LAO PDR

Intervention strategy

for the development of biofuels

Analysis of Opportunities and Challenges from a smallholder point of view

Vientiane, March 2009

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Contents

List of Figures

List of Tables

Overview

This case analyses the role and involvement of SNV in the development of the biofuel value chain in Lao PDR. Biofuel is a new and innovative sector raising questions, uncertainties but also promises and guarantees as new source of energy. Impacts are focused on creating employment, diversifying income, and increasing production while providing safer and cleaner access to energy for rural communities; hence, this chain integrates both impact areas of SNV, designed in the new strategy 2007-2015.

During three months of investigation, SNV explored most appropriated ways to invest in this sector, analyzing biofuel feedstocks, production models, processing technologies, actors' interests and markets trends.

The present document is divided into two main parts; the first part describes the opportunities and provides background information in the Asian Region on biofuel market, biofuel policy and biofuel feedstocks while the second part illustrates the challenges through a business case approach for SNV intervention in Lao PDR and providing an intern Return on Investment.

The business case tries to answer a simple question: **Can biofuel generates incomes for rural communities, while preserving environment and contributes to SNV impact areas.** To answer this question, sub-questions have to be answered such as:

- Why should SNV get involved in the biofuel sector?
- What are the products SNV should select?
- How should SNV implement activities?
- Where should SNV invest and focus?
- With whom should SNV link to develop the sector?

This case argues that SNV could consider the biofuel value chain in this sector of 'Small Holder Cash Crop (SHCC)' as a promising source of revenue, income and production for rural communities that could be linked to growing market demand in the country as well as in the region. SNV return on investment is positive even with present economic turmoil and conservative figures of projection.

Yet, the investment plan for SNV must consider an inclusive business approach targeting policy, environment and social aspects to created an enabling environment for biofuel sustainable production and consumption.

Business Case summary

Sector:	Biofuel
Feedstock:	Jatropha Curcas
Portfolio:	All
Clients:	LIRE (Knowledge & Dev.);
	Kolao (Inclusive Business);
Possible Clients:	New division of MEM (Policy & Gov.);
	APPC & LAPC;
	Departments at provincial level;
	Farmer Associations (Value Chain);
Possible Partners:	EU & ADB (Resource Mobilization);
	FAO & EEP Finn Program (Policy and Dev.);
Yield:	1 ton of seed per hectare (scenario 500 to 2000 Kg/Ha)
Extraction ratio:	25% (4Kg of seed for 1 liter of biodiesel)
Plantation:	10,000 Ha per year planted
Production:	To reach 5% of national consumption (20 million Liter)
Farm gate price:	500 KIP per Kilo (0,05 €)
Retail price Diesel:	5,040 Kip/L
SNV Investment :	165,000€ per year (Phase 1) 50,000 € (Phase 2)
Advisory day:	275 days per year (Phase 1) 105 days (Phase 2)
Gross farmer revenue:	From 25€ to 250€ per Ha
Employment:	32500 to 130,000 depending on yield & extraction ratio
Total farmers' income:	3.2 M € to 8.1 M€
National saving:	100 billion Kip (10 million € - Opportunity cost);
SNV ROI:	170% by 2015 (10% of total ROI)

Part 1: The Opportunities

This first part presents the opportunities of biofuel in the region in providing information on market (demand, supply and price) on the policy situation at the regional level and national level and in presenting the various feedstocks compatible for biofuel production.

1 Biofuels market: A Regional perspective

The production and use of biofuels have entered a new era of global growth, experiencing acceleration in both the scale of the industry and the number of countries involved. Surging investment in biofuel production is being driven by a variety of factors, including the development of more efficient conversion technologies, the introduction of strong new government policies (due to Kyoto agreement), and, of course, the rising/fluctuating price of fossil oil. Recently, many governments, addressing the world economy crisis by enhancing competitiveness, invest in innovation for new technologies. On sector in particular, the car industry, should become more competitive and enable to gain first advantage from being "environmental friendly" which will be needed worldwide in the future.

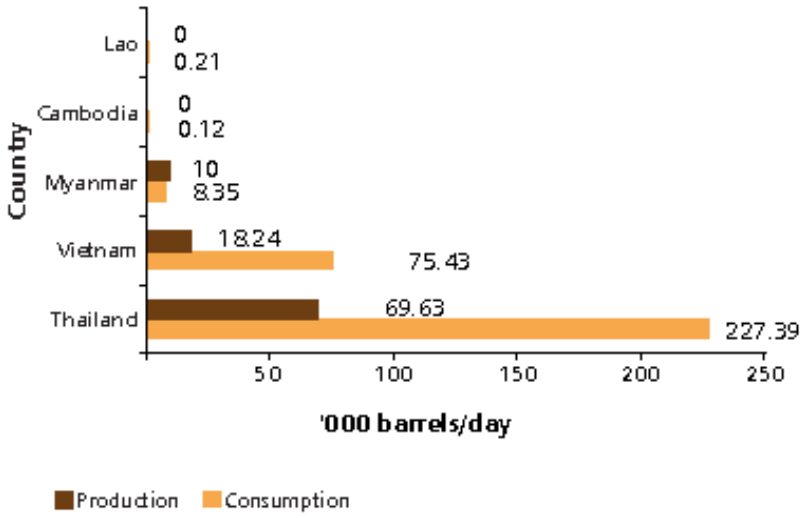
1.1 Biofuel demand

Many say Asian demand for biofuels will pick up if food inflation is controlled, giving governments more elbow room to strengthen mandatory blending policies and ensure they are implemented. In 2007, Asia Pacific's biodiesel consumption was likely to reach1.3 million tons with China, Australia, Indonesia and the Philippines being the largest markets, according to a report by Frost & Sullivan[1].

A study[2] on biofuel, conducted jointly by SNV and WWF, reported that within the Greater Mekong Sub-region (GMS with Cambodia, Laos, Myanmar, Thailand, Vietnam, and Yunnan province of the Peoples' Republic of China), energy demand is projected to increase between 7% and 16% per annum – faster than the expected rate of economic growth – placing great stress on existing energy systems. However, these energy demands mask great disparities in energy usage. The Asian Development Bank (ADB, 2007[3]) estimated that 50 million out of 300 million people in the GMS are not reached by electricity and must rely on traditional fuels.

[1] Strategic Analysis of the Asia Pacific Biodiesel Industry; Frost & Sullivan, Nov 2007, Pages: 146
[2] Developing Sustainable Pro-poor Biofuels in the Mekong Region and Nepal "A holistic approach looking at smallholder benefits from an economic, social and environmental point of view. SNV-WWF, 2009. Pages: 77
[3] Asian Development Bank. 2007. Biofuel and renewable rural energy initiative in the greater Mekong Sub-region.

Figure 1: Percentage Increase in Oil Consumption and Production in the GMS, 2001 and 2005.



Source: http://tonto.eia.doe.gov/country/index.cfm.

1.2 Fuel supply

Biofuels, which include ethanol and biodiesel, can be produced from many plants and crops. However, readily available food crops such as corn, rapeseed and oil palm have become the first option in many countries, fuelling demand for these crops and a bruising round of food inflation that has pushed up the cost of many staples.

Asia biodiesel producers need to address the likelihood of continued pressure on feedstock costs and ensure that they can produce as cost-effectively as possible, while simultaneously exploring alternative lower-cost feedstock supplies. Consequently, alternative feedstocks such as waste cooking oil and Jatropha are being actively explored by producers in the region. As these are available at a lower cost than the main vegetable oils, they can improve commercial viability for the biodiesel sector.

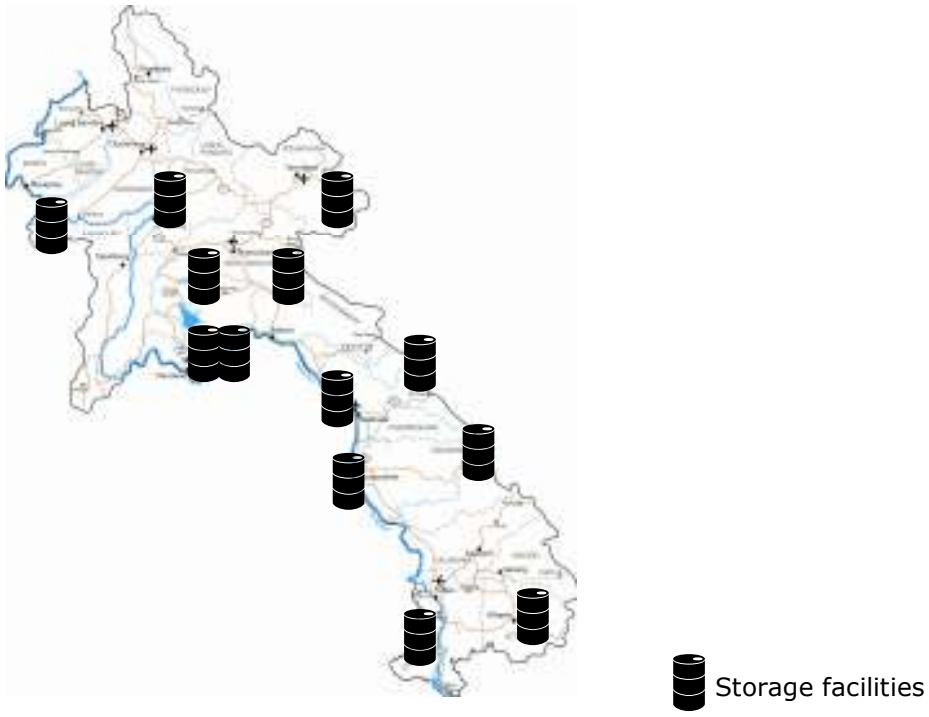
If successful, the shift to marginal, low-maintenance crops as feedstock could yield the policy push that is necessary for the growth of the Asian biofuels industry. The crop switch also could benefit the region's land-rich, populous countries by unlocking the value of less-fertile areas.

Although there are several strong drivers of growth in the Asia biodiesel industry, both for increased supply as well as demand, the past year witnessed a significant downturn in the fortunes of the biodiesel industry. This was mainly

due to the significant increase in global feedstock prices (with the rise in palm oil prices being particularly dramatic), and the fall in mineral diesel prices since the end of 2008. As a result, plants have delayed production, produced at below capacity or been deferred altogether.

With special regards to Lao PDR, the fuel supply comes through Thailand (75%) and Vietnam (25%). Meanwhile, Lao State Fuel Company (LSFC) has a major retail network for fuel with 362 filling stations over the country and 25 hand-pump stations (in remote areas). Nearly all of the provinces of Laos is established with storage facilities (see figure 1b below) with a global storage capacity of 23 million Litres. In Savannakhet and Khammouane Province, two storage facilities per province are established; at the borders with Vietnam on the East side and at the border with Thailand on the West side. LSFC confirms that processing units could be installed on storage facility sites if biofuel should be processed at provincial level. According the Lao State Fuel company, the global national fuel consumption in Laos is estimated at 600 million litres per year of which 65% is Diesel import. Biofuel production, in term of surface cultivated, could be a feasible venture for the country to reach national target of 5%.

