

# Global Market Study on Jatropha

## Final Report

**Prepared for the World Wide Fund for Nature (WWF)**

London/Berlin, May 8<sup>th</sup>, 2008



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This report has been written by GEXSI, with guidance from WWF. The report was sponsored by BP in support of the efforts of the Roundtable on Sustainable Biofuels.

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- 2 Background and Methodology of the Study**
- 3 Results on a Global Level**
- 4 Results on Regional and Country Level**
- 5 Case Studies on Jatropha Projects**

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## **The Jatropha industry is in a very early stage of development**

Currently, no coherent overview of global activities in Jatropha exists. For this first global market study, GEXSI interviewed more than 170 experts in 55 countries and collected 160 online questionnaires to create a first global inventory of Jatropha projects. The general result is that the Jatropha industry is still in a very early stage: Very few projects are more than two years old and hardly any project can demonstrate significant production of Jatropha oil yet.

## **Nevertheless, approximately 900,000 hectares of Jatropha have already been planted**

Although the industry is in its early stages, we could identify 242 Jatropha projects, totalling approximately 900,000 hectares. More than 85% of the land cultivated is located in Asia. Africa counts for approximately 120,000 hectares followed by Latin America with approximately 20,000 hectares.

## **Jatropha will see enormous growth: 5 million hectares are expected by 2010**

The number and size of Jatropha projects currently being developed is increasing sharply. This is the case in almost all regions of the world which are suitable for Jatropha cultivation. It is predicted that each year for the next 5-7 years approximately 1.5 to 2 million hectares of Jatropha will be planted. This will result in a total of approximately 5 million hectares by 2010 and approximately 13 million hectares by 2015.

# 1 Management Summary (2)



## **Global investments of up to 1 billion USD expected every year**

Assuming an average investment of 300-500 USD per hectare, the expected growth path of the industry will lead to worldwide investments totalling 500 million to 1 billion USD every year for the next 5-7 years.

## **The Jatropha industry structure will transform dramatically**

Today, the global Jatropha industry is dominated by government supported programs and a few larger internationally oriented private players. We are observing a trend of major oil companies and international energy conglomerates entering the field with plans for large-scale investments.

## **Smallholder farmers play a vital role in most Jatropha projects**

Two thirds of all projects analysed work with local outgrowers, often in combination with a managed plantation. 50% of all project developers in Latin America and Asia opted for this combined approach. Pure plantation models are most frequent in Latin America (44%). In Africa, where two thirds of the projects integrate smallholders, pure outgrower models are equally important as the combined model.

## **Jatropha has not led to a reduction in food production**

In our sample analysis, only 1.2% of areas planted with Jatropha had been used for food production in the 5 years prior to the start of the project. 70% of all projects analysed practise some form of intercropping. Therefore, Jatropha cultivation supports food production if formerly unused areas are developed.

# 1 Management Summary (3)



## **Jatropha has not contributed to the destruction of primary forest**

According to our data sample, only 0.3% of any cultivated areas were previously primary forest, and 5% secondary forests.

## **Political support for Jatropha is already strong, and developing further**

So far – especially in Asia – governments have been the main driver for Jatropha cultivation and developed specific Jatropha programmes. Rising crude oil prices are now creating a strong demand for biofuels. Therefore, large oil and energy conglomerates are beginning to implement large-scale Jatropha projects. In the course of this process, the focus of government regulation will shift towards more general frameworks for the biofuel sector.

## **Production is focused on domestic markets**

Production for local markets is more important than export, especially in Asia. For domestic markets, the use of unrefined Jatropha oil is seen equally important as the transesterification into biodiesel.

## **Jatropha is typically planted using semi-intensive methods**

Most Jatropha plantations have nurseries and apply cultivation techniques such as pruning or fertilisation. About half of the projects use some type of irrigation.

**Carbon credits are not yet an issue for the majority of projects**

The majority of projects have not taken action to participate in a carbon offsetting scheme so far. This may be the case because accepted methodologies for certification are not yet in place.

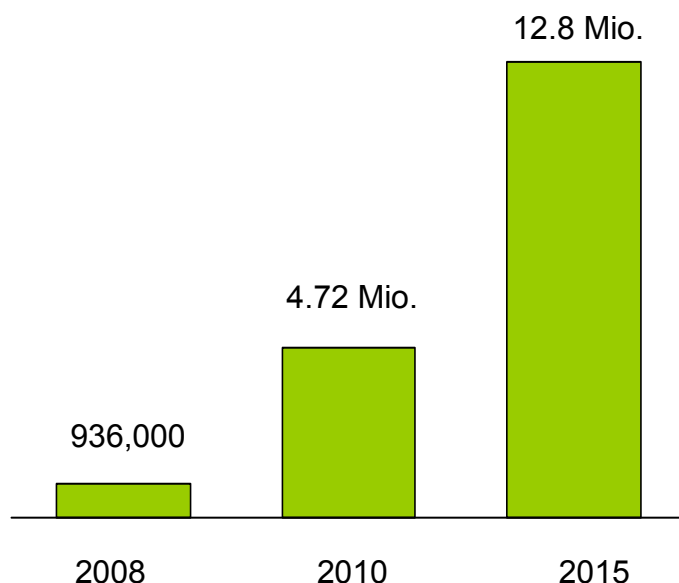
**Jatropha research is dominated by Asia**

The majority of projects do research on Jatropha. However, there are great regional disparities: 85% of the projects analysed in Asia are involved with Jatropha research, compared to 54% in Latin America and only 36% in Africa.

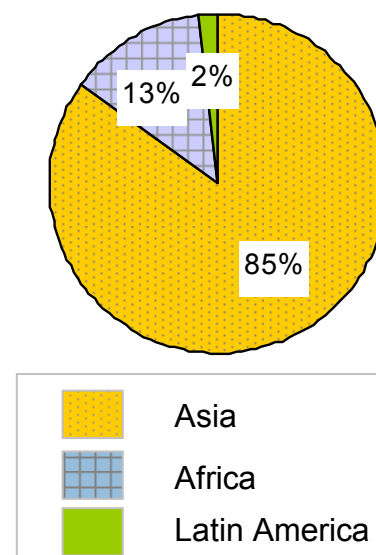


# 1 Management Summary (5)

**Scale of Jatropha plantations 2008-2015 (ha)**



**Distribution of Jatropha plantations 2008 (ha)**



## Comments

An enormous growth is predicted by experts to the Jatropha industry. 1-2 million hectares are expected to be planted annually in the next years all over the world.

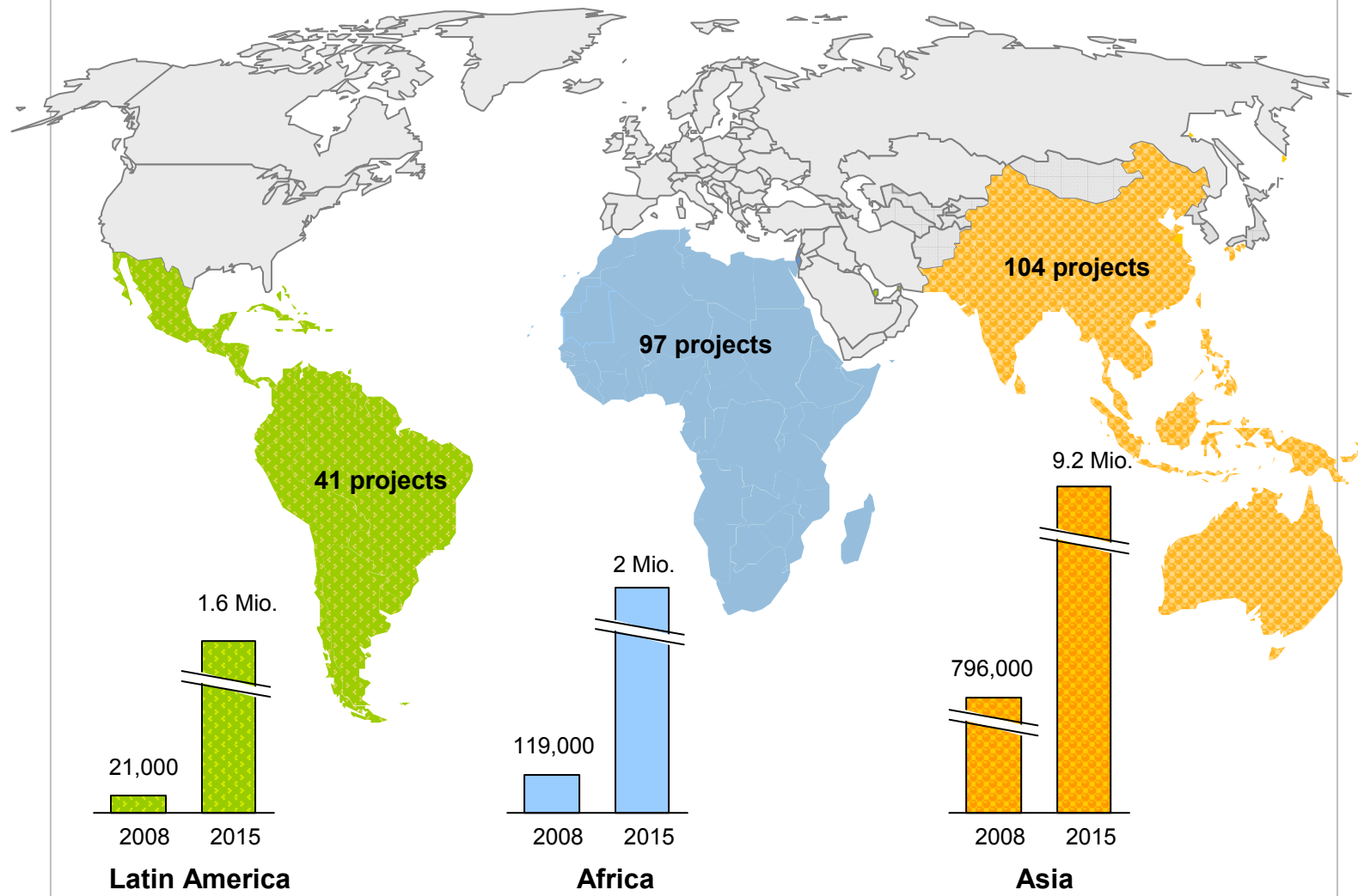
The clear focus of Jatropha plantations today lies in Asia – more than 80% of identified project areas are situated there. Among the Asian countries, India plays with more than 400,000 ha the largest role, followed by China. In the other regions, Brazil, Zambia, Tanzania and Madagascar are most important today.

In the future, Asia is expected to prevail with more than 70% of global acreages developed there until 2015.

n = 242 identified projects and 176 expert interviews; Source: GEXSI Survey 2008, Expert Country Estimates

# 1 Management Summary (6)

Scale of Jatropha projects (ha) and number of projects today





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## 2 **Jatropha – General Features**

### **Jatropha curcas**

- Is a perennial oil-bearing shrub or small tree
- Produces seeds that contain approx. 30-35% of non-edible oil
- Originates from Central America and is known today in many countries throughout the tropics
- Is drought resistant and survives at an annual precipitation of down to 300mm
- Has traditionally been used as “living fences” and for production of soap, medicine, oil for lamps etc.



Photos: A. Renner

## 2 Jatropha – Potential Upsides and Downsides

### Advantages

- Jatropha yields a **high-quality oil** which is well suited for use in the transport and energy sector.
- Jatropha has a high **yield potential** of more than 2 tons of oil per hectare per year.
- Jatropha can grow on **poor soils** that are not suitable for food production; it is suited for the rehabilitation of waste lands.
- It grows, among others, in **semi-arid regions** not suited for oil palms.
- Jatropha requires significantly **less water** than oil palms (approx. 1/10).
- Jatropha seeds do not have to be processed immediately (unlike palm); therefore **remote areas** can be included in the production schemes.
- Jatropha can be planted as a hedge around fields or on unused land and offers **smallholders** an opportunity to create additional revenues.
- Jatropha is well suited for **intercropping**, in particular during the first years while the trees are small.
- Jatropha oil can be **used locally** to fuel vehicles, diesel generators, lamps or cooking stoves without a transesterification into biodiesel.

### Risks and Challenges

- Jatropha is a **wild species**, not a domesticated industrial crop.
- **Yield expectations** are very uncertain due to inhomogeneous results and the lack of improved seed material; research on Jatropha and plant breeding has just started.
- Jatropha will not produce good yields in poor conditions; there are **trade-offs** between rehabilitation of wastelands and maximisation of oil production.
- Harvesting is very **labour-intensive** and may jeopardise the economic viability.
- **Pests and diseases** are a problem for Jatropha as they are for any other crop, particularly in monoculture.
- **Large-scale production** schemes may heavily distort local social and eco-systems.
- Jatropha contains **toxic substances**. So far, no technologies exist to remove these, and hence the seed cake currently cannot be used as fodder for animals.

### The Challenge

Jatropha is a plant which is known in Latin America, Africa and Asia for a long time. Only recently, however, its potential as a biofuel energy crop has been discovered by governments, the financial community or project developers. There are great hopes that Jatropha may offer a sustainable alternative to other, less or not sustainable energy crops, as it can grow on marginal land where it would neither compete with food production nor with nature conservation. In the past few years, a vast number of Jatropha projects have been planned and started.

As the Jatropha industry is still in its infancy, there is little consolidated knowledge on the acreage of Jatropha currently planted out. There are no industry standards yet, nor does a commodity market for Jatropha oil exist. Neither do we know much about the social and ecological impact of the current projects as well as of future large-scale investments and ambitious governmental programs on Jatropha. Are Jatropha projects generally benefiting smallholder farmers and restoring wastelands? Or are there serious sustainability issues which needs to be addressed?

### The Approach

WWF has contracted GEXSI to conduct a global market study on Jatropha which draws a general picture of the current status and future outlook of project developments in Latin America, Africa, and Asia. The study looks both into the scale of projects as well as into the different organizational schemes and cultivation methods. The data is based on interviews with country experts as well as with project representatives. The study has been performed in February and March, 2008, and was complemented by desk research. The Jatropha study reveals information which has not been compiled and made public before. It aims to inform the stakeholders wishing to participate in the debate on paths towards sustainable biofuel production on a global scale.



### About WWF

The World Wide Fund for Nature (WWF) is the largest multinational conservation organisation in the world. WWF's unique way of working combines global reach with a foundation in science, involves action at every level from local to global, and ensures the delivery of innovative solutions that meet the needs of both people and nature. Among others, WWF promotes sustainable approaches to the use of renewable natural resources.

### About the Roundtable on Sustainable Biofuels

WWF is a founding member of the Roundtable on Sustainable Biofuels (RSB). The RSB is an international initiative bringing together farmers, companies, non-governmental organizations, experts, governments, and inter-governmental agencies concerned with ensuring the sustainability of biofuels production and processing.

The Roundtable is hosting a series of meetings, teleconferences, and online discussions with the aim of achieving global, multi-stakeholder consensus around the principles and criteria of sustainable biofuels production

The RSB will develop a sustainability standard for biofuels during the first half of 2008. However, this standard will include broad principles and criteria and will need to be refined at the crop level and probably also at the regional level. For some of the well-known commodities, such as palm oil, soy or sugarcane, this crop specific work is already under development. For other crops, such as Jatropha, such work is in its infancy. Several Jatropha stakeholders would like to set up a working group to discuss issues around Jatropha, and probably work on guidelines and Better Management Practices for Jatropha plantations. These instruments would be developed in close relationship with the RSB.



### About GEXSI

The Global Exchange for Social Investment – GEXSI ([www.gexsi.org](http://www.gexsi.org); [www.gexsi.com](http://www.gexsi.com)) is an international organisation with offices in London and Berlin that promotes pro-poor investments. Our mission is to support social entrepreneurs in low-income regions worldwide to move from philanthropic support to commercial investment.

Since 2005, GEXSI has built up a Jatropha Expert Network comprising three continents. Our aim is to promote triple bottom-line investments into Jatropha projects that benefit smallholder farmers, protect the environment, and provide sufficient returns to the investors.

Apart from coaching and mentoring of entrepreneurs, GEXSI is currently building up a Jatropha platform ([www.jatropha-platform.org](http://www.jatropha-platform.org)) that brings together industry, research, project developers and well as other interested parties such as NGOs and development aid.





## 2 Methodology used for the Study (1)



### Our approach in a nutshell

We have acquired the information in this study through expert interviews via

- An online questionnaire
- Telephone interviews as well as
- Email correspondence

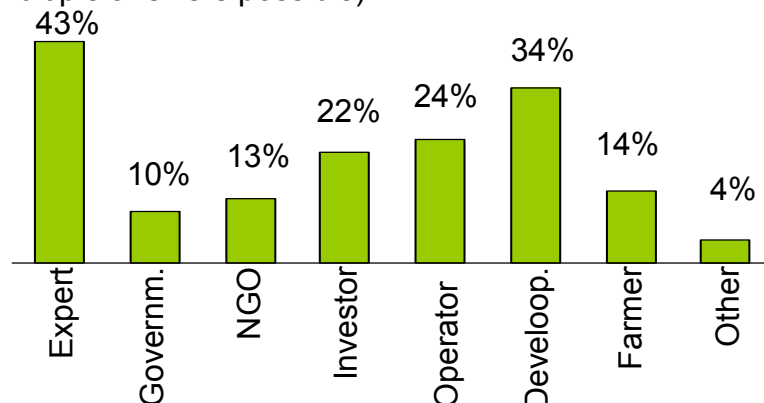
complemented by internet research and in-house expertise.

The key focus was on assessing the

- Current and planned acreage of Jatropha plantations
- Type of projects (public / private)
- Organizational models (plantation / outgrowers / ...)
- Different cultivation schemes
- Sustainability issues (such as former land use)
- Economics and value chains

### Type of experts interviewed

(multiple answers possible)



### Key figures

We have interviewed

**176** Experts in

**55** countries

We have identified and processed data of

**242** Jatropha projects

We received **160**

fully completed online questionnaires between February 18th and March 21st, 2008.

## 2 Methodology used for the Study (2)



### Acreage: Validation of Data

As there is no global market for Jatropha oil yet, there is no market indicator on output of Jatropha plantations which would allow to give indications of plantation sizes. Moreover, the publicly available estimates on current and future acreages often vary drastically.

Therefore, in order to draw a realistic picture on the development of Jatropha plantations, we analysed two different sources of data separately and compared the results:

- **Country Data:** Estimates from experts on total Jatropha acreage in a specific country
- **Project Data:** Data gathered from projects we have identified which were then aggregated

Both types of data have their strengths and weaknesses. The estimates of the (regional) experts depend on their individual background and vary from person to person.

Project representatives on the other hand are often reported to over-estimate their expansion potential. However this deficiency may be compensated by the fact that it is impossible to identify all projects, and that projects will be developed which will have an impact on the 2010 and 2015 figures which are not in place yet. We excluded data which had obviously been mistaken or where the source of data did not seem reliable (as is the case for much information found in the internet).

