partners through business plans.

Regarding Revenues, in the general plan, the industrial partner purchases the oil. In the pilot program the small farmer has the option of selling the oil, or paying a fee and taking the biodiesel from produced, under a one year pre negotiated contract. Once several

	Rights	Responsibilities	Revenues
Co-operative or similar organisations	- Use of their land - Right to plant selected crops - Marketing decision on whether to sell oil to industrial partner or other market actor	- Delivery of seeds - Payment of processing fees	- Sale of seeds or biodiesel - Improvement in corn yields - Less expensive fertilisers
Fertiliser preparation groups	- Use of by products - Earn revenue for their work	- Follow quality control and process for fertiliser	- Sale of fertiliser
Industrial partners (Large producer)	- Use of their land - Right to plant selected crops - Decision on selling the biodiesel, or self-commercialisation	- Delivery of seeds - Payment for processing fees - Co-ordination of transportation	- Sale of biodiesel - Less expensive fertilisers
Extraction plant (owned by the co-op)	- Charge a fee for the service - Charge a low fee for by-products sold to the women of small producers	- Good maintenance of extraction equipment - Careful weights and inputs from producers	- Fee for processing
Transesterification plant (industrial partner of large company)	- Charge a fee for the service - Process oil for commercialisation	- Good maintenance of equipment - Comply with the purchase agreement - Comply with quality control requirements	- Processing fee - Sale of biodiesel
TechnoServe	- Publications of research material and results from the project - Replicability	- Support to small producers in technical matters - Co-ordination with larger producers	- Income from donors - Non-profit - Co-ordination with local agencies
Academia, investigation organisations	- Publications of research material and results from project - Replicability	- Support to small producers in technical matters - Publication of results	- Possibility of donations, grants, etc.

clusters are in place, the entrance of larger companies is considered, either to process or simply to purchase the oil.

Analysis of Livelihoods Outcomes

In terms of Financial Capital, the Guatemala biofuels program can have a significant impact on poverty reduction, by providing extra income to small farmers. The introduction of a crop that grows in marginal areas, and can be planted with corn, is particularly attractive. In the corn production economic analysis, these small producers typically generate a total income of $ 1 500 per year, or approximately $ 0.70 per person per day. With the Jatropha opportunity, the income from 1 ha will total $ 1265, (oil $ 930 + fertilizer $ 620, minus $ 285 costs). If we add this to the $1 500, the new total is of $ 2 765 per year, or approximately $ 1.25 per person per day.

Natural Capital is enhanced by the project through improvement of the soil with organic fertilisers from the seed cake residues of the Jatropha processing.

In the TechnoServe model, producers are organised to generate scale for the industrial process with the participation of larger actors who will invest in the production equipment, the main Physical Capital needed for the initiative.

Human Capital has been enhanced through training of small farmers and entrepreneurs while in general the relative strengths of different types of actors (researchers, entrepreneurs, farmers etc) have been harnessed in this project to enable the creation of a value chain which previously did not exist.

Social Capital has been developed through the establishment of co-operatives and clusters of producers. Additionally the support to the farmers' organisation assists collective action by the small farmers, improving their influence within the system, and enabling them to develop other support actions, such as co-operative shops, purchasing in bulk for members etc.

Overall Conclusions

Jatropha is considered a particularly good option in marginal area of Guatemala as it requires low watering, has high adaptability to soils with low nutrient content, and enriches the soil with nitrogen and potassium. It yields approximately 1900 litres per hectare per year, has low implementation costs and a long life span (30 – 50 years). It is also common in Guatemala, where it is used in fences. It can have a high economic value in biodiesel and sub-products such as organic fertilizer, briquettes and biogas from seed-cake, shells and fruit. It can also provide opportunities for women in the communities responsible for by-product production. Many small farmers in the settlements have ideal land, which is poor and has no crops planted, making this project a possible win-win, for the small farmer, the environment and the country as a whole.

Key challenges to the project moving forward will be ensuring the continued participation and flow of benefits to small farmers as volumes increase. Additionally, the energy access benefits to rural people will also be an important test of its long term impact on rural livelihoods.

Case 13 - Peru Veg-Oil Recycling

Initiative Name	*Vegetable oil recycling and use in Peri-Urban areas around Lima*
Location	*Lima, Peru*
Starting Date and Duration	*Starting year 1998, duration 10 years and starting year 2004, duration 4 years.*
Funders	*Self-financing*
Project Initiator	*Small business entrepreneurs Rafael Tam Siu and Agustin Jacobo Gonzáles*
Overall Budget	*Not determined*
Output	*500 280 litres. biodiesel per year, approximately 41 690 litres per month and 295 620 litres of biodiesel per year, approx. 25 500 litres per month.*
Area of Land	*Not applicable*
Beneficiaries	Service stations, transporters, bakeries, occasional private customers.

Background and Context

Biodiesel in Peru is a new industry which needs to be developed, from the production of raw materials to the logistics of distribution and from knowledge about the product to market demand. There are some well established companies with installed capacity, but which have not yet entered into the productive phase. Production is concentrated in small rudimentary businesses, located in the peri-urban area of the city of Lima.

Taking into account difficulties in obtaining raw materials and the high international prices of agricultural inputs and food, the task of making biodiesel production a profitable industry looks particularly challenging. The price of used oil has increased in the informal market by almost 100% over previous years.

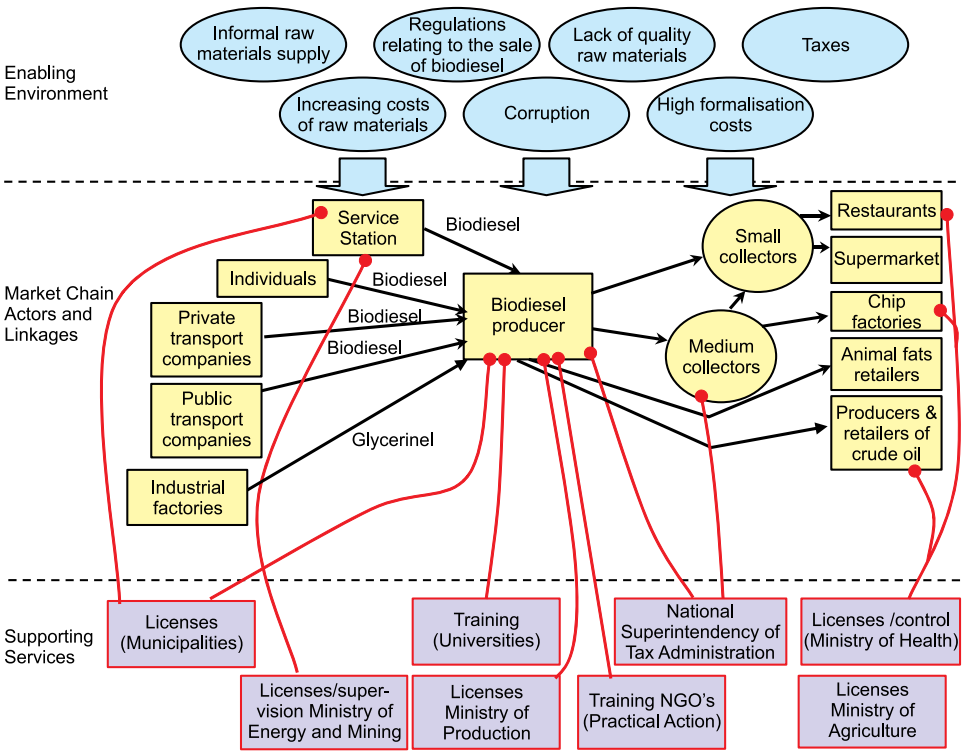
Biocombustibles del Peru is a small company set up by Rafael Tam in 1998. Mr Tam had previously worked for a company related to the sale of petroleum products, where he learned about Natural Gas and the production of biodiesel. There he saw the opportunity to establish a business in biofuels as a viable alternative as it is easy to produce and it does not require making changes in the engine. Initially, Mr Tam studied the entire process, beginning with the collection of oils. He began working with fast food chains and supermarkets, collecting the oil and monitoring it, in order to maintain certain quality standards.

Another illustrative case is that of Mr Jacobo, who became interested in biodiesel production as an alternative source of income when he shut down his building materials business. Mr Jacobo sought information on the internet about how to produce biodiesel, and once he had developed his product, he attended a training course conducted jointly by the NGO Solutiones Prácticas-ITDG (Practical Action) and Universidad Nacional Agraria La Molina.

In both cases these are informal businesses. The formalisation process to become an authorised biodiesel producer is very complex and expensive which, in most cases, renders small producers unable to do so. Biocombustibles del Peru is registered as a producer at the Ministry of Production, and has a permit to produce biodiesel and collect waste oils. However, to comply with all legal requirements, it needs permission from the Ministry of Energy and Mines and OSINERGMIN, The Energy and Mining Investment supervisory

body. Mr Jacobo has been unable to formalize his business at any stage. Despite this, both companies collect oil and have established good relationships and contacts with other market chain actors.