Figure 1b: Fuel storage facilities from LSFC in Lao PDR

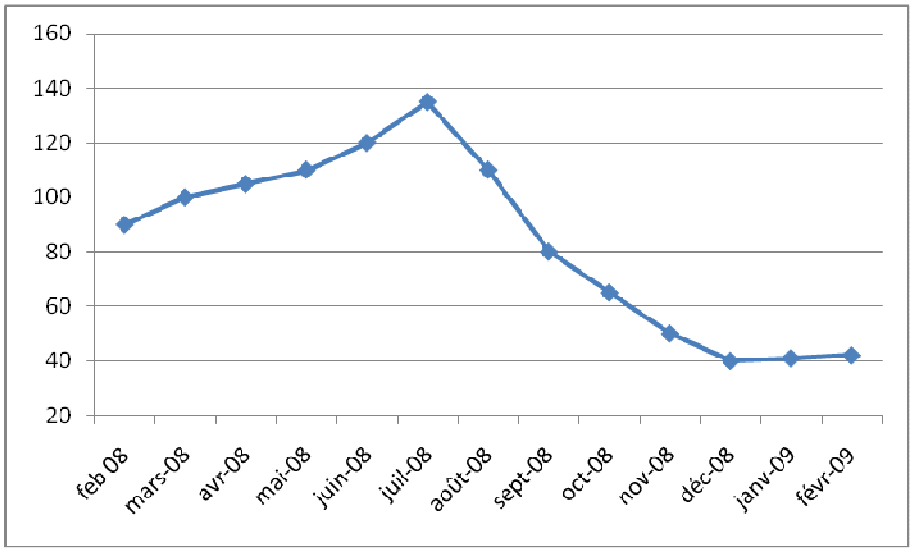


Source: Adapted from LSFC

1.3 Biofuel price

The price of biofuel can be diverse according to the cost of production and the raw material used. Hence, to estimate biofuel price, it is relevant to follow fossil diesel prices on the international market that can easily be used as benchmark. Prices averaged almost $100 per barrel in 2008, with daily spot prices ranging from almost $150 per barrel in early July to about $30 per barrel towards the end of the year. Under current economic and world crude oil supply assumptions, prices are expected to average $43 per barrel in 2009 and $55 per barrel in 2010[4].

Figure 2: Monthly average price per barrel of fossil fuel on the world market in US$ per barrel

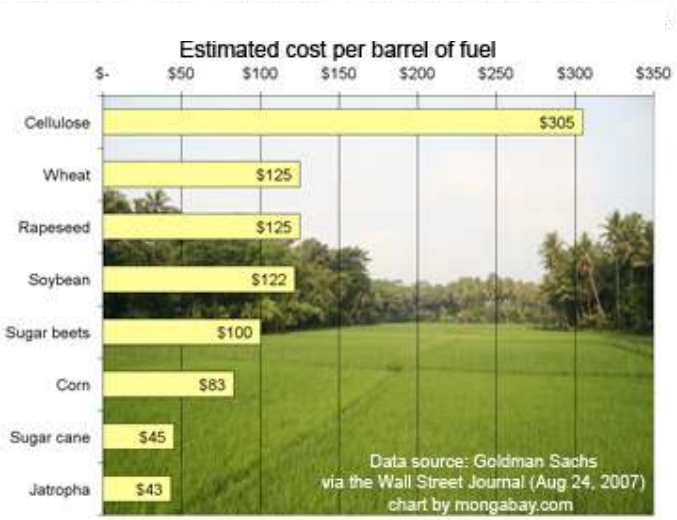


Source: US energy admnistration

A study published in June 2008 by the Food and Agriculture Organization showed that cassava is competitive as a feedstock when crude oil is at $45 a barrel[5]. A recent Goldman Sachs report said Jatropha seeds could produce biodiesel at $43 a barrel, which makes it one of the best choices for future biodiesel production. A barrel[6] of fuel extracted from sugar cane costs $45, while from cellulose it can cost up to $ 305[7].

[4] http://www.eia.doe.gov/emeu/steo/pub/contents.html
[5] The State of Food and Agriculture: BIOFUELS: prospects, risks and, opportunities. 2008
[6] A Barrel equals to 159 litres
[7] Yang, S. C. 2007. Green trend to refine toxic bush into oil. Business Week, 1041, page 166.

Figure 3: Relative costs of biofuels from various feedstocks



Source: Goldman Sachs, 2007

1.4 Biofuel blending and distribution

Many countries allow up to 5% biodiesel in blends without labelling. This has many advantages for the industry as it gives a lot more flexibility if there are biodiesel supply disruptions. This approach means the supplier has to ensure the blend meets the regulated diesel specification and is fit for purpose. Biodiesel could be blended at the refinery or at storage sites without too much modifications or investments for national companies. Transport and logistics of biofuel take a fair amount of total production cost, estimated between 30 and 40% of production cost[8]. This argues for countries, like in those in the Mekong Region, where remote production areas and lack of road infrastructure for decentralized processing units located near production areas or for portable units that move from location to location.

Summary: The biofuel market in the Mekong Region and in Lao PDR is steadily growing and despite fossil price fluctuation, the demand increases while consumers are becoming more environmental conscious addressing climate change issues. Jatropha is one of most prominent feedstock for biofuel production as its cost is significantly low compared to other raw materials.

[8] Challenges of Jatropha Products Trading from Logistics and Commercial Points of View. Dr. Eng. Christophe de Landtsheer, MD, Tank Terminal Technologies Jatropha World Conference 2009 Kuala Lumpur

2 Policy: Government and local initiatives seek to create new market for biofuel

2.1 Regional Policies: A consensus

Frost & Sullivan research[9] mentioned that most governments in the Asia Pacific region are recognizing that biodiesel can effectively reduce oil imports, improve fuel security, and stimulate domestic agriculture. Initially, the biodiesel sector in Asia Pacific focused on export opportunities, especially to the European Union. However, the past year has seen many countries move to stimulate domestic consumption aided by volume sales mandates, tax benefits, volume targets and other benefits. These measures should strengthen demand in the region and provide a viable alternative to exporting, although export markets will remain critical for the industry in some countries.

An analysis conducted by IFAD[10] encouraged biofuel policy development that could serve the dual purpose of meeting national energy and food needs. It would also require 1) improving both food and energy crops to ensure that the plants selected for production in remote areas have the productivity to be competitive and 2) investing in soil and water conservation practices and infrastructure to ensure competitive development of biofuels. Such policies should also aim to develop an active rural energy policy, as this would provide the basis for intensifying agriculture and with it, food security.

ADB[11] is also reviewing current policies on promoting Rural Renewable Energy (RRE) development in the Mekong Region and ADB is identifying the appropriate policy levers to encourage sustained growth in the subsector, especially in strengthening public–private sector partnerships, encouraging investment, and promoting cross-border trade. It is stipulated that policy should ensure sustainable development; and growth of the biofuel sector by capturing a wide spectrum of activities involving 1) land use and land-use change, 2) impact on natural resources, particularly water and 3) address the economic, social, and environmental implications of widespread biofuels production use and trade.

2.2 National policy: A way toward a "pro poor" approach

In Lao PDR, the recently developed draft national policy[12], on 'fuel saving and promotion of biofuel production', targets to reach a 5% share of biofuels use by 2015. One challenge is to implement policy measures to ensure that the growing use of bio-energy is conducive to diversify and increase revenues, thus, that "biofuel becomes pro-poor" as recommended by ADB and IFAD. This will be the case if the production is labour intensive, the processing technology for provision

[9] Strategic Analysis of the Asia Pacific Biodiesel Industry; Frost & Sullivan, Nov 2007, Pages: 146
[10] Biofuel Expansion: Challenges, Risks and Opportunities for Rural Poor People Paper prepared for the Round Table organized during the Thirty-first session of IFAD's Governing Council, 14 February 2008 Prepared by: Vineet Raswant, Nancy Hart and Monica Romano.
[11] Rural Renewable Energy in the Greater Mekong Sub-region, Asia Development Bank, 2008
[12] Ministry of Energy and Mines, Department of Electricity, 2006

of local energy is simple and there is promotion of public-private sector partnerships when producing for national or international markets.

Economies of scale are necessary for farmers and for the country to take advantage of biofuel opportunity. Yet, small-scale farmers face obstacles in accessing supply chains, transporting crops to processing plants or selling through middlemen and policy measures would be required to ensure that small farmers are part of the national drive to promote biofuel production.

In November 2008, the Government of Lao PDR (GoL), through the Prime Minister office, has set priorities in the first place for biodiesel development while focusing on Jatropha Curcas production as primary feedstock.

At the meso level, some provinces in Lao PDR do have their own development plan, like in Khammouane[13]. The plan stipulates that biofuel, among many other crops, could be beneficial for the province and its economic development.

Summary: Policy is one of the key issues to make the production of biofuel sustainable and pro-poor oriented. Land use, natural resources and social aspects should be particularly addressed while government set up policy at country level to ensure benefit from the beginning of the value chains where small holders contribute to biofuel production. The government of Laos has set priority for the development of biodiesel while promoting Jatropha as primary feedstock.

3 Resource: Feedstock's sourcing

Biofuels, as earlier mentioned, include ethanol and biodiesel. Since the Government of Laos set priorities on biodiesel only, it is foreseen that SNV should focus on feedstocks that are potentially valuable within the country agro-ecological conditions and compatible with biodiesel production. The potential oil crops that can be found locally in Laos are namely Jatropha, Soybean, Palm Oil and Castor Oil plants[14]. However, exploitation of these crops for oil production is not implemented at the same level and the crops are not all suitable for all geographical zones of the country. The most interesting crops (potential in Laos) that can be afterward processed into biodiesel are described below and further description on feedstock for ethanol are provided in annex 1.

[13] *Leading the Way* Khammouane Development Report and Strategy (2006 – 2015) Khammouane Province, Lao People's Democratic Republic, November, 2006

[14] Based on interview with Dr. Maydom Chanthanasinh from the National Authority for Science & Technology of the PM Office, and NEDO-LIRE report on biofuel in Lao PDR as well as on desk study with literatures review.

3.1 Jatropha

Jatropha Curcas[15] is a succulent that sheds its leaves during the dry season. It is best adapted to semi-arid conditions, where grassland-savannah, or thorn forest scrub vegetation prevail naturally. Its present spread is in the dryer tropics with rainfall from 300 to 1200 mm per annum. Jatropha production occurs mainly at low altitudes in the tropics from zero to 500 m and it is adapted to average annual temperatures (20 to 28°C in its places of origin). It can withstand slight frost. It is not sensitive for day length. It performs best on well-drained soils with good aeration and is well adapted to soils with low nutrient content. Root formation is reduced in heavy soils. Jatropha does not resist water pounding. Jatropha can be grown in most provinces in Lao PDR.

As it is not a food or forage crop, it plays an important role in deterring cattle, and thereby protects other valuable food or cash crops. Jatropha seeds can be pressed into bio-oil that can be used to run diesel engines, which in turn can drive pumps, food processing machinery, or electricity generators. The bio-oil can also be the basis for soap making. The pressed residue of the seeds is a good fertilizer and can be used for biogas production.

