

Impacts of Jatropha Plantation on Smallholders

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ACRONYMS AND ABBREVIATIONS

ADB	Asian Development Bank
DAFO	District Agriculture and Forestry Office
FOA	Faculty of Agriculture
GOL	Government of Lao PDR
HHs	Households
KOLAO	Korea and Lao Group
LAK	Lao Currency (kip)
Lao PDR	Lao People Democratic Republic
NAFRI	National Agriculture and Forestry Research Institute
NTFP	Non Timber Forest Product
NUOL	National University of Laos
PAFO	Province Agriculture and Forestry Office

Units of Measurement

cm = centimetre

kg = kilogram

ha = hectare

Exchange Rate as at 2 December 2008

LAK 8,500 = US\$ 1.00

SUMMARY

Background

Jatropha plantation is spreading significantly in Lao PDR. The country's oil imports are currently at approximately 350 million litres of fuel per year and rising, thus increasing the pressure to develop practical alternatives. Jatropha is a crop which can produce biodiesel, grows well in parts of Lao PDR, and is becoming popular in many other countries such as India, USA, Burma, Thailand, and Nicaragua. It has been grown as bio-fencing and for traditional medicine, but not commercially. However, the Lao government and many private companies there have recently become interested in growing *jatropha curcas*.

One such company is the KOLAO Farm and Bio Energy Company, the largest jatropha plantation company in Lao PDR. It plans to plant 50,000 ha for Vientiane province and 120,000 ha across the country. Production also needs large amounts of labour for land preparation, planting, maintaining and harvesting. The labour is drawn from small-holders in local areas. Proper studies of the impacts are needed in order to avoid unforeseen risks to small holders and adapt production techniques.

This study aims to determine certain basic socio-economic backgrounds of small holder farmers in jatropha plantation areas in Vientiane Province, in order to better understand their situational contexts and the potential positive and negative impacts of jatropha plantation.

The scope of the study extends to management principles, capability building activities, skills support programs and materials, and corporate infrastructure to ensure that locals involved in growing this crop for the company, or providing labour, are not unfairly disadvantaged. The research gives particular consideration to displacement of previous economic or subsistence activities including cultivation of rice (irrigated or swidden) and collection of NTFPs from previously undeveloped lands.

Issues

The study found that the Jatropha Production Project had positive impacts on small holders in the production areas, especially in terms of job opportunities and income for local small holders; capacity building for the small holders involved; and some small holders were also allowed to inter-crop upland rice with the jatropha.

However, there were also some adverse impacts on the small holders including: some conflicts emerging between the small holders and the Jatropha Production Company concerning payments (including insufficient and late payments), management of land concessions, and failures to get workers on proper contracts.

Furthermore, the areas used for jatropha production were in the fallows, therefore displacing NTFPs that rural people used to gather in these areas and reducing natural grazing areas for common domestic animals such as cattle and buffalo.

Policy implications

There were positive impacts in Vientianne province from the Jatropha project, especially in terms of providing job opportunities, income for small-holders and capacity building. However, from this project we have also learned that there are some areas for improvement and have prepared some recommendations for largely low-cost strategies to address these issues. The recommendations can be grouped into three main categories:

1. Reform company administration and human resource management
 - prepare a labour-use plan to avoid labour shortages during cropping season;
 - improve time record keeping for the workers;
 - improve the payment system so that it makes payments on time;
 - prepare contracts for all labourers to secure their jobs;
 - prepare and publicise roles and responsibilities of each employee level; and
 - prepare and publicise all relevant rule and regulations for employees.
2. Capacity building in local areas:
 - continue to provide capacity building to local people in jatropha production;
 - organise study tours to experienced countries (such as India) to learn about the production techniques;
 - prepare a step-by-step jatropha production manual and make it easily/freely available; and
 - prepare an easily/freely available crop calendar to make monitoring easily.
3. Sustainable production and land management:
 - continue to allow small-holders to inter-crop cash-crops with jatropha in the first and second years;
 - consult with experienced experts in jatropha production or related industrial crops for the best production practice;
 - check seed quality before planting; and
 - conduct on-farm experiments to increase the production.

The Approximate Size Of The Areas Under Jatropha Plantation In Each Province In 2007

No.	Province	Kolao Farm and Bio Energy Company		Lao Organic Product Promotion Group	
		Planted Area (ha)	Target Area (ha)	Planted Area (ha)	Target Area (ha)
1	Vientiane Capital	115.16	115.16	175	250
2	Luangnamtha	+	+	100	300
3	Oudomxay	+	+	150	300
4	Houaphanh	+	+	550	1,500
5	Xayaboury	+	+	200	500
6	Vientiane	2,024.37	50,000	10	100
7	Bolikhambay	1,016	1,016	200	300
8	Khammuan	+	+	30	300
9	Savannakhet	100	100	45	100
10	Champasack	18,838	20,000	45	100
Total		22,093.53	71,231.16	1,515	3,850

Source: Kolao Farm and Bio Energy Company and Lao Organic Product Promotion Group

1. RESEARCH QUESTIONS AND OBJECTIVES

1.1 Background

Fuel is essential for national development, supporting the operation of machinery and equipment. However, Lao PDR has no natural oil resources. Every year the country imports approximately 350,000,000 litres of fuel per year, and these imports are gradually and significantly increasing. The price of the fuel has also progressively risen over the years from US\$0.24 per litre in 2002 to US\$0.70 per litre in 2005 (Souliyo, 2006). As a result many countries, including Lao PDR, are increasing emphasis on locally available renewable energy sources.

Most countries in the world are now concerned about greenhouse and global warming issues. Thus, there is considerable interest in using renewable and green products. Jatropha is a crop which can produce biodiesel. It is becoming popular in many countries such as India, USA, Burma, Thailand, and Nicaragua. There is also considerable interest from the Lao PDR Government. Many companies in Lao PDR are interested in growing jatropha curcas.

Recently many companies have become interested in investing in commercial jatropha plantations in Lao PDR. The crop has been planted in the country for many decades as bio-fencing and traditional medicine, but not commercially

The KOLAO Farm and Bio Energy Company, the largest jatropha plantation company in Lao PDR, will plant 120,000 ha in the country. The company has plans for planting 50,000 ha for the Vientiane Province. These plans for large-scale commercial production may influence small holders in the production areas. Therefore, before adopting the new production techniques, proper study of the impacts is needed in order to avoid unforeseen risks to small holders.