The Initiative Market Map



The main feature of the chain is the atomisation of vendors and informality in trade relations. The suppliers of oil are shops that sell food (restaurants, fast food outlets and neighborhood diners), which sell directly to the biodiesel producer. There is also a network of small collectors, who gather the product as edible oil and, at a lower scale, animal fat, in an informal manner so as to evade health authorities. There are formal systems of solid waste collection provided by companies (such as EPS-RS) which are formally constituted and are the only ones that can lawfully perform these functions. Finally, there are sellers of 'virgin' animal oils, which come from birds, fish and other animals, who will transport the oil directly to the biodiesel manufacturer.

Biodiesel, once produced by these small businesses, is marketed to different consumers: fuel suppliers, public transport companies, individual consumers, companies using the product for their fleets of vehicles and factories using it for their boilers. Biodiesel producers also, in some cases, receive the used oil from the suppliers (for example a fast food chain) transform it into biofuel and gives it back to the same suppliers who pay for the service. A characteristic of the existing business relationships in the chain is the

informality: both the supply of raw materials, primarily used edible oil as well as the biodiesel produced are sometimes delivered without invoices and without following certain basic sanitary measures.

There is also a relationship with the suppliers of chemical products for the production of biodiesel. There is a formal commercialisation of these products between the distributors of chemical components and the producers of biodiesel.

NGOs and universities, such as Practical Action (Soluciones Prácticas-ITDG) and the Universidad Nacional Agraria La Molina, train the small producers so that they can get a quality product and maintain consumers' confidence towards the use of biodiesel. On the other hand, there is ignorance on the part of the authorities over biodiesel production and the informality of trade relations present in the chain, due primarily to the complex legalisation procedures mentioned above.

The two cases mentioned above are not considered competitors in the market. In the case of Rafael Tam, he would like to produce at larger scales. His business relations are very good; he invests in the business and would like to have a formal production chain. For this reason his market is different from Agustín Jacobo´s market. Agustin sells to the local market informally and has a traditional (artisanal) production.

Relationships between Market Actors

As far as oil providers are concerned, a distinction should be made between the providers of used edible oil and those of animal fat. The former sell the oil directly to the producer in small quantities, or through collectors. The latter sells the oil directly to the biodiesel producer, without any intermediary. Introducing this product to the market is complicated because of its uncertain quality originated from the extraction methods that are used.

	Chemical component providers	Small collectors of vegetable oils	Medium collectors of vegetable oils	Biodiesel producers	Gas stations	End consumers
Chemical component providers						
Small collectors of vegetable oils	None					
Medium collectors of vegetable oils	None	**Fair**, Informal, competitive				
Biodiesel producers	**Good**, formal, commercial	**Good**, informal, commercial	**Good**, informal, commercial			
Gas stations	None	None	None	**Good**, commercial		
End consumers	Informal, commercial	None	None	**Fair**, informal, commercial	**Good**, formal, commercial	

The small oil collector tours the various establishments in the city of Lima, at night or at dawn, to get the product used during the day or week, depending on the size of the business, and sells it directly to the biodiesel producer or to a bigger collector who works informally and surreptitiously, operating in marginal and dangerous areas of the city. They store it in 100 litre drums or in water tanks. The medium collector also gathers used car oil, which is used for other activities.

The biodiesel producer buys vegetable oils from these suppliers, produces biodiesel and sells the product on an informal basis to some public transport companies and small factories near the production site. As can be noticed, trade relationships among the different actors in the chain are mostly informal, and in a clandestine atmosphere, hiding from authorities, who in some cases, when they witness commercial operations, demand bribes not to intervene.

All relationships are purely commercial. There are no donors or any kind of financial support available. Producers invest their money or get bank loans, or in some cases, get informal loans to carry on with their businesses.

For example, Mr Jacobo only succeeds in making a profit when he can get oil for less than $10 per 18 litre can. The biodiesel market has not yet developed, although there are expectations about potential demand as of 2009, indicated the entrepreneurs of this small business.

Balance of Rights, Responsibilities and Revenues of Market Actors

With regards to **rights**, the oil providers have the right to market the used oil for a marginal gain. There are no clear rules governing this market, so all those involved in marketing (especially small and medium collectors who trade informally), are exposed to

	Rights	Responsibilities	Revenues
Oil Providers	- To sell used oil	- Ensure oil does not get contaminated	- Income for the sale of used oil - Income for the sale of vegetable oil - Income for the sale of animal fat oil
Small collectors	- None, they act informally and semi-underground	- Not to alter the composition of the raw material	- Proceeds from the purchase and sale of used oil
Medium collectors	- None, they act informally and semi-underground	- Not to alter the composition of the raw material	- Proceeds from the purchase and sale of used oil
Biodiesel producer	- To produce biodiesel - To collect waste oils - No clear permission for operation from Ministry of Energy	- To inform the suppliers how to store the oil in order to avoid contamination - To observe the necessary safety measures - To make biofuel (he has the capacity and the knowledge) - To have a good quality product - To look after the health of workers	- Income from sale of biodiesel to gas stations, transport companies, etc - Income from sale of glycerine to end consumers (brick companies, factories, boilers, etc.)
Gas stations	- To have biodiesel available for sale	- They must not buy altered fuel	- Income for the sale of biodiesel to consumers
End consumers	- To have an economical product for their activities	- They must not buy altered fuel	- Purchase of biodiesel which permits lower operational costs

the arbitrariness of the authorities. Biodiesel manufacturers say that regulatory authorities should be familiar with regulations and production standards, so as not to accuse biofuel producers of illegal activities due to their ignorance. The producers suggest that municipalities carry out a campaign in restaurants supporting of the use of used edible oil in biodiesel, regulating its disposal and recycling to ensure a greater amount of raw material available. Gas stations have the right to sell biodiesel and other users are entitled to acquire a product that allows them to reduce their operating costs. In the case of biodiesel users, they do not know that the product they are using has been obtained informally (in most of the cases) by oil providers. If gas stations want to sell biodiesel, they have to buy the mixture (diesel oil and biodiesel) from a wholesaler, who would have to buy it from a licensed registered producer (this system does not allow small providers to sell to mixing centres). This makes small scale trade of biodiesel an informal business and also affects quality.

In terms of **responsibilities**, the oil providers have the duty to ensure that used edible oils are not contaminated with water or detergent. Small and medium collectors have the duty not to alter the oil they trade. The biodiesel producers feel they have the duty to inform their raw material suppliers about the procedures to follow to avoid polluting it. The producer also feels it is his duty to take necessary safety measures as well as to supervise the manufacturing process. The gas station owners have the moral obligation to buy biodiesel rather than adulterated fuel or to tamper with the fuel.

The oil providers generate **revenues** from the sale of their oil. Small and medium suppliers earn money from the used oil they trade. For medium collectors the sale of used edible oil is just a part of their income, since they also sell used oil from automobiles. For the biodiesel producer, the current gains are not significant. They report that the business is not profitable due to the increase in the price of raw materials, mainly oil, and because they have to compete with informal soap manufacturers and even illegal oil recyclers. The income that allows them to give sustainability to companies comes from producing and selling other products, such as glycerin (by-product from biodiesel production) which is sold to end consumers for brick companies, etc. The gas stations obtain profits from the sale of biodiesel to the public transport units and end consumers, who attain a benefit by reducing their operating costs by selling a product (a mix of biodiesel and diesel oil) at the same price as the diesel oil, making a few cents per gallon of biodiesel.

Impacts on Livelihood Assets

In terms of **financial capital** the biodiesel business is vulnerable, risking the sustainability of enterprises, with little or no return offered to producers due to increased prices and scarcity of raw materials, both natural oils/ fats and used edible oil. There are other contextual factors such as lack of financial support from the government or the formal banking system, forcing producers to turn to informal financing systems, which can charge monthly fees of 20%. Another factor is the absence of an efficient chain, with a starting point in the cultivation of raw material (palm, canola, pine nuts, etc), which has its own problems (such as lack of seeds, land, agricultural financing, and water, among others). Mr. Tam (Biocombustibles of Peru) tried to promote their cultivation, but failed due to the aforementioned disadvantages. He is now investigating the production of oil from micro algae.

The existing biodiesel plants were implemented with equity capital. In terms of infrastructure, the requirements for production are not very demanding, the plants are small and artisanal.

The aspects that currently sustain the existing biodiesel manufacturing business are **human and social capital**. The owners are highly trained, both technologically and in business. They are also entrepreneurs with a vision of complementary businesses to sustain business initiatives. With regard to social capital, it appears that manufacturers have succeeded in establishing a network of actors around their businesses. On the one hand, family members or friends involved in the business of selling cooked food provide the raw material, the used edible oil; on the other hand, the manufacturer offers jobs in the area where the plant is located, taking a kind of "social license" delivered by the local population, as it constitutes a source of employment for the youth of the area.