It is a tall bush or small tree (up to 5-6 m height). The lifespan of this perennial bush is more than 50 years, and it can grow on marginal soils with low nutrient content. Jatropha Curcas, or "physic nut" has a straight trunk with thick branches. It has green leaves with a length and width of 6 to 15 cm. The fruits have an "American Football" type of shape, of about 40 mm length and each contains 3 seeds (on average), which look like black beans. with similar dimensions, of about 18 mm long (11-30) and 10 mm wide (7 – 11) The seed weight per 1000 seeds is about 750 grams, which is equivalent of 1333 seeds per kg on average. The seeds contain more than 30% of oil by weight. The yield per tree is estimated between 1.5 and 4 kilo depending on the varieties, agro ecological conditions and agricultural practices. Thus, in general a hectare can yield between 2.2 tons and 10 tons depends on density and yield per tree. At farmers level (without knowledge and training), it is also reported that production are sometime less than 1 ton/ha and sometime not more than 300 kg/ha. If planted in hedges, the reported productivity of Jatropha is from 0.5 kg to 1.0 kg of seed per meter of live fence. Detailed information on Jatropha Curcas is presented in Annex 2 in this report.

[15] Information based on consultant researches and field activities

Table SWOT Analysis for Jatropha

Strengths	Weaknesses	Opportunities	Threats
-Life span of 30 years; -Grows on low-grade land with minimal input -Many by products; -Not browsed by animal; -Works well with intercropping; -Start fruiting after 2 years.	-Still unknown optimal production method (on research) -There is now an awareness of this crop but no extensive knowledge as of yet. -Some insects pests and disease - Unsynchronized fruit maturity	-Suitable growing conditions in Lao PDR -Global recognition of a high quality bio-diesel crop; -Processing at community level -Carbon credit methodology on progress -Yield can significantly increased with adequate inputs and production methods -Recognised as priority feedstock by GoL	-Health risk of Poisoning -Market price uncertainty

3.2 Soy Bean

The soybean[16] is a species of legume native to East Asia that is currently grown in the Asian Region. Soybeans are an important global crop, providing oil and protein. The bulk of the crop is solvent-extracted for vegetable oil and then the soy meal is used for animal feed. A small proportion of the crop is consumed directly by humans. Soybean can grow up to 3,000 m above sea level making an interesting crop for the mountainous regions of the study area such as in northern Laos. As with other bio-oils, Soy biodiesel can be an environmentally friendly fuel as it is renewable, nontoxic and biodegradable. However, as with other biofuel crops this depends on the way the feedstock is produced. As in the case of palm oil, soy has been the subject of many environmental campaigns, as large-scale development especially in South America has resulted in conversion of forests and caused environmental degradation. Smallholder soybean production shows high revenue to cost ratios so the crop is profitable. For biofuel production, the oil content is only 15%, compared with 30% for Jatropha. However, proponents of soy-based biodiesel emphasize that oil for biofuel is only a by-product of the edible meal and therefore soybean farmers are not reliant on

[16] Information based on the report Developing Sustainable Pro-poor Biofuels in the Mekong Region and Nepal "A holistic approach looking at smallholder benefits from an economic, social and environmental point of view. SNV-WWF, 2009. Pages: 77

only one market. Soybean is a nitrogen fixer and improves productivity of subsequent crops by 10% to 15% (e.g. rice, maize, etc.) but can also lead to soil erosion and pollution due to agrochemical use depending on land-use practices. Yield are estimated around one to 1.5 T/ha and it is reported that Soybean is only cultivated around the Luang Prabang Province being promoted by one international export-import company.

Table SWOT Analysis for Soy Bean

Strengths	Weaknesses	Opportunities	Threats
-Annual plant -Suitable for altitude -Multi utility for food and fodder production -Improve soil quality by fixation of nitrogen	-High temperature necessary -Low oil contents -Labour intensive -No production developed	-Suitable in cropping system -Reduce chemical fertilizing	-High investment for oil extraction -Technology for processing under develop in Asian region No Lao demand

3.3 Palm oil

Palm[17] is perennial plant can be used for efficient production up to 30 years. The high photosynthesis productivity of the plant causes yields of about 7 tons of fruit per ha and per year. It is reported that from 10 tons of fruit, 3 tons of pericarp oil and 750 Kg of seed kernel can be produced. Now this is the most effective production of oil in tropical areas. After a time of three to four years, the plants can be harvested for the first time. For the cultivation of oil palms, high input of labour, fertilizer and propagation material for planting is necessary, which lead to high investment costs on the side of the farmers.

Palm trees have high requirements to environment concerning humidity, temperature and a certain content of salt in the air, which can only be found at areas close to the sea. Hence, in most areas of Laos, a production of palm oil is not possible and the attempt brings the risk of disinvestments.

[17] Information based on Survey on Fossil Fuel Consumption for Energy Efficiency Conservation to Promote the New Technology of Biofuel in Lao PDR, NEDO-LIRE, 2008

Table SWOT Analysis for Palm oil

Strengths	Weaknesses	Opportunities	Threats
-High yield -High oil contents -Technology for processing exist	-Start yielding only after 3-4 years -High investment costs and long return on investment -Water sensitive -Pest and disease sensitive	-Long term investment and secure land ownership -Various By-products -Biomass production -Create employment on large scale plantation	-Not applicable to most areas in Laos -Market volatility and strong fluctuation -Little knowledge on plantation -No Lao demand

3.4 Castor oil

Castor oil[18] is a widespread plant in tropical regions. It is a fast growing, perennial shrub, which can reach a height up to 20 meters. Castor can resist the dry season and thus can be cultivated in Lao PDR without irrigation. It can be integrated in intercropping system. The plant does not have many requirements regarding the soil quality and can be therefore cultivated on wastelands.

The fruits do not come to maturation at the same time. This makes the harvest complicated because the mature fruit bunches must be selected first and then picked by hand up to five times per year. A mechanical harvesting and processing system exists but quite costly which leads to high investment at the farm site.

The seeds of castor contain a high amount of oil (up to 60 %) and a high yield of oil per hectare (0.4 to 1.8 tons / ha) can be exploited. Besides the use of biofuel, castor oil can be used for medicinal and chemical purposes. The oil has a substantially higher viscosity than other plant oils. Therefore, using it for engines could cause technical problems in the fuel injection. The seeds are very toxic (lethal dose is 0.18 g per kg body mass) and therefore a possible intoxication of humans e.g. while harvesting and animals should be kept in mind

[18] Information based on Survey on Fossil Fuel Consumption for Energy Efficiency Conservation to Promote the New Technology of Biofuel in Lao PDR, NEDO-LIRE, 2008

Table SWOT Analysis for Castor oil

Strengths	Weaknesses	Opportunities	Threats
-Grow well in Lao -Rich in oil contents -Multipurpose uses	-Lack of technical and extension support -Low price on seed -Not synchronised maturity -High cost of harvesting -Not well develop yet in Laos in term of plantation	-Demand market in the region from neighbourhood countries	-Early Private sector initiatives have left farmers with their production. -No scale plantation and current production. No Lao demand

Summary: The various potential feedstocks shown opportunities to address biofuel production in Lao PDR, but most of them are still at their infancy in term of production, processing and commercialization. The most prominent and visible feedstock is Jatropha Curcas. Field visits and stakeholders interviews have confirmed that trends and several nurseries and private sectors investments have been established in the several provinces in the country.

Part 2: The challenges

Based on the opportunities for biofuel development, this second part describes a business case for SNV-Lao analyzing challenges while implementing activities in the biofuel sector. This case is based on answering simple questions addressing the whole value chain steps, considering all stakeholders from macro to micro levels, identifying geographical focus and estimating the investment SNV would have to provide to make this case feasible considering the motto:

You do not save money by building half a bridge…

4 SNV-Laos involvement in biofuel sector

4.1 Why should SNV get involved in the biofuel sector?

If biodiesel continues its rapid growth around the globe, the impact on the agricultural sector will be important. Increased jobs and economic development for rural areas in developing countries is possible if governments put the appropriate policies in place and enforce them. The more farmers are involved in the production, processing, and use of biodiesel, the more likely they are to benefit from them.

Enabling farmer ownership over more of the value-added chain will improve rural livelihoods. This not only helps improve the well-being of farm families, it increases the positive effects as greater farm income is circulated in local economies and jobs are created in other sectors. As biofuel industries grow, this multiplier effect will have impacts on the provincial, national, and regional levels. Greater farmer ownership will also help prevent a repetition of the dynamics in the current global food industry, where very large processors are able to exert pressure on producers.

A biodiesel industry that is locally oriented in which farmer-owners produce fuel for their own use is more likely to guarantee benefits to a rural community. In these situations, farmers may risk bad seasons and poor harvests but, by adding value to their own products and using these goods locally, they are also less vulnerable to external exploitation and disruptive market fluctuations. Although liquid fuels produced at home are often used for cooking or electricity, rather than transportation, it is worth noting that readily available technologies to convert biofuel into energy (for hand tractors, irrigation pumps, ...) promise to be a more directed way to alleviate poverty, especially in more remote, oil-dependent regions.

In Laos, where access to modern forms of energy is still limited or absent (50% off-grid[19]), government and development agency support, like SNV, for small-scale biofuel production can help provide clean, accessible energy that is vital for rural development and poverty alleviation.

[19] Discussion with Grayson Heffner consultant energy at the World Bank

Current major investments in Lao PDR are taking place and two majors companies (Kolao Farm(KF)[20] and Lao Agriculture Promotion Company (LAPC[21])) both plan a 20 million US$ investment (excluding processing factory). Another company (Agricultural Products Promotion Company (APPC[22])) is securing investment worth the same amount. All of them have large-scale plans (from 240,000 Ha to 20,000 Ha) to produce biodiesel with small-scale farmers in various provinces of the country. Cross borders' investors (Vietnam, China and Thailand) are also aggressively looking for feedstocks production to comply with policy targets and to meet growing demand in these respective countries.

Finally yet importantly, while effective action to reduce greenhouse gas emissions requires a coordinated global response, in which most industrialized countries will play their part, adaptation can be effectively advanced at a local scale like in Laos with the production of biofuel considered as green energy. Thus, SNV could play its role and contribute to address climate change one of the most important issues for governments around the globe and specifically in the Asian Region.

Summary: Climate change is a proven fact and reducing gas emission is a share responsibility; Biofuel is part of the solution! Several studies, recent discussions and researches prove that biofuel can contribute to communities' development and provide access to sustainable energy. Lao government has engaged in promoting the biodiesel sector and reduce it dependency on fossil fuel import as well as applying Kyoto directives. Major Private Investments are already in place in the country and more stakeholders get involve by the day. Yet, SNV should also be part of the solution in supporting current dynamic, providing sustainable guidelines, linking small holders to market and thus contributing to impact areas of the strategy until 2015.

Victor Hugo once remarked: "You can resist an invading army; you cannot resist an idea whose time has come". Today biofuel is such an idea.

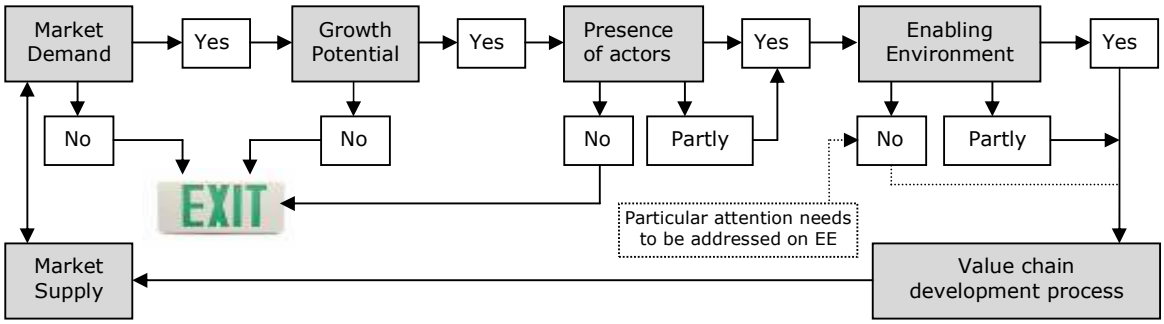
4.2 What feedstock SNV should focus on?