1.2 Research Objectives

The objectives of this research are to study:

- 1) some certain basic socio-economic backgrounds of small holder farmers in jatropha plantation areas in Vientiane Province, Lao PDR;
- 2) jatropha production systems;
- 3) positive and negative impacts of jatropha plantation on small holder farmers; and
- 4) mitigations to negative impacts.

2. RESEARCH METHODOLOGY

2.1 Study location

The research location is in Vientiane Province, one of 17 provinces in Lao PDR. The province is located north of Vientiane Capital and shares borders with 4 provinces such as Vientiane Capital, Luang Prabang, Xieng Khounag and Bolikhamxay (see Figure 1). Its chief town is Phonhong. The province has the total area of approximately 22,500 square kilometres with a population of approximately 373,700 peoples in 2004. Vientiane province is divided into nine districts: Phonhong, Thourakhom, Keo Oudom, Feuang, VangVieng, Kasy, Saysomboon, Hom and Sanakham.

2.2 Key assumptions

The study involved many different organisations and people. It involved different government agencies including the Ministries of Agriculture and Forestry, Energy and Minerals, and Industry and Commerce. It also involved the Provincial Agriculture and Forestry Office in Vientiane Province, as well as many villagers from different villages. The participation of people from all levels, from the top levels down to local communities and local authorities, were very important to this research. Without their participation, it would not be successful.

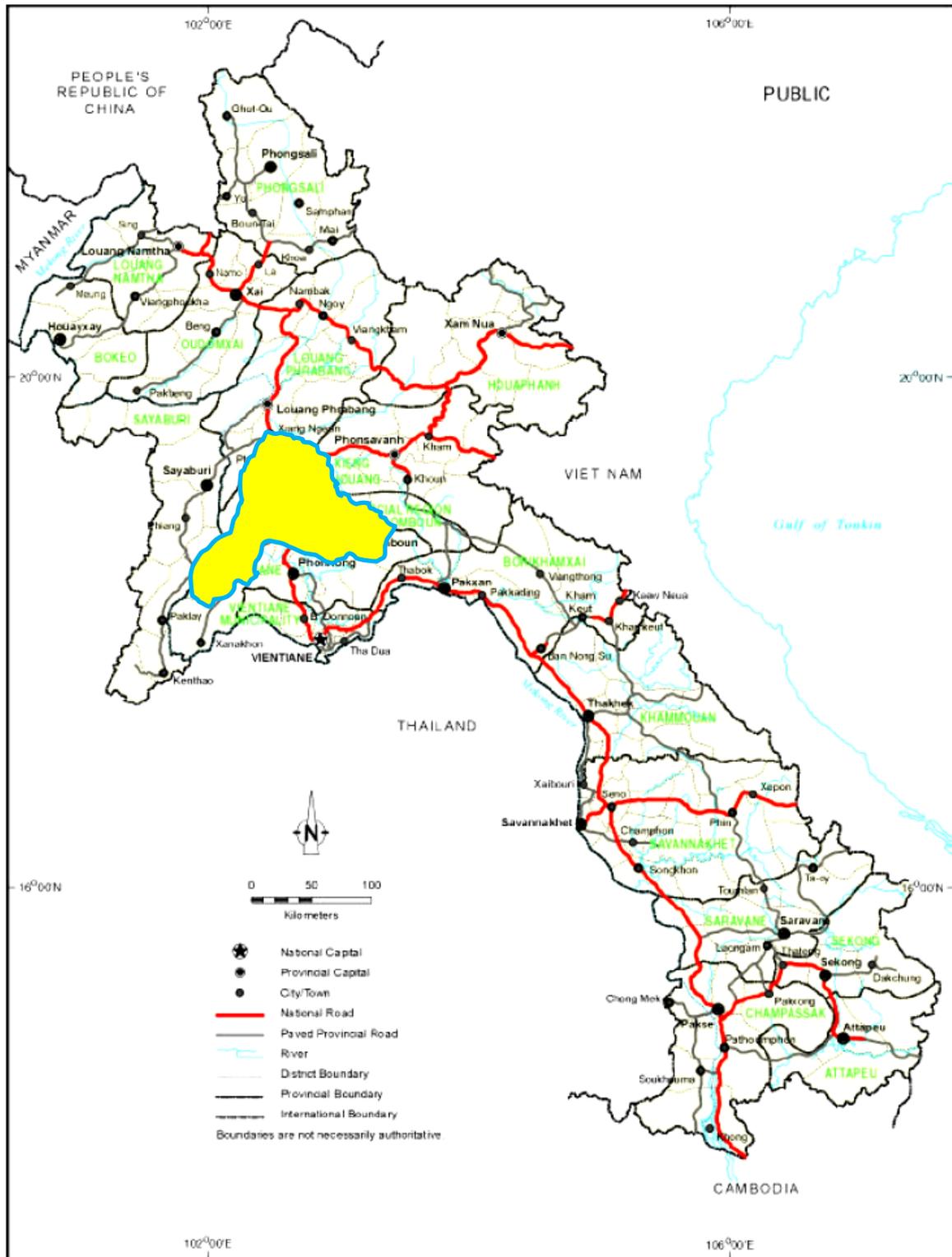
2.3 Population and samples

The research population were small holders in the important jatropha plantation areas of Naduang, Nam Phao, and Phonthong Nuea, with a total number of more than 1,200 small holder households. For the study, approximately 10 per cent or 121 people were selected for deep interviews. The detail can be seen in the table on the next page.