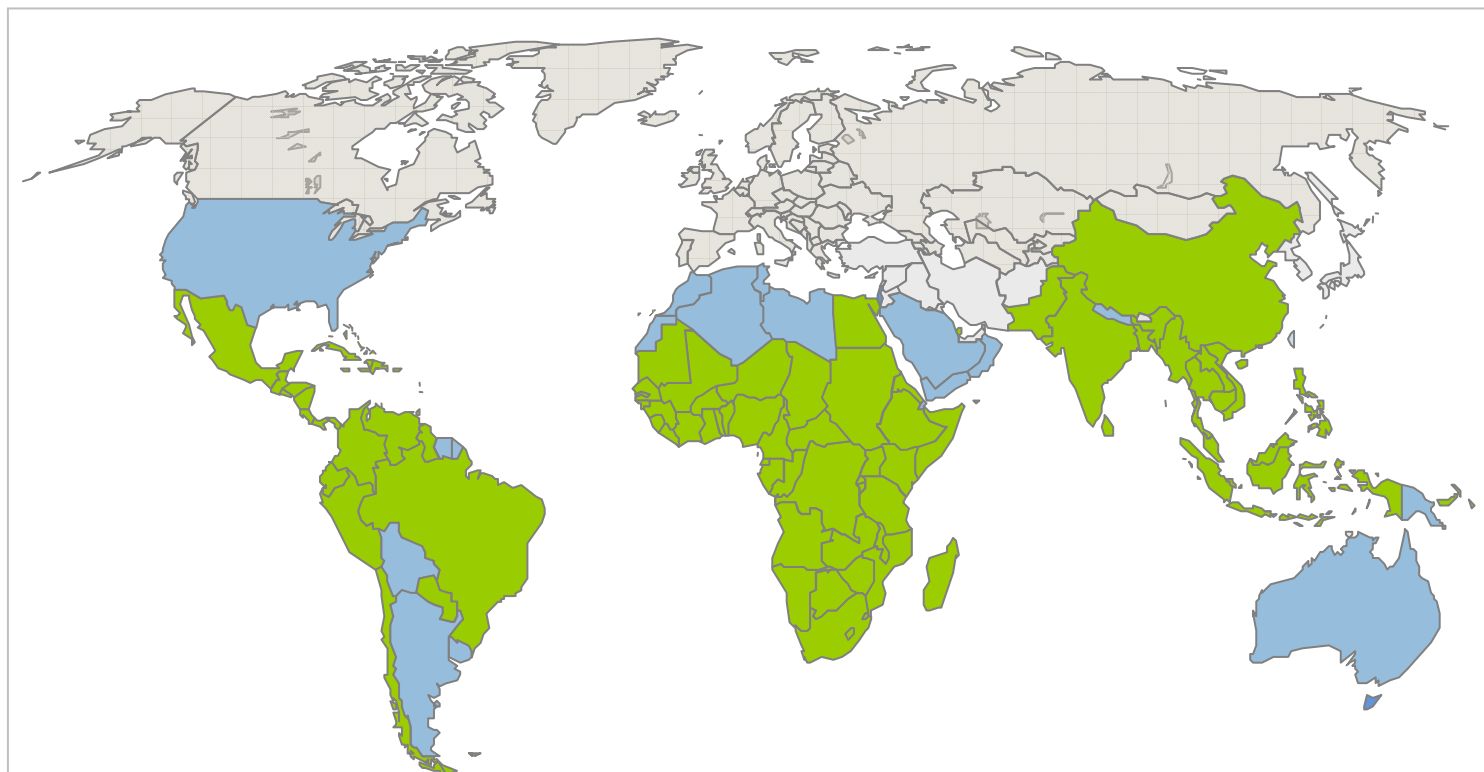
### On the interpretation of acreage figures

*The data on current and future acreages of Jatropha plantations has to be interpreted with care.*

*The data we received for the different countries were in line with our expectations. The differences between country expert estimates and project representative's estimates could also be explained in most cases.*

*However, there is one major caveat: As Jatropha is a wild crop which is only at the beginning of domestication, many projects initially had poor results; in many projects, only a low percentage of the trees planted out actually survived. This may cause a significant over-estimation of the acreage and output as the figures in this report do not indicate the state of the plantations.*

## 2 Selection of Countries



### 1 st priority

Countries analysed with first priority:  
Highly suitable climatic conditions for  
Jatropha cultivation

→ Jatropha projects known or very  
likely to exist



### 2 nd priority

Countries analysed with second  
priority: Suitable conditions for  
Jatropha cultivation

→ Jatropha projects may exist



### 3 rd priority

Countries not analysed:  
Jatropha projects not expected (e.g. due  
to climatic reasons), highly unlikely (e.g.  
due to very high labour costs) or difficult  
to research (e.g. due to political crises)

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**Jatropha research is dominated by Asia**

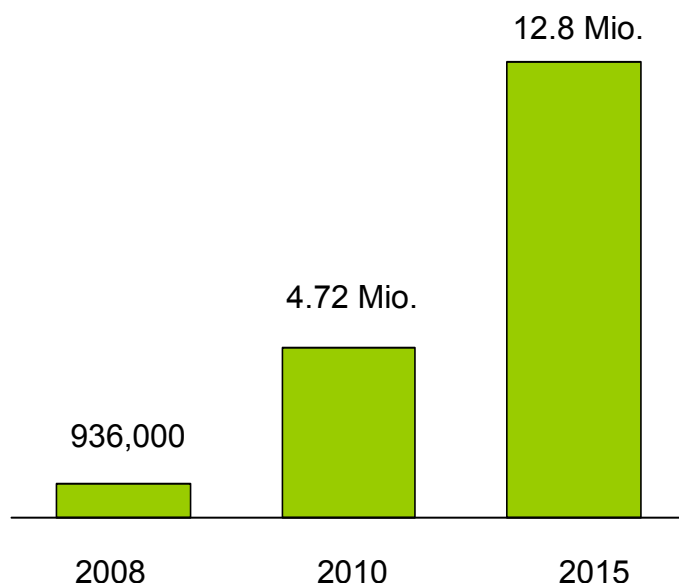
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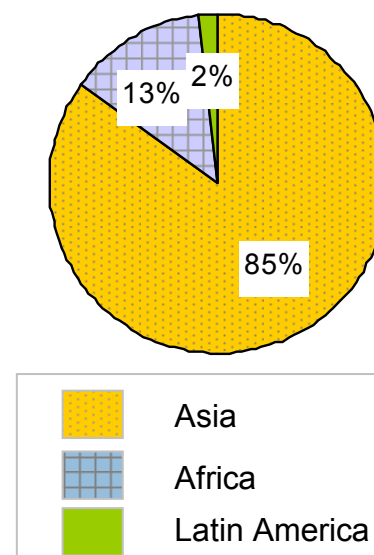
### 3 Scale and Development of Jatropha Activities



Scale of Jatropha plantations 2008-2015 (ha)



Distribution of Jatropha plantations 2008 (ha)



#### Comments

Experts predict the Jatropha industry to grow enormously. 1-2 million hectares are expected to be planted annually in the next years worldwide.

More than 80% of identified project areas are situated in Asia. Among the Asian countries, With more than 400,000 ha, India is the largest cultivator, followed by Cambodia and China. Outside Asia, Brazil, Zambia, Tanzania and Madagascar are most important for Jatropha cultivation.

In the future, Asia is expected to prevail with more than 70% of global acreages developed there by 2015.

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### 3 Scale and Development of Jatropha Activities

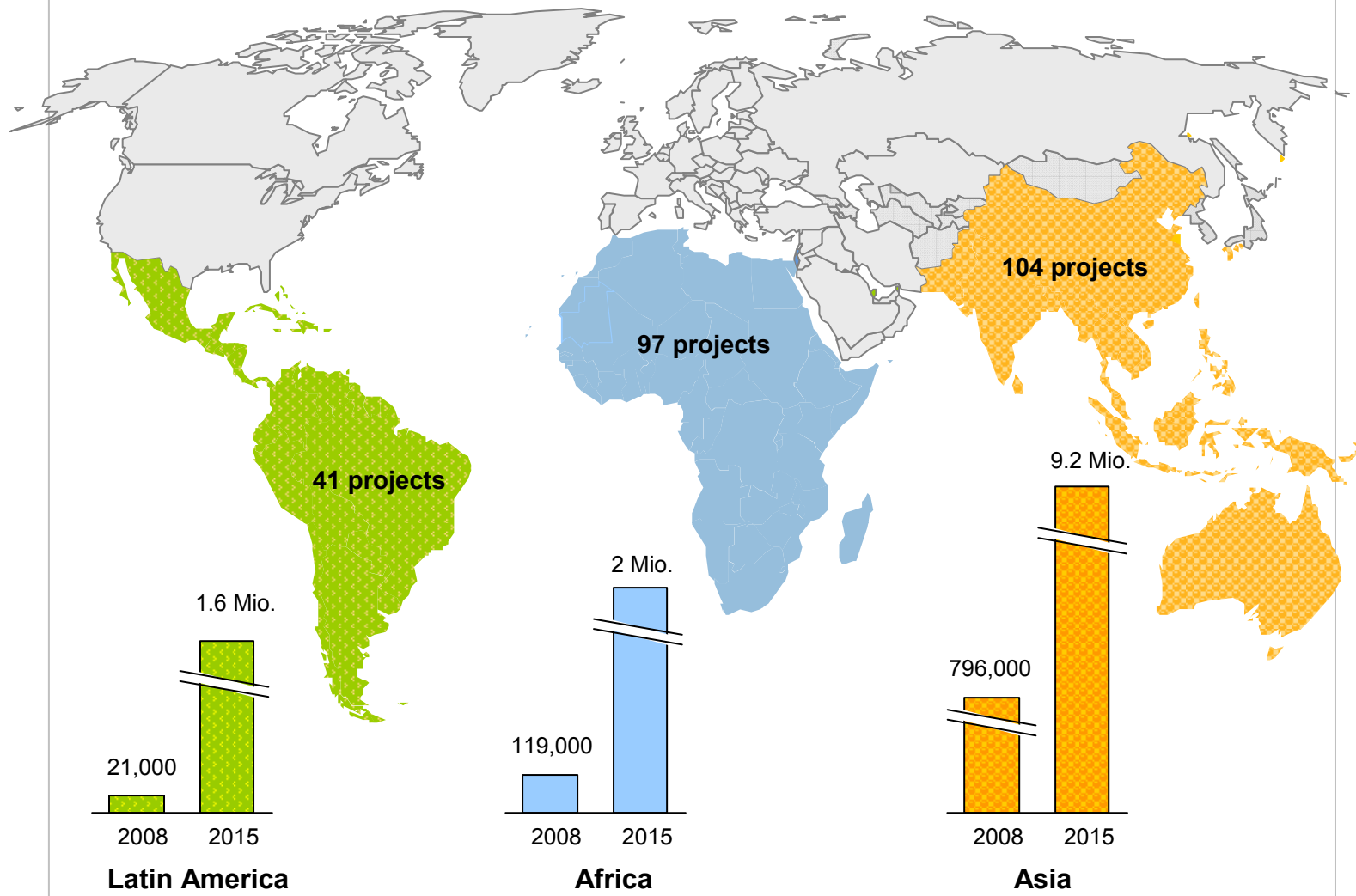
#### Scale of Jatropha plantations 2008-2015 (ha)

	Latin America	Africa	Asia	Total
Expert estimates scale Jatropha plantations 2008 (ha)	27,000	73,000	911,000	<b>1,011,000</b>
Number of projects identified in the study	41	97	104	<b>242</b>
Scale of projects identified (ha)	21,000	119,000	796,000	<b>936,000</b>
Expert estimates scale Jatropha plantations 2010 (ha)	330,000	630,000	3,760,000	<b>4,720,000</b>
Expert estimates scale Jatropha plantations 2015 (ha)	1,600,000	2,000,000	9,200,000	<b>12,800,000</b>

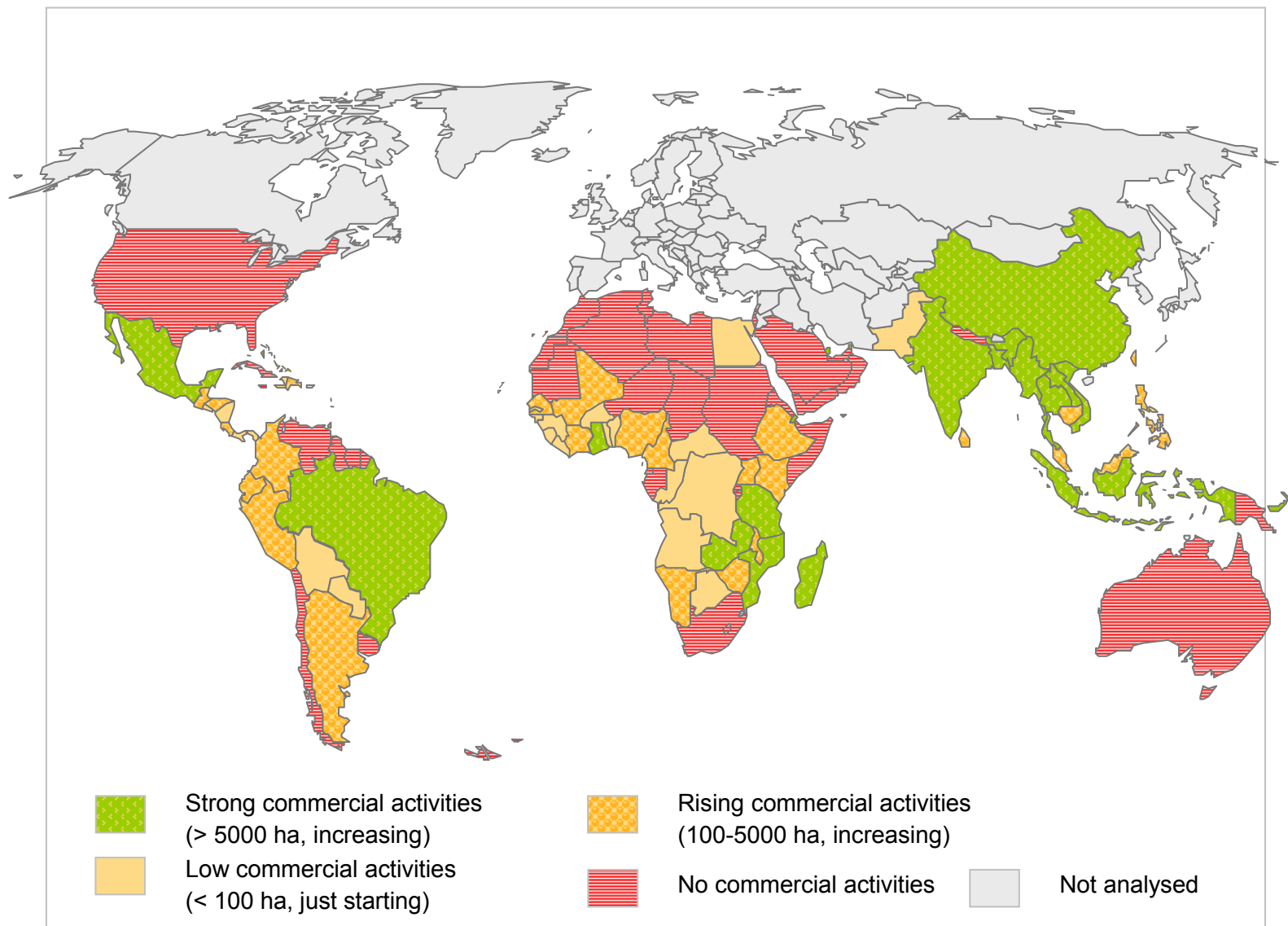
#### Comments

To achieve plausible estimates for Jatropha activities, we asked Jatropha experts for their views on the scale of Jatropha activities in different countries and regions. We then identified projects and gathered outside and inside estimates about their sizes. As expected, expert estimates and bottom up project analysis differ in results – but not to such an extent that expert estimates appear implausible.

Scale of Jatropha projects (ha) and number of projects today




































































































### 3 Scale of Commercial Jatropha Activity




### 3 Scale of commercial Jatropha Activity




America		Africa		Asia & Polynesia			
	Argentina		Algeria		Liberia		Bangladesh
	Belize		Angola		Libya		Cambodia
	Bolivia		Burundi		Mali		China
	Brazil		Burkina-Faso		Mauritania		India
	Chile		Botswana		Madagascar		Indonesia
	Colombia		Cameroon		Malawi		Lao
	Costa Rica		Cape Verde		Morocco		Israel
	Cuba		Chad		Mozambique		Malaysia
	Dominican Republic		Central African Republic		Namibia		Maldives
	Ecuador		Congo, Democr. Rep.		Nigeria		Myanmar / Burma
	Guatemala		Congo, Republic		Rwanda		Nepal
	Guyana		Côte D'Ivoire		São Tomé and Príncipe		Oman
	Haiti		Djibouti		Senegal		Pakistan
	Honduras		Egypt		Sierra Leone		Papua New-Guinea
	Mexico		Ethiopia		Somalia		Philippines
	Jamaica		Eritrea		South Africa		<i>Polynesian Islands (selected)</i>
	Nicaragua		Equatorial Guinea		Sudan		Saudi-Arabia
	Panama		Gambia		Swaziland		Sri Lanka
	Paraguay		Gabon		Tanzania		Taiwan
	Peru		Ghana		Togo		Thailand
	Suriname		Guinea		Tunisia		Timor-Leste
	Uruguay		Guinea-Bissau		Western Sahara		Vietnam
	USA		Kenya		Zambia		United Arab Emirates
	Venezuela		Lesotho		Zimbabwe		Yemen