SNV investigates the biofuel value chain from a market demand perspective, hence paying more attention to end use consumers and helping to compete for market share. The problem is to identify what feedstock validates to enter the

[20] Kolao Farm plan to produce 240,000 Ha of Jatropha over the country divided into 140,000Ha with smallholders scheme and 100,000Ha with own management. Korean investment
[21] LAPC plans to produce 30,000 Ha of Jatropha in several provinces but principally in Savannakhet province with smallholders' scheme. China investment
[22] APPC plans to produce 20,000 Ha of Jatropha Houaphane and Xiangkhouang provinces with smallholders' scheme. French investment

development of the value chain. The various feedstocks described above in part 1 of the document have been screened through the following steps (*figure 4*) to selected feedstock feasibility for biofuel development. Jatropha is the most prominent feedstock that shape with all steps and respond to the link between market demand and market supply.

Figure 4: Steps analysis for feedstock selection and value chain development



Source: SNV-Laos

Jatropha has been presented for many years as the "Eldorado" plant promising fast and cheap solution to produce green energy and to reduce poverty around the globe. Yet, these enthusiastic messages about the miracle plant have disappeared to become more realistic and objective. First planting experiences on farms (large, medium and small scale) are showing their results and yields expectation are far beyond assumption, not mentioning business plans in the trash. Stakeholders (private sector, researchers[23] and investors) agree that Jatropha production requires much more attention and technical skills, as claimed 3 or 4 years ago, and that Jatropha must be selected according to local condition (Phenotype vs. Genotype[24]). Even the scope of Jatropha oil export (to EU and USA) is regarded as long-term objective, if any. Investors are reserved to start (or to continue) investing without guarantee on results[25].

So, why SNV should select Jatropha? The general message is now "small is beautiful" rather than "big is fantastic". The research is ongoing and interesting results are coming up. Actors from the private sector (main investors) want to create better relationship with small producers and going step by step implementing their business model, setting up decentralised processing units (close to production areas) are considered and the end-use consumption of biofuel should benefit producers and citizens from land of origin (policy development). Yet, from a smallholder cash crop perspective, SNV plays a crucial

[23] Many researchers and scientists called early for precautious approach but their voices were not heard from the crowd.

[24] Phenotype = Genotype + Environmental conditions

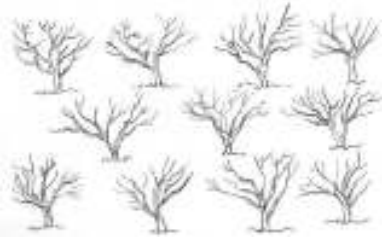
[25] But also due to global economic conjuncture and oil price to its lower

role with its value chain development and inclusive business concept, not mentioning policy support and knowledge development!

Jatropha can be planted in various methods and therefore be adapted to various farming systems. The three methods below offer the producer the liberty to adapt according to the investment in labour, land and finance resources available.

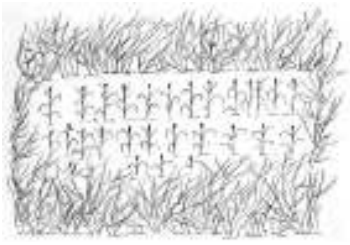
Figure 5: Various planting methods for Jatropha production

Jatropha plantation are mostly made for industrial farming but can be planted by small producer depending on land availability. One hectare can take from 1500 up to 2500 trees depending on density.



Monoculture

The planting of Jatropha as a living hedge has positive environmental effects, as it protects the soil from wind erosion. As Jatropha is inedible even by animals (except when the plants are seedlings), the Jatropha hedges will also protect gardens from damage due to animals



Hedges & crops protection

Intercropping Jatropha with other annual crops increases the productivity per area planted and contribute to biodiversity, while minimizing pest and disease. Moreover, the roots of the plant bind the topsoil, and consequently less loss of soil is carried away by surface runoff.

Intercropping

Production models can vary and be adapted to local conditions, to investment dimensions, stakeholders involved and end used possibilities. According to these criteria, the production of Jatropha could be shape into four production models:

1. Large scale plantation
2. Large scale plantation with out-grower scheme[26]
3. Independent small holder producers
4. Small holder producers link to private sector investor

[26] Kolao Farm would like to develop this model, but they face problems and challenges in getting large scale land concession. Plan to get 100,000Ha on large scale plantation and 140,000Ha out-grower scheme.

Taking the present context in Laos where access to land is a difficult issue the models 1 and 2 are the most unlikely to take place. Model 3 is also unlikely to be valuable since production will be difficult to organize and address economy of scale per unit of production. The most favourable model is the fourth one that can also been identified at provincial level and where small holders are in close relationship with private investors under contract farming scheme.

In addition and from the description of various feedstocks for biofuel production, SNV should focus on Jatropha Curcas for the following reasons:

- The government of Laos has set priority to biodiesel production;
- The government of Laos has identified Jatropha as main feedstocks for biodiesel;
- Jatropha is native of the country and can be grown in different ecological zones of the country;
- All/most initiatives in Lao PDR toward biofuel production are Jatropha oriented;
- Main private sectors investments are in place and in development;
- Jatropha is rich in oil contents;
- Biofuel production costs are lower than most other feedstocks;
- Jatropha can be integrated into existing farming system;
- Jatropha is most likely to benefit small holder in term of revenue and value added and processing technology are affordable at community level;
- Jatropha get special attention by researchers around the globe to improve varieties, production method, processing technology and distribution.

Summary: Compared to other feedstocks, Jatropha is the most promising to contribute to biofuel development. Jatropha needs input and maintenance to produce significant yield and be economically valuable. Processing and use at community level are feasible, market demand for Jatropha oil is growing and investments are taking place. The most suitable model to develop an economy of scale and create a "win-win" situation is to promote valuable and solid links between private sector investment and smallholders. Production in Lao PDR should peak in the next couple of years and contribute noteworthy to biodiesel production in Lao PDR.

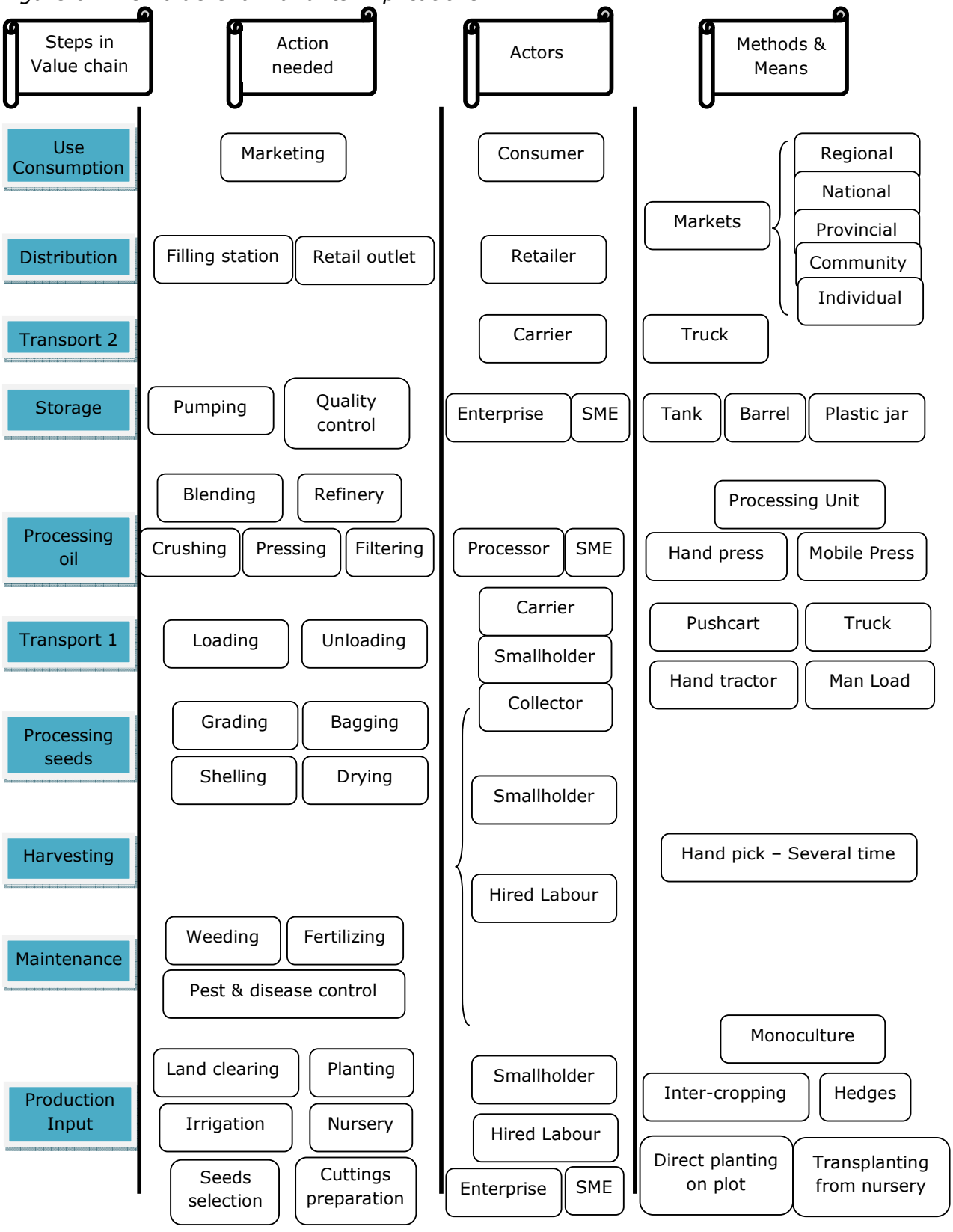
The Planning Commission of India stated: "Out of all feedstocks, Jatropha must be regarded as a sure inclusion and the foundation around which a plan can be built if for nothing but its pure hardiness and stress handling ability. It is just a tree that has enough credentials".

4.3 How should SNV implement activities?

SNV should use two approaches to develop biodiesel based on 1) the value chain development and 2) Inclusive Business concept. Due to the versatility of Jatropha, the value can take different shapes considering different production

methods, several processing technologies, diversity in equipments, different storage and transport facilities and multipurpose market demands and end use purposes. In term of value chain, the Jatropha can be pictured as followed in *figure 6*.