Table 1: Research population and sample size

No.	Plantation Areas	No. of Households	Sample Size
A	Naduang Area	414	41
1	Naduang Village	121	
2	Phudindaeng Village	169	
3	Viengsamai Village	124	
B	Nam Phao Area	478	48
1	Nam Phao Village	220	
2	Houysi Village	76	
3	Lak 33 Village	76	
4	Lak 24 Village	44	
5	Lak 18 Village	62	
C	Phonthong Nua Area	317	32
1	Phonthong Nua Village	126	
2	Vangkhee Village	191	
	Total	1,209	121

Figure 1: Study location in Vientiane Province, Lao PDR



Source: ADB (2002)

2.4 Data collection and analysis

The research was conducted in Vientiane Province. The research method used is a semi-structured interview with both individuals and focus groups, implementing both qualitative and quantitative research approaches. The research steps included:

- 1 collecting relevant secondary data to identify the total population;
- 2 identifying research sample size from the total population by applying a scientific calculation method;
- 3 selecting a suitable sampling method;
- 4 developing a structural data collection device;
- 5 testing the tool;
- 6 improving the tool;
- 7 collecting data by face-to-face or focused group interview;
- 8 analysing the data by using SPSS for Windows Program to find frequencies, percentage, mean (\bar{X}), minimum, maximum, and standard deviation (S.D.); and
- 9 interpreting the results and writing report.

2.5 Research Schedule

The detailed research plan is illustrated in Table 2 (below).

Table 2: Research schedule

No	Activities	2008											
		J	F	M	A	M	J	J	A	S	O	N	D
1	Formulate research team												
2	Collect and review secondary data and information												
3	Develop interview guideline/questionnaire												
4	Collect data in the field												
5	Input and analyse data												
6	Drafting report												
7	Finalise report												

3. FINDINGS AND DISCUSSION

The results of this study have been classified into three main parts:

1. Socio-economic backgrounds of the small holder farmers in the jatropha production area;
2. Jatropha production systems in Vientiane Province; and
3. Positive and negative impacts of jatropha plantation on small holders.

Discussion of relevant details for each part follows.

3.1 Socio-Economic Backgrounds of the Small Holder Farmers

This section has been divided into two parts (social and economic) which are indicated in Tables 3 and 4.

Some Certain Basic Social Backgrounds

Some certain basic social backgrounds of the small holder farmers in jatropha plantation area in Vientiane Province are shown in the Table 3. The table illustrates the frequencies and percentages of each value of independent variables which are gender, age, main occupation, education level, number of household members, number of household full-time labourers, and key decision maker in the family.

Gender

The majority of the respondent farmers were male, accounting for 91.7 per cent, while the remaining 8.3 per cent were female.

Age

The minimum age of the farmers was 20 years old, while the maximum age was 70. The average age of the farmers was 42.7 years old.

Main Occupation

The majority of the small holder farmers (86 per cent) had farming as their main occupation, while the remainders were government employees (3.3 per cent), businessmen (2.5 per cent), workers in private companies (2.5 per cent), and others such as unemployed persons and retirees (5.8 per cent). (See Table 3)

Education Level

Most of the respondent client farmers (52.1 per cent) had primary school-level education or lower; 31.4 per cent of them had secondary school-level education;

11.6 per cent had never attended any formal education; and only 5 per cent of them had vocational-level education or higher.

Table 3: Frequencies and percentages of the small holders classified by social backgrounds

Social Backgrounds	Frequency (n=121)	Percentage (%)
1. Gender		
Male	111	91.7
Female	10	8.3
2. Age		
Maximum	70	years
Minimum	20	years
Mean	42.7	years
3. Main Occupation		
Farmer	104	86.0
Government employee	4	3.3
Businessman	3	2.5
Worker in a private company	3	2.5
Others	7	5.8
4. Education Level		
Never go to school	14	11.6
Primary school and lower	63	52.1
Secondary school	38	31.4
Vocational and higher	6	5.0
5. Number of Household Members		
Maximum	12	people
Minimum	2	people
Mean	6.43	people
6. Number of Household Full-Time Labourers (>15 years old)		
Maximum	6	people
Minimum	1	people
Mean	2.38	people
7. Key decision maker in the household		
Both husband and wife	65	53.7
Husband	45	37.2
Wife	5	4.1
Others (single family)	6	5.0

Numbers of Household Members

The minimum number of household members was 2 people, whilst the maximum number was 12 people. The average number of household members was 6.43 people.

Number of Household Full-Time Labourers

The minimum number of household full-time labourers was 1 person, while the maximum was 6 people. The average number of the household full-time labourers was 2.38 people.

Key Decision Maker

Key decisions in the household had to be agreed between both husband and wife. More than half of the respondent farmers (53.7 per cent) said that both husband and wife make decisions together. Although 37.2 per cent of them responded that the husband was the key decision maker in the family, only 4.1 per cent said that the wife was the key decision maker in the household.

Some Certain Basic Economic Backgrounds of the Client Farmers

Some certain basic economic backgrounds of the small holder farmers are shown in the Table 4. The table shows the frequencies and percentages of each value for independent variables, which are: total land holding; agricultural land holding; land ownership; current land use; total annual household income; total annual farm income; total annual non-farm income; total annual household expenses; total annual agricultural expenses; and total annual non-farm expenses from 1 May 2007-30 April 2008.

Total Land Holding

The minimum total land holding was nil, while the maximum was 11.99 ha. The average total land holding was 2.73 ha.

Land Ownership

The majority of the farmers (74.4 per cent) had owned lowland rice fields and horticultural garden, while the rest of them had accessed to the land of the government or parents or relatives (25.6 per cent). However, only 8.3 per cent of them owned upland areas, while the rest almost of them (91 per cent) just had permission to use the land from the government and use the land of their relatives.

Current Land Use

Most of the client farmers (94.2 per cent) used their land for crop productions. They also used the land for livestock production, construction and residence, and integrated agricultural production, which were accounted for 54.5 per cent, 22.22 per cent, and 2.5 per cent respectively.

Total Annual Household Income (From 1 May 2007-30 April 2008)

The lowest total annual household income was LAK 545,164, whereas the highest was LAK 63,222,000. Average total annual household income was LAK 15,504,231.

Total Annual Farm Income (1 May 2007-30 April 2008)

The lowest total annual farm income was nil, whereas the highest was LAK 33,000,000. Average total annual farm income was LAK 4,942,983. (See Figure 2)

Total Annual Non-Farm Income (From 1 May 2007-30 April 2008)

The lowest total annual non-farm income was LAK 545,164, whereas the highest was LAK 63,222,000. Average total annual non-farm income was LAK 6,369,637 (See Figure 2).