Mr, Jacobo only buys oil when the price is less than US$ 11; if the price is higher he does not but it as he would not make a profit when selling the biodiesel, and if he did it would be too low. In the case of Rafael Tam, he collects the oil himself, so he can control the quality and lower the price of transport.

The impact on **natural capital** would occur when all actors in the production chain recycle the oil avoiding oil being disposed off through drains, causing damage to the environment, especially water pollution.

Overall Conclusions

Today the biodiesel business is not a profitable activity in Peru. It is in a situation of vulnerability due to structural conditions (lack of natural inputs) and contextual ones (increase in the price of raw materials such as used edible oil). Producers have to compete for the raw materials with the informal and even illegal activities (such as the recycling of edible oil). There is also much ignorance of the business on the part of the authorities, lack of clear rules for supplying raw material, mistrust amongst the various players in the current market chain, and little apparent interest on the part of the government in promoting an efficient and competitive biodiesel production chain.

While all the other players in the chain win (the owners of the eating establishments for the sale of prepared food, the small and medium collectors, the owners of the gas stations, etc.), the biodiesel producer has low or no profits, holding his business afloat by selling other products, such as glycerin. With regard to the market, demand is small, because consumers are not familiar with the product. In order to sell on the formal market, it is necessary to have licenses and in this case it could only be sold to authorised companies. This means that it could not be sold directly to gas stations as is current practice. There is also much ignorance about the attributes of biodiesel. These two factors contribute to the vulnerability of the biodiesel manufacturing business. In Peru, there are three plants with a large capacity to produce biodiesel. They have been inaugurated recently but have not yet started producing due to the high cost of raw materials, making the end product more expensive than mineral diesel. The biodiesel market is currently a small business, with many problems. Had it not been for the personal abilities, both professional and businesslike, of the biodiesel manufacturers and the support network they have, the businesses would not have been able to establish and move forward.

Case 14 - Thailand Jatropha Co-operative

Initiative Name	*Zero-waste management in Jatropha production for biofuel development in small scale farmer communities*
Location	*Viengsa District, Nan province, Northern Thailand*
Initiation Date and Duration	*1st October, 2006, 5 year duration*
Funders	*Matching funded by the Department of Co-operative Promotion ($30K), the Co-operative League of Thailand ($10K), Nan Provincial Governor ($30K) and Viengsa Agricultural Co-operative ($30K).*
Project Initiator	*Kasetsart University in co-operation with the Co-operative League of Thailand*
Overall Budget	*$100 000*
Output	*292 000 Kg Jatropha seeds p.a., 365 000-730 000 Kg fertilizer p.a., 73 000 Litres of biofuel p.a., 500 KW small scale power plant, 1 825 000-2 190-000 kg charcoal or biomass p.a.*
Area of Land	*To date about 240 hectares (120 hecaters per community). Expected to reach about 600 hectares (5 communities)*
Beneficiaries	*To date 1 000 farmers- Income, Expected to reach 2 500 farmers- Income, 500 Households- Electricity, 5 000 Farmers- Fertilizer*

Background and Context

A middle-income country in Southeast Asia, Thailand has made important progress in social and economic development since the Asian financial crisis of the late 1990s. Today, the Thai economy is driven by exports of electrical goods and agriculture. More than 40% of the population works on farms and rice is the most important crop in the country. In Thailand, access to electricity by the poor reached more than 99% by 2001. 62% of domestic energy demand is met by imports of fossil fuels and biomass energy accounts for more than 44% of supply from domestic sources.

In Viengsa District, primary sources of income are corn, soyabean, vegetables, longan (fruit), pigs, fish and cows and the average daily wage is $ 6. Aside from low wages, lack of land ownership is also a vulnerability issue for the local population as access to land for crop production is vital for securing a livelihood. The most important natural resources available to the local population are fresh water and forests, although the latter is being cut down year on year. Between 1990 and 2005, total forest cover reduced by 9.05%, or 1 445 000 hectares (Mongabay, 2008). Energy supply for households is predominantly gas and charcoal for cooking and petroleum for machinery and transport. Increases in the international price of petroleum have caused agricultural production costs to rise. One method for reducing fuel costs is for farmers to use renewable energy, such as biodiesel from Jatropha, to power farm machinery. Jatropha has many advantages for small scale farmers- it is a versatile crop, drought tolerant, fast growing and suitable for cultivation in various soil conditions.

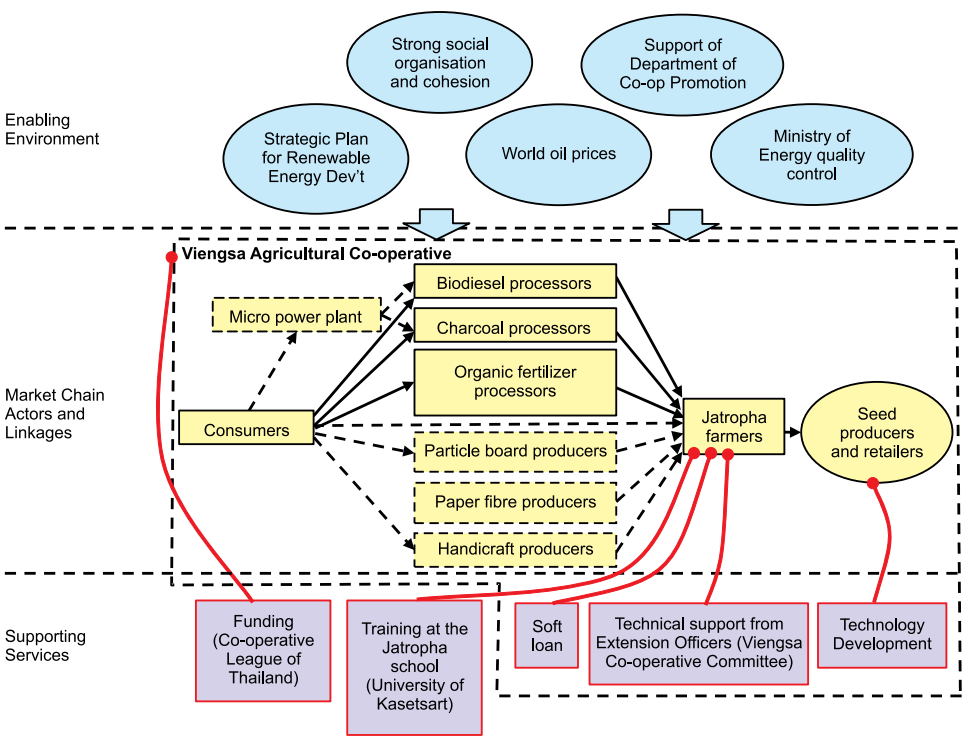
In 2006, the University of Kasetsart began working with 500 farmer members of the Viengsa Agricultural Co-operative to develop Jatropha production, primarily for biodiesel. The rationale behind the project was that Jatropha could form the basis of a community-level income and employment generation programme. The plant grows very quickly,

is drought resistant and produces seeds all year round when irrigated. Jatropha seeds are processed to produce biodiesel which provides fuel for electricity generation, farm machinery and local transport. Besides its known value as an energy crop, other parts of the Jatropha plant have economic value and are sold by the farmers to generate important additional income. The cakes and hulls yield good quality organic fertilizer while the leaves and stems are used for fuel, either as biomass or charcoal. Paper and particle boards will be made from the stems and branches as well as handicrafts once initial market research has been undertaken and potential for sales identified.

$ 100 000 funding was secured to provide training for farmers in land and seedling preparation, transplanting and spacing, water and pest management, fertilizer application, harvesting, drying and storing and equipment for Jatropha production. The project is currently in its second year of implementation. Out of a total 5 000 co-operative members, 500 farmers attended an initial training course on Jatropha production. More than 1 000 farmers have now been trained and are growing Jatropha for sale. It is intended that over the next three years, a further three communities will receive training totalling 2 500 farmers in the District.

The Initiative Market Map

With respect to the enabling environment, the Thai Government's Strategic Plan for Renewable Energy Development strongly advocates the production of renewable energy for national use and contains a key target to increase the renewable energy share of



commercial primary energy to 8% by 2011. In 2006, the Government produced a roadmap for biodiesel and bioethanol production. The biodiesel roadmap sets out a vision for 2012 when it is anticipated that production capacity will be sufficient to serve the entire nation. The initial focus of the roadmap is, however, on community-based biodiesel production for local use. The Ministry of Energy quality control guidelines will apply once biodiesel is sold outside the Co-operative.