Strong activity  
> 5,000 ha



Starting activity  
100-5,000 ha  
increasing trend



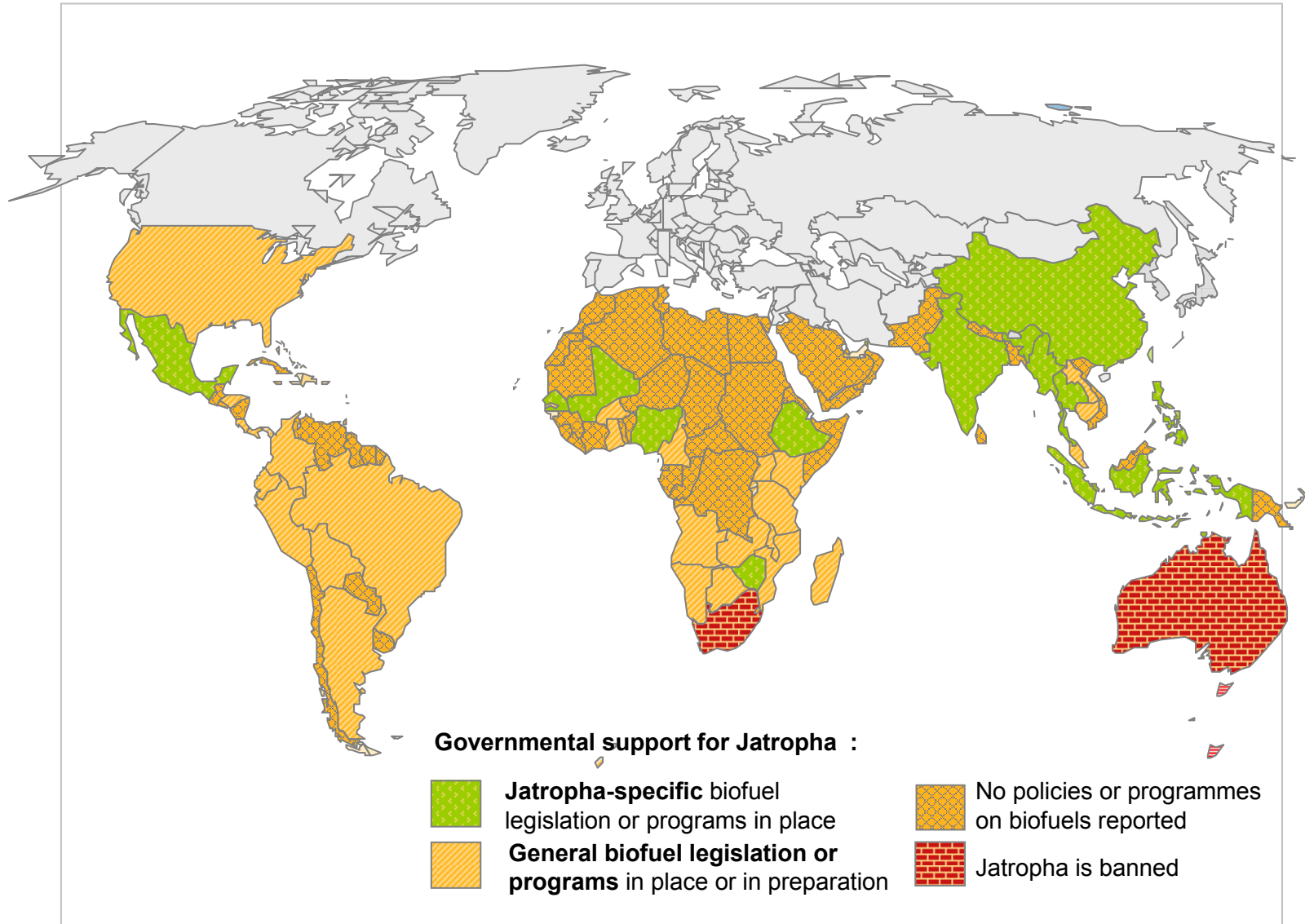
Low  
activity reported



No  
activity reported

### Jatropha Industry Structure

- The **largest Jatropha projects** today are government initiatives that typically work with smallholder farmers in Asia. These projects prevail especially in India and China.
- The biggest **private companies** in the field regarding planted acreages are
  - D1-BP Fuel Crops (operations predominantly in Asia and Africa)
  - Mission Biofuels (Asia)
  - Sunbiofuels (Ethiopia, Tanzania, Mozambique)
  - GEM Biofuels (Madagascar)
- A **wave of large scale investments** especially from oil majors are expected in the near future. The joint venture company D1-BP Fuel Crops of BP and D1 Oils in 2007 was the first indication of this trend. Now major oil companies e.g. in China are devising their market entry.
- It is expected that the industry structure will **change dramatically** in the next few years, with large (multi-)national energy and oil companies entering the field, driven by climbing crude oil prices and pursuing the quest for larger volumes of alternative and sustainable feedstock.



### 3 Political Support for Jatropha Cultivation



#### General observations:

More than 50 governments worldwide have announced national biofuel targets, with a growing number located in emerging markets. There already exists a number of countries which draft specific policies to promote Jatropha as a means to secure energy supply, improve the livelihoods of the rural poor or to protect the environment (e.g. soils, watershed, climate).

The range of instruments is broad and includes, among others, national targets for Jatropha plantations, different types of plantation or reforestation programs, financial support for growers, for research and/or for investors as well as a mandatory biodiesel blending. In some countries (such as South Africa or Australia), Jatropha is not allowed as a commercial crop due to its classification as a weed.

#### Asia

Jatropha has a strategic role for many governments in Asia:

- India uses several incentive schemes to induce villagers to rehabilitate waste lands through the cultivation of oil bearing trees such as Jatropha.
- In China, the national oil companies are the dominant player in Jatropha project development.
- Myanmar pursues a rigid national plan on Jatropha expansion.

#### Africa

- The governments in Senegal, Mali, Nigeria, Ethiopia and (in particular) Zimbabwe have formulated policies which explicitly focus on the promotion of Jatropha.
- Many countries actively promote investments in renewable energies (e.g. Ghana, Tanzania, Malawi or Kenya) or facilitate the access of land to interested investors.

#### Latin America

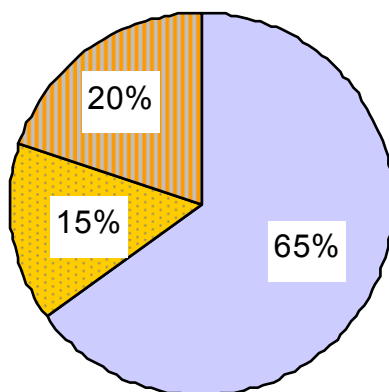
- Specific targets or programs on Jatropha have been developed, among others, by the Mexican and the Colombian government.
- High expectations are on the Brazilian government which considers to include Jatropha in its social biofuel program. This would have a great impact on project development in Brazil and the overall dynamics of the industry in Latin America.



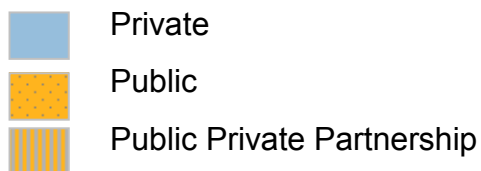
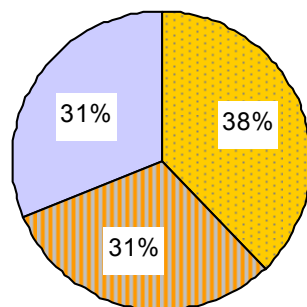
### 3 Public versus Private Ownership



#### Ownership – Global - Public vs. Private \*



#### Case Study: India



#### Notable Regional and Country Differences

The global picture clearly points at a significant majority of private projects. This also mirrors the situation in the three major Jatropha cultivation regions. In Africa, 81% are **privately owned projects**. In Asia and Latin America, only approximately half of the projects identified are purely private.

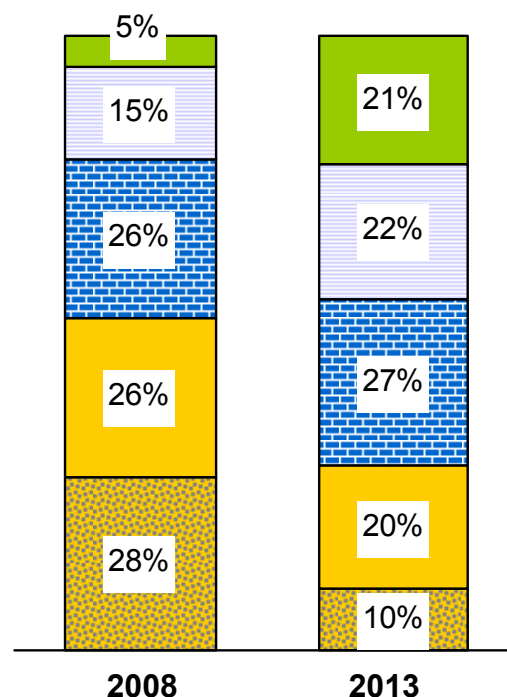
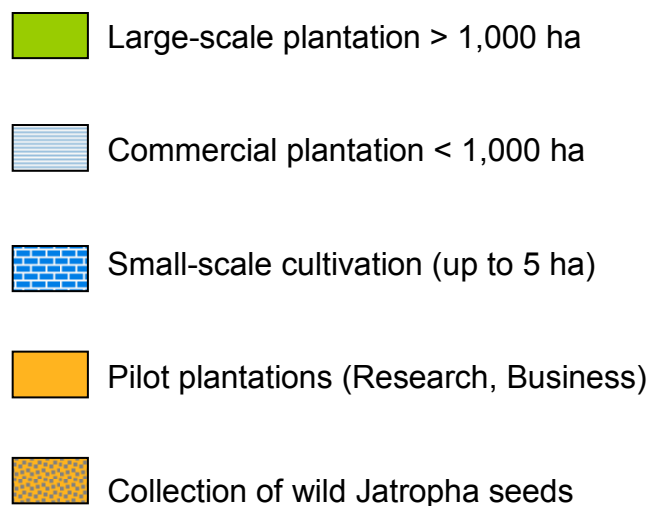
However, this is not the case in: **China** (80% of projects by state owned companies), **Burma** (100% public), **India** (appr. 30% public, private and PPP) and **Indonesia** (40% PPP). This is particularly of interest as these are the countries with the largest Jatropha plantations today. The example of India shows that public initiatives as well as public private partnerships play a vital role in developing the emerging Jatropha industry.

Jatropha Projects in **African countries** are almost **entirely private** (81% on average, public (10%) and PPP (9%)). Notable differences to this result are mainly due to the predominance of **public projects** in **Egypt** and **Zimbabwe** (67% and 100%) and the comparatively high number of **PPP-projects** in **Botswana** (50%), **Ghana** (33%), **Tanzania** (20%) and **Egypt** (33%).

\* Information from n = 180 projects  
Source: GEXSI Survey 2008

### 3 Development of Jatropha Schemes by 2013

#### Scale of Jatropha plantations \*

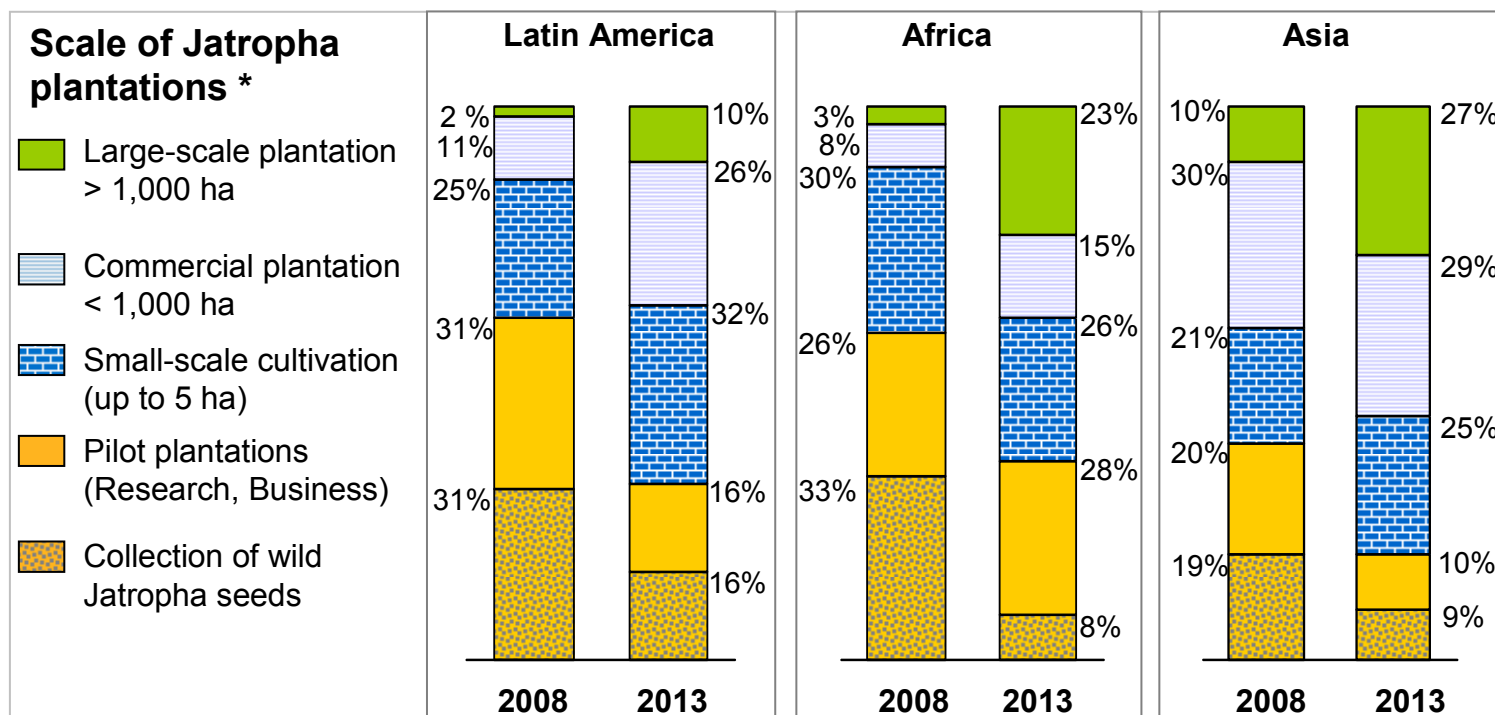


#### Comments

The chart shows the percentage of total land use for different Jatropha plantation scales on a global average according to expert estimates. Today, about 80% of areas planted with Jatropha are used in a very “small scale” approach, i.e. wild collection and plantations up to 5 ha. This clearly indicates that the industry is still at an early stage. Five years from now, the experts we interviewed assume that almost 50% of the areas cultivated by Jatropha will be larger, i.e. more than 5 hectares. It is assumed that more than 20% will become large scale operations of more than 1,000 ha.

\* Information from 33 countries with strong or starting Jatropha activities; Source: GEXSI Survey 2008, Expert Country Estimates

### 3 Development of Jatropha Schemes by 2013



#### Comments

It is important to take regional differences into account: Today, South-East Asia has a higher than average proportion (> 45% of used land) of large scale Jatropha operations (> 5 ha), especially in the Philippines, China, Indonesia and Malaysia. This trend will become more dominant in the future. More than 60% of areas in Asia are expected to be large scale operations by 2013. In India, on the other hand, Jatropha cultivation takes place on a very small scale. This will prevail in the future (only appr. 25% of areas for large scale projects in 2013) and may be due to the Indian government strongly supporting small scale schemes.

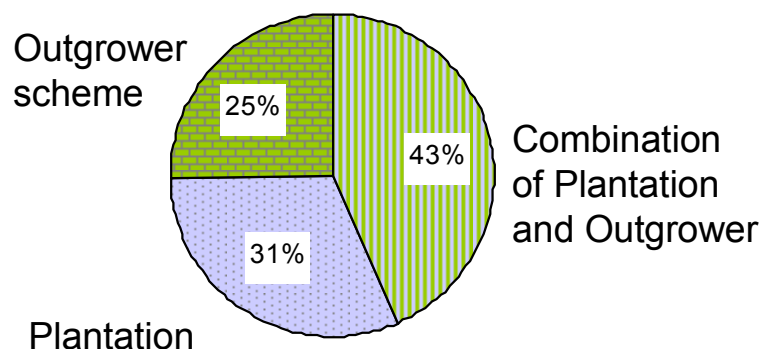
Africa and Latin America will develop similarly to the global averages, with a high percentage of very large projects predicted in Brazil and Ghana in 2013.

\* Information from n = 33 countries with strong or starting Jatropha activities; Source: GEXSI Survey 2008, Expert Country Estimates

### 3 Jatropha Project Types and Processing



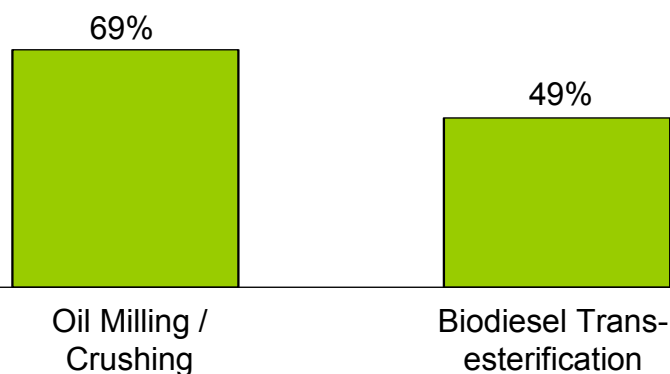
#### Project Schemes \*



#### Comments

Two thirds of all projects analysed work with local outgrowers, often in combination with a managed plantation. 50% of all project developers in Latin America and Asia opted for this combined approach. Pure plantation models are most frequent in Latin America (44%). In Africa, where two thirds of the projects integrate smallholders, pure outgrower models have even importance as the combined model (31% and 36% respectively). Pure outgrower schemes are very rare in Latin America (only 2% of our project sample).

#### Processing\*\*

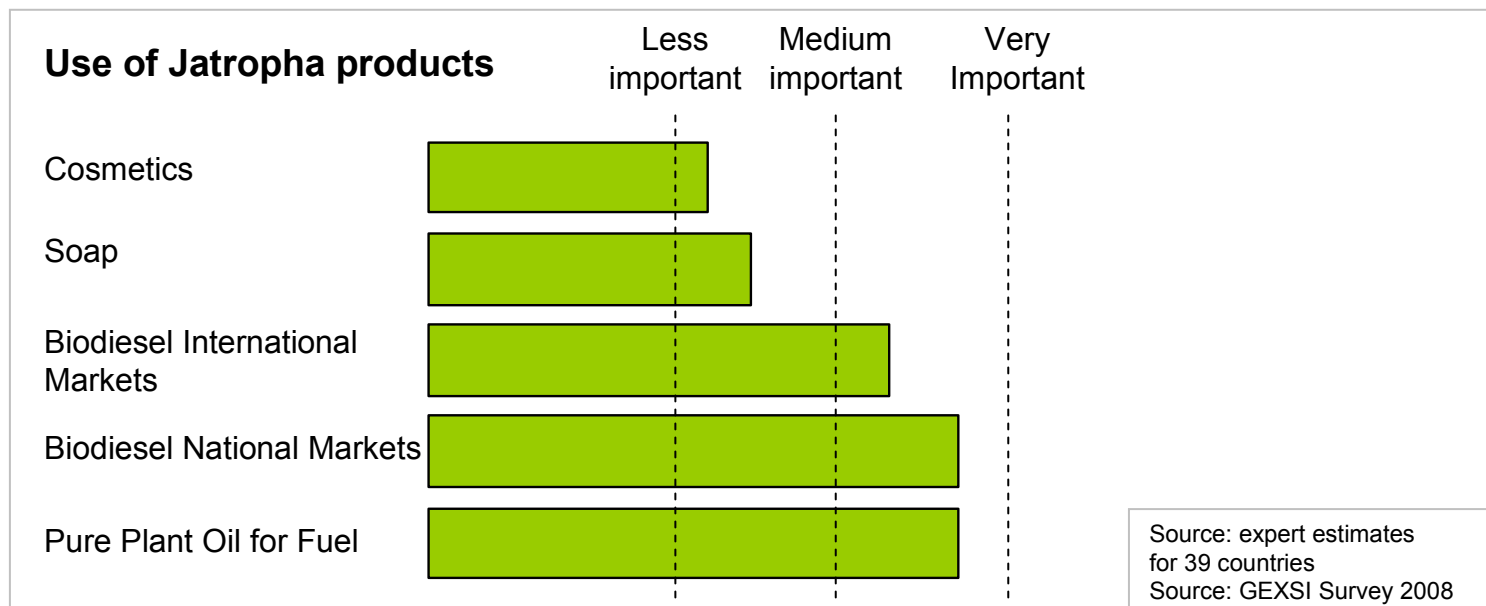


#### Comments

Most projects plan to set up their own crushing facilities. The majority of projects analysed do not intend to invest in biodiesel refinery (transesterification).