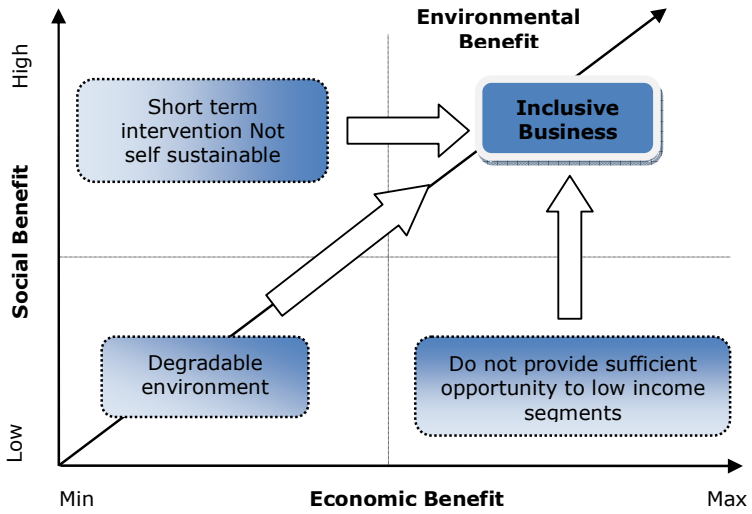
Figure 6: The Value Chain and its implications



Source: SNV-Lao

In merging the complexity of the Jatropha value chain and adopting the fourth model of production (smallholders' links to private sector); the Inclusive Business Model[27] (IBM) could play a major role in developing the biodiesel in Lao PDR. With special regards to biofuel development, IBM was modified, because we recognized the fact that not only economic and social dimensions are vital (as in the original model), but it considers as well environmental aspects, a key for sustainable biofuel production

Figure7: Inclusive Business Model with Environmental Component



Source: SNV-Laos

IB concept for partners and potential clients was addressed during the investigation with stakeholders. IB was generally well received by stakeholders and a genuine interest in getting more information on the process and steps was identified. Several principles were shared such as:

- Environmental and sustainability criteria
- Land use policies and land tenure by small-holders
- Job / income creation for local communities
- Transparent and fair contract farming and out-sourcing arrangements
- Investment in building capacity
- Positioning of cash-crop production in current farming systems
- Transition from subsistence to commercialized economy and access to market
- Financial system to support

[27] Inclusive business was defined as entrepreneurial initiative promoting poverty alleviation". Key feature of the approach is that pro poor value chains are developed with the full participation of agri-businesses from the start, ascertaining the capture of markets. From there, the production, marketing and pricing modalities will be derived and agreed upon.

Beside the two majors approaches (Value Chain and IB), SNV has developed a more coherent approach at regional level. For biofuel development in the Asian Region, SNV based its intervention on five axes that should create demand and supply for sustainable biofuel development that optimizes social, economic and environmental benefits, whilst minimizing biofuel key negative impacts.

Axis 1 – Supporting production at community's level
Axis 2 – Applying the Inclusive Business model and the biofuel production
Axis 3 – Supporting sustainable National Biofuel Policies
Axis 4 – Developing Global, regional and national knowledge
Axis 5 - Promoting sustainable Biofuel standards

For axis 5, SNV will follow international standard developed in 2008 (see annex 3 for detail of the standards) that comprises global principles and criteria for sustainable biofuels production issued during the Roundtable on Sustainable Biofuels. The criteria cover main topics such as: 1) legal framework and governance, 2) social responsibility and pro poor development, 3) natural resources management, 4) partnership and dialogue and 5) capacity strengthening and development.

Summary: SNV has gained years of experience in value chain development and to date SNV is promoting business with focus on small holders' inclusion. SNV is involved in other countries within the region (Vietnam specifically and to some extend Nepal and Cambodia) where the biofuel approach can be harmonized with Lao PDR interventions. Applying the integrated approach of the 5 axes covering production, business model, policy, knowledge and sustainable production could be beneficial for the development of the biofuel sector and of course for the stakeholders along the value chain.

The Economist journal quoted: "One of the myths for business to succeed, it is that entrepreneurs must produce some world-changing new product". Biofuel is one of them.

4.4 Where should SNV invest and focus?

Jatropha has been planted in several provinces around the country over the past 3 years and several nurseries are ready to provide seedlings for next season plantation (starting June-July 2009). Many of these early plantations have not met expectation of production due to inadequate production methods, wrong planting materials, conflicts between farmers and investors, etc... Yet, it is estimated that 20,000 Ha (planted) could be easily reached at the end of 2009 if all seedlings and existing plantation converge with best practices and lessons learned from earlier trials. In year, 2010 onward, planted area could add 10,000

Ha every year if businesses elaborated in the past years go according to plan[28]. Presently, Jatropha plantations have been identified in all provinces were SNV is involved. The map below on the left shows the existing intervention area of SNV and existing Jatropha production. The map on the right highlights where Jatropha is also produced but where SNV is not currently implementing activities.

Figure 8: Current and potential production areas for Jatropha production

Biofuel development and current SNV activities

Biofuel development potential

Source: SNV-Laos

Summary: Jatropha plantations can be introduced in all provinces of Lao PDR but not everywhere within the province. Jatropha does not grow well in altitude above 800 m (where frost and cold temperature is a factor), Jatropha production is not recommended. Where areas are dedicated for food production, Jatropha should not be promoted. Many of the provinces have other suitable areas for Jatropha production (degraded land, sloppy areas, versatile soil, etc). It is foreseen that production methods must be adequate to respond to low soil fertility to yield economic sustainability. Most companies are already investing in different provinces and SNV should be able to address private sector interest if SNV-Client relationship is identified and elaborated.

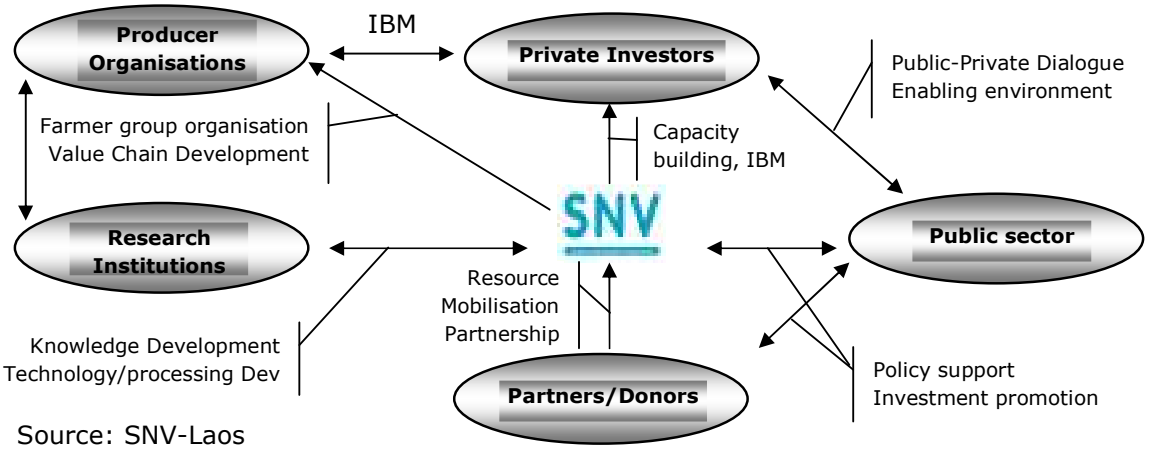
The geographical and provincial focus of SNV interventions should not weight on decision, but opportunities and private sector investments should prevail.

[28] 10,000 Ha per year is a conservative estimation based on 2009 figures and nurseries potential. Koloa Farm plans to target 240,000 Ha over the next 3-4 years, but this seems unrealistic according to field realities.

4.5 With whom and what role should SNV play?

The development of a new sector can only be made possible if all stakeholders from the public and private sectors are involved. The client, in this integrated approach, is not a single entity but rather a constellation of clients addressing different aspects of the value chain as shown in *figure 9*. The role of SNV can be specific with each of the sectors addressed ranging from resource mobilisation, knowledge development to farmer groups organisation.

Figure 9: Position and role of SNV



Source: SNV-Laos

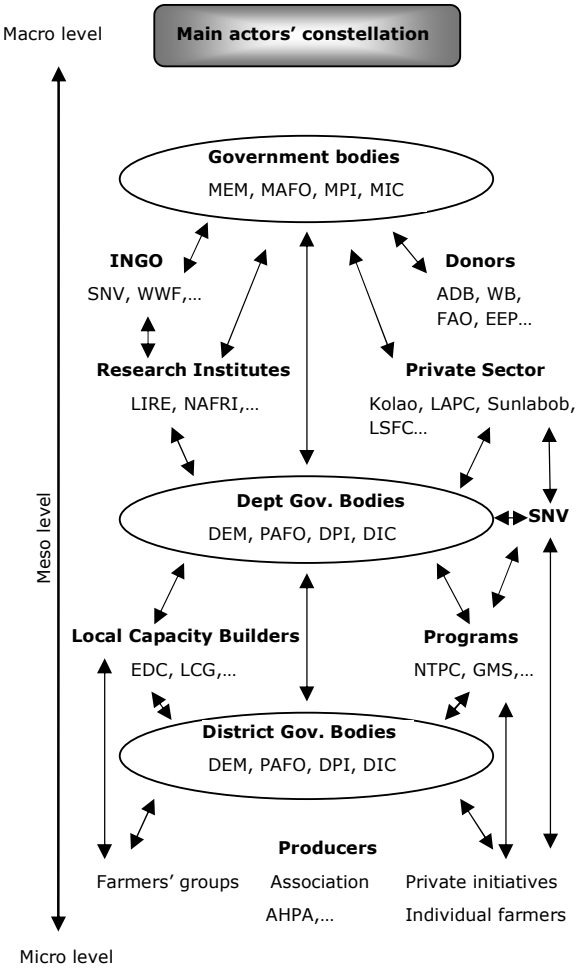
At the macro level and at policy level, SNV aims at supporting the Department of Electrification (DoE) of the Ministry of Electricity and Mines (MEM) to establish the framework and the policy for biofuel production. With this regards, MEM proposed the establishment of a new division, in the DoE, called "New and Renewable Energies" that will address all bio-energies issues for the country. From a private sector perspective, SNV links to serious investors (i.e. Kola Farm (target, Lao Agricultural Promotion Company, etc...) who aim at developing biofuel with a sustainable comportment that will directly contribute to farmers and communities' development. SNV also engages with Laos State Fuel Company (LSFC) as a main distributor of fuel mandated by the government to develop biofuel for the nation.

From a research and knowledge aspect, SNV works with Lao Institute for Renewable Energy (LIRE) that focuses on renewable energies development notably for the rural people in exploring and assessing practical sustainable and efficient solutions. Moreover, LIRE operates as an exchange platform that allows actors in the energy sector to exchange insights, experiences and ideas. At the meso level, SNV focuses with provincial authorities such as the Provincial/District Agriculture and Forestry Department (PAFO/DAFO) who support farmer's

organisations, disseminate production technologies and provide extension material to small-scale holders. SNV establishes contacts to farmer associations that need access to market and capacity strengthening to play a major role in value chain development. This client constellation is crucial to address all aspects of the sector and coordinate activities from production to end consumption.

Figure 10: Main actor constellation

Other stakeholders involved & their roles: Besides, the client constellation, it exists a wide range of programs and partners that are vital for the establishment of his new emerging market. The Asian Development Bank (ADB) is one of the major actors in the Great Mekong Sub-region financing a program on biofuel and rural renewable energy development for poverty reduction that aims principally at supporting governments with policy development. FAO plays also a role in policy support[29] in the region under the same co-financing. The government of Finland also launched a support program[30] (EEP) for biofuel in the Mekong Region. The Nam Theun Power Company (NTPC), through its Downstream Program financed by the World Bank, is also supporting biofuel development in the Khammouane Province targeting 20 000 households. From the public sector at the provincial level, many departments are closely linked to biofuel development such as the departments from Planning & Investment (DPI), Agriculture & Forestry (PAFO/DAFO), Industry & Commerce (DIC) and Energy & Mines (DEM).