Total Annual Household Expenses (From 1 May 2007-30 April 2008)

The lowest total annual household expenses were LAK 1,009,000, whereas the highest were LAK 77,542,000. Average total annual household expenses were LAK 8,485,592.

Total Annual Agricultural Expenses (From 1 May 2007-30 April 2008)

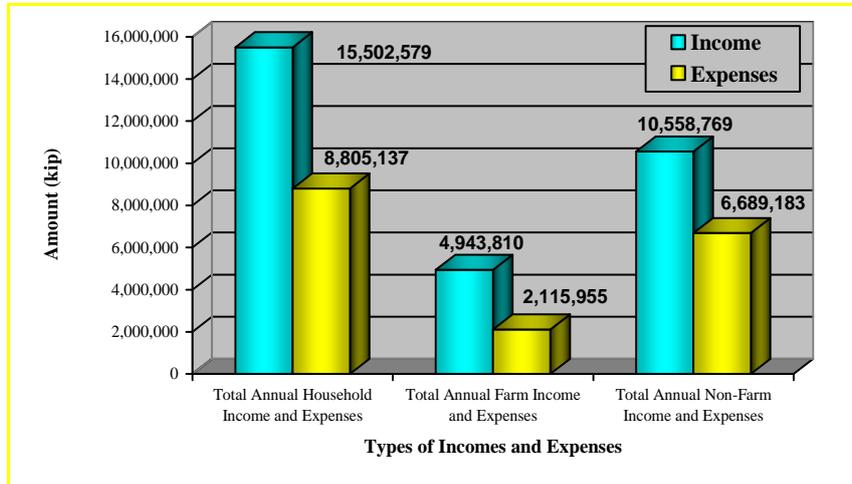
The lowest total annual farm expenses were nil, whereas the highest were LAK 20,582,000. Average total annual farm expenses were LAK 2,115,955.

Total Annual Non-Farm Expenses (From 1 May 2007-30 April 2008)

The lowest total non-farm expenses were LAK 545,164, while the highest were LAK 63,222,000. The average total annual non-farm expenses were LAK 6,369,637.

Generally, small-holders had higher average total annual household incomes than average total annual household expenses. Small holders had more non-farm income than farm income, because their agricultural production was mainly for household consumption (Figure 2).

Figure 2: Average annual income and expenses of small holders



Number of Livestock

The small holder farmers raised different types of animals for family consumption, and also for sale when they need cash. The common animals raised were cattle, buffalo, pig, goat, and poultry. On average, the respondent farmers each had 4.93 head of cattle and buffalo; 2.63 head of pigs and goats, and 20.5 head of poultry.

Table 4: Small-holders classified by economic backgrounds (May 07-April 08)

Economic Backgrounds	Frequency (n=121)	Percentage (%)
1. Total Land Holding		
Maximum	11,99	ha
Minimum	0.0	ha
Mean	2.73	ha
2. Lowland area ownership		
Own Land	90	74.40
Other (Having permission to use and relative's land)	31	25.60
3. Upland area ownership		
Own Land	10	8.30
Other (Having permission to use and relative's land)	111	91.00
4. Current Land Use		
For Crop Productions	114	94.20
For Livestock Production	66	54.50
For Construction and Residence	20	22.22
For Integrated Agricultural Production	3	2.50
5. Total Annual Household Income		
Maximum	63,222,000	LAK
Minimum	545,164	LAK
Mean	15,504,231	LAK
6. Total Annual Farm Income		
Maximum	33,000,000	LAK
Minimum	0	LAK
Mean	4,942,983	LAK
7. Total Annual Non-Farm Income		
Maximum	147,800,000	LAK
Minimum	50,000	LAK
Mean	10,561,248	LAK
8. Total Annual Household Expenses		
Maximum	77,542,000	LAK
Minimum	1,009,000	LAK
Mean	8,485,592	LAK
9. Total Annual Agricultural Expenses		
Maximum	20,582,000	LAK
Minimum	0	LAK
Mean	2,115,955	LAK
10. Total Annual Non-Farm Expenses		
Maximum	63,222,000	LAK
Minimum	545,164	LAK
Mean	6,369,637	LAK
11. Total Number of Cattle and Buffalo		
Maximum	42	heads
Minimum	0	heads
Mean	4.93	heads
12. Number of Pigs and Goats		
Maximum	35	heads
Minimum	0	heads
Mean	2.63	heads

13. Number of Poultry		
Maximum	200	heads
Minimum	0	heads
Mean	20.5	heads

3.2 Jatropha Production Systems in Vientiane Province

Introduction

Jatropha (physic nut variety) is a large (3-4 metre high) soft-wooded deciduous shrub, also known by the local name as “Mark Nhao”. The genus *jatropha* belongs to the *Euphorbiaceae* family.

It can grow in different soil types and climate conditions. It can grow in soils with low fertility and moisture content. Jatropha is not grazed by animals, even goats. Therefore, it is commonly planted as a live bio-fence around fields. It can be cultivated successfully in regions with scanty to heavy rainfall (with annual rainfall ranging from 500-1200 mm).

The bushy jatropha plant bears numerous side branches arising from its main stem. The flowers are yellowish green in loose panicles. The flowering occurs twice in a year, during March-April and September-October. The ripe fruit are about 2-5 cm large and yellow. The seeds resemble castor seeds in shape, either ovoid or oblong, and are covered in a dull brownish black capsule.

Jatropha is newly introduced for commercial production in Lao PDR. It is mostly planted by private companies for producing biodiesel.

Jatropha Plantation Technique

The Plantation Land area

Vientiane Province is the border between lowland and mountainous, which is in the north of Vientiane Capital. It consists of many mountains and the land is hilly and sloping. Mostly, villagers have used the land for shifting cultivation. After the government implemented policies to stop slash and burn agriculture, most of the lands were left to fallow. Afterwards, the sloping lands were used for planting jatropha.

Land Preparation

The jatropha plantation area was cleared to remove other plant species which would be competitors for available nutrients in the soil. During the land preparation phase, the covered trees and shrubs were slashed and burned during the dry season (March to

April). The seedbed preparation methodology for jatropha cultivation was quite similar to that required for upland rice cultivation, which does not need to ploughing (Figure 3).