The Jatropha supply chain has been developed by two main institutions: The University of Kasetsart and the Viengsa Agricultural Co-operative. The University of Kasetsart initiated the project, identified the key partner - the Viengsa Agricultural Co-operative - and secured the necessary funding. Viengsa Agricultural Co-op was established in 1970 to help farmers reduce the cost of production and today has around 6 000 members. Jatropha requires a reasonable scale of production in order for a small scale industry to be set up at community level. A sufficient number of farmers in the Viengsa Co-operative were interested in Jatropha development hence the co-operative was selected to take part in the project. A particular advantage of the Viengsa Co-op is that its members receive a soft loan to buy the raw materials required for crop production from the seed retailers (also Co-op members), thus making it easier for farmers to be involved.

The Co-op and it members are the principle Market Chain Actors in this project and their working relationships are key to its success. Once harvested by the farmers, the seeds, hulls, leaves and stems are sold on to other members of the Co-op for processing. Biodiesel is sold to members of the Co-op about 20% cheaper than open market cost, with priority going to those members who need fuel for tractor engines. Organic fertilizer is recommended by the Co-operative for use by community members on crops such as rice, vegetable and fruit. Charcoal is sold direct to households for use in cooking. A community micro power plant is also due to be set up. Biomass or charcoal will be sourced from Co-operative producers to power the plant's steam turbine. This power plant will serve five to ten nearby communities within a 50Km radius (all Co-operative members). It is also anticipated that once some market research has been conducted by members, paper fibre, particle board and handicrafts will also be produced for sale.

In terms of Supporting Services, the University established and runs the Jatropha School which provides training on Jatropha production and processing into marketable products. By September 2008, more than 5 000 participants had graduated from the school. The project has also trained participants to design and construct machinery to process the various parts of Jatropha into products to suit different scales of production. The Co-op provides supporting services to its members in term of the aforementioned soft loan, technical support in seed production from extension officers and technology support to the biodiesel processors.

Relationships between Market Actors

Dr Sombat Chinawong is the staff member at the University of Kasetsart responsible for project implementation and monitoring and is the resident Jatropha development expert. The University approached donors to secure funding but the University itself pays for

	Farmers	Seed retailers	Biodiesel processors	Charcoal processors	Fertilizer processors	Viengsa Co-operative Committee	Kasetsart University	Dept of Co-operative Promotion	Co-operative League of Thailand
Farmers									
Seed Retailers	**Good** formal, financial								
Biodiesel processors	**Good**, formal, financial	None							
Charcoal processors	**Good**, formal, financial	None	None						
Fertilizer processors	**Good**, formal, financial	None	None	None					
Viengsa Co-operative Committee	**Good**, formal, financial & technical	**Good**, formal, financial & technical	**Good**, formal, financial & technical	**Good**, formal, financial & technical	**Good**, formal, financial & technical				
Kasetsart University	**Good**, technical	None	None	None	None	**Good**, formal, technical			
Department of Co-operative Promotion	None	None	None	None	None	**Good**, formal, financial	**Good**, formal, financial		
Co-operative League of Thailand	None	None	None	None	None	**Good**, formal, financial & technical	**Good**, informal, technical	**Good**, formal, regulatory & financial	

staff working at the Jatropha School. The Co-operative League of Thailand has signed a Memorandum Of Understanding with Viengsa Agricultural Co-op to provide financial resources for this project and is also responsible for inspecting all the Co-op's activities. The relationship between the University and the Co-operative is purely technical, with the University providing research, training and technical support at the school. Co-op members who want to take part in the Jatropha development project nominate themselves for inclusion. Members then sign an agreement with the Viengsa Agricultural Co-operative Committee which is renewed on a yearly basis. Relationships between the different co-operative members are formalised via contracts established and overseen by the Co-operative Committee. These agreements fix and guarantee prices for raw materials and Jatropha products. Farmers receive financial support from the Co-operative in the form of a soft loan, which is formalised with a contract. Farmers also receive some technical support from Co-operative Extension Officers. The Department of Co-operative Promotion is part of the Ministry of Agriculture and Co-operatives and is the lead Government agency to promote and develop co-operatives and farmer groups. The Co-operative League of Thailand (CLT) is a nationwide confederation of the co-operative movement operating under the Government's Co-operative Act. The CLT receives funding from and is also regulated by the Department of Co-operative Promotion. The Viengsa Agricultural Co-op also receives funding from the Department of Co-operative Promotion to support the purchase of equipment. The CLT has provided funding for this project, as well as providing technical support more generally.

Balance of Rights, Responsibilities and Revenues of Market Actors

Actors\'3Rs'	Rights	Responsibilities	Revenues
Farmers	- Use of land for farming - Sales of Jatropha products - Buy biodiesel as a priority user - Land rights	- "Caretakers" of the land and natural resources; Cultivating the crops - Jatropha harvest and delivery to the various processors - Repay soft loan with interest	- Income from selling Jatropha products - Loan from Co-operative
Seed retailers	- Selling Jatropha seeds	- Produce seeds and sell to farmers	- Income from selling seeds
Biodiesel processors	- Selling biodiesel	- Press seeds and produce biodiesel - Sell to the Co-operative members	- Income from selling biodiesel
Charcoal processors	- Selling charcoal	- Produce charcoal and sell to member households	- Income from selling charcoal
Fertilizer processors	- Selling fertilizer	- Produce fertilizer and sell to Co-operative members	- Income from selling fertilizer
Viengsa Agricultural Co-operative Committee	- Voluntary and open membership - Democratic member control - Autonomy and independence.	- Provide loans to members - Committee and Members' meetings - Marketing Jatropha products to members - Fixing prices for products - Contracting between members	- Re-paid loans with interest - Grant from project donors
Kasetsart University	- Undertake academic activities	- Project development and coordination - Human resource development - Farmer training - Advice and consultation - Technical assistance - Farm research	- Funding from project donors for technical support
Department of Co-operative Promotion	- Promote Co-operatives throughout the country	- Provide financial support to the Viengsa Agricultural Co-operative for investment in equipment	- Funding from Central Government
Co-operative League of Thailand (CLT)	- Promote, develop and set standards for Co-operatives in Thailand	- Provide financial support to the Viengsa Agricultural Co-operative - Provide technical assistance - Control and inspect Co-operative activities	- Subscriptions - Government subsidies - Donations of money or property - Proceeds from sales of technical books, documents or other items - Money or property received in return for services rendered - Interest derived from CLT property

No fee is charged to the farmers for attending the Jatropha School. Farmers are guaranteed fixed prices at sale for their goods by the Co-operative as follows: $ 0.20 per kg seeds, $ 0.01 per kg hulls or leaves or stems. During the first year, farmers are allowed to grow 200 plants each so that they can gain adequate experience. This number can increase in the second year up to a maximum of 800 plants generating a total income of about $ 395. With an average annual price of production of $ 183, each farmer makes a profit of just over $ 180 dollars. Annual loans from the Co-op to farmers total around $ 28 500. Each farmer receives an annual loan of $ 60 which has to be paid back within the year at a rate of 5-6% interest (1-2% less than that of a commercial bank). Farmers must pay all other costs of production. The Co-operative is responsible for formalising arrangements between members, for holding regular Committee and members meetings to ensure good governance and transparency and for providing technical support to the project. The daily income generated by the Co-operative from selling Jatropha products is about $ 580 from: biodiesel ($ 172), organic fertilizer ($ 287) and charcoal ($ 125). On this basis, total annual income for the Co-operative is $ 211 230. Annual production costs of $167 360 are made up of materials ($ 228 per day), processing ($ 114 per day) and marketing ($ 114 per day). Average profit from Jatropha products is therefore $ 43 940. Currently all revenue is generated by and stays within the Co-operative. Sales external to the Co-operative are expected only when production is increased.

Analysis of Livelihoods Outcomes

In terms of human capital, the farmers have gained new knowledge in farming and management techniques. Farmers also now have a good understanding of the entire market chain. Furthermore, farmers have utilised new technologies to improve crop yield. Women's involvement in the project has been key, with women taking responsibility for tasks including harvesting, raw materials preparation, and the processing of products.

With respect to natural capital, this project has helped decrease local environmental degradation through improved agricultural practices. Instead of using chemicals fertilizers and pesticides which used to contaminate local water supplies and leave toxic residues in the soil, farmers are now using organic fertilizer produced by Co-operative members. In some sloped areas, Jatropha plantations have reduced soil erosion. The plantations have also helped increase soil fertility and soil moisture content.

Formal agreements between farmers and other Co-operative members have strengthened social capital under a new formal status which increases their rights to get a better income from their main assets. These relationships have been reinforced by peer learning. Social capital has also been increased via job creation which has reduced migration of community members to the city.

Physical capital has been increased through the introduction of new technologies and machinery for pest and water management, fertilizer application, harvesting tools and processing machinery.