Source: SNV-Laos

[29] Bioenergy and renewable Energy for rural poverty reduction in the Greater Mekong Sub-region: Project number: TCP/RAS/3202 (D). Policy development for biofuel for the benefit of rural communities Project budget: US$ 374,000.

[30] Finnish Ministry of Foreign Affair (MFA) launched a tender for "Appraisal Mission on Interventions on Energy and Environment Partnership with the Mekong Region" (Mekong EPP Appraisal).

Summary: Potential clients and partners for biofuel development do exist in Lao PDR. SNV needs to position itself from the macro to the meso level and from the public & private sectors to the research and partners organisations. The demand for coordination, capacity building and knowledge development is most needed and many stakeholders are looking for a steering entity that could set the sector in motion and enhance existing initiatives to a higher level to position the biofuel sector as a significant driver in Lao PDR economic development.

The "connecting people capacities" modus has never been so true!

5 Return On Investment (ROI)

Investing in a new sector or a new value chain means commitment and engagement for SNV but also input in term of human resource and financing. This chapter presents scenarios of investment and the expected economic return. ROI can address social and environmental aspects in doing business which will not be developed in this chapter but which is important and could be investigated at a later stage of implementation.

5.1 ROI in a nut shell

The ROI analysis will answer the questions considering how much the investment contributes to achieving goals and producing the desired results. It considers direct, indirect, and opportunity costs. The indirect costs include such things as conference, over time, seeking for partnership and resource mobilisation. An opportunity cost could be the loss of return or revenue we would have received had we chosen a different alternative.

Beside the economic return, we can address the efficiency of SNV approach in a way of describing the effectiveness of the implemented activities in relationship to costs (or other inputs). Efficiency cannot be separated from effectiveness, since using resources and failing to achieve a desired outcome can be little more than waste; again. Efficiency is usually expressed in terms of optimizing the value of a return for a given cost or input, or alternatively minimizing the cost for a given value of result. It is possible, of course, to improve efficiency without necessarily achieving an optimum. As long as it is possible to compare cost/effectiveness or return ratios for alternative systems or methods, it is possible to make judgments about efficiency.

How much "Bang for the Bucks"? There are several approaches[31] of ROI calculation (expressed in percentage[32]), but the bottom line is the final value divided by the initial investment (formula is bit more complicated than that,

[31] The Net Present Value (NPV) will not be used in this exercise as it is proposed that SNV will be investing over a period of years and not as one single investment phase.

[32] ROI = 100% means that return is double as the invested capital
ROI > 0 means that investment is profitable
ROI<0 means lost investment
ROI > -100% means invested capital can never been refunded

but...). The question is how much should SNV invest? One thing to keep in mind, it is not only to target at a positive ROI but to reach expected results; a) investing too much might not be possible within SNV allocated budget while minimizing ROI, b) low investment might hamper results achievement and endorse a negative ROI. Last, SNV cannot claim the full ROI on biofuel production since many other stakeholders contribute also to its development.

The following calculations are conducted in two steps; 1) looking at expected results in term of Production, Income and Employment and 2) looking at SNV investment and its return.

5.2 First assumptions

The ROI is based on assumption and hypotheses that must be presented before investigating calculation. The proposed figures are conservative and/or realistic to pretend representing the current situation of market price, yield expectation, oil extraction ratio, labour cost, etc. The following scenarios and estimations will be based on the following:

- ✓ The units used for calculation are Hectare (Ha), Litre (L), Euro and Kip (€ and KIP), Kilo (Kg), Tons (T) and percentage (%);
- ✓ In average one farmer produces one hectare of Jatropha;
- ✓ Yield per hectare can range from 500 Kg to 2,000 Kg. It is reported that yield can be lower than 300 Kg/ha but we estimate that good practices are in place and that those are applied at producer level (thus, 500Kg minimum yield);
- ✓ Oil contents per seed: 30%, this ratio also depends on seed quality; it can range from 20 to 35%;
- ✓ Oil extraction ratio: one (getting the 30% of oil per seed, means 100% extracted). Hand presses at small holder level are reported to be less efficient than mechanised ones (electric or diesel engine generated) and the extraction ratio can drop to 0.6 to 0.8;
- ✓ Diesel price on the 16th of March 2009 at retail outlet in Vientiane is 5040 Kip per litre (0.5€). It is believed to be at its lowest, so a good conservative figure for calculation. The biodiesel price is pegged to the fossil diesel price to compete at market value. For present calculation the biodiesel price is fixed over the year assuming of being the lowest one at present time;
- ✓ Exchange rate: 10,000Kip/1€ and 1.3 US$/1€
- ✓ Processing/transport/retail costs are estimated at once at 30% of total production cost;

- ✓ Target production is in line with biofuel policy (5% of biodiesel by 2015). This figure might be ambitious but we should try to follow government targets.

5.3 What are the goals for Production, Income and Employment?

5.3.1 The Production

In term of production estimation, global national fuel consumption (for LSFC) is estimated at 600 million litre per year of which 65% is diesel import. A quick calculation shows that biofuel production (in term of surface cultivated) could be a feasible venture for the country to reach national target of 5% (19,500,000 litres of biodiesel, circa 20 million litres). Taking Jatropha feedstock (and 30% of oil extracted) as an example, the land under biodiesel production could oscillate between 130,000ha and 32,500ha depending on yield per ha.

Table 1: Production area in Ha of biofuel to target 5% of diesel consumption at national level with 30% oil extraction ratio

Production in Kg/Ha	500	750	1000	1250	1500	1750	2000
Oil Extracted in %	30						
Production of Oil in L/Ha	150	225	300	375	450	525	600
Land in production in Ha	130,000	86,667	65,000	52,000	43,333	37,143	32,500

Source: SNV-Laos intern calculation

Between projected figures and current investment plans: During the present study, the three investigated private sector companies plan to set up nearly 300,000 Ha of Jatropha according to business proposals with the lion share of 240,000 Ha for Kolao Farm only. It was demonstrated that to meet Lao PDR national demand only, a maximum of 130,000 Ha to a minimum of 32,500 Ha were necessary depending on yield. Assuming, that private sectors targets meet expectation than two options appear; 1) Lao PDR can increase its 5% blend biodiesel to 10-15% depending on yield and oil contents per seed or 2) Lao PDR can export the difference between the 5% national target and the total production of biodiesel. The second option is most likely since private sector already mentioned that their goals were to export biodiesel to their respective country[33]. It is not clear on how the whole issue will be developed between the Lao government and the private sector to meet national demand and export demand once biodiesel has reached significant production level to address both sides.

The time factor: To reach 130,000 Ha (yielding 500 Kg/Ha) and to target 5% of national consumption by 2015 (7 years period), 18,500 Ha should be planted every year. If yield can reach 2T/Ha of seed, the amount of hectares, planted per year, drops to 4,600 Ha, a more realistic figures. To reach private sector targets

[33] Except for APPC who would like to promote production and consumption at provincial level

over the same period, 43,000 Ha per year should be planted. To meet their target, private sector will have to revise their investment period or to reduce target, because it will be impossible/very difficult to target 43,000 Ha[34] per year under present conditions in Lao PDR.

5.3.2 The Employment

In term of employment, in view of one producer per ha and the yield scenario in table 1, global employment at national level could be estimated between 32,500 to 130,000 jobs depending principally on yield per Ha. These figures represent only the producer's level and the number could easily increase while including suppliers, processors, transporters, traders, retailers, etc...

5.3.3 The price of seed per kilo and gross income

One of the major concerns in the biodiesel production is: what is the market price but most important what is the price at farm gate level? What farmers could benefit from it? The following calculation and the development of price structure take current fossil fuel at retail outlet for reference.

Considering various oil extracting ratio (due to performance of machinery and the oil content of seed) ranging from 15 to 35%, the number of kilo needed for processing increases inversely proportionally to this extracting ratio. Considering a gross price per kilo to reach fossil fuel price at the pump, the price per kilo of seed, ranges from 756 Kip to 1,764 kip. Taking into consideration transport, processing and retail costs (estimated here at only 30% from gross price) the gross farm gate price per kilo ranges from only 529 Kip to 1,235 Kip per kilo of seed.

Table 2: Optimum farm gate price calculation according to retail fuel price per litre and oil extracting ratio

Price of fossil fuel at the pump in L/Kip	5,040				
Oil Extracted in %	15	20	25	30	35
Nbr. of Kg of seed needed for 1 L of oil	6,67	5,00	4,00	3,33	2,86
Gross price per kilo of seed in Kip	756	1008	1260	1512	1764
Transport, Processing and retail costs	30%				
Gross farm gate price in Kip/Kg	529	706	882	1058	1235

Source: SNV-Laos intern calculation

If fossil fuel at the pump would rise to 7,500 Kip/L, the gross farm gate price of seed could range from 788 Kip to 1,838 Kip/Kg. If the price picks at 10,000 Kip/L at the retail outlet (as some months ago), the gross farm gate price per kilo of seed could jump from 1,050 Kip to 2,450 Kip/Kg depending on oil extraction ratio.

[34] This applies especially to Kolao Farm since they plan to plant 240,000 Ha.

Considering the yield, in the above production scenario in table 1, from 500 to 2 000 kilo per ha and a gross farm gate price of 529 to 1235 Kip per kilo of seed, a producer could earn a gross revenue from the 265,000 Kip (25€) per Ha to 2.47 million Kip (250€) per Ha.

Looking at global figures, the gross national income generated at farm gate level could range from 3.25 million € (130,000 farmers with 25€ gross income per Ha) to 8.125 million € (32,500 farmers with 250€ gross income per Ha). These figures could be reached only by 2015 if the target of 5% is accomplished.

Summary: Total production area, to achieve government goal, could range from 32,500 Ha to 130,000 Ha depending on yield and oil extraction ratio. Employment could range in the same order applying the ratio of 1 Ha produced by 1 farmer. Gross revenues at farm level could also range from a meagre 25€/Ha to a more interesting figures of 250€/ha also depending mostly on two factors; yield and extraction ratio. It is also shown that if biodiesel price is pegged to the fossil price, the gross revenues at farm level will increase dramatically.

Today in the present economical turmoil, biodiesel feasibility is fragile, but it is in these periods where consolidating new ideas become vital competitive weapon.

5.4 SNV investment

Considering the challenges and opportunities described along this document and to achieve the above, SNV needs to invest in term of human resources, time and finance, but how much? In order to further estimation a second round of assumption is necessary.

5.4.1 Second assumptions

- ✓ To target national demand, SNV considers to invest in three portfolios presently established;
- ✓ One national advisor per portfolio is engaged in developing biofuel at 33% of its time per year thus a total of 1 national advisor per year (165 days/year);
- ✓ One international advisor to coordinate activities with 30% of his time per year (50 days);
- ✓ Backup support from Portfolio Coordinators/management and external advisors (30 days per year);
- ✓ SNV contracts Local Capacity Builders to support biofuel development and activities;
- ✓ SNV should play a major role in the biofuel development but cannot claim full ROI according to Production, Income and Employment (PIE). We

estimate that SNV could get 10% of total PIE returns only as other stakeholders are committed to the sector development.

- ✓ Average SNV advisory day cost is 519€ per day with a breakdown of 362€ for an national advisor and 714€ for an international advisor[35];
- ✓ National senior consultant cost is estimated at 200€ per day as local capacity builders[36];
- ✓ Biofuel production grows by 10,000 Ha per year in Lao PDR;
- ✓ The following calculation are based on conservative figures considering average yield of 1 Tons of seed per Ha, extracting ratio of 25% per kilo of seed, farm gate price of 500 Kip/Kg (0.05 €/Kg), and production cost 30%;
- ✓ Prices and costs remain constant over the calculation period to ease calculation. No interest rate, no inflation rates are considered for the same reason.