Land preparation

Jatropha varieties

The common jatropha varieties found in Lao PDR are red and white jatropha. However, the red variety is smaller in terms of tree and fruit. Therefore, the most common planting variety is white.

The seeds planted were mainly from within the country, brought from areas that have similar environmental conditions to Vientiane Province (i.e. mountainous and high altitude) such as Xaiyaboury Province. Some were also imported from the neighboring countries like Thailand.

The seeds were collected by local people and then sold to an agent without cleaning and grading. The seed quality was not tested in terms of purity and germination rate, and these factors impacted on seedling numbers.



Local black jatropha seed

Planting Time

Jatropha production in Vientiane Province is based on natural environmental resources. Therefore, the commercial production Vientiane Province had just started planting during beginning of the rainy season between May to June in 2007.

Planting Techniques

Jatropha is one of the easiest crops to plant. It can be grown from seed, stems or branches. In local areas, villagers usually planted jatropha for bio-fencing by stems. However, for commercial production in Vientiane Province, jatropha was commonly planted by seed. The planting techniques seen were direct seed and transplanted seedling.

a) Planting by direct seed

Jatropha seeds were placed into the soil with human labour. 1-2 seeds were placed in each hole with approximately 50x50 cm spacing between the holes. The planting rate was approximately 80 kg per ha, with a plant density of 40,000 trees per ha.

After one year, the young plants were relocated to a spacing of 2x2 metres. Direct seed plantation was not satisfactory, because the germination rates were very low (about 45 per cent) and the planting areas were covered by weeds.



Jatropha planting by direct seed

b) Planting by transplanted seedlings

Transplanted seedlings were also used in jatropha production in Vientiane Province. Before a seedling can be transplanted, it has to be prepared in a nursery. Seedlings can be prepared by two methods: from seeds or from branches.

- Preparing seedlings by seed

There are two methods for preparing seedlings by seed:

o Seed propagation in a plastic bag:

First, a growing media is prepared by mixing the clay and rice husk in the ratio of 7:3 parts. After that it is put into 5x8 inch plastic bags. Then a seed is placed into the media. The seed will usually germinate within 7-10 days.

o Seed propagation in a seedbed:

First, a 120 cm wide seedbed is prepared. The length of the seedbed is depended on the land area. The bed is commonly 15 cm high. Seeds are placed into the soil with 15 cm spacing and 2 cm depth. The seeds germinate within 7-10 days, with a germination rate of 60 per cent. The seedlings are ready to transplant about 25 days after sowing.

- Preparing seedlings from jatropha branch cuttings:

First, a seedbed is prepared (as per propagation by seeds). After that branches from a healthy plant are cut into 30 cm pieces and vertically dipped

into the seedbed. The seedlings are ready to transplant after 20 days, when they have 4 leaves.

Figure 6: Jatropha propagation by stem



- Transplanting seedlings

Seedlings are transplanted with 2x3 metre spacing between plants. The total plant density is 1666 trees per ha. The best transplanting time is the start of the rainy season, during May and June, in order to obtain sufficient water for growth.

Jatropha planting by seedling



Jatropha Integrated Cropping System

The commercial jatropha production in Vientiane Province was a mono-cropping system. Following a recommendation from the Evaluation Impact Assessment Team (Sysaneth et.al., 2007), the KOLAO Farm and Bio Energy Company decided to integrate some cash crops such as soybean and maize into jatropha production areas.

However, these integrated production systems had just been implemented (in their first year) and the anticipated production had not been yet harvested.

Soybean with Jatropha

Once the jatropha planting was complete, the soil between the plants was ploughed for soybean. Soybean seeds were placed into the soil with 30x70 cm spacing. Therefore, 3 rows of soybean could be planted in the same space as one jatropha plant. The plantation rate was approximately 40 kg per ha.

Maize with Jatropha

Rows between the jatropha plants were prepared for maize in the same way as for soybean. However, only one row of maize could be planted per space. The maize seeds were sown with 30 cm spacing. The plantation rate was approximately 20-30 kg per ha.

Figure 8: Inter-cropping jatropha with soybean and maize during the first year



Crop Maintenance

Jatropha crops have very low maintenance requirements. It is resistant to drought, heat, rain, and insect pests. However, to obtain greater yields and continue production, the crop needs some basic maintenance such as weeding, pruning, pest and disease controlling, and application of additional fertiliser.

Weed Control

Weeding is essential during the first year of planting, because grasses are major competitors for jatropha and can slow growth. Three weedings were done during the first year. The first weeding was done within one month after planting, during July. After that weedings were done twice with two months interval.

Branch Pruning

Branch pruning is necessary and provides several benefits. It helps to keep the jatropha plants uniform over their area. Pruning also increases the number of branches per tree and potential for fruit production. In addition, it can reduce shelter for some pests.

Before the jatropha plants were allowed to bear fruit, they were pruned at least twice. The first pruning was done 6-8 months after planting, by cutting the stem about 30 cm above the soil. The second pruning was done 5-6 month later by cutting the branches 50-60 cm above the ground.

Once the jatropha trees fully matured, they were regularly pruned at least once a year (after harvesting) to keep the plants in shape and allow them to access to sunlight and ventilation.

Branch pruning



Pests and Diseases

Jatropha is one of the most pest and disease resistant plants. However, some common pest damage was found in the production areas in Vientiane Province.

It was found that young, germinating plants were commonly attacked by grasshoppers. The pest likes to eat the tops of the new seedlings during the first two weeks. This is a major problem for jatropha plantation in Vangvieng areas. The other common pest damage was caused by termites. The pests like to eat the plant's lower parts, especially those underground such as root system and stem. Aphids were also found in some new leaves of young jatropha plants during the flowering period.

Although these problems had been already been considered by the field staff of the jatropha plantation company, they had not yet prepared any preventative measures.

Jatropha plant damaged by grasshoppers and termites



Fertiliser Application

The jatropha plantation in Vientiane Province has not yet used chemical fertilisers. Only bio-fertilisers such as compost were used in the nursery areas.

However, the amount of compost was insufficient for the entire production area. Only a few plants were provided with the [required?] rate of 10 grams of compost per plant. It was applied after the first weeding by placing it on the soil surrounding the plants.