With respect to financial capital, cash flow analysis has shown that the Co-operative should be able to break even by the end of its second year of operation. Indirect financial benefits of this project have been experienced by fruit and vegetable producers, who have obtained on average 30% more for their organic products

Overall Conclusions

Key to this project has been the insulation of the entire market chain within a Co-operative that has provided financial incentives for its members to take part by fixing and guaranteeing prices for buying/selling raw materials and end-products. In order for the project to sustain this success efficiency of equipment will need to be improved, along with an increase in producer numbers.

In addition to generating important financial returns for members, the project has also increased food and energy security. Once the revenue has been raised, a micro power plant will provide low-cost renewable energy to thousands of households in the District and assist communities to reduce their dependence on expensive imported petroleum. Income generating activities are expected to increase once market research for additional Jatropha products has been conducted. Food production is expected to increase thanks to lower production costs.

The main success of the project has been to secure beneficial working relationships along the entire market chain from seed producers to end consumers. The take-up from farmers has been sufficient for the project to gain credibility from its success. It is hoped that this particular model for community Jatropha development will be taken up by other communities in Viengsa Agricultural Co-operative. If the model is successfully scaled-up, there are plans for it to be recommended to central Government to be incorporated into a national plan for community-based biofuel development. It is anticipated that this model will assist the country in meeting the biofuel targets set out in the Government's two roadmaps, as well as promoting environmentally sound farming practice.

Case 15 - Vietnam Biogas Farm

Initiative Name	*Development of biogas market in Thanh Hoa province*
Location	*Thanh Hoa province, Viet Nam, Asia*
Initiation Date and Duration	*From July 2006 to date*
Funder	*Enabling Access to Sustainable Energy program (EASE) of the Organisation for Educational Training Consultants (ETC) of Netherlands (http://www.etc-international.org/index.php?id=41)*
Project Initiator	*Center for Rural Communities Research & Development (CCRD)*
Overall Budget	*ETC support: 73 980 Euro . Contribution of beneficiaries: 56 850 Euro*
Energy Output	*504 000 m3 biogas for cooking and lighting . (Estimated: 900 m3 of biogas per household per year)*
Area of Land Under Cultivation	*None*
Beneficiaries	560 households using biogas as free fuel in this province (9870 is the total number with biogas units across all 61 VACVINA chapters)

Background and Context

The Vietnamese economy has been one of the fastest growing economies in Asia over the last two decades. Its dramatic transition and growth have been attributed to a series of reforms, known as Doi Moi which began in the late 1980s. The reform process was initiated to replace the centrally planned and subsidised economy by a market-oriented system. Economic growth at nearly 8% per year has reached all socio-economic groups, benefiting the poor and reducing poverty from 58% in 1993, to 28% in 2002, and 18% in 2007.

Within the agricultural sector, a Vietnamese farmer's conditions have improved dramatically, mainly through the allocation of land to peasants. Farmers are encouraged to manage their own family plots. The Vietnamese have developed a concept of integrated farm management, and the Vietnamese Gardener's Association (VACVINA) has national responsibility to promote this concept – called the VAC integrated system. VAC refers to a form of small-scale bio-intensive faming where gardening, fish rearing and animal husbandry are closely integrated. VAC makes optimal use of land, water and solar energy to achieve high economic efficiency with low capital investment.

With a high population density, there is a need to use environmentally friendly renewable energy sources whilst retaining agricultural production, and to avoid forest depletion which adversely affects land productivity through drought, flooding and erosion.

Traditional fuels such as wood and coal for cooking are becoming increasingly scarce and expensive, and can contribute to deforestation. The forest depletion rate in Vietnam is more than 4% per year.

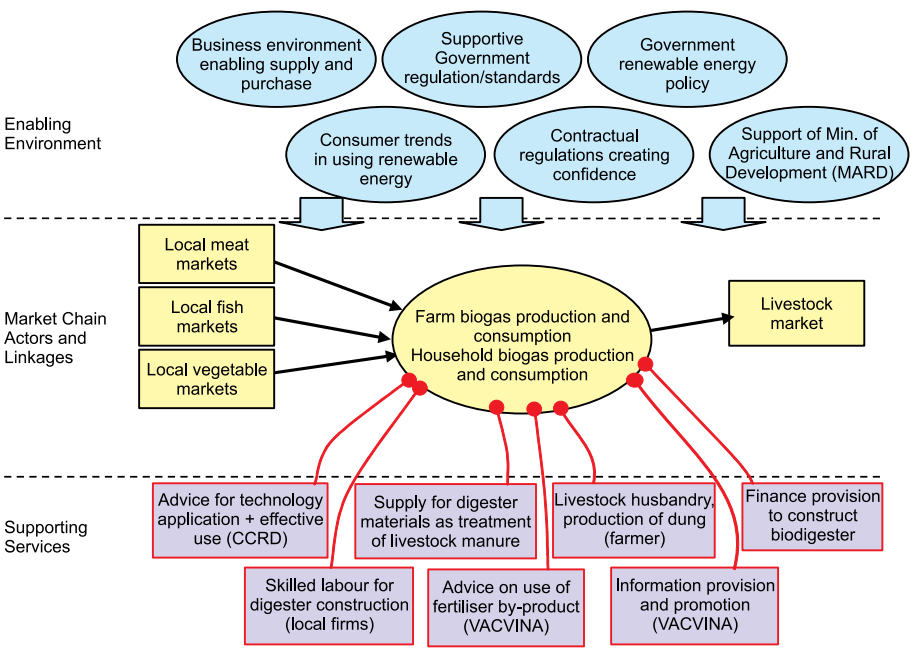
In Vietnam, 80% of households engage in farming and agricultural waste poses a threat to the environment due to fresh animal dung being discharged into open gutters and community waterways. An increasing population leads to intensive agricultural practices, damaging the environment. The treatment of animal and human waste by biodigestion

is one method introduced to address these issues. It increases the production and use of renewable energy, is a safe treatment for human and animal waste, reduces deforestation, increases the capacity of farmers to supply more food, and supports the livelihoods of farmers and vulnerable people.

Vietnam is divided into provinces, districts, communes and wards. A commune has a population of 1 000 to 2 000 households. Phu Loc is one of 26 communes in the Hau Loc District of Thanh Hoa province, the second largest province in Vietnam. Located in the North-Central region, it has a population of nearly 4.5 million of which 80% is rural.

From August 2006 a market-oriented approach was adopted to introduce biogas systems, with support from the ETC/EASE program. Phu Loc - one of 20 project communes, has 1720 households. Currently 80 households use biogas. Depending on the quantity of dung (pigs, cows, buffalo), the households have been consulted, and provided with bio-digesters by local suppliers. Some households have received 18-25% discount of total cost of biogas plants as an "early bird" promotion, offered by local biogas service providers. Others have paid full market price.

The Initiative Market Map



The CCRD initiative has been based on market-oriented approach in order to build a network of autonomous product providers for sustainable biogas development. This is the first cooperation between CCRD and ETC/EASE of Netherlands for Enabling access by market orientation in Vietnam for sustainable energies to the poor.

A biodigester produces enough daily fuel for cooking and lighting. It improves the surrounding environment, whilst livestock produce meat, milk and fish products for local consumption and subsistence farming. Vegetable production is enhanced through use of biogas slurry - a high value bio-fertilizer. Thus, farmers and households provide all the inputs and use all outputs.

CCRD is one of the most active NGOs and is responsible for VACVINA's main activities and targets; promoting animal husbandry, providing equipment to biogas service providers, and perfecting the 'VAC system' as a closed production system without waste. VACVINA has a network of offices at commune level most are involved in retailing farm supplies and equipment. VACVINA branches, after training, lead biogas market development as service providers, that to satisfy the demand of the potential customers who have atleast 5-7 pigs or 2-3 cattle. Using local available materials (bricks, cement, sand, stone) the household biodigesters offered by providers will be designed for different sizes based on quantity of animal dung (quantity of anilals) that needed to be treated in every household daily. The main maintenance will be required after 4-5 years only for emptying slurry as a sediment at bottom of digesters. This could be done easily by household as the case of the maintenace for a septic tank that when-known in rural of Vietnam.

The VACVINA biogas model, designed by CRRD, was recognised by MARD who decreed that it could be installed nationwide. CCRD promoted biogas technology through the local network of VACVINA offices. The VACVINA provincial chapter is responsible for continuous monitoring and support at commune level, supervised at district branch level. Supervised by the provincial chapter, district chapters are responsible for monitoring suppliers and managing credit for commune level providers. Biogas service providers take responsibility for the sale, construction and installation of turn-key biodigesters, training clients and honouring the warranty to households and farmers.

The peri-urban and rural households and farmers must have at least 4-6 pigs or 2-3 cattle which provide all the inputs (animal dung). Households use the biogas as fuel and slurry as fertilizer. They pay the total installation cost for the digesters to local service providers, and operate the biodigester using instructions provided by local service providers.