5.4.2 The cost of investment

SNV investment could be made in 2 phases; a first period from 2009 to 2012 for implementation and establishment of activities and a second period from 2012 to 2015 for consolidation and follow up.

For the first period, considering the above assumption, SNV would invest per year (over a period of 4years) the total of 122,850€ per year in term of advisory days with a break down in table 3.

Table 3: Advisory cost in € per year for SNV in biofuel sector (2009-2012)

Advisor/support/consultant	Advisory Day	Cost per day in €	Total in €
1 Nat. advisor Portfolio South	55	362	19910
1 Nat. advisor Portfolio Central	55	362	19910
1 Nat. advisor Portfolio North	55	362	19910
1 Int. Advisor (Central?)	50	714	35700
Backup support/management	30	714	21420
Local Capacity Builders (LCB)	30	200	6000
Total	**275**		**122,850**

Source: SNV-Laos intern calculation

[35] Based on Regional Directive on the 22 January 2008
[36] Based on SNV Internal rate table (Junior, medior, Senior and National International Consultant)

To support activities implementation a top up of 27,150€ (very conservative) could be invested in workshops, activities, studies and research at provincial level and/or at national level. Taking a contingency of 10% (15,000€) the total investment for SNV sums up to 165,000€ per year (7.5% of total SNV budged[37]).

In the second period (2013-2015), this total investment should be reduced while biofuel activities are taking a cruise speed where there is just a necessity for follow up and monitoring of activities. Thus, it could be estimated that SNV does not need an international advisor or LCB supports anymore and therefore it invests in national advisors and some days for management and coordination, allocating as well a small budget for activities and/or contingency. The total investment for SNV in the second period sums up 50,000€ with a breakdown in table 4.

Table 4: SNV investment in € per year for SNV in biofuel sector (2013-2015)

Advisor/support/consultant	Advisory Day	Cost per day in €	Total in €
1 Nat. advisor Portfolio South	30	362*	10860
1 Nat. advisor Portfolio Central	30	362	10860
1 Nat. advisor Portfolio North	30	362	10860
Backup support/management	15	714	10710
Activities/contingency	Lump sum		6710
Total	**105**		**50,000**

* Cost per advisory day remains constant for the exercise

Source: SNV-Laos intern calculation

Summary: For the first period SNV will be investing 660,000€ (165,000X4) and for the second period the sum of 150,000€ (50,000X3) thus a total of 810,000 over the next 7 years period until 2015. 380 advisory days will be spent divided into 72% for the first period and 28% for the second period for follow up and monitoring.

5.4.3 SNV Return

The following calculation, of SNV return, is based on very conservative figures to address risks and future uncertainties. The present economic situation (low fossil prices) provides a very good opportunity to avoid over speculative figures and keep objectivities for optimal decision.

In view of an established 20,000Ha of plantation in 2009 over the country (not yet in production) and the planting rate of 10,000Ha per year effective,

[37] Based on the Strategic Plan Lao PDR 2008-2009 and Management Agreement 2008 (Page 52) with global budget of 2,199,000€ for 2009.

100,000Ha will have been planted by 2017. Taking an average yield of 1T/Ha and oil extraction ratio of 25%, Lao PDR will reach 5% target by 2017 with 20 M of biodiesel produced[38].

Now, taking a 500Kip/Kg (0.05€) of seed at farm gate level and considering a 30% production cost of gross revenue, net total farmer revenues ranges from 300,000€ in 2011 to 1.2 M€ in 2017 (20,000 to 80,000 farmers involved). Individual farmer revenue is €15/Ha, which can be considered worst-case scenario with given figures. Increasing the extraction ratio by 10% and the farm gate price of seed by 0.03€/Kg, net farmer revenues increase from 15 to 24€ per Ha (based on 1T/Ha). Hence, technology, yield, surface under cultivation and market prices are key elements to determine messages to invest in biofuel production.

Table 5: SNV ROI per year in biofuel sector (2009-2015-2017)

	Years								
	2009	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**
Area planted (Ha)	20 000	30 000	40 000	50 000	60 000	70 000	80 000	90 000	100 000
Total production of seed (T)	Planted but not in production before 2 years		20 000	30 000	40 000	50 000	60 000	70 000	80 000
Total Oil produced (Lx1000)			5 000	7 500	10 000	12 500	15 000	17 500	20 000
Farm Gross Rev. (X1000€)			1 000	1 500	2 000	2 500	3 000	3 500	4 000
Total Farm Net Rev. (€)			300 000	450 000	600 000	750 000	900 000	1 050000	1 200 000
SNV investment in €	165000	165000	165000	165000	50 000	50 000	50 000	End of SNV strategy plan	
SNV ROI claiming 100%	-100%	-100%	-39%	173%	1100%	1400%	1700%		
SNV ROI claiming 10% only	-100%	-100%	-39%	17%	110%	140%	170%		

Source: SNV-Laos intern calculation

SNV ROI is based on net farmer revenues and not on gross farmer revenues or on global market revenues. Moreover, SNV ROI has been calculated at two levels 1) taking grant that revenues generated at farmer level are due only to SNV activities and 2) taking only 10% of the ROI considering SNV activities only part of stakeholders' activities who contribute as a whole to biofuel development.

[38] It is assumed that the fossil diesel consumption does not increase in this calculation. In reality this is unlikely, since LSFC stated an increase of consumption of 5% per year. Hence, with present figure, Lao PDR will not reach target and thus either planted area must increase or yield and oil extraction ratio must improve

Taking this second option into consideration, SNV ROI will be negative in the first 3 years of activities while becoming positive in year 4 with ROI of 170% by 2015.

Summary: Can we afford this? In principle yes! All calculations have been based on very conservative figures and it can be considered as a worst-case scenario, where SNV return is half of the invested capital. Moreover, as stated at the beginning of this chapter, economic ROI is only one part of the return. We need to consider that social and environmental aspects will be part of the activities and both are foreseen with a positive ROI.

So: Let's do it

Annexes

Annex 1: Feasible Feedstock crops in Lao PDR for Ethanol production

Annex 2: Jatropha characteristics

Annex 3: Roundtable Sustainable Standard for biofuel development

List of additional documents available from the current investigation

1. Actors' profile in Lao PDR
2. Biofuel Fact sheet in Lao PDR
3. Result Chain Analysis
4. Field visits in Savannakhet and Khammouane Provinces Report (Jan. 09)
5. Jatropha World Conference Report (Kuala Lumpur)
6. Asia Biofuel Workshop Report (Bangkok)
7. Biofuel development in the Mekong Region & Nepal Report (Published)
8. Asian Regional Framework for Biofuel development (Draft)
9. Summary and CDROM for the Mekong & Nepal Report (Published)
10. Contact List of stakeholders involved in biofuel development (Outlook)

Annex 1. Feasible Feedstock crops in Lao PDR for Ethanol production (Modified and adapted from an analysis of NEDO-LIRE, 2008)

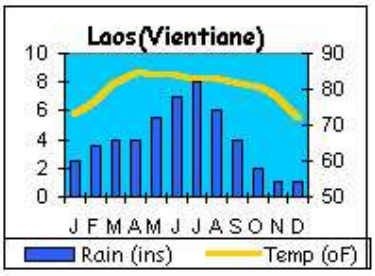
Crop	Pro's	Con's	Notes
Corn	• short harvesting period (60 days after plantation) • many available market opportunity	• need higher fertility • Lower price (800k/kg) • Corn is a commodity traded on the market, so price is affected by other markets	• Lao farmers especially in Vientiane capital and the northern Laos such as Xiengkhouang province have been traditionally planted corn for more income besides rice because of available market opportunity. • The market of corn are local, Thai, Vietnam. • 3-5T up to soil fertility
Cassava	• Withstand harsh environments like serious drought • Major source of low cost carbohydrates for populations in the humid tropics. • Adapt well to semi-arid marginal, wasteland. • A lot of by-product • Cassava roots are very rich in starch suitable for ethanol production	• Toxic fresh parts (root, leaf) • Cassava is a commodity traded on the market, so price is affected by other markets • Low market price • Bulky and harvesting intensive	• Cassava is usually planted by the farmers in Laos for home consumption. • Hmong people (one of three main Lao ethnic groups) usually plant cassava for feeding their livestock especially pig and cattle. • Military have grown cassava for export purpose. The main export markets are Vietnam and China. Year 2008, 200 ha countrywide were developed for cassava plantation to grow cassava. The target plantation area are the southern province like Bolikhamxay, Savannakhet, Champasack • Faculty of Agriculture, Napong campus just grow cassava for feeding livestock (No action on ethanol) • 25-50T up to the fertility and species (like Kaset50, Layong60, Layong75…) they have different root yield
Sugarcane	• High yields • The stems are rich in sugar which has many uses, including ethanol • Most predominant raw materials for fuel ethanol production in the world	• Needs lots of water • Labour intensive	• Large holder farmers don't seem to exist in Laos, but few big companies involve in sugarcane plantation and sugar production(see in annex) • 50 to 60 T/ha
Sweet sorghum	• Most species are drought tolerant and heat tolerant and are especially important in arid regions. • suitable for warmer climates • Low cost of production (3 time less than sugar cane	• need hot and humid climate • Still on research • Complex processing technologies	• This crop is in abundance in Xiangkouane province, Laos but no market in Laos

Annex 2: Jatropha characteristics for Lao PDR

Characteristics of Jatropha

Practical and adapted for Laos production

Agro ecological condition



Jatropha Curcas is best adapted to semi-arid conditions, where grassland-savannah, or thorn forest scrub vegetation prevail naturally. Jatropha is a succulent that sheds its leaves during the dry season. It is most suitable in the dryer tropics with rainfall from 300 to 1200 mm per annum. Jatropha occurs mainly at low altitudes in the tropics from 0 to 500 m and is adapted to average annual temperatures (20 to 28 C in its places of origin). It can withstand slight frost. It is not sensitive for day length. It performs best on well-drained soils with good aeration and is well adapted to soils with low nutrient content. Root formation is reduced in heavy soils. Jatropha does not resist water pounding. Thus, Jatropha can be produced in many different provinces in the country and specifically in the Khammouane and Savannakhet provinces.