Harvesting

The ready jatropha fruit was mostly picked by hand. The shells of the fruit were removed and the seeds dried in the sun, before being put in a bag and transported to the biodiesel plant.

In Vientiane Province, the jatropha had been planted for only one year and was still in a vegetative growth phase. Thus, there was no actual production yet.

3.3 Impacts of Jatropha Plantation on Small holder Farmers

Positive Impacts

Impacts on Community

The KOLAO Farm and Bio Energy Company contributed to community development during the start of the Jatropha Production Project. The company:

- contributed funds to support renovation and construction of primary school buildings in Naduang and Nam Phao village to the value of LAK 30,000,000 and LAK 23,142,000 respectively;
- funded gravity water system repairs to the value of LAK 5,300,000; and
- provided materials towards construction (such as nails, steel, cement, and zinc roofing) of a village office in Phonthong Village, to the value of LAK 43,000,000.

Impacts to the Small Holders

The most important advantage derived from the jatropha production was that it provided local people with incomes and job opportunities, which accounted for 70.25 per cent of the respondents. Five per cent of the small holders also responded that the Jatropha Production Company had allowed them to inter-crop upland rice with the jatropha plants during the first year, which will bring them further benefits.

The research had found that 81.8 per cent had been employed by the Jatropha Production Company as chiefs of labour, contractors, contract labourers, casual labourers, and village coordinators. This employment provided income of between LAK 250,000 and 12 million per person per year.

Table 5: Incomes of small holders who participated in the Jatropha Production Company

No	Responsibilities	Numbers (Person)	Wages (LAK/person/annual)		
			Minimum	Maximum	Average
1	Chief of labour	6	5,000,000	9,540,000	6,216,333
2	Contract labour	23	1,600,000	12,000,000	3,795,652
3	Casual labour	79	250,000	8,000,000	1,914,051
4	Village coordinators	4	2,600,000	8,400,000	5,188,000

The Jatropha Production Company provided some capacity-building to the small holders before implementing the project. Of the respondents, 8.3 per cent (10 people) received training and participated in study tours organised by the project on jatropha production techniques.

The Jatropha Production Project had little effect on small holders' land areas. Most of them (more than 80 percent) said that their land areas such as lowland, upland, horticultural garden, and fallow land had not been affected by the project. However, 5.79 per cent responded that their upland area had been reduced (by an average of

0.61ha), because they changed to plant permanent crops such as agar and teak. This can attributed to the national strategy of reducing slash and burn agriculture.

Table 6: Impact on land areas

No.	Type of land	Changing (%)			Average Increase (ha)	Average of Decrease (ha)
		No change	Increase	Decrease		
1	Lowland rice	92.56	5.79	1.65	0.43	0.32
2	Upland rice	82.64	11.57	5.79	1.97	0.61
3	Garden	88.43	10.74	0.83	0.63	0.20
4	Fallow	93.39	4.13	2.48	1.05	1.20

Some of the small holders (11.57 per cent) were allowed to plant upland rice in the jatropha plantation areas. As a result, upland rice production increased (by an average of 518 kg per household).

Table 7: Impact on agricultural production

No	Type of Production	Changing (%)			Average Increase (kg)	Average Decrease (kg)
		No change	Increase	Decrease		
1	Lowland rice	66.94	12.40	20.66	192	473
2	Upland rice	79.34	11.57	9.09	518	837
3	Vegetables	92.56	5.79	1.65	92	60
4	Fruit products	96.69	1.65	1.65	155	10
5	Maize	94.21	4.39	0.83	173	20

Negative Impacts

Although the Jatropha Production Project in Vientiane Province had many positive impacts for the small holders, it also generated some negative impacts.

Some small holders (13.22 per cent) responded that they had some conflicts with the Jatropha Production Company. The major problems were payments and land concessions. 5.79 per cent of the villagers complained that their names had not been recorded while they were working. As a result, they did not get payment. 35.54 per cent of them also had problems with late payments from the company. Furthermore, some jatropha plantation areas had displaced upland production for some small holders (4.13 per cent).

Jatropha plantation also initiated some conflicts among the villagers, as 12.4 per cent were disappointed with the selection of group members to work as contractors for the Jatropha Production Company.

Only 23.1 per cent of respondents had made a one year contract with the project, while the rests (76.9 per cent) had not yet made contracts. This can generate uncertainty for the small holders.

The project also had some negative impacts on the availability of household labour, agricultural productions and non-timber forest products (NTFPs).

The Jatropha Production Project had some adverse affect to the availability of household labour for household production activity. Of the small holders, 18.18 per cent responded that the availability of household labour for household production purposes had been reduced.

Animal production in Vientiane Province is mainly a free grazing system, in which animals are let free to eat natural grass. The Jatropha Production Project reduced the natural grazing area available, decreasing small holders' capacity to raise large animals such as buffalo, cattle, goat and pigs. In response, they started to increase numbers of small animals which need less land area, such as poultry, with the consequence that poultry numbers increased (Table 8).

Table 8: Animal production

No	Type of Land	Changing (%)			Average Increase (Head)	Average of Decrease (Head)
		No Change	Increase	Decrease		
1	Buffalo/Cattle	47.11	16.53	36.36	1.68	3.25
3	Goat/Pig	59.50	18.18	22.31	3.23	5.75
4	Poultry	58.68	24.79	16.53	13.83	20
2	Goat	91.49	4.96	3.31	2.5	3.25

The Jatropha Production Project had many impacts on NTFP outputs in the local areas:

- 36.36 per cent of small holders said that they had more difficulty in finding NTFPs such as wild mushrooms, vegetables, fruit and animals;
- 19.83 per cent responded that the diversification of NTFP species was also reduced;
- 42.98 per cent responded that there was a reduction in the availability of wildlife and natural aquatic animals.

4. CONCLUSIONS AND RECOMMENDATIONS

4.1 Conclusions

Jatropha plantation is significantly spreading over the country. The KOLAO Farm and Bio-energy Company plan to increase the total production area to 120,000 ha across the country. In Vientiane Province the company aims to increase to 50,000 ha. Production also needs large amounts of labour for land preparation, planting, and harvesting. The available labour would be drawn from small holders in the local areas.