Relationships between Market Actors

	Farmers	Biogas service provider	VACVINA groups	CCRD	MARD
Farmers					
Biogas service provider	Technical, financial and formal				
VACVINA	Technical, financial and formal	Technical, Regulatory, formal			
CCRD	Informal, technical	Technical, formal	Technical, formal		
MARD - Ministry of Agriculture / Rural Development.-	Regulatory, financial, Informal	Regulatory, Informal	Regulatory, Informal	Regulatory, Informal	

Balance of Rights, Responsibilities and Revenues

Actors\'3Rs'	Rights	Responsibilities	Revenues
Small Farmers Large Farmers	- Use of land for farming including animal raising - Sales of animals (pigs, cows, buffaloes) for meat and milk products etc	- Protect the environment via agriculture production - Paying back loans if any - Operating and maintaining digesters while cleaning pigsty	- Income from farm products. - Saving money using biogas as a free fuel - Saving money by using slurry as a fertilizer
Biogas service providers	- Rural and agricultural service provision	- Promoting biogas installations for sustainable rural and agricultural development including fertilizer	- Income from selling biodigester and/ or wages building biodigesters - Income providing bio-additive to farmers for producing biofertilizer
CCRD -NGO as National technical assistance Center, on VAC promotion including biogas	- Research & Development of advanced technologies including biogas. - Enabling access to sustainable energy to reduce poverty - Providing information, consulting and training - Improving community management capacity	- Enforcing VACVINA regulations regarding its objective on promoting VAC integrated system including biogas technology	- Income providing bio-additive to farmers for producing biofertilizer - Income from selling tools and biogas equipment
VACVINA chapters at all level	- Developing VAC integrated systems with farmer groups, including animal husbandry - Policy advocacy with reference to farmer's rights	- Enforcing VACVINA regulation, revised every 5 years to include responsibilities assigned to relevant chapters & NGOs under VACVINA	- Income from Association member fees.

VACVINA branches at commune level have the rights to rural and agricultural service provision. They lead biogas market development as biogas service providers, and train on the technical aspects. Their responsibilities are to: stimulate interest and demand; receive marketing and technical training; plan and implement the marketing campaign; contact clients and sign turn-key biodigester contracts; supply all necessary materials; liaise with CCRD for tools and biogas equipment; mobilise teams of builders; train the user; guarantee the product. Providers give a 5-year warranty on defects under normal usage on all components. Revenue is through selling biodigesters, bio-additives for biofertilizer production as CCRD agents and other retailing farm supplies and small equipment. Membership fees help to support the organisation to manage its activities. Technicians selling and installing are paid on a 'per unit installed' basis. They do not receive a salary from the local provider. Additional workers are recruited locally and paid for masonry work by negotiation. The costs of local promotion, technical support and warranty are covered by the profits generated from sales.

VACVINA provincial & district chapters have the right to convene farmers for VAC integrated system development training, including animal husbandry. Given the number and dispersed nature of the districts and communes, the VACVINA provincial chapters are responsible for continuous monitoring and support to the commune level providers. Supervised by a provincial chapter, they monitor the activities of biogas providers, participate in training sessions and manage credit facilities for commune level suppliers. Part of the revenue of province and district level VACVINA chapters comes from membership fees. The remaining income comes from consulting services to Government Agriculture development projects.

CCRD have research and development rights for advanced technologies for sustainable rural and agricultural development including biogas. CCRD is responsible for providing access to sustainable energy including biogas, providing information, consulting, training and improving community management capacity. CCRD also provides suppliers with materials, tools and equipment and liaises with representatives of VACVINA chapters to oversee in more detail the activities of local VACVINA chapters. Revenue for CCRD comes from selling tools and biogas equipment, bio-additive to farmers for producing biofertilizer, and consulting servives to national development projects.

Households & farmers' rights enshrined in the Doi Moi reforms to allocation of land, farmers include selling of animals (pigs, cows, buffaloes, etc) and meat, milk and vegetable products at market. They can earn money through selling cooked products for which they used biogas as a free fuel. They can use biogas slurry as fertilizer, saving money avoiding chemical fertilizers.

Analysis of Livelihoods Outcomes

Although farmers do not receive an income directly from biogas, the digesters do contribute to an increase in **Financial Capital** as follows:

Generating more income from animal raising: Without the support of a biodigester, a household can raise 1-2 pigs or one cow/ buffallo only to avoid contamination by animal waste. With a biodigester, the environment is protected, so a household can raise more animals and generate more income. For some households, animal husbandry will bring in 60-75% of their total income.

Saving fuel: Biogas replaces firewood and coal for the entire family's needs for cooking and electricity for lighting produced by a generator using biogas. This represents a direct yearly saving of $80 to $200 for those previously buying all their fuel.

Saving time in gathering firewood: The time saved from not having to gather fuel (from 50 to 90 days /person /year), can be channelled to income generating activities.

Sustainable Agricultural Practice: Fertilisers generated by the bio-digestion process have high nutrient value, and are safe to use on fruit trees, fishpond, rice paddies and vegetable gardens and are preferable to chemical fertilizers.

Installing a hygienic latrine is beneficial for families without latrines. A bio-digester can be coupled with an energy-generating latrine using human waste. The latrine is a fraction of the cost of a regular installation.

Additional income and prestige is achieved by local VACVINA chapters, including technicians and local masons, by providing turn-key biodigesters through the extra paid employment and service to the community.

*Biogas has also been shown in this initiative to improve community relationship*s, increasing **social capital**. A specific community culture in Vietnam has existed for thousands years requiring families "to preserve good relationships with your neighbours" so that your family is well regarded. Animal and poultry-raising activities help many households to improve their income, but in the overcrowded areas of rural Vietnam, animal waste poses health threats and neighbours suffer from the bad smells. The clean environment created by using biogas contributes to improved relationships.

The large membership of VACVINA makes makes use of this social capital in scaling up this initiative. The 1986 Doi Moi economic reforms in Vietnam provided farmers with land – albeit with very small plots. Without knowledge, investment capital, seeds or tools, families could not escape poverty due to inefficient traditional farming methods. VACVINA trained farmers in improved agricultural practices. Farmers started growing efficiently, generating better income and gradually reducing poverty. VACVINA became a reputable and well-known Vietnamese organisation.

The current initiative provides the most cost-effective, reliable model for households wishing to purchase a biogas plant, which is part of a wider family of products (BiOVAC additive to produce bio-fertilizer) and the intensive VAC agriculture model.

Natural capital is protected and enhanced through a *reduction in forest felling*. It is estimated that in Vietnam, woodfuel consumption averages 1.5kg per day (500 kg /year / person). In some areas, the figure is much higher (around 1 500 kg per person per year – *Report of Vietnam Forest science Institute -1996*).

With respect to greenhouse gases, CCRD's calculation shows that a biodigester can capture an average 2.5 cubic metres of methane per day, or 900 cubic metres per year per digester.

Safe and proper treatment of animal waste: The human and animal waste treated by the biodigester meets all criteria required by Government standards on BOD (biological oxygen demand) and COD (chemical oxygen demand). In rural communities, the slurry produces no contamination of water or land from animal wastes.

Human capital is developed through a combination of health and sanitation improvements. Biodigesters improve general sanitary conditions on family plots. To collect the manure, animals are kept in pens or cages, reducing the health hazards related to free roaming animals.

Pens are also kept much cleaner by the daily removal of the manure required for biodigester operation. The foul smell, especially from pigsties, is greatly reduced, as the biodigestion process is anaerobic and smell-free. Disease-carrying flies and parasites are also reduced.

Safe agricultural products: The use of biodigester effluent as a fertiliser for the fishpond or garden, as opposed to green animal manure, produces fish, fruits, and vegetables that are safer for human consumption.

Biogas is a very clean and efficient energy source, free from the hazardous smoke and gases produced by wood or charcoal. Women typically assigned to the daily cooking chores have repeatedly reported the benefits of biogas on their immediate environment. Most women have also cited the time saved from scrubbing soot-covered pots and pans as an important advantage of biogas cooking.

In terms of **physical capital**, the availability of an inexpensive but rich organic fertiliser reduces the costs and risks associated with chemical fertilisers (overuse, product contamination, and leakage into wastewater). The use of biodigesters promotes effective and healthy recycling of existing biomass resource, and encourages the sustainable agricultural practices promoted by the VAC project.

Overall Conclusions

The initiative appears to have has had a positive effect on rural stable livelihoods. Biogas complements sustainable agricultural production in the animal husbandry sector, generating additional income, protecting the local environment and enabling access to sustainable energy for the poor. Biogas is an essentially free resource that can replace traditional fuels (coal, firewood, rice straw etc). Local service providers benefit through new employment opportunities and enhance their income.

The main success factor of the biogas project in Thanh Hoa has been based on the Enabling Access to Sustainable Energy program, a 5-step market orientation strategy (ETC/EASE) focused on enhancing capacity building of community-based organisations with relevant necessary skills. Otherwise, the biogas project impact would have been similar to others based on an NGO-subsidized approach and would probably have failed once the programme ended.