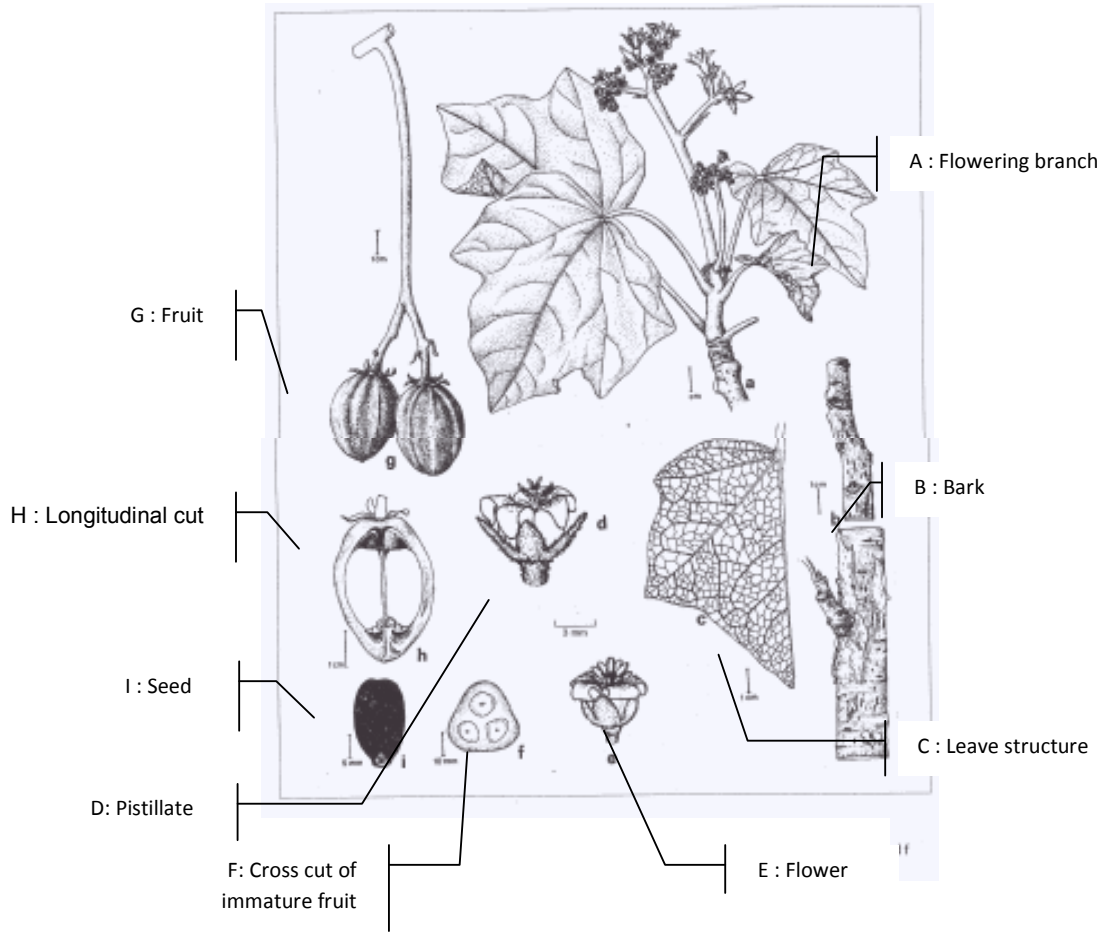
Jatropha uses

As it is not a food or forage crop, it plays an important role in deterring cattle, and thereby protects other valuable food or cash crops if it is planted on hedge around the farm plots. Jatropha seeds can be pressed into bio-oil that can be used to run diesel engines, which in turn can drive pumps, food processing machinery, or electricity generators. The bio-oil can also be the basis for soap making. The pressed residue of the seeds is a good fertilizer and can be used for biogas production. Many farmers in Laos use pedestrian tractors and Jatropha oil can directly be used to run diesel engines for agricultural machinery or any diesel power engines used in communities.

Jatropha characteristic

It is a tall bush or small tree (up to 6 m height). The lifespan of this perennial bush is more than 50 years, and it can grow on marginal soils with low nutrient content. Jatropha Curcas, or “physic nut” has a straight trunk with thick branches. It has green leaves with a length and width of 6 to 15 cm. The fruits have an oval type of shape, of about 40 mm length and each contains 3 seeds (on average), which look like black beans. with similar dimensions, of about 18 mm long (min 11- max 30) and 10 mm wide (min 7 – max 11) The seed weight per 1000 seeds is about 750 grams, which is equivalent of 1333 seeds per kg on average. The seeds contain more than 30% of oil by weight. The branches contain whitish latex, which causes brown stains that are difficult to remove. Normally five roots are formed from seeds: one tap root and four lateral roots. Plants from cuttings do not develop the tap root, only the laterals. The appearance of the plants in a hedge can vary a lot. You may find plants with no leaves (dormant position) beside plants with green leaves.

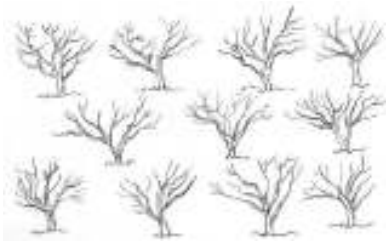
The Physiology of the plant



Planting methods

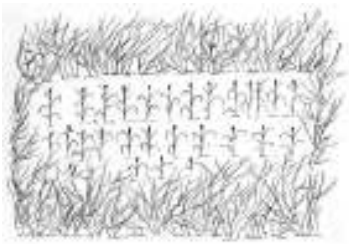
Jatropha can be planted in various methods and therefore be adapted to various farming systems. The three methods below offer the producer the liberty to adapt according to the investment in labour, land and finance resources available.

Jatropha plantation are mostly made for industrial farming but can be planted by small producer depending on land availability. One hectare can take from 1500 up to 2500 trees depending on density.



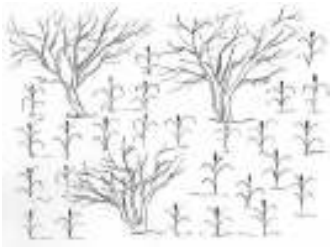
Monoculture

The planting of Jatropha as a living hedge has positive environmental effects, as it protects the soil from wind erosion. As Jatropha is inedible even by animals (except when the plants are seedlings), the Jatropha hedges will also protect gardens from damage due to animals



Hedges & crops protection

Intercropping Jatropha with other annual crops increases the productivity per area planted and contribute to biodiversity, while minimizing pest and disease. Moreover, the roots of the plant bind the topsoil, and consequently less loss of soil is carried away by surface runoff.



Intercropping

Maintenance & Pest and Disease

Ploughing and (re)planting are not needed regularly, as this shrub has a life expectancy of approximately forty to fifty years. The use of pesticides and other polluting substances are normally not necessary, due to the pesticide and fungicidal properties of the plant. Other, some diseases, especially on monoculture, have been reported, like root rotting (phytophthora), leafs spot (pestalotiopsis, cercospora), die branches (Pinnaspis strachani) and fruits suck (green and blue bug)

Weeding & maintenance

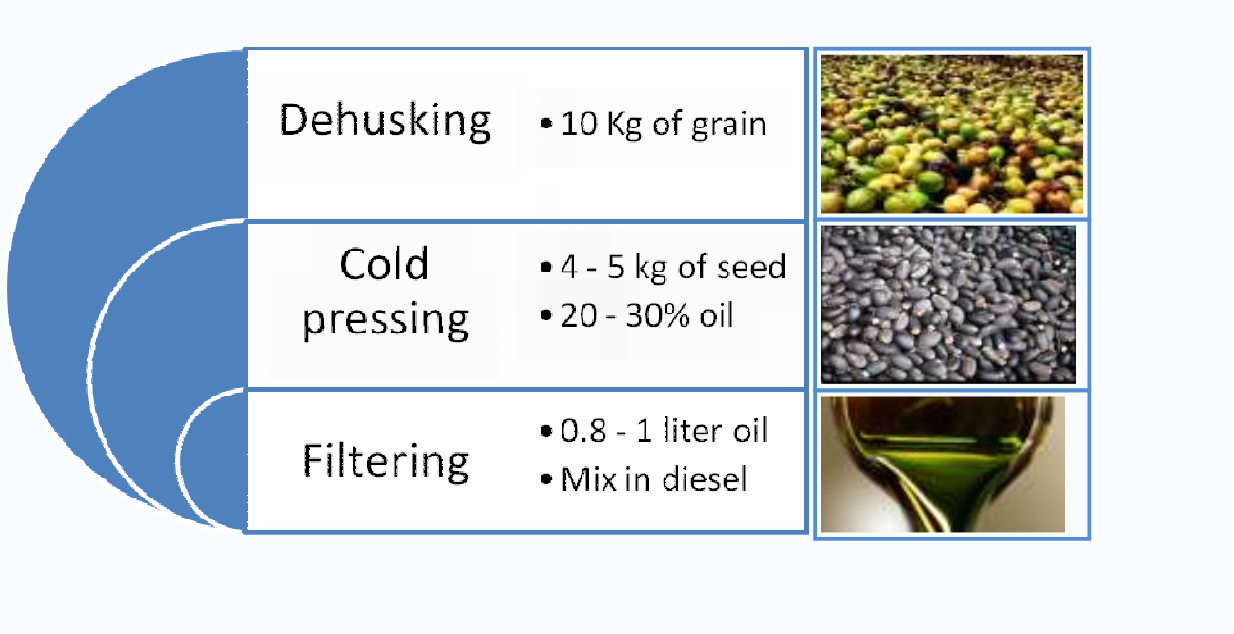
Harvest and Yield

While Jatropha can starts yielding from 9 – 12 months after planting, the effective yield is obtained only after 2 - 3 years time to peak to mature yield after 5 years. The yield per tree is estimated between 1.5 and 4 kilo depending on the varieties, agro ecological conditions and agricultural practices. Thus, in general a hectare can yield between 2.2 tons and 10 tons depends on density and yield per tree. At farmers level (without knowledge and training), it is also reported that production are sometime less than 1 ton/ha and sometime not more than 300 kg/ha. If planted in hedges, the reported productivity of Jatropha is from 0.5 kg to 1.0 kg of seed per meter of live fence.

Processing

Even if Jatropha cultivation is economically less attractive than other crops production, the non monetary benefits for smallholder farmers expected from Jatropha, can be important to consider. Jatropha oil production lends itself to decentralized processing and local markets. The oil produced by farmers could fuel their numerous diesel engines, thereby creating a local market and positive multiplier effects for employment and local economic growth. Jatropha can be pressed with normal press use for oil palm processing and after be filtered before final use. The main steps are represented below

Main processing step at farmer level



Annex 3: Overview of criteria developed for sustainable biofuel development and SNV Intervention Areas

INITIATIVES	Cramer NL (July 2006)	UN Framework (April 2007)	Sustainable Biofuel Consensus (March 2008)	RSB (August 2008)
Legal Framwork & governance		Implication for Trade, Foreign exchange balances and Energy Security	Integrate and better coordinate policy frameworks	Legality: Follow laws of the country
			Make sure that trade policies and climate change policies work together	Land rights: biofuel should not violate land rights
Social responsability & Pro poor development	Welfare & Wellbeing	The ability of Bioernergy to provide energy services for the poor	Assess benefits and impacts of biofuels trade, use and production, and monitor them	Human and labour rights: Ensure decent work and the well being of workers
	Labor condition conform to local law	Implications for Agro-Industrial development and job creation	Address negative indirect effects of biofuels trade, use and production	Rural and social development for indigenous peoples and communities
		Health and Gender implication of Bioenergy		Biofuel should not impaire with food security
	Food security	Implication for food security		
Natural Ressource Managment	CO2 Balance	Impacts on Biodiversity and Natural Ressource Management	Reward positive impacts and investments, including through carbon management	Greenhouse Gas Emissions reduction
	Nature and biodiversity, Soil, water	Implication for Climate Change		Conservation in Biodiversity, Soil, Air and Water
Partnership & Concertation		Implications for Government Budget	Use informed dialogues to build consensus for new projects	Consultation, planning, and monitoring
Capactiy strenghening and development			Increase investment in research, development and demonstration	Economic efficiency, technology, and continuous improvement
			Build capacity to enable producers to manage carbon and water	