\* Sample: n = 160 projects \*\* Sample: n = 95 projects Source: GEXSI Survey 2008

### 3 Main Use of Jatropha Products



#### Comments

Globally, transport and energy are most important uses for Jatropha oil. The most interesting result is that national applications seem more important than exports. This holds for all three regions we analysed. International markets are of more importance in Asia and Latin America than in Africa.

Moreover, the direct use of pure vegetable Jatropha plant oil is as important as transesterification into biodiesel. Soap production based on Jatropha oil appears most common in Africa. In Latin America this is true for the production of cosmetics from Jatropha.

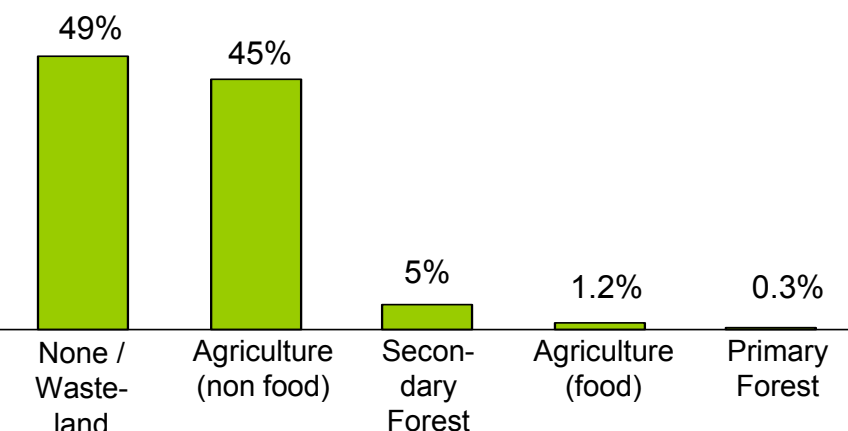
By-Products: Using Jatropha press cake as fertilizer is the most important application. Plans for producing biogas from the press cake are more prevalent in Asia and Latin America than in Africa.

The direct sale of seeds is of higher importance in Latin America than in Africa.

### 3 Sustainability Issues – Land Use for Jatropha

#### Projects identified:

#### Former land-use on project sites (used hectares)\*



#### Comments

According to the experts we interviewed, deforestation for the cultivation of Jatropha is only a minor issue. Yet, there was a general concern that these statements may be biased.

However, actual project data confirms this: Data from 90 projects with a total planted area of approximately 325,000 ha shows that primary forest existed on about 0.3% of the cultivated land in the last 5 years, and secondary forest existed on 5%.

Food production has been replaced on 1.2% of planted areas. This is in line with results of expert interviews indicating that replacing food production is of minor importance for Jatropha cultivation.

The main areas used for Jatropha cultivation in our sample are wasteland and former non-food production areas.

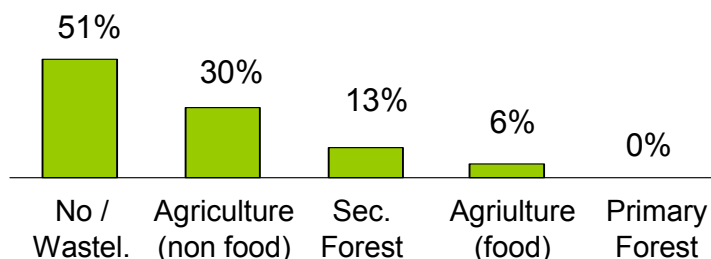
#### Estimate Country Experts\*\*

Cultivation affects primary forest	Cultivation affects secondary forest	Cultivation affects food production	Cultivation mainly on marginal land
1 not at all	1 not at all	1 not at all	1 not at all
2	2	2	2
3	3	3	3
4	4	4	4
5 very much	5 very much	5 very much	5 very much

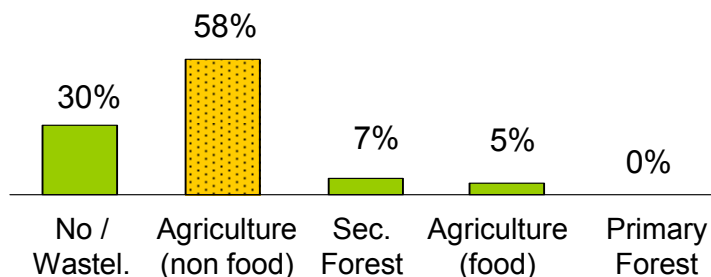
\* Sample: n = 90 projects with a total planted acreage of 325,000 ha \*\* Source: GEXSI Survey 2008: Country and Project Experts

### 3 Sustainability Issues – Land Use for Jatropha

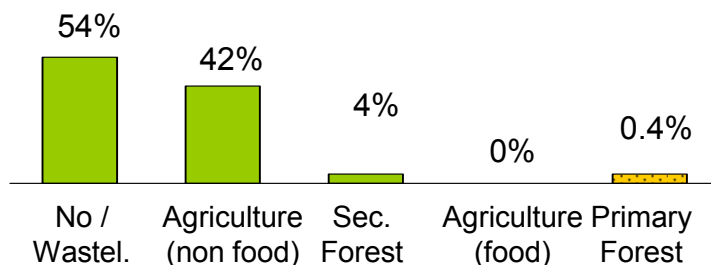
**Latin America: Former land-use on project sites\***



**Africa: Former land-use on project sites\***



**Asia: Former land-use on project sites\***



#### Comments

Broken down into regional results, the prior land use for our sample of 90 Jatropha projects with a total acreage of 325,000 ha shows no drastic deviations from the global results.

In Latin America, one larger project partially used secondary forest to a significant extent, which resulted in this figure being above the global average.

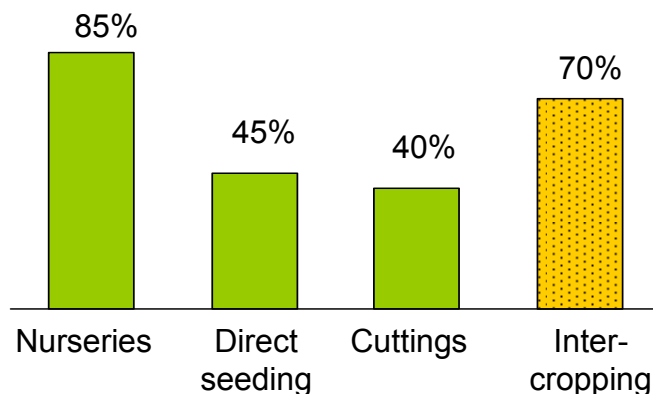
In Africa, very large volumes of former non-food plantations are being used to plant Jatropha. This is due to the existence of large abandoned non-food plantations.

Finally, Asia is the only area where primary forest has been used to some extent to plant Jatropha. In our sample, this is the case in Malaysia and Sri Lanka.

\* Sample: n = 90 projects with a total planted acreage of 325,000 ha

### 3 Cultivation Techniques

**Planting techniques \***

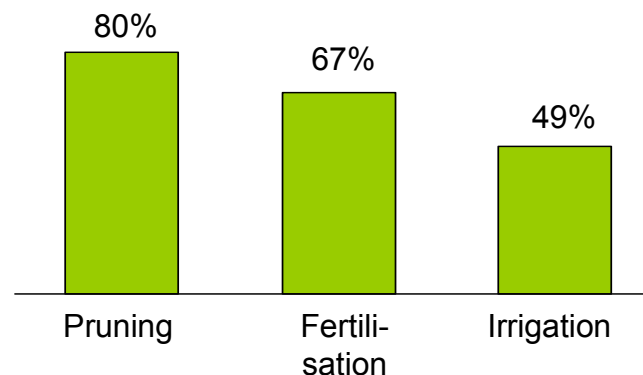


#### Comments

Most projects analysed use nurseries, but direct seeding and cuttings are used as well. At least 20% of projects use two or three methods in parallel.

Interestingly, 70% of projects state that they use intercropping with other food or non food crops. This means that potentially, Jatropha could increase food production, if non-cultivated lands are developed.

**Maintenance techniques \*\***



#### Comments

Most projects apply more or less intensive plant caring. This contradicts the widely held opinion that Jatropha needs little care and attention.

No notable differences occur between the type of fertilizer applied. Organic fertilizer, mostly press cake, manure and NPK (Nitrogen, Phosphate, Potassium) are reported to be used in the majority of projects.

In Africa, far less irrigation is used for Jatropha cultivation than in Asia or Latin America.

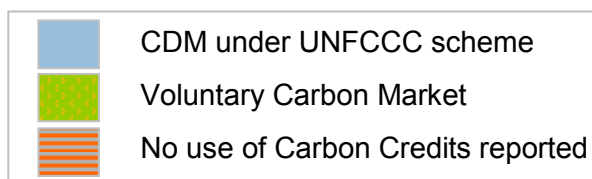
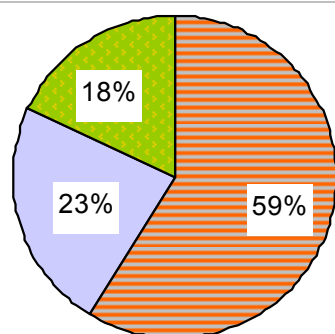
\* Sample: n = 95 projects \*\* Sample: n = 90 projects Source: GEXSI Survey 2008



### 3 Use of Carbon Credits & Research Activities



#### Use of Carbon Credits \*



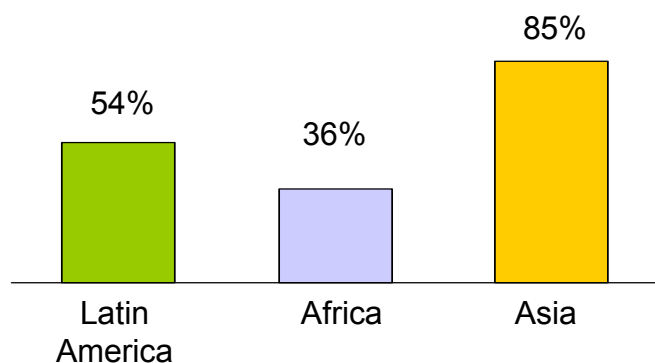
#### Notable Regional Differences

Project information gathered indicates that throughout the world, the majority of projects **do not** include Carbon Credits into their models. This is especially the case in Latin America (80%).

**CDM under the UNFCCC** scheme are most widely explored in Asia (39%) and to a lesser extent in Africa (20%) and Latin America (10%). Yet projects reported difficulties in applying for CDM. Methodologies still need to be developed. Also, local governments do not always have the organisational structures required by UNFCCC in place. Voluntary emission offsetting schemes are most frequently applied in Africa.

\* Project information from 34 countries, Source: GEXSI Survey 2008

#### Research activities (% of projects)\*\*



#### Notable Regional Differences

Overall, more than 50% of Jatropha projects do research. However, 85% of Asian projects report research activities. In Latin America, 54% of projects do research, whereas in African countries only about a third (36%).

The main focus of the research is breeding, identifying high-yielding varieties and cultivation techniques (pruning, spacing, fertilization).

\*\* Project information from 32 countries; Source: GEXSI Survey 2008

### Content

- 1 Management Summary**
- 2 Background and Methodology of the Study**
- 3 Results on a Global Level**
- 4 Results on Regional and Country Level**
- 5 Case Studies on Jatropha Projects**

## 4 Results on Global Level

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### 4-1 Latin America

### 4-2 Africa

### 4-3 Asia

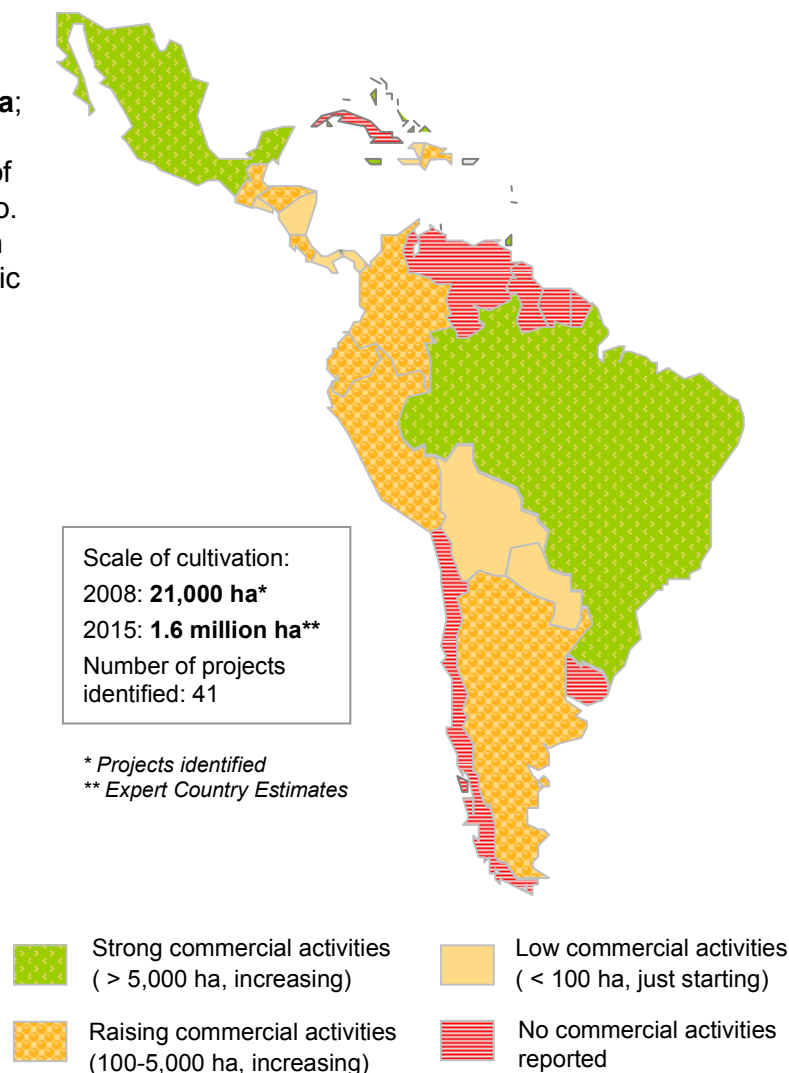
## 4-1 Latin America – Regional Overview



### General observations

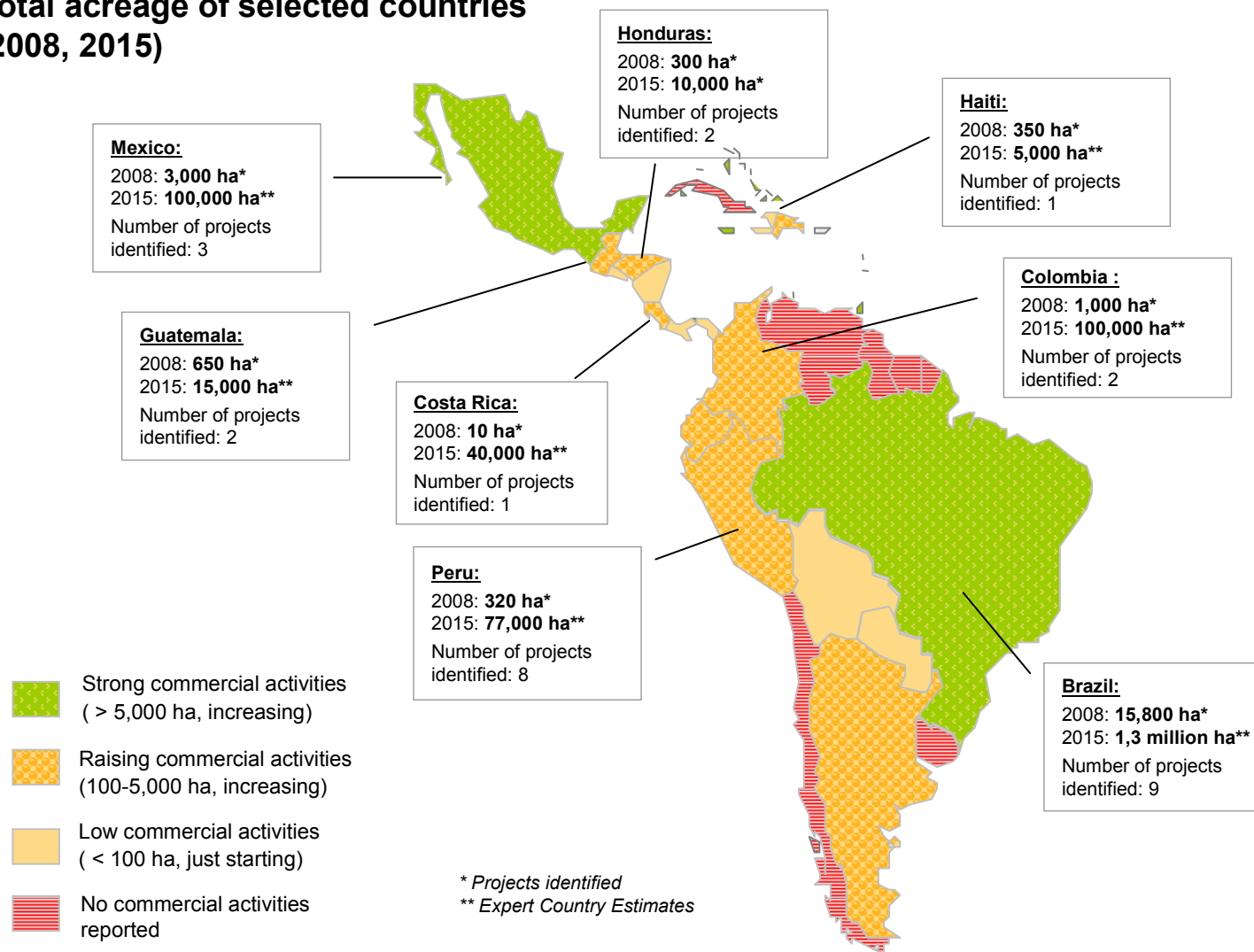
*Jatropha curcas* originates from **Central America**; however, the cultivation of *Jatropha* as a biofuel crop has taken up only recently, with exception of two projects which started more than 5 years ago. Today, *Jatropha* projects exist or are prepared in almost all Latin American countries where climatic conditions allow for it. Key findings are:

- The largest acreage of *Jatropha* plantations today exist in **Brazil** where we have identified projects totalling an acreage of **15,800 ha**. This is about ¾ of the total acreage of all projects identified in Latin America. Brazil is followed by **Mexico, Colombia and Guatemala**.
- The interviewed experts estimated that the total acreage under cultivation throughout Latin America will have risen up to **1.6 million hectares** by the end of 2015.
- The relative high **labour costs** compared to many regions in Africa or Asia may hinder project developments where government support does not compensate this cost; it may also lead to a higher degree of mechanizations in countries like Brazil which has an established agro-industry.



## 4-1 Latin America – Regional Overview

### Total acreage of selected countries (2008, 2015)



## 4-1 Latin America – Regional Overview



### General Overview on country analysis

#### Central America & Caribbean

<b>Mexico</b>	Haiti
<b>Guatemala</b>	Dominican Republic
Belize	
Honduras	
El Salvador	
Nicaragua	
Costa Rica	

#### South America

**Brazil**  
Colombia  
Ecuador  
Peru  
Bolivia  
Paraguay  
Argentina

A map of Latin America where countries are shaded to indicate their analysis status. Solid green indicates a country profile chart, light green with a grid indicates a country in brief chart, and red with horizontal stripes indicates no chart. Mexico, Brazil, and Colombia are solid green. Guatemala, Ecuador, Peru, and Argentina are light green with a grid. Haiti, Dominican Republic, Belize, Honduras, El Salvador, Nicaragua, Costa Rica, Paraguay, and Chile are red with horizontal stripes.