Small holder farmers in jatropha plantation areas had an average age of 42.7 years. The majority of them have education up to primary school level. The average full-time labour available per household is 2.38 people. The average total land holding area was 2.73 ha, while the majority of them (74.4 per cent) owned the land. The average total annual household income was LAK 15,504,231, while the average total annual agricultural and non-agricultural incomes were LAK 4,942,983 and LAK 10,561,248 respectively. The average total annual household expenditure was LAK 8,485,592, while the average total annual agricultural and non-agricultural expenditures were LAK

2,115,955 and LAK 6,369,637 respectively. The small holders produced agricultural products mainly for home consumption, while they earned cash from non-farm activities.

Although jatropha has been known in Lao PDR for many decades it is the newest commercial crop, and has been planted in commercially in Vientiane Province for only 2 years. The production practices used were similar to those commonly used in upland rice production. Land preparation started with slashing, burning and cleaning. After that, jatropha seeds were placed into the soil by direct seeding method. In some areas, transplanted seedlings were also used. Some cash crops such as soybean and maize were integrated with the jatropha during the first and second year. After planting, regular crop maintenance activities such as weeding, pruning, disease and pest controlling, and applying fertilisers were implemented.

The Jatropha Production Project had positive impacts for small holders in the production areas:

- it provided job opportunities and income to small holders in the production areas;
- it provided capacity building to the small holders involved; and
- some small holders were also allowed to plant upland rice in the jatropha production areas.

However, the Jatropha Production Project also had some adverse impacts on the small holders in the production areas:

- some conflicts emerged between the small holders and the Jatropha Production Company regarding the payment and land concession;
- some small holders faced insufficient and late payments;
- not all small holders had signed contracts with the company, which may lead to insecurity over their jobs and incomes;
- the areas used for jatropha production were in the young and old fallows, which reduced the availability of NTFPs that rural people find in these areas; and
- reduced availability of natural grazing areas for production of common domestic animals such as cattle and buffalo.

4.2 Recommendations

In order to improve the existing jatropha production and reducing the impacts on small holder farmers, it is recommended that the Jatropha Production Company:

- 1) continue to allow small holders to plant cash crops integrated with jatropha during the first and second year;
- 2) continue to provide capacity building to local people in jatropha production;
- 3) organise study tours to experienced countries (such as India) to learn about the production techniques;
- 4) conduct on-farm experiments to increase the production;
- 5) prepare a step-by-step jatropha production manual and follow it strictly;
- 6) check seed quality before planting;
- 7) prepare a crop calendar to make monitoring easily;
- 8) prepare a labour-use plan to avoid labour shortages during cropping season;
- 9) consult with experienced experts in jatropha production or related industrial crops for the best production practice;
- 10) improve time record keeping for the workers;
- 11) improve the payment system so that it makes payments on time;
- 12) prepare contracts for all labourers to secure their jobs;
- 13) prepare and publicise roles and responsibilities of each employee level; and
- 14) prepare and publicise all related rule and regulations for employees.

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Annex: Interview Questionnaire

Impacts of Jatropha Plantation on Small Holders

No.....

date...../...../ 2004, Name of the interviewer.

Name of the interviewee.....; Tel No:.....;

House Number..... Village..... Groups No..... Zone
District..... Vientiane Province

Part 1: Some socio-economic backgrounds of small holders

1. Gender 1). Male 2). Female

2. How old are you?.....years old.

3. What is your main occupation?

- 1). Farmer 2). Business man,
- 3). Government employee 4). Worker in a private company,
- 5). Others (please specify.....)

4. What is your education level?

- 1). No Education 2). Primary school and lower
- 3). Secondary school
- 4). Vocational/mid level Certificate (Specify the area.....)
- 5). Diploma/under/post graduate (Specify the area.....)

5. Number of household members.....people.

No	name	gender	age	status	Relative	Education level	Job	Health status
1								
2								
3								
4								
5								
6								
7								
8								
9								
10								

6. Number of household full-time labor (between 15 to 45 years old)people.

7. How is the main key decision maker in the family?

- 1). Husband 2). Wife 3). Both 4). Both

8. Total land holding.....ha, Agriculture land holding.....ha

no	Land of type	Lands (m ² or ha)	Land ownership statement			
			Own land (Have ownership statement)	Have use certificate	Rent	Others
1	Lowland Rice					
2	Upland rice					
3	Garden					
4	Building					
5	Animal production					
6	Others.....					

9. Present land use.

- 1). Cultivate crops (please specify.....)
 2). Raising animals (please specify.....)

- 3). Both cultivating crops and raising animals (please specify.....)
- 4). Others (please specify.....)

10. Animal Production

No	Type of animal	Quantity (heads)
1	Poultry	
2	Goat	
3	Pig	
4	Cattle	
5	Buffalo	
6	Water animal (fish; frog)	
7	Others.....	

11. Equipments

No	Type of Equipment	Quantity
1	Tractor	
2	Thresher	
3	Rice mill	
4	-Trolley	
5	Car	
6	Motorbike	
7	Other.....	

12. Total household cash income in last year (between 1/4/2007 to 31/3/2008).

1.) Total farm income.....kip.

No	Source of income	Total income	Sale quantity (Kg, Tone, head)	Price/unit
1	Rice			
2	Paddy rice			
3	Cereal crops			
4	Vegetable crops			
5	Fruit crops			
6	Fish			
7	Cattle			
8	Buffalo			
9	Goat			
10	Pig			
11	Poultry			

12	Eggs (poultry)			
13	Others (please specify.....)			

2.) Total non-farm income.....kip.

No	Source of income	Cash (kip/year)
1	Salary	
2	Wages (please specify.....)	
3	Handicrafts (please specify.....)	
4	Business (please specify.....)	
5	Relatives include sons and/or daughter (please specify.....)	
6	Wild and water animals available	
7	NTFP (please specify.....)	
8	Rent (land, house, others...) (please specify.....)	
9	Others (please specify.....)	

3). Total household cash income.....kip.

13. Total household expenses in last year.

1.) Total farm expenses.....kip.