Insufficient money to buy a household biodigester has been identified as one factor that limits biogas development in the community. Biogas use requires farmers to pay even more if they wish to incorporate hygienic latrine. Currently, there are insufficient finance mechanisms through which farmers can access credit for building VACVINA biogas plants. The demand is still immense as Vietnam has nearly 10 million households involved in various forms of animal husbandry.

7.2 LIST OF CONTRIBUTORS

Case Study Project Manager – Steven Hunt (Practical Action Consulting)
FAO Project Manager – Olivier Dubois (Climate Change and Bioenergy Unit – NRCB)

For More information about specific cases contact info@pisces.or.ke in the first instance to be directed to the appropriate individual.

	Region	Country	Case	Lead Author(s)	Case Manager / QA	Contributors / Editing
1	W Africa	Mali	Mali Jatropha Electrification	Ousmane Ouattara	Dr Smail Khennas	Ibrahim Togola
2	W Africa	Senegal	Senegal Chardust Briquettes	Mireille Ehemba	Dr Smail Khennas	
3	W Africa	Senegal	Senegal Typha Charcoal	Mireille Ehemba	Dr Smail Khennas	
4	E Africa	Tanzania	Tanzania Sisal Biogas	Virginia Harden	Steven Hunt	
5	E Africa	Tanzania	Tanzania Palm Oil	Dr Tom Molony	Steven Hunt	
6	E Africa	Kenya	Kenya Charcoal Afforestation	Dr Fridah Mugo	Tameezan Wa Gathui	
7	E Africa	Ethiopia	Ethiopia Ethanol Stoves	Milkyas Debebe	Dr Ben Muok	
8	S Asia	India	India Jatropha Electrification	Santosh Kumar Patnaik	Dr A Nambi	
9	S Asia	India	India Biodiesel Waterpumping	Santosh Kumar Patnaik	Dr A Nambi	Ramani Sankaranarayanan
10	S Asia	Sri Lanka	Sri Lanka Biomass Spice-Drying	Upamali Surangika	Ramani Nissanka	Becky Clements
11	L America	Brazil	Brazil Ethanol Micro-Distilleries	Regina Couto	Angela Higueras	
12	L America	Guatemala	Guatemala Jatropha Biodiesel	Marta Rivera	Angela Higueras	
13	L America	Peru	Peru Veg-Oil Recycling	Gaston Lopez, Maria Lozano, Fernando Acosta	Angela Higueras	
14	SE Asia	Thailand	Thailand Jatropha Co-operative	Becky Clements	Steven Hunt	Prof Sombat Chinawong
15	SE Asia	Vietnam	Vietnam Farm Biogas	Pham Van Tanh	Ramani Nissanka	

7.3 TOR FOR THE OVERALL CASE STUDY ACTIVITY

Objective

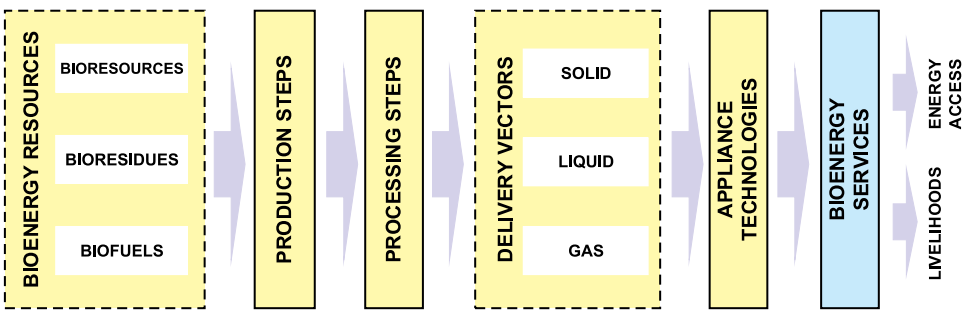
To highlight cases in which local production and/or consumption of Bioenergy is bringing livelihoods benefits to rural communities, and learn lessons about how these benefits have been realised. In this way to bring the rural livelihoods side of Bioenergy into the international debate.

Background

Rural development is often seen as one of the main factors driving the interest in Bioenergy, alongside high energy prices, energy security and climate change. Indeed, Bioenergy has significant potential to promote rural development and contribute to poverty reduction, especially when it uses locally-produced feedstock, through:

- Wider and more on-demand availability of energy, with all its related services for local development (for households, communities and productive uses)
- Job creation, both directly and indirectly, and especially for bioenergy projects based on agriculture
- An alternative in terms of agricultural production, thus contributing to income diversification for farmers
- As a result of the above, increased local revenue generation

However, developing Bioenergy systems that contribute to poverty reduction as well as enhancing energy, food and water security is a complex challenge. Understanding the true impact of Bioenergy Systems on rural livelihoods requires improved understanding of the nature of the complete market chains, and of the different business models, technologies, institutional arrangements and policy drivers at the various stages in the chain, which can lead to very different livelihoods outcomes. PISCES conceptualises Bioenergy systems as energy pathways which may be illustrated as below:



This diagram shows the various Bioenergy Resources and how they are converted ultimately into energy access and livelihoods outcomes. However, not only does the use of the energy result in livelihoods opportunities via energy access and productive uses, but each step and sub-step in the system (as well as wastes and co-products) represents a separate livelihoods opportunity and has its own interlinked characteristics in terms of possible technologies, capacities required, financial implications, institutional arrangements, governance issues, access rights, risk characteristics, environmental impacts etc.

This study sets out to better understand these existing systems, how they have evolved, what constraints they face, and the extent to which different approaches really do enhance rural livelihoods. In this way the study hopes to synthesise lessons about what elements

and approaches might be incorporated in future project designs and policy frameworks, so as to maximise the beneficial contribution of Bioenergy to rural livelihoods.

Scope

The cases should highlight a range of feedstocks (Bioresources, Bioresidues and Biofuels) but with an emphasis on the new field of liquid biofuels and "modern" energy conversions from other forms of Bioenergy. The cases should cover a cross section of end-uses including electricity, cooking/heat and mechanical power. The cases should cover Latin America, West Africa, East Africa and South Asia with a minimum of 3 cases from each region.

Tasks

This will be primarily a desk study although where possible field visits may be undertaken or notes from previous field visits used. Tasks undertaken will be as follows:

- Conduct a brief Literature Review and finalisation of methodology and Case Study selections from Africa, Asia and Latin America which can provide insights and lessons into the practical, technical and institutional challenges and opportunities of Small-Scale Bioenergy Initiatives and their contribution to rural livelihoods in particular.
- Within each Case Study:
  - Conduct Market Chain Analysis (participatory where possible) to establish the full extent and features of the Bioenergy market chain
  - Conduct 4R's analysis of the Relationships and balance of Rights, Responsibilities and Revenues at each stage of the Market Chain and between actors including those in the Enabling Environment and the Supporting Service sectors.
  - Conduct Livelihoods Assessment of both the Vulnerability Context and the Livelihoods impact of the chain on each participant group
  - Draw conclusions on the extent to which the initiative contributed to rural livelihoods and lessons as to how this has been achieved
- Analyse and compare Case Studies to highlight:
  - Common factors and inconsistencies between initiatives and livelihoods outcomes especially regarding types of Bioenergy, Resources, Management/Business models, technologies used, cost efficiency, policy environments, institutional arrangements and stakeholders' '4Rs'.
  - General lessons and conclusions based on the case studies
- Submit a draft consolidation report to IDWG-Bioenergy and PISCES during a one-day workshop to be held in Rome
- Include comments on the draft in the final version of a consolidation report and submit to the NRC Director and PISCES Research Director.

Deliverables

Deliverables from the Case Study project will be as follows:

  - Inception report: Structure of main report, methodology and final titles and outline of case studies – 5th September 2008

- Draft Case Studies and Consolidation Report – 25th October 2008
- Presentation workshop at FAO including Powerpoint Summary – week of 27th October 2008
- Final Consolidation report including Case Study annexes – 15th November 2008
- Joint FAO/PISCES Policy Brief – By end 2008 (not included in this agreement)

Case studies will be 5 pages each and according to the agreed Case Study Template. Case studies will be attached as Appendices to the final report which will be 25-40 pages in length.

Deliverables will be provided on schedule to the Director, Environment, Climate Change and Bioenergy Division at FAO, and the Research Director of the PISCES Research Programme Consortium.

7.4 CASE STUDY TEMPLATE

Case Study Template – 5 PAGE LIMIT

Initiative Name	
Location	*Town, Country, Region*
Initiation Date and Duration	*Date and duration in years*
Funder(s)	
Project Initiator	
Overall Budget (if available)	*In US$*
Output	*Eg In kWh per annum or other if not applicable, please specify*
Area of Land	*Eg under cultivation in Hectares*
Beneficiaries	*Numbers – Group – Benefit* *Eg. XXX Farmers – Income, XXX Households – Electricity etc*

Background and Context

Introduction to the town, country and region context and background.