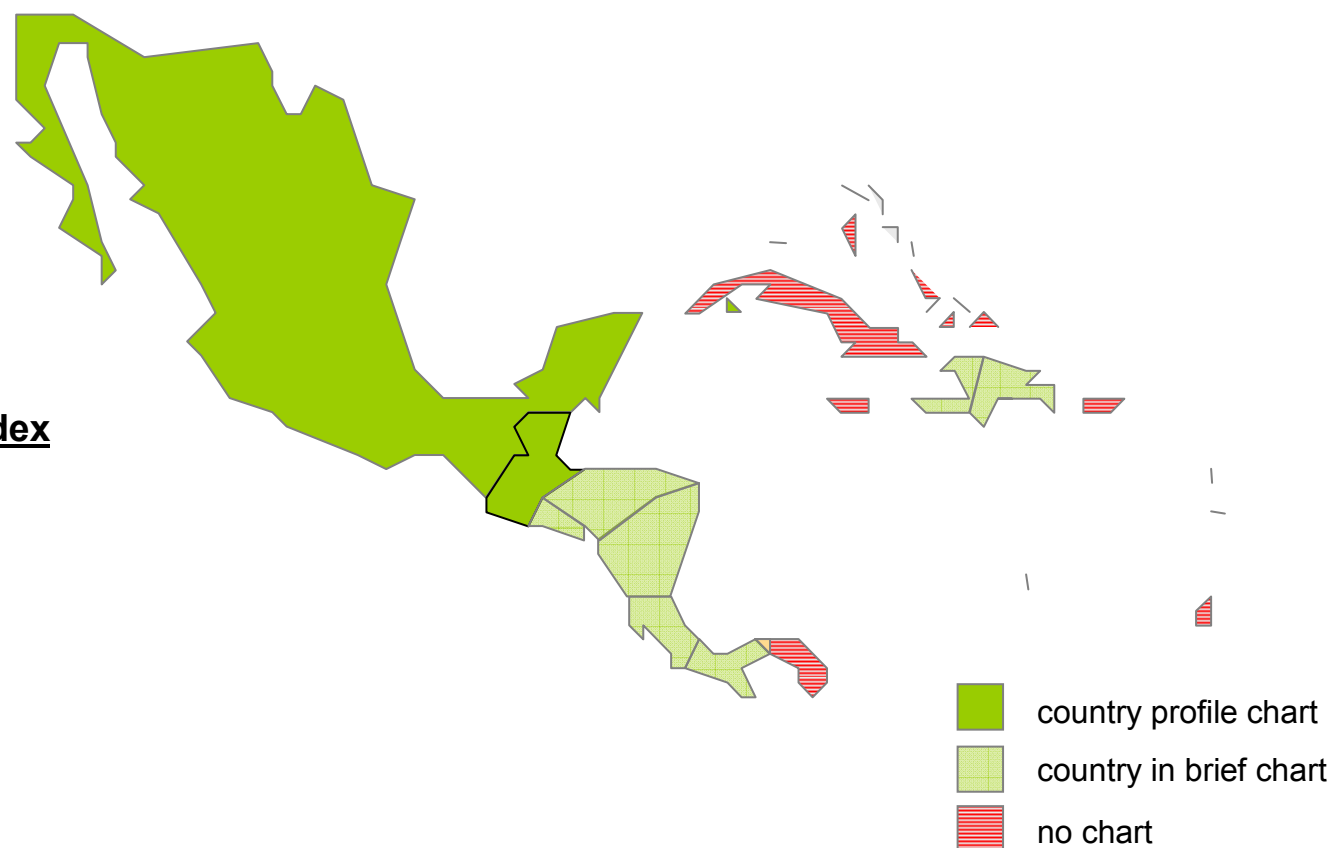
	country profile chart
	country in brief chart
	no chart

## 4-1 Latin America – Central America & Caribbean



### Country Index

**Mexico**  
**Guatemala**  
Belize  
Honduras  
El Salvador  
Nicaragua  
Costa Rica  
Haiti  
Dominican Republic



## 4-1 Latin America – Mexico



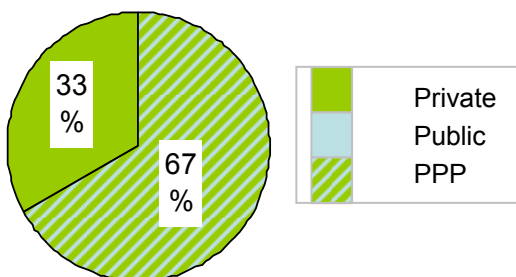
### Summary & Comments

Jatropha is native to Central America and Mexico, and is found in many regions. However, commercial use of the plant is relatively new. The first commercial plantations of Jatropha were set up in 2006 only - mainly supported by regional governments. These programs aim to organise and support smallholder farmers to produce Jatropha in order to supply feedstock for biodiesel refineries located in the region. The governments of Michoacán and Chiapas started two ambitious projects, each of them aiming at 120,000 hectares to be cultivated by 2015.

### Scale of Jatropha Cultivation

	Expert Estimate	Projects identified
current	6,500 ha	3,070 ha
2010	44,000 ha	110,030ha
2015	100,000 ha	240,000 ha

### Project Ownership



### Government Programs

#### **Jatropha / Biofuel Legislation**

In February 2008, the Mexican Government passed a law to develop and promote biofuels without threatening food production. Social inclusion and benefits for the most marginalised communities are also included in this legislation.

Jatropha was recently included in a governmental reforestation program that provides economic support to producers. The government has established inter-institutional working groups to promote the production of Jatropha

#### **Barriers for Jatropha investments**

No specific barriers have been reported.

#### **NGO-Initiatives**

The Instituto Politécnico Nacional (IPN) has been researching Jatropha for nine years and is an important provider of technical assistance.

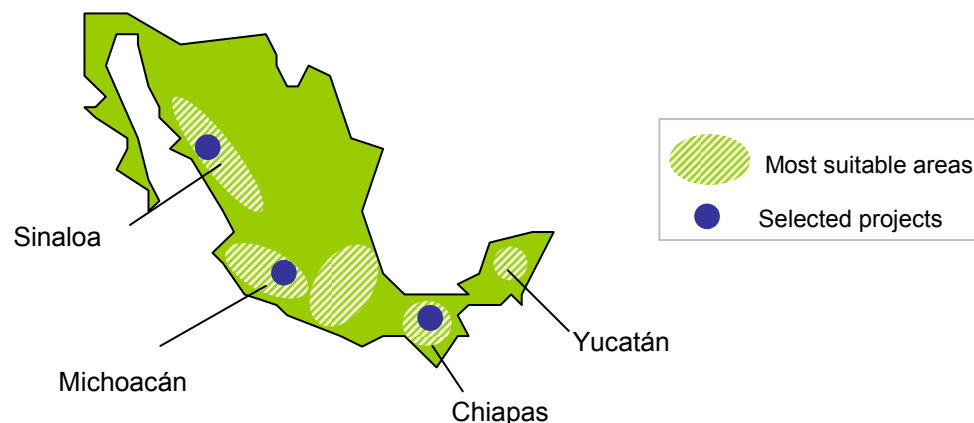
Last year, the Fundación Produce Sinaloa (organisation of agricultural producers) established a pilot plantation of 5 ha in the north-west. It is conducting a viability study to establish a Biodiesel refinery in this region.



## 4-1 Latin America – Mexico

### Regional Distribution

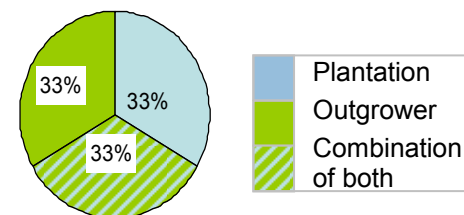
Wild *Jatropha* grows in many regions of Mexico and is commonly used as 'Living Fences' by the local farmers. The non-toxic variety can be found in the state of Veracruz and in the Yucatan Peninsula. The most suitable regions for *Jatropha* are the south-east, large areas near the Pacific Coast and central-southern Mexico.



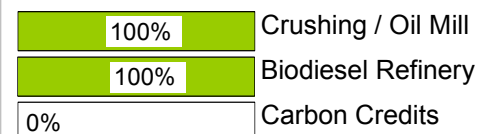
### Project Evaluation

- The two main projects strive to set up *Jatropha* outgrower schemes operated by smallholder farmers that sell their feedstock to biodiesel refineries.
- According to the information received, most plantations are being established on land which was either not previously used or used for non-food agriculture.
- Irrigation and fertilization are so far not seen as vital inputs for *Jatropha* projects in Mexico by experts and project developers interviewed.
- Relatively high labour costs may be a factor that undermines the economic success of the projects.

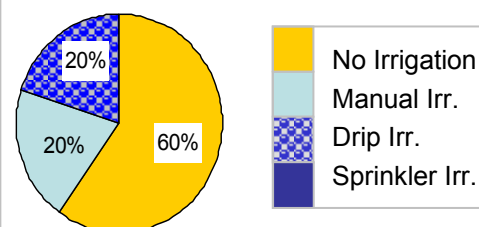
### Plantation Model



### Value Chain Elements



### Irrigation Models






### Prices



Seeds (per kg /dry)	\$0.42
Labour (per day)	\$9.47
Diesel at pump	\$0.62

6 experts interviewed  
3 projects analysed

## 4-1 Latin America – Mexico

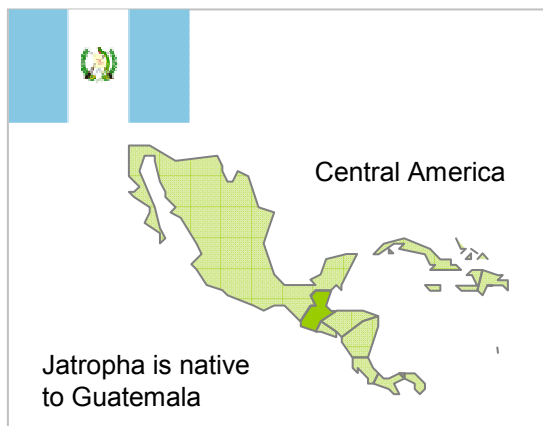


Project	Source	Type	Project Location	Ha (2008)	Ha (2015)
Government of Michoacán / Vecernergy de México	1		Michoacán	3,000	120,000
Chiapas Governmental Project	1		Chiapas	50	120,000
Fundación Produce	1		Sinaloa	5	
<b>Acreage non-disclosed projects</b>				15	
<b>Total</b>				<b>3,070</b>	<b>240,000</b>

-  Commercial project
-  Non-commercial project

- 1 Interview / Questionnaire with project representative
- 2 Interview / Questionnaire with external project expert
- 3 Public sources

## 4-1 Latin America – Guatemala



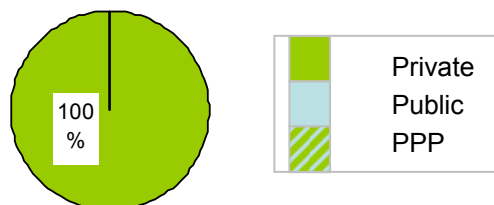
### Summary & Comments

Jatropha is native to Guatemala and grows in many regions. Guatemala was among the first countries to cultivate Jatropha for commercial purposes, and is therefore more advanced in these activities than neighbouring countries. The first commercial attempts started in 2002 and have increased steadily, although the production scale is relatively small. National and international investors have shown interest in producing Jatropha in Guatemala due to the suitable climatic conditions. The Ministry of Agriculture identified 600,000 hectares of marginal lands which would be suitable for Jatropha without risking deforestation or substituting food production.

### Scale of Jatropha Cultivation

	Expert Estimate	Projects identified
current	600 ha	650 ha
2010	5,000ha	650 ha
2015	15,000 ha	1,200 ha

### Project Ownership



### Government Programs

#### **Jatropha / Biofuel Legislation**

There exists no biofuels legislation. The government is currently working on a National Strategy for Bioenergy production, which may lead to a Biofuel Law.

#### **Barriers for Jatropha investments**

There are no barriers for Jatropha investments. However, Biodiesel made out of Jatropha oil can not be sold to the public.

### NGO-Initiatives

The NGO **Technoserve** has been actively promoting Jatropha production, mainly to small farmers as an additional source of income.

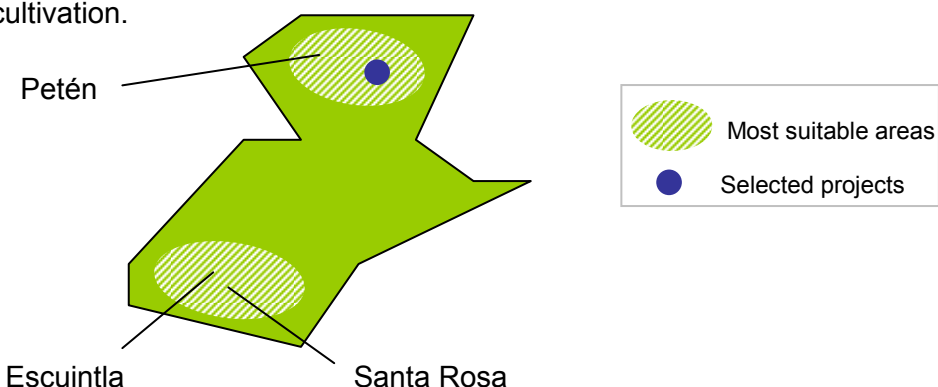
**USAID** is currently providing financial support for Jatropha projects in cooperation with **Technoserve**.

**Energy and Environmental Partnership with Latin America** promotes renewable and sustainable energy systems and has provided financial support for Jatropha projects in Guatemala.

## 4-1 Latin America – Guatemala

### Regional Distribution

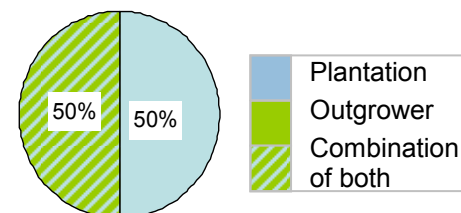
Climatic conditions in Guatemala make it possible to plant Jatropha in many regions. The most favourable climatic and agronomic conditions are reported to be on the South Coast. However, due to high land prices and competitive sugar cane plantations, most Jatropha plantations are located in the north and north-east, which are also suitable for cultivation.



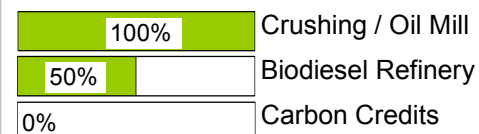
### Project Evaluation

- The largest project implemented so far is a 600ha plantation operated by Biocombustibles de Guatemala. The not-for-profit organization Technoserve currently prepares an outgrower scheme which will integrate smallholder farmers into Jatropha production.
- Most plantations are being established on marginal lands, which were not previously used.
- Irrigation and fertilisation are common practices in the projects identified

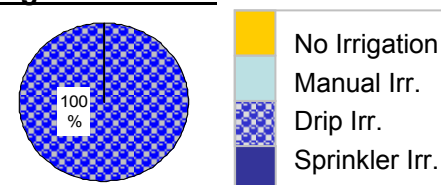
### Plantation Model



### Value Chain Elements



### Irrigation Models



\*this chart is based on information from only one project



### Prices

<b>Seeds (per kg /dry)</b>	<b>\$0.20</b>
<b>Labour (per day)</b>	<b>\$7</b>
<b>Diesel at pump</b>	<b>\$1</b>

2 experts interviewed  
2 projects analysed

## 4-1 Latin America – Guatemala



Project	Source	Type	Project Location	Ha (2008)	Ha (2015)
Biocombustibles de Guatemala	1			600	
Technoserve	1			20	600
				<b>Acreage non-disclosed projects</b>	
				<b>Total</b>	<b>620</b>
					<b>1,200</b>

 Commercial project

 Non-commercial project

- 1 Interview / Questionnaire with project representative
- 2 Interview / Questionnaire with external project expert
- 3 Public sources

## 4-1 Latin America – Belize



### Belize

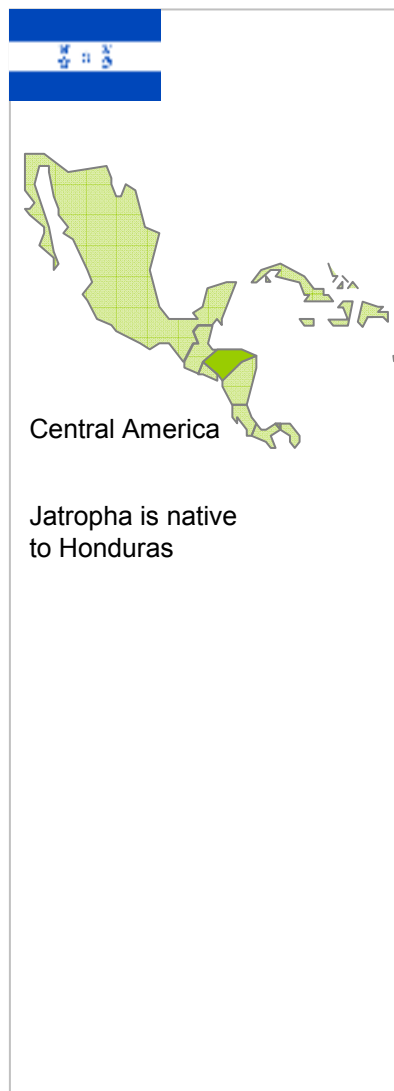
☒ Jatropha exists ☐ Jatropha locally used ☒ Commercially farmed

**Policies:** In 2003, the Government conducted an energy sector analysis, which highlighted the importance of renewable energies as an alternative source of energy. However, there is no legislation that regulates the commercialisation of Jatropha oil.

**Projects:** The Tropical Studies and Development Foundation is a non-profit organization which has been working with Jatropha in Belize since 1998. They are currently conducting the project “Jatropha for Biodiesel” funded by the Energy and Environmental Partnership with Central America. This project aims to set up demonstration plots with improved seed material and to establish a small biodiesel processing unit. They are also developing the project “Commercial demonstration farm for Jatropha Cultivation”. This project aims at setting a precedent for commercial projects to achieve national production of biodiesel in Belize and reduce dependence on oil imports. They plan to establish 81 ha in the near future, with a projection of a total of 1,600 ha. The research scope of the project includes intercropping Jatropha with groundnuts, hot pepper and pintos peanut. There have been positive results so far. Additionally, research is being done on rehabilitating degraded land and fighting deforestation by planting Jatropha.

**Market:** High labour costs and shortage of labour may be an impediment for the development of commercial activities with Jatropha.

## 4-1 Latin America – Honduras



### Honduras

☒ Jatropha exists   ☐ Jatropha locally used   ☒ Commercially farmed

**Policies:** In December 2007, the Honduran Government approved a Biofuels Law, which highlights biofuels as a means to generate employment, increase energy self-sufficiency and contribute to the decrease of local and global pollution. Income tax exemptions are offered to biofuel producers for the first twelve years of operation.

**Projects:** The largest plantation as of today was established by Agroipsa (Agroindustria Piñón Sociedad Anonima). So far, the company has planted 300 ha of Jatropha in the south and is planning to expand up to 10,000 ha.

The Energy and Environmental Partnership of Central America has financed a project in Olancho which is setting up pilot plantations. The final objective is to establish a biodiesel refinery in the region.

Gota Verde is a demonstration project of small-scale biofuel production to support rural employment and development. It is a 18 ha plantation in the north, which was financed by a group of European foundations.

There is another experimental project of about 70 hectares in Choluteca (province located in the south). The German development agencies GTZ and DED jointly with the Common Fund for Commodities (CDC) are funding a demonstration project in Honduras that aims to convert mini-buses to run on pure plant oil.

**Market:** There is an increasing interest and support for biodiesel production. Jatropha is one of the highlighted cultivars, alongside palm and castor oil.

## 4-1 Latin America – El Salvador & Costa Rica



### El Salvador

☒ Jatropha exists ☐ Jatropha locally used ☐ Commercially farmed

**Policies:** The Government is working on a draft legislation to regulate the biofuel market.

**Projects:** The National Institute of Agricultural Technology is setting up pilots to define the best agronomic practices for Jatropha. It has been highlighted as an energy crop favourable for cultivation as it grows well in this area and there is a great availability of unused land.

Two more small private projects that are setting up pilot plantations have been identified.



### Costa Rica

☒ Jatropha exists ☐ Jatropha locally used ☒ Commercially farmed

**Policies:** The Government of Costa Rica created a Commission in 2004 to evaluate the introduction of biodiesel into the energy grid. A working group has been set up to draft a legislation to regulate the biofuel market.

**Projects:** Energias Biodegradables de Costa Rica is setting up pilot projects to produce Jatropha. The company has a biodiesel refinery and have plans to introduce Jatropha as a feedstock for its biodiesel plant. Pan-am Biofuels Inc. is operating Jatropha plantations in the north-east and, according to their website, they have started activities for the construction of a 720 ha Jatropha farm.



## 4-1 Latin America – Nicaragua



### Nicaragua

☒ Jatropha exists ☐ Jatropha locally used ☐ Commercially farmed

**Policies:** Since 2007, the Nicaraguan Congress has been working on a draft legislation related to the commercialising and production of biofuels.

**Projects:** Nicaragua hosted the first large scale project of Jatropha to produce biodiesel in 1990. The project was a joint effort of the Nicaraguan and Austrian Government to reduce the country's dependence on oil imports, to combat deforestation and to create rural employment. Unfortunately, the project was not successful. Problems with the farmers' cooperatives and the low productivity of the plantations led to the project being abandoned in 1999. → For more detailed information see Case Study

## 4-1 Latin America – Haiti & Dominican Republic



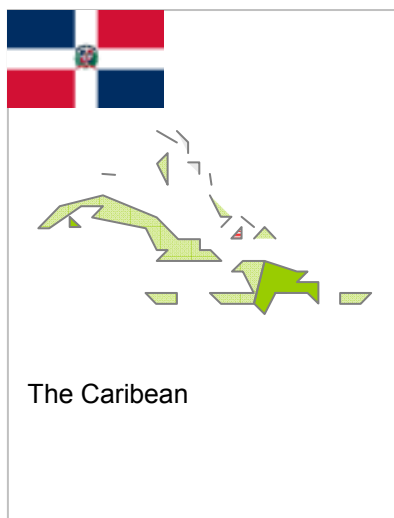
### Haiti

☒ Jatropha exists ☐ Jatropha locally used ☐ Commercially farmed

**Policies:** No Governmental policies or support mechanisms have been identified for the production of Biofuels in Haiti.

**Projects:** USAID has a pilot project which aims to demonstrate the viability of Jatropha to produce biodiesel and combat deforestation. Haiti could be a very suitable location to produce Jatropha, which is due to its serious deforestation problems, its high dependence on oil imports and high levels of rural unemployment.

**Market:** Experts estimate that less than 100 ha are currently being planted with Jatropha. However, they expect the establishment of approximately 1,000 ha by 2010 and 5,000 ha by 2015.



### Dominican Republic

☒ Jatropha exists ☐ Jatropha locally used ☐ Commercially farmed

**Policies:** The Government is currently working on a draft legislation for Renewable Energies.

**Projects:** GTZ and the Dominican Institute of Development have founded a project on the border of Haiti, which aims to combat deforestation. The Ministry of Economy and Development announced a leasing agreement with Vecenergy Bida Dominicana to plant 18,000 ha of Jatropha. The target of this company is to cultivate a total area of 60,000 hectares.

## 4-1 Latin America – South America



### Country Index

#### **Brazil**

Colombia

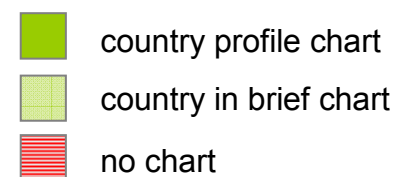
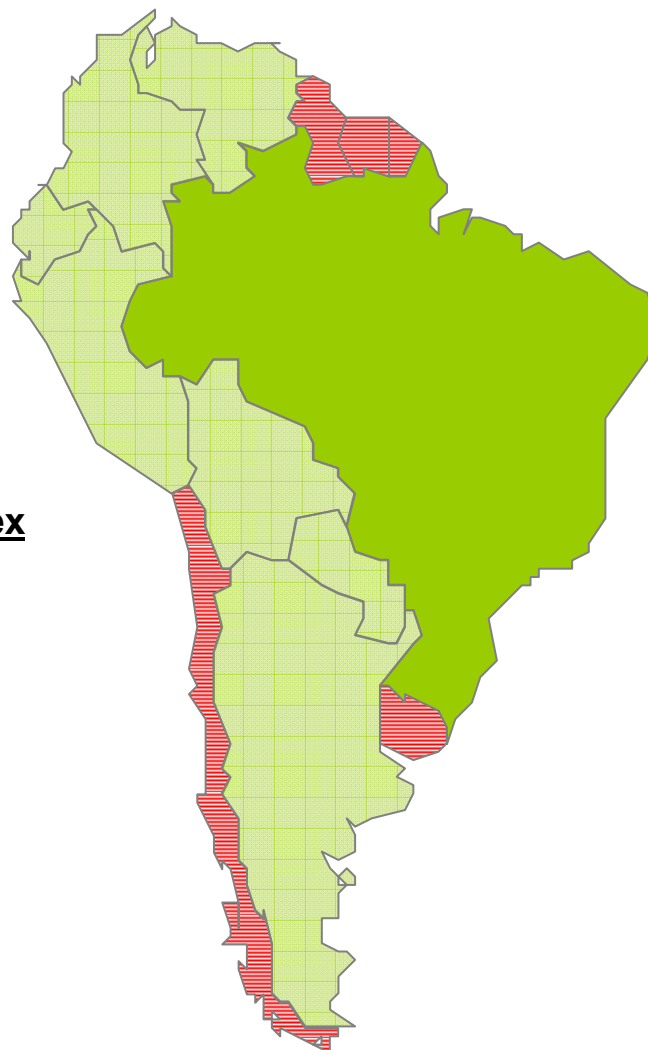
Ecuador

Peru

Bolivia

Paraguay

Argentina



## 4-1 Latin America – Brazil



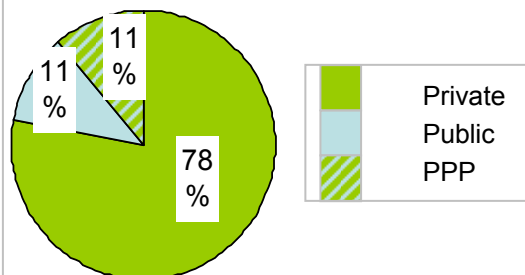
### Summary & Comments

Brazil is one of the world's leading biofuel producers. Although Brazil's biofuel strategy focuses mainly on ethanol, biodiesel production in Brazil is on the rise. President Lula has repeatedly highlighted the exceptional characteristics of Jatropha, and governmental support is expected to start in the next few years. However, the Jatropha industry is still in its infancy. Currently, the prevailing form of production is private farms of up to 2,000 hectares. Many of these projects have plans for expansion. The inclusion of Jatropha in the Social Biodiesel Program would certainly accelerate this process.

### Scale of Jatropha Cultivation

	Expert Estimate	Projects identified
current	17,500 ha	15,819 ha
2010	250,000 ha	105,000ha
2015	1,300,000 ha	196,000 ha

### Project Ownership



### Government Programs

#### Jatropha / Biofuel Legislation

The National Program of Production and use of Biodiesel (2003) is aiming for a blend of 2% biodiesel by 2008 and 5% by 2013. The program promotes production of biodiesel from different oil seeds and regions, as well as social inclusion and job creation. Jatropha is expected to be included in this program in the future.

#### NGO-Initiatives

The Brazilian Association of Jatropha Producers ([www.abppm.com.br](http://www.abppm.com.br)) is promoting Jatropha production.

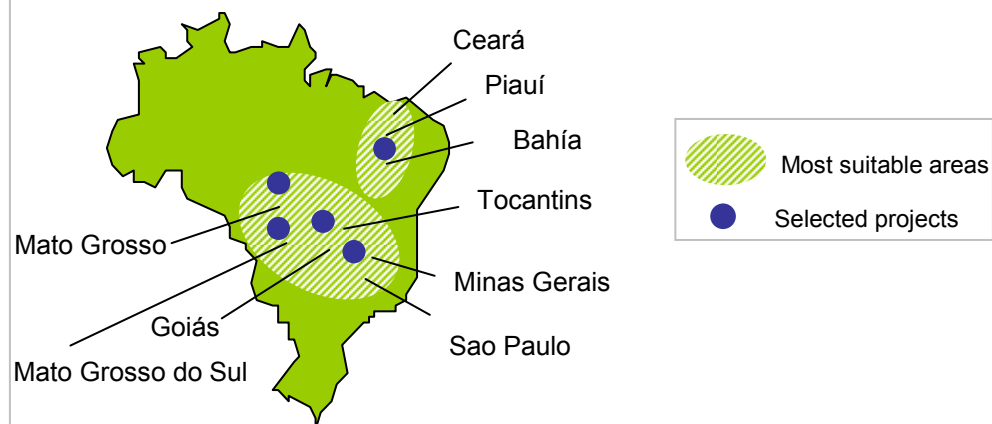
### Barriers for Jatropha investments

There are no legal barriers against Jatropha investments. However, the uncertainty about whether or not Jatropha will be supported within the social biodiesel program is seen as a barrier for large investments. Jatropha is not yet included due to a lack of scientific research. If the government approves financial support, plantations are expected to grow in number and size. High labour costs may represent an obstacle for large scale operations, but family farmers may benefit from a new source of income.

## 4-1 Latin America – Brazil

### Regional Distribution

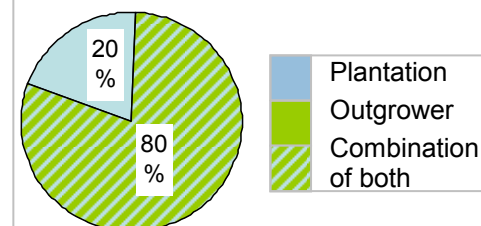
Jatropha is not native to Brazil and was most likely introduced by the Portuguese. Climate conditions are most favourable in the central-west, the north-east and the south-east regions of Brazil. The far north (rainforest) and the far south (lower temperatures) are less suitable.



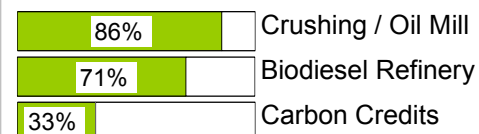
### Project Evaluation

- Pruning is widely used as a cultivation technique. Almost all projects apply fertilisers. Irrigation is applied in less than 50% of the projects.
- Almost all projects aim to set up their own oil milling facilities and two thirds of the projects already have their own biodiesel refinery. Carbon credits play a lower role in our project sample.
- From the data received, it seems that the majority of projects are developed on land not previously used for agriculture or on non-forestry land which had not been used in the past 5 years for any agricultural purposes.
- Most projects reported to have a sustainability policy, including measures like intercropping, efficient use of water and social inclusion of rural farmers.

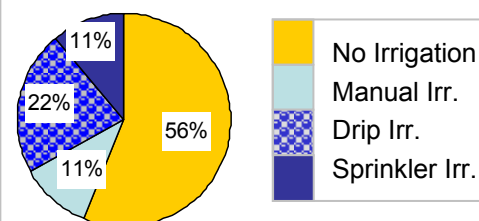
### Plantation Model



### Value Chain Elements



### Irrigation Models





### Prices

Seeds (per kg /dry)	\$0.30
Labour (per day)	\$15
Diesel at pump	\$1

10 experts interviewed  
5 projects analysed

## 4-1 Latin America – Brazil

Project	Source	Type	Project Location	Ha (2008)	Ha (2015)
Sada Bioenergia	1		Not disclosed	-	-
ECOMAXX	1		Central Northern Goiás	25	
BioTins / Saudibras	1		Caseara, Tocantins	4,100	100,000
NNE Minas Agroforestal	1		Janauba, Minas Gerais	54	
BIOFISCHER	1		Colider, Mato Grosso	100	40,000
Curcas Diesel Brazil	2		Jales, Sao Paulo	20	
Plant.a.Bio Agrotecnologia	1		Minas Gerais	-	-
Fusermann Biodiesel	1		Southern Mato Grosso	2,000	25,000
CARAMURU	2		Intercropping in different locations	2,000	
EMBRAPA	2		Dourados, Mato Grosso do Sul	20	
Plantation Oswaldo Aguir	2		Ribas do Rio Pardo, Mato Grosso do Sul	800	
Prefeitura de Cuiabá	3		Cuiabá, Mato Grosso	0	15,000
			<b>Acreage non-disclosed projects</b>	6,700	16,000
			<b>Total</b>	<b>15,819</b>	<b>196,000</b>

 Commercial project


 Non-commercial project

1 Interview / Questionnaire with project representative

2 Interview / Questionnaire with external project expert

3 Public sources

## 4-1 Latin America – Colombia



South America

### Colombia

☒ Jatropha exists   ☐ Jatropha locally used   ☒ Commercially farmed

**Policies:** Colombia has had a Biodiesel Law since 2004 (Law 939). This law established a compulsory 5% blend for biodiesel by 2008. Biodiesel is exempt from the 25% VAT, which has to be paid on regular diesel.

**Projects:** Two projects have been identified in Colombia. The first is being operated by Biojatro. A pilot plantation of 30 ha was established in 2007. The company is planning to expand to 3,000 ha by 2012 and set up its own biodiesel production facility.

The second project, located in the Department of Vichada, has a plantation of 1,000 ha and is planning to expand further.

**Market:** Jatropha will mainly be supplied to biodiesel refineries as feedstock.

## 4-1 Latin America – Ecuador



### Ecuador

☒ Jatropha exists    ☐ Jatropha locally used    ☒ Commercially farmed

**Policies:** Executive decree No. 2332/1994 declares a national interest in the production and commercialisation of biofuels in Ecuador.

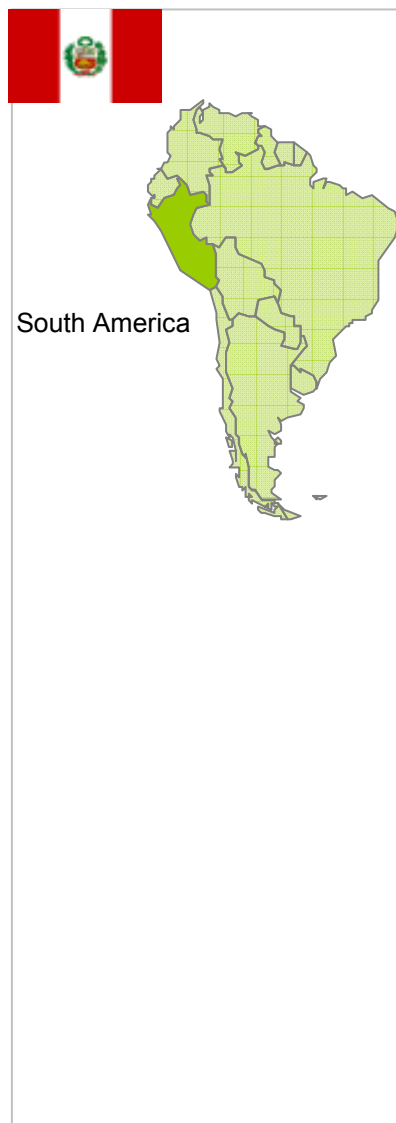
**Projects:** The Ministry of Agriculture, the State Government of Manabí and the Corredor Ecologico organisation are working together on a project in the Department of Manabí. They are planning to establish a total of 50,000 ha within the next five years.

The National Institute of Agricultural Research is running a research project on Jatropha, covering seed selection, pest control and production methods.

The GTZ is doing an economic-feasibility study for Jatropha projects.



## 4-1 Latin America – Peru



### Peru

☒ Jatropha exists ☐ Jatropha locally used ☒ Commercially farmed

**Policies:** Peru has had a law since August 2003 which promotes the biofuel market (Law 28054). In 2007, the Government implemented a National Program to promote the use of biofuels. However, there is no specific legislation or governmental support for the cultivation of Jatropha.

**Projects:** GEXSI has identified several research and pilot projects. The German agencies GTZ and DED are working on research and demonstration projects to develop the biofuel market, in which Jatropha plays an important role.

The Research Institute of the Peruvian Amazon and the University Cayetano Heredia are also undertaking research programs.

BIOPER has established some trials in Lambayeque, on the north coast.

Heaven Petroleum is planning a 5,000 ha Jatropha plantation to produce feedstock for its biodiesel refinery.

ISPAIA Energia is undertaking a feasibility study with the view to establishing a large scale plantation.

**Market:** The GTZ and DED programs are targeting small-scale oil production for local and regional use in transport and electricity. Heaven Petroleum and ISPAIA Energia are targeting the national and international markets.

Country experts estimate that there will be about 70,000 ha of Jatropha plantations by 2015.

## 4-1 Latin America – Bolivia



### Bolivia

☒ Jatropha exists    ☐ Jatropha locally used    ☐ Commercially farmed

**Policies:** The Bolivian Congress is working on a legislation to promote the production of biofuels. An important aspect of this law is the exclusion of basic food crops for the production of biofuels.

**Projects:** The Research Institute of Tropical Agriculture is working on a research project to analyse the possibilities of planting Jatropha.

The Australian organisation Suntree Pty Limited has signed a bilateral agreement with the Federal Government to develop Jatropha projects.

**Market:** Due to its climatic conditions and availability of land, Bolivia would be a suitable location for Jatropha cultivation.

## 4-1 Latin America – Paraguay



### Paraguay

☒ Jatropha exists   ☐ Jatropha locally used   ☒ Commercially farmed

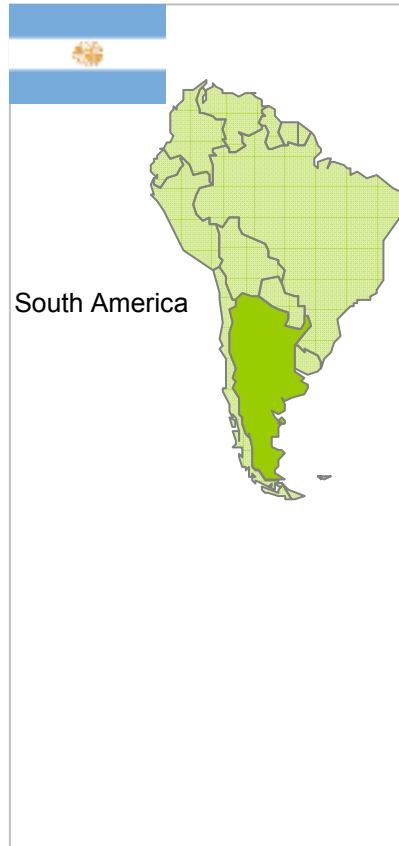
**Policies:** A law exists to promote biofuels (Law 2748/2005).

**Projects:** The Moises-Bertoni Foundation has established several pilot plantations as a part of a research program in the Departments of San Pedro and Canindeyú. In total, 15 ha have been planted.

According to internet sources, the company Agros is planning a 1,000 ha Jatropha plantation and has a target of 10,000 ha.

The Argentinean newspaper El Cronista reported that three Argentinean companies are interested in setting up a 100,000 ha Jatropha plantation in Paraguay.

## 4-1 Latin America – Argentina



### Argentina

☒ Jatropha exists ☐ Jatropha locally used ☒ Commercially farmed

**Policies:** In May 2006, the Argentinean Congress passed a law to promote and regulate the use and production of sustainable biofuels (Law 12692/2006). However, there is no specific legislation and no barriers against the cultivation of Jatropha. According to internet sources, there is a project to raise national interest in cultivating Jatropha.

**Projects:** Some small-scale projects have started cultivating Jatropha in the north-east region, which is suitable for Jatropha cultivation due to its climatic conditions.

Mas Jatropha SRL has been conducting trials and research on seed selection, climatic conditions and harvesting.

Cultivos Energéticos SRL has been working with Jatropha since 2004 and is currently planning to establish 500 ha.

The Company Patagonia Bioenergia is setting up trials with Jatropha in Formosa.

## 4 Results on Global Level



**4-1 Latin America**

**4-2 Africa**

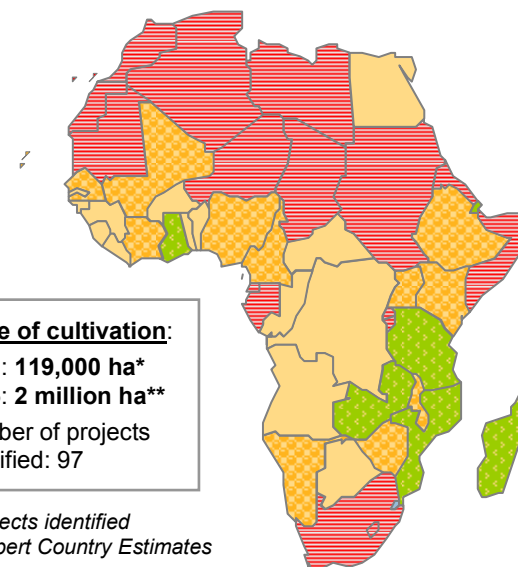
**4-3 Asia**

### General observations

Jatropha has been known in many countries in Sub-Saharan Africa for generations. It has been planted as hedges (to serve as a „living fence“) or has been used for artisan soap production or medicinal purposes. Development agencies supported pilots for decentralized rural energy supply.

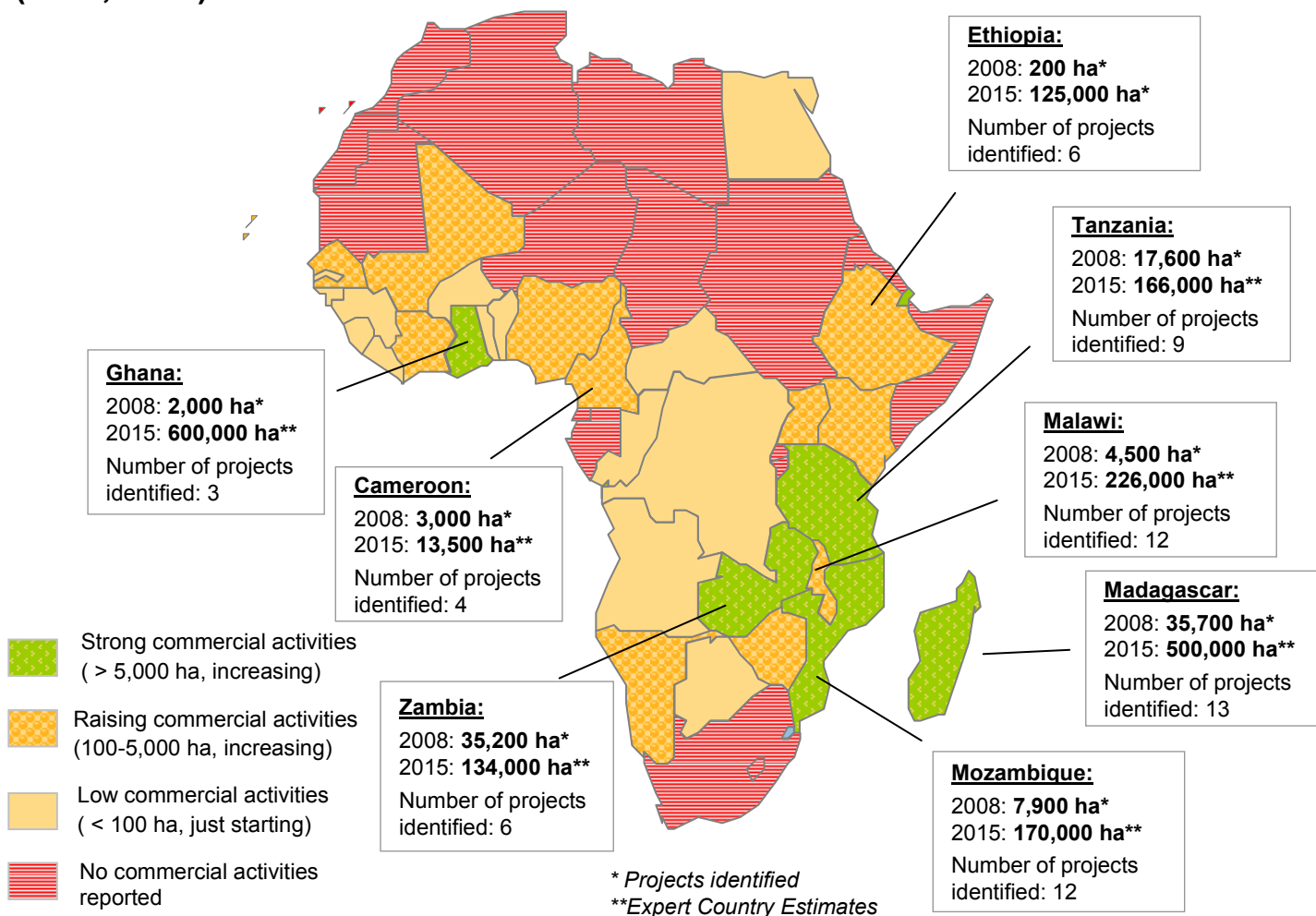
Today, significant investments in cultivating Jatropha as an energy crop take place in Africa. However, there are strong regional disparities:

- **Northern Africa:** There are very little Jatropha-related activities due to the extreme arid climatic conditions; several pilot projects that make use of sewage water for a year-round irrigation are tested in Egypt.
- **Western Africa:** Mali and the Cape Verde Islands have a long-tradition in Jatropha cultivation; the focus in Mali lies on the use of pure plant oil for village energy supply. However, large-scale projects are currently prepared in several West African countries, such as Ghana, Nigeria or Cameroon.
- **East Africa:** The largest project developments have been reported in Tanzania, followed by Ethiopia. Jatropha-related activities have started at a small scale also in Kenya and Uganda and are likely to rise dynamically.
- **Southern Africa (including Madagascar):** Apart from Botswana, Angola and – due to the prohibition of commercial Jatropha plantations – South Africa, ambitious commercial operations are currently developed throughout Southern Africa. The largest acreage under cultivation currently exist in Madagascar and Zambia, with each about 35,000 hectares, followed by Mozambique.



## 4-2 Africa – Regional Overview

### Total acreage of selected countries (2008, 2015)



## 4-2 Africa – Regional Overview



### Regional structure of Africa country analysis

#### Northern Africa

Libya  
Egypt  
Sudan

#### East Africa

Ethiopia  
Uganda  
Kenya  
Tanzania

#### Western Africa

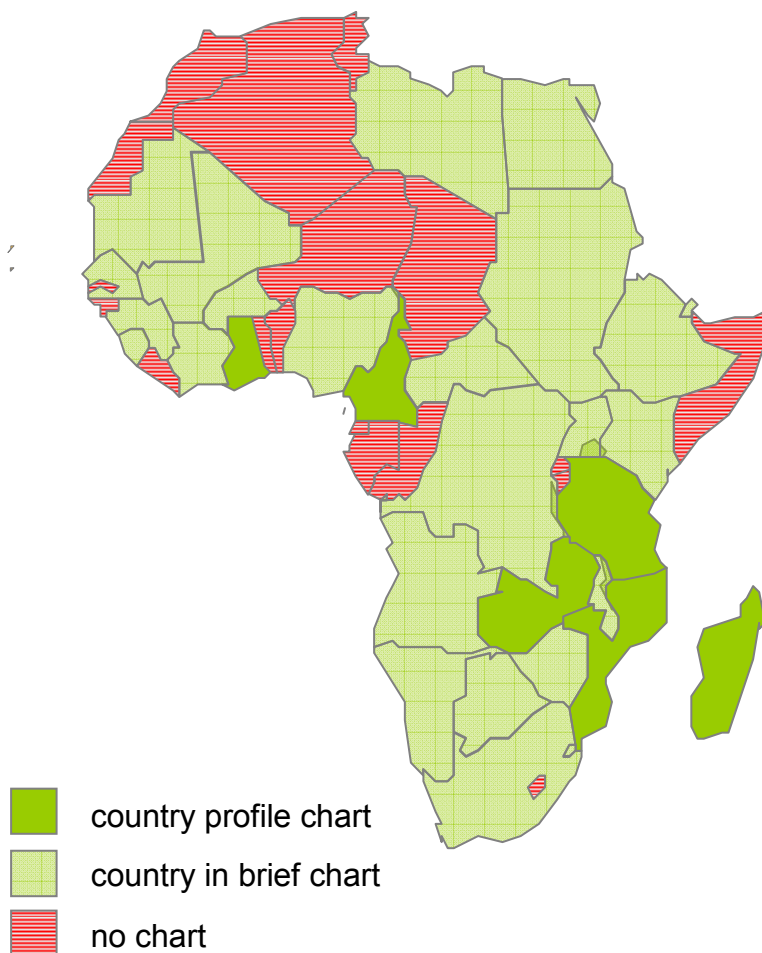
Cape Verde Islands  
Mauritania  
Senegal  
Mali  
Burkina Faso  
Sierra Leone  
Ivory Coast  
Ghana  
Nigeria  
Cameroon

#### Southern Africa

Angola  
Namibia  
South Africa  
Botswana  
Zimbabwe  
Zambia  
Malawi  
Mozambique  
Swasiland  
Madagascar

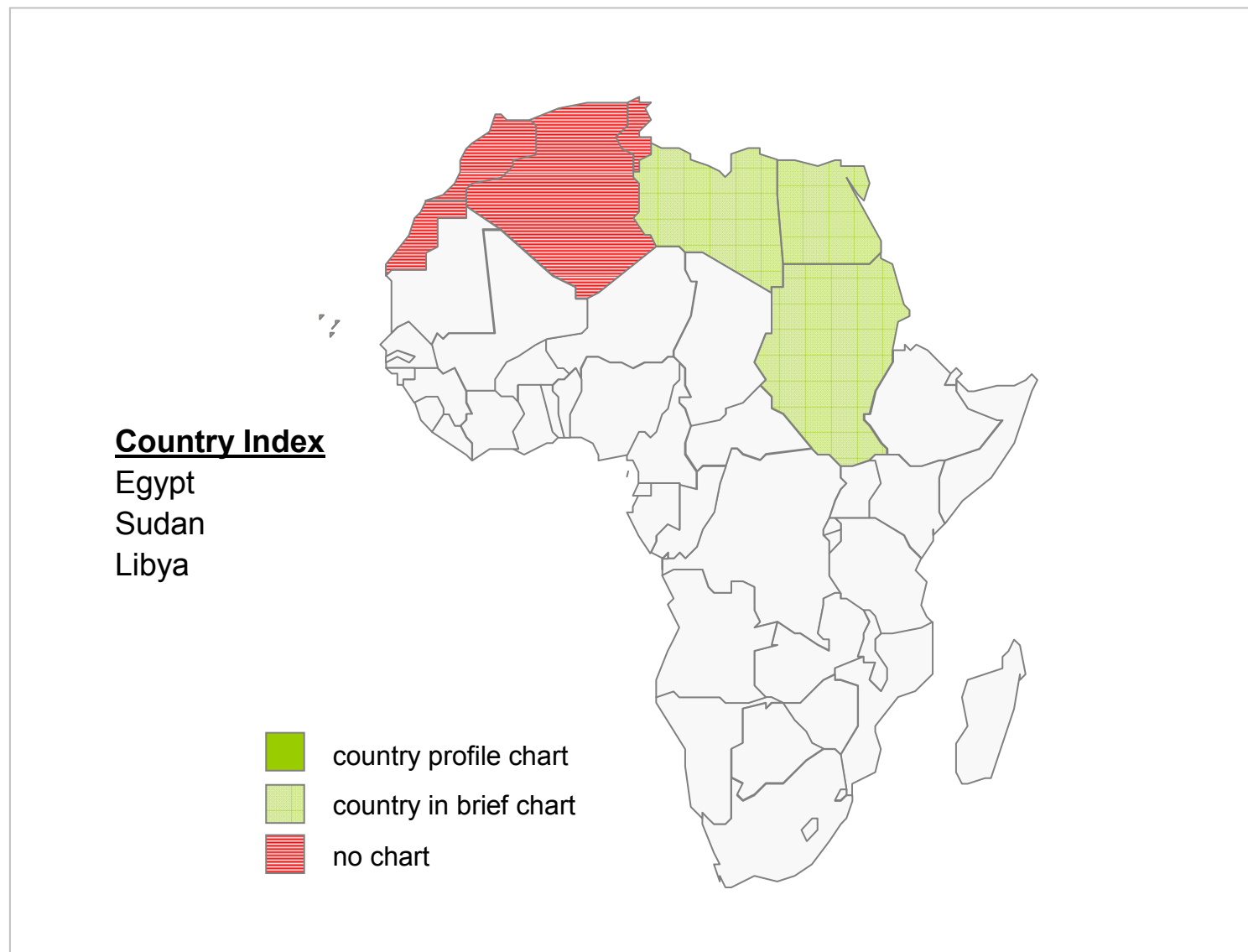
#### Central Africa

Democratic Republic of Congo  
Central African Republic

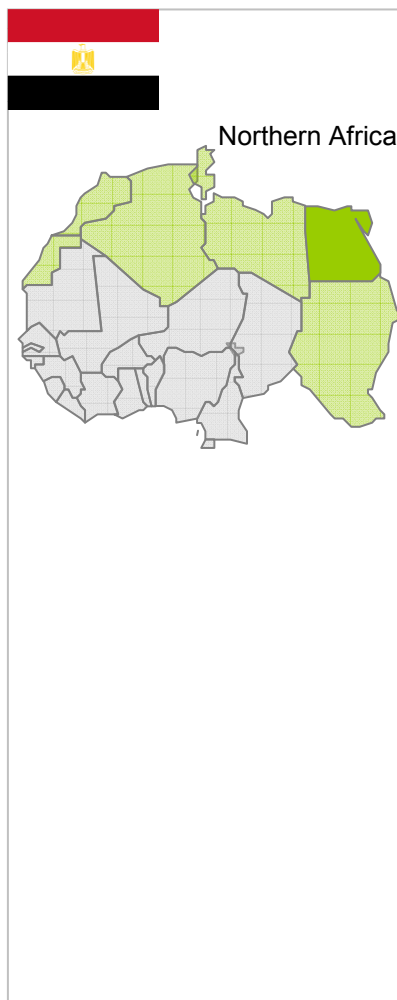




## 4-2 Africa – Northern Africa



## 4-2 Africa – Egypt



### Egypt

☒ Jatropha exists   ☐ Jatropha locally used   ☒ Commercially farmed

**Policies:** No legislation or government policies on biofuels or Jatropha exist or are currently being drafted.

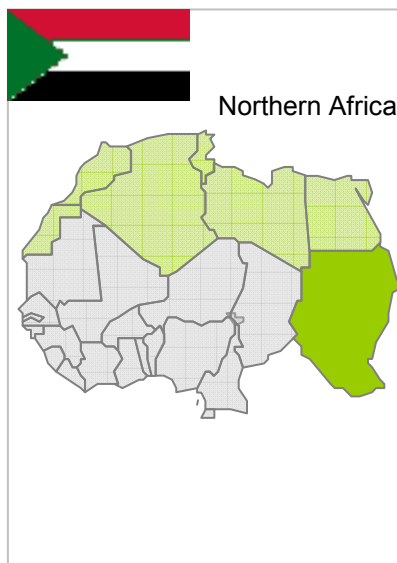
**Projects:** Currently, there are several government supported pilot projects being implemented or prepared in Egypt. They all use sewage water to irrigate Jatropha planted in nearby desert lands. The government supports this - also as a means to protect urban areas against sand storms.

The most prominent plantation has been set up close to the city of Luxor. Approximately 140 ha have been planted on sandy desert soil. The region is very hot with temperatures above 40°C on 260 days a year. Sewage water from the city is used for irrigation and fertilisation. It is applied with a drip irrigation scheme adapted to sewage waters. The Jatropha plants are reported to grow well.

A further plantation irrigated with sewage water was set up near the city of Suez under the same governmental scheme with less than 100 ha. The growth of the Jatropha plants is reported to be not as good as in the Luxor project. Presumably, this is due to lower temperatures and higher salt content of the soil.

Further small scale cultivation of less than 5 ha exist as plantations with sewage water irrigation.

## 4-2 Africa – Sudan and Libya



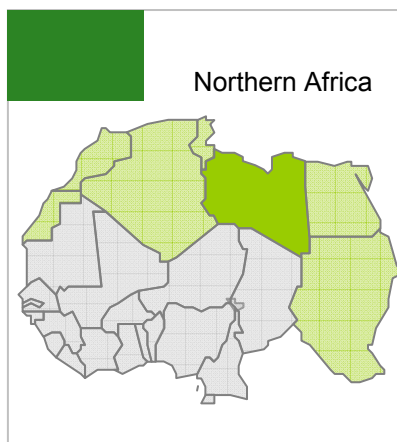
### Sudan

☒ Jatropha exists   ☒ Jatropha locally used   ☐ Commercially farmed

**Policies:** No government policy or legislation on Jatropha cultivation or biofuels in general is currently in place or being drafted, according to public sources.

**Projects:** In Sudan, *Jatropha curcas* is found in many areas such as Khartoum State in central Sudan, Kassala State in the east and Kordofan State in the west of the country.

In the south, it is a dominant part of the vegetation in the states Bahr El Jebel and Bahr El Gazal. Farmers mainly cultivate Jatropha as hedges to protect their fields. No further use of Jatropha seeds by the local population has been reported.

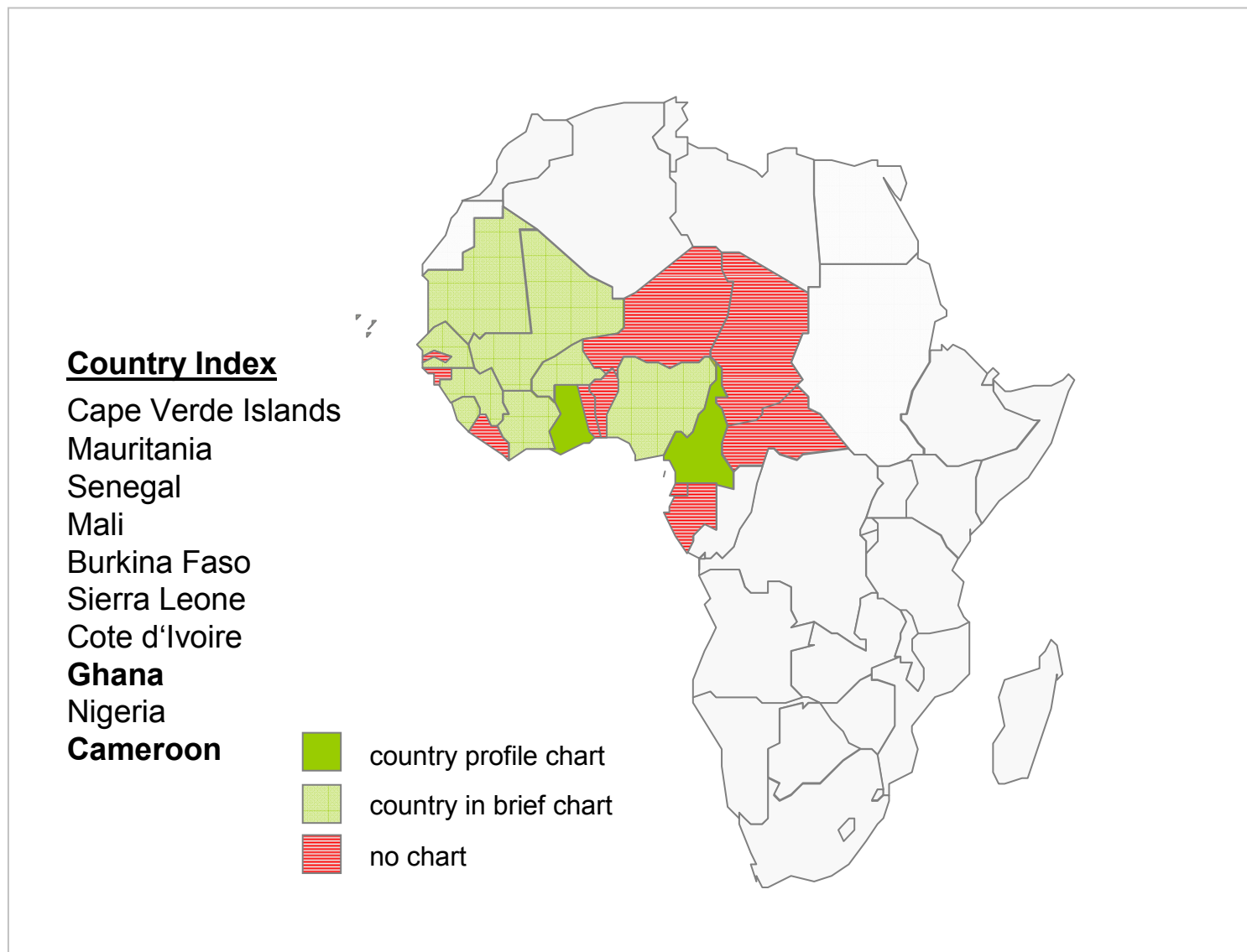


### Libya

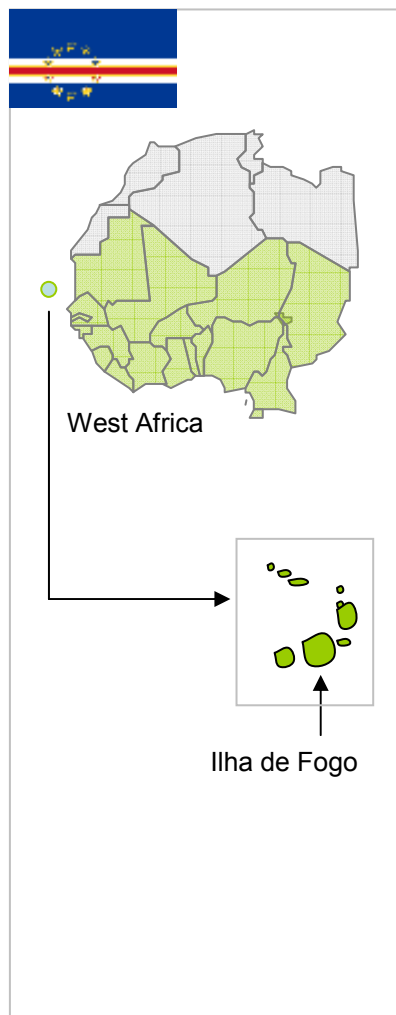
☐ Jatropha exists   ☐ Jatropha locally used   ☐ Commercially farmed

Jatropha has been confirmed to not exist in Libya, due to adverse climatic conditions.

## 4-2 Africa – West Africa



## 4-2 Africa – Cape Verde Islands



### Cape Verde Islands

☒ Jatropha exists    ☐ Jatropha locally used    ☒ Commercially farmed

**Policies:** No government policy or legislation regarding Jatropha or biofuels is currently in place or in preparation, according to country expert information. The agricultural focus of the Government is on food security.

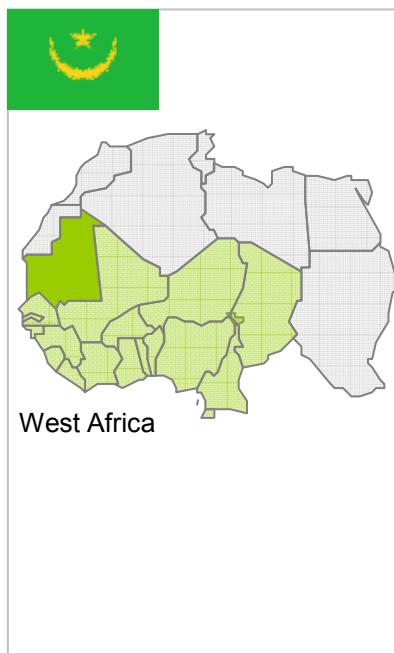
**Projects:** Public sources suggest the existence of two smaller projects, mainly with focus on research and the production of cuttings and seeds. The companies mentioned in this context are “Agroproductos” and the Dutch horticultural research and breeding company “Agriom B.V” in a joint venture with the firm “Agro Centro”. The information could not be confirmed by other sources.

**Abandoned Plantations:** Large Jatropha plantations set up during colonial times by the Portuguese still exist but are no longer managed. They mainly serve as a source of fire wood for the local population. There is no report on the use of seeds. The plantations are predominantly found on the arid island of Fogo.

**Jatropha History:** The export of Jatropha oil and products was an important part of the Cape Verde export economy in the beginning of the 20th century. After the islands gained independence from Portugal in 1975, production and cultivation did not continue.

**Reforestation:** In the 1980s and 1990, reforestation projects were undertaken to curb erosion. The program included Jatropha, though to a minor extent.

## 4-2 Africa – Mauritania



### Mauritania

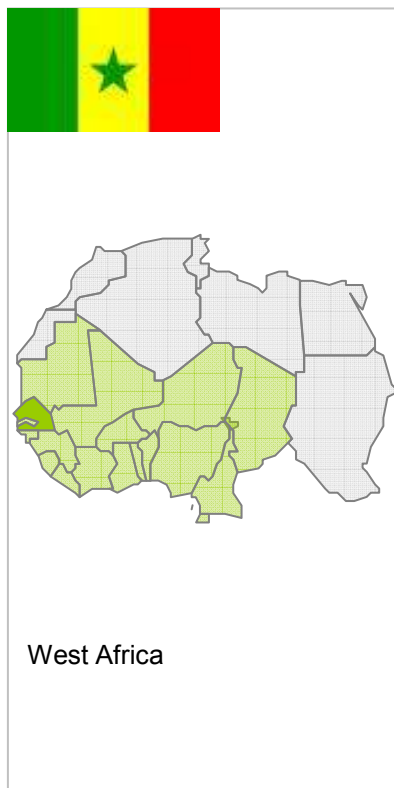
☐ Jatropha exists   ☐ Jatropha locally used   ☐ Commercially farmed

**Policies:** The Mauritanian government is looking for options to integrate Jatropha in its efforts to reduce desertification. A mission by FAO in March 2008, however, concluded that chances for a successful implementation of such a policy seem low.

**Projects:** Jatropha has been reported not to exist in Mauritania apart from a very small pilot project at the Senegal river. The reason given is the severely dry climate.

**Market:** Mauritania is heavily dependent on imports of agricultural products. It is therefore not considered sensible to allocate the already scarce areas of agriculturally suitable land for the production of energy crops.

## 4-2 Africa – Senegal



### Senegal

☒ Jatropha exists   ☒ Jatropha locally used   ☒ Commercially farmed

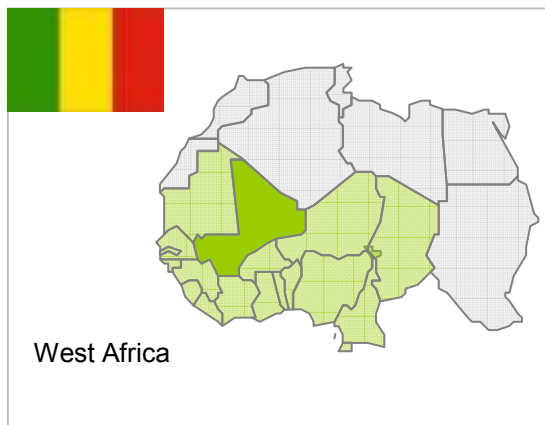
**Policies:** The Senegalese government is promoting Jatropha via capacity building and investment promotional activities. The governmental target is to have approximately 300,000 ha planted by 2012 in order to secure Senegal's self-sufficiency in biodiesel by that year. The plan is designed and will be followed-up by the Ministry of Agriculture.

**Projects:** The climate throughout Senegal is suitable for growing Jatropha. Jatropha cultivation is on the rise, but so far, mainly pilot plantations and small-scale projects have been established. Commercial plantations are currently being set up or being prepared.

**Market:** Jatropha can be found in various areas throughout Senegal and is planted in hedges as a living fence by local farmers. There is no established market for Jatropha oil yet, but nuts are sold as seed material and seed cake is sold as fertilizer. In addition, the production of soap based on Jatropha oil has been reported. Sococim Industries, a cement manufacturer, uses the seeds for energy production by burning them.



## 4-2 Africa – Mali



### Summary & Comments

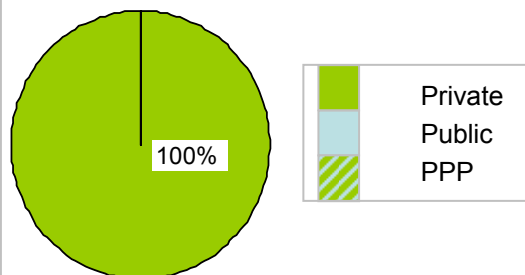
In Mali, Jatropha has been used for generations as a ‘living fence’, protecting food crops against animals and reducing erosion if carefully planted. Traditionally, the seeds were also collected by women and used for medical treatments.

Most current Jatropha projects in Mali are locally oriented and have the common goal to improve living standards in the country by bringing electricity and work, especially to rural areas. Jatropha is usually planted in hedges.

### Scale of Jatropha Cultivation

	Expert Estimate	Projects identified
current	1,800 ha	700 ha
2010	10,000 ha	1,050 ha
2015	23,000 ha	10,950 ha

### Project Ownership



### Government Programs

#### Jatropha Legislation

The “Déclaration de Bamako pour la promotion du Pourghère”, initiated by the Ministry of Mines, Energy and Water, formulates the goals of the government, which include:

- technology transfer & research extension.
- raising awareness throughout the population.
- creating a regional Jatropha coordination center.

No legal decisions have been made yet.

#### NGO-Initiatives

The Mali Folkecenter ([www.malifolkecenter.org](http://www.malifolkecenter.org)), which is representing the “Danish Folkecenter for Renewable Energy”, is promoting Jatropha production and use. It works closely with other initiatives and the government.

#### Barriers for Jatropha investments

There are no barriers for Jatropha investments as such. However, as the government in Mali is focusing on the local benefits of Jatropha projects, the incentives for foreign for-profit projects are higher in other African countries.



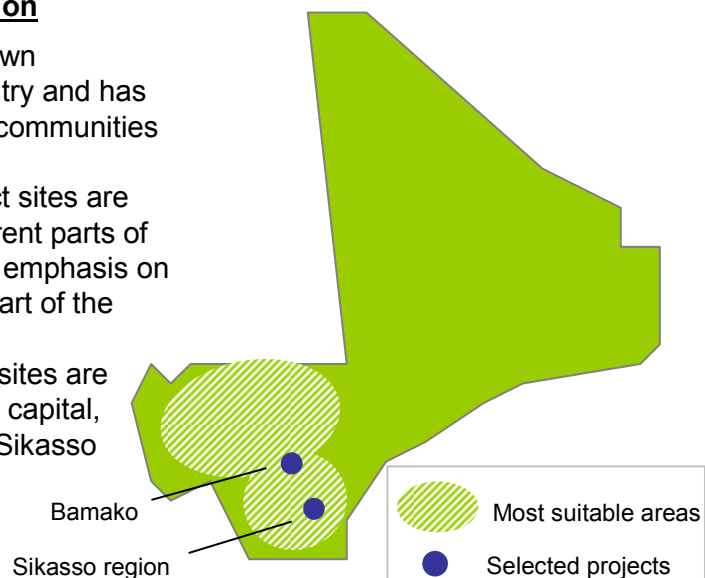
## 4-2 Africa – Mali

### Regional Distribution

Jatropha is well known throughout the country and has been used by local communities for a long time.

The Jatropha project sites are spread among different parts of the country, with an emphasis on the south-western part of the Mali.

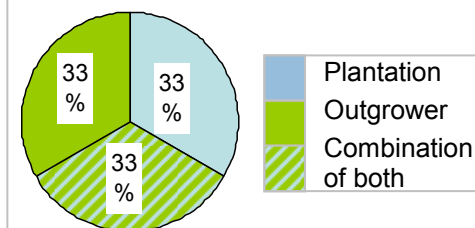
Established project sites are situated north of the capital, Bamako and in the Sikasso region.



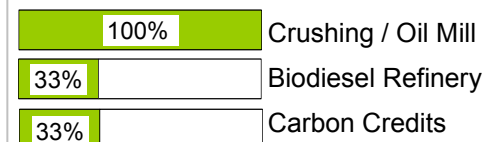
### Project Evaluation

- The Mali Folkecenter has established the concept of Multifunctional Platforms: A small cylinder diesel engine is used to power a mill and a Jatropha oil press, to produce oil and press cake. After a simple conversion, the engine can use the Jatropha oil as fuel. It can also power a generator for battery charging, rural electricity, a water pump or a compressor.
- An international consortium is currently implementing a jatropha project with a strong carbon-offset component, targeting 450,000 certified emission reductions (CERs) by 2012.
- The interviewed experts did not see much potential for irrigated projects at this stage.

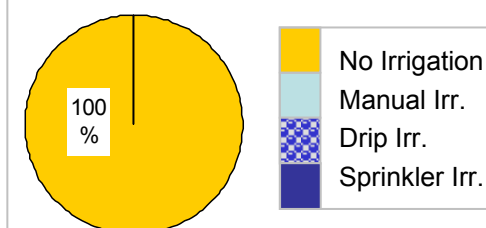
### Plantation Model



### Value Chain Elements



### Irrigation Models



### Prices

Seeds (per kg /dry)	0.1 \$
Labour (per day)	2 \$
Diesel at pump	1 \$

2 experts interviewed  
4 projects analysed

## 4-2 Africa – Mali



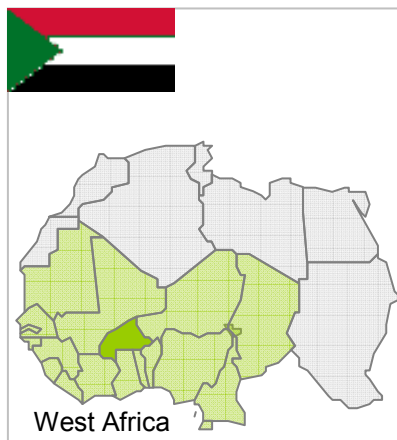
Project	Source	Type	Project Location	Ha (2008)	Ha (2015)
Mali Folkecenter	2		Throughout Mali	50	200
Mali Biocarburant SA	1		Throughout Mali	0 (project developer is only buying nuts from locals)	0
Eco-Carbone (+ partners)	3		Not disclosed	300	10,000
Rural electrification project (Mali's National Centre for Solar and Renewable Energy)	3		Throughout Mali	< 5 per village, 70 villages	5 per village, 150 villages

<b>Acreage non-disclosed projects</b>	0	0
<b>Total</b>	<b>700</b>	<b>10,950</b>

- Commercial project  
 Non-commercial project

- 1 Interview / Questionnaire with project representative  
2 Interview / Questionnaire with external project expert  
3 Public sources

## 4-2 Africa – Burkina Faso & Sierra Leone

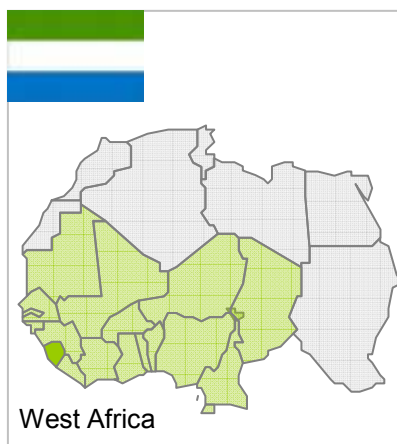


### Burkina Faso

☒ Jatropha exists    ☒ Jatropha locally used    ☐ Commercially farmed

**Policies:** The government is planning to promote biofuel production, but no tangible steps have been undertaken yet.

**Projects:** Jatropha is traditionally known in Burkina Faso and has been used locally, especially for medical purposes. Plantation projects in Burkina Faso are still in their infancy, e.g. small pilot plantations and research projects.