No	Item	Quantity/year (Kg, T, heads)	Unit Price	Total (kip/year)
1	Land preparation			
2	Seed and seeding			
3	Fertilizers			
4	Chemicals			
5	Bio-fertilizers			
6	Livestock			
7	Feeds			
8	Vaccines and medicines			
9	Aquaculture			
10	Farm equipments			
11	Cultivation and planting			
12	Culture rice			
13	Harvest			
14	Threshing			

15	Transportation			
16	Irrigation			
17	Fencing and housing			
18	Maintenance			
19	Others (please specify.....)			

2). Total non-farm expenseskip.

No	Item	Quantity/year (Kg, T, heads)	Price/unit	Cash (kip/year)
1	Food consumption			
2	Clothe consumption			
3	Education			
4	Take care health			
5	Traditional(Basy, wedding)			
6	Gambling(lotteries)			
7	Electrical cost			
8	Land taxable			
9	Rent			
10	Interest on loan			
11	Others(please specify.....)			

3). Total household expenses.....kip.

Part 2: Impacts of Jatropha Plantation

1. What is your relationship with the Jatropha Production Project?

- 1). No relationship (Number 8 across)
- 2). Labor How many people?.....How much wages?.....
- 3). Capitalist How much?.....
- 4). Self cultivation How many area?.....ha, How much?.....
- 5). Land owner How many area?.....ha, How much?.....
- 6). Farm equipment owner Please specify.....How much?.....
- 7). Other.....Please specify.....

2. Description of the project contract

- 1). No contract Why?.....
- 2). Land concession contract How many area?.....ha,
How many year?....., How much?.....
- 3). Land rent contract How many area?.....ha,
How many year?....., How much?.....
- 4). Contractor How many year?.....How much?.....
- 5). Broker How many year?.....How much?.....
- 6). Buyer How many year?.....Quantity.....
amount.....
- 7). Permanent labor How many years?.....How many people?.....
How much money?.....
- 8). Others..... How many years?.....How much?.....

3. Benefit Sharing with the Project?

- 1). Money How much per year?.....
- 2). Product Quantity per year?.....
- 3). Others (please specify.....) Quantity per year?.....

4. What is your responsibility in the project?

- 1). Coordinator salary per month or annual?.....
- 2). Group leader salary per month or annual?.....
- 3). Contractor head salary per month or annual?.....
- 4). Permanent labor salary per month or annual?.....
- 5). Temporary labor salary per month or annual?.....
- 6). Others..... salary per month or annual?.....

5. Have you ever received training courses or taken study trips on jatropha planting or biodiesel production?

- 1). No
- 2). Yes (How many times?....., About: 1).....
2).....
3).....

6. How did you get assistance from the Jatropha Production Project?

- 1). Employment How many people?.....
How much salary or all year?.....
- 2). Production technique Please specify.....
- 3). Seeds Quantity....., How much money?.....kip
- 4). Capital How much?.....kip
- 5). Equipment production please specify.....How much?.....
- 6). Fertilizer or chemical Quantity....., How much?.....kip
- 7). Others (please specify).....How much?.....kip

7. Please specify your jatropha plantation areas (if you gave answer no.4 to Question 1).

- 1). Area No. 1ha, Character area.....
Land is (rice field, garden...)....., Are you plant present?.....
- 2). Area No. 2.....ha, Character area.....
Land is (rice field, garden...)....., Are you plant present?.....
- 3). Area No. 3.....ha, Character area.....
Land is (rice field, garden...)....., Are you plant present?.....

8. What are the benefits from the project for your village?

- 1). Village office How many building?....., How much?.....kip
- 2). School How many building?....., How much?.....kip
- 3). Access road How far?.....km, How much?.....kip

- 4). water supply How many built?....., How much?.....kip
- 5). Grant for education How much capital?....., How much?.....kip
- 6). Grant for development village How much in total?....., How much?.....
- 7). Equipment for building What is it?....., How much?.....
- 8). Transport services Details....., How much?.....
- 9). Health center How many built?....., How much?.....kip
- 10). Irrigation How far?.....km, How much?.....kip
- 11). Others (please specify) , How much?.....kip

9. What are the changes after having the jatropha project?

No	Please specify of change	Order change			Quantity of change	What is cause?	How do you solve the conflict?
		Add	Normal	Reduce			
A.	Area make production agriculture						
1	Paddy rice	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>			
2	Upland rice field	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>			
3	Garden	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>			
4	Field for feed animals	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>			
5	Fallow	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>			
6	Others(please specify).....	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>			
B.	Crop product						
1	Paddy rice	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>			
2	Upland rice	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>			
3	Corn	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>			
4	starch crops: cassava, sweet potato	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>			
5	Vegetables: cucumber, chili...	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>			
6	fruits: orange, mango, tamarind...	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>			
7	Others(please specify).....	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>			
C.	Livestock product						
1	Cattle	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>			
2	Coat	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>			
3	Pig	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>			
4	Poultry	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>			
5	Others (please specify).....	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>			
D.	Inputs for production						
1	Financial expenses	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>			
2	Labor numbers	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>			
3	Wages	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>			
4	Donation	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>			
5	Land rent	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>			
6	Vehicle and equipment rent for farm	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>			
7	Transport cost	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>			
8	Agricultural production value in the local	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>			
9	Others (please specify).....	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>			
E.	Vehicle and equipment rent for farm						
1	Tractor	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>			
2	Transport: pickup	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>			
3	Rice mill	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>			
4	Tools for agriculture	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>			

5	Facilities for house	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>			
6	Others (please specify).....	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>			
F.	NTFP						
1	Difficulty in finding NTFP	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>			
2	Type of NTFP	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>			
3	Quantity available of NTFP	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>			
4	Forest animals and fish	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>			

10. Were there any conflicts resulting from the Jatropha Production Project?

No	Conflict	Yes	No	If yes, please specify	Problem solving techniques
1	Between different companies				
2	Between local community and the company				
3	Between person and the company				
4	Between districts				
5	Between villages				
6	Between group of peoples in the village				
7	About land rental				
8	About employment				
9	About wages				
10	About social welfare				
11	Others (please specify.....)				

11. Your ideas about the Jatropha Production Project

1). What are the biggest advantages from the project for you or your family?

1.
2.
3.

2). What are the biggest disadvantages from the project for you or your family?

1.
2.

3.

Your comments (optional)

.....
.....
.....
.....
.....
.....

Remarks:

.....
.....
.....
.....
.....
.....
.....