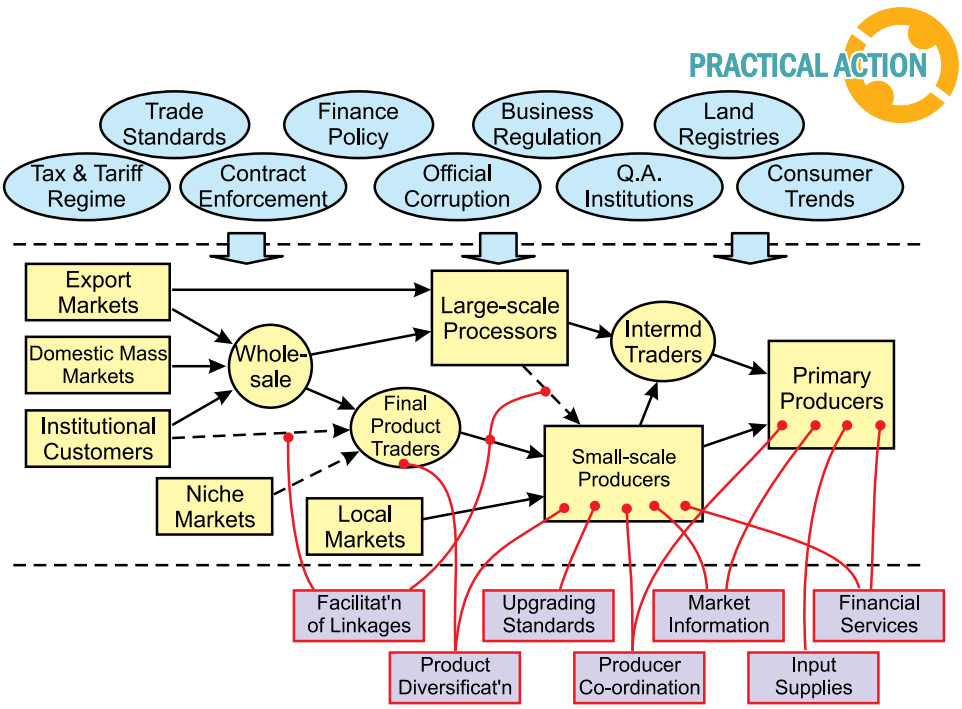
Describe in particular the Vulnerability Context relevant to the initiative such as Trends (population, resources, conflict, economics, governance and technology), Shocks (Human Health, natural disasters/risks, economic shocks, conflict, crops/livestock) and Seasonality (of prices, production, health and employment). For more information on describing the Vulnerability Context see: http://www.livelihoods.org/info/guidance_sheets_pdfs/section2.pdf

Narrative introduction to the initiative, main players, phase of the initiative etc. Has there been evidence of natural scale-up, are there plans for this or is the project currently at pilot stage?

Description of the financial situation of the project eg self-sustaining, ongoing subsidies in place, project funding support only. What is the financial profitability of the system, what is the proportion of subsidised and self-financing? Proportion of public and financial capital involved in the scheme?

The Initiative Market Map

Each case study should have a market map produced for it to the fullest extent possible in the format below. Ideally this would be done through a participatory market mapping process but if not it may be produced from consultation with market actors or from existing knowledge of the project (with the source noted). For guidance on completion see: http://practicalaction.org/docs/ia2/mapping_the_market.pdf



Provide narrative description of the Market Map including interesting or unusual features. Note features which are specific to the project/initiative design intent and features which have evolved naturally. Note use of any co-products and wastes as well as the main chain.

Relationships between Market Actors

Complete the example table below describing the relationships between the various actors identified in the Market Map above (replace existing sample inputs). Highlight key types of relationship such as Technical (support and knowledge sharing), Financial (purely commercial), Regulatory (incentive or legally driven), Informal as well as any other relevant types. For guidance on completion see: http://www.policy-powertools.org/Tools/Understanding/docs/four_Rs_tool_english.pdf

	Eg Farmers:	Eg Woodcutters	Eg Charcoal traders		
Eg Farmers:					
Eg Woodcutters	Eg Poor, Informal				
Charcoal traders	Eg Poor, Informal	Eg Financial, Informal/formal			

Provide narrative description of the relationships between the market actors highlighting instances where the initiative has broken down relationship barriers to enable progress, methods used by the project to forge or improve relationships, public-private partnerships and institutional arrangements such as co-operatives, associations and forums etc

Balance of Rights, Responsibilities and Revenues of Market Actors

Complete the table below replacing the example inputs with the various actors listed down the left hand side and their respective Rights, Responsibilities and Revenues with regards to the initiative. For guidance on completion see: http://www.policy-powertools.org/Tools/Understanding/docs/four_Rs_tool_english.pdf

Actors\'3Rs'	Rights	Responsibilities	Revenues
Eg Small farmers	- Forest usage rights - Use of land for farming - Sales of forest products if allowed	- "Caretakers" of the land and natural resources	- Subsistence from the forest - Income from farm products and some forest products
Eg Woodcutters	- Cutting wood	- None	- Income from selling charcoal and/or wages from cutting wood
Charcoal traders	- Selling charcoal	- None	- Income from selling charcoal
Eg Forestry Service	- Collecting forest use fees	- Managing the forests - Enforcing regulations	- Income from forest use fees

Provide narrative discussion of the allocations of rights within the initiative/case and how these affect actions, risks, security etc.

Provide narrative description of the distribution of responsibilities between the actors. These may be implied by their role, enforced by regulation or contracts etc. Discuss how these responsibilities are mirrored or not by Rights discussed in the previous paragraph. Draw conclusions from this on who carries which risks.

Provide a narrative, and where possible quantified, description of the revenue flows between each stage of the market chain. Highlight any patterns in this flow such as seasonality.

Provide a brief assessment of the balance of rights, responsibilities and revenues of market actors and its implication on the market chain.

Analysis of Livelihoods Outcomes

Summarise the livelihoods outcomes of the initiative drawing on the understanding presented of the various market actors involved with the initiative and their respective Relationships, Responsibilities, Rights and Revenues. How have the 5 Types of Livelihoods capital (Human, Natural, Social, Physical and Financial) for the actors in the market chain been affected by the Initiative and what is the sustainability of this change? Describe the Direct, Indirect and Feedback/Virtuous Circle contributions to these forms of capital. For more information on quantifying and qualifying types of Livelihoods Assets see: http://www.livelihoods.org/info/guidance_sheets_pdfs/section2.pdf

How have technical and Institutional aspects in particular affected the Livelihoods Outcomes?

Have there been any environmental impacts which may have had a circular impact on Livelihoods?

Overall Conclusions

Has this project maximised its potential to support rural livelihoods? If not, why not? What blockages or interests mean that this does not happen?

What are the crucial failure and success factors?

What are the key factors affecting the sustainability of the initiative?

References and Bibliography (not included within 5 page limit)

Provide full details of documents referred to, interviews conducted including dates etc

Full notes and supporting documentation (not included within 5 page limit)

Provide all relevant interview notes, pictures,

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31. Small Scale Bioenergy Initiatives, Brief description and preliminary lessons on livelihood impacts from case studies in Asia, Laôhn America and Africa, **(E)**
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ENVIRONMENT – CLIMATE CHANGE – BIOENERGY – MONITORING AND ASSESSMENT
FAO - ENVIRONMENT AND NATURAL RESOURCES MANAGEMENT WORKING PAPER

This study was conducted between September and November 2008 under a joint initiative of FAO and the Policy Innovations Systems for Clean Energy Security (PISCES) Energy Research Programme Consortium funded by DFID.

The focus of the study was on the impacts that different types of local level Bioenergy initiatives can have on Rural Livelihoods in different contexts in the developing world. Livelihoods are understood as the enhancement of the full range of natural, financial, human, social and physical capitals on a sustainable ongoing basis.

The 15 cases were selected from 12 countries in six regions of Latin America, Africa and Asia. Cases were selected to highlight the use of a range of bioenergy resources, including natural bioresources, bioresidues from existing agricultural, forestry or industrial activities; and biofuels (solid and liquid) from purpose grown energy crops.

The initiatives match these resources to a range of energy needs including cooking, mobility, productive uses and electricity for lighting and communication - thereby highlighting the scope of bioenergy applications. The approach taken also considers the non-energy by-products of production processes where these form, or could form, a significant added benefit in terms of livelihoods, revenues and efficiency.

The case study approach combines a Market Systems perspective, the "4Rs" Framework of Relationships, Rights, Responsibilities and Revenues to the actors in the system, assessment of the impacts of the initiatives on the Livelihoods Assets of the actors in the chain, and consideration of the sustainability of these impacts.

In the final part of the study preliminary conclusions are drawn and recommendations on future areas of work are made.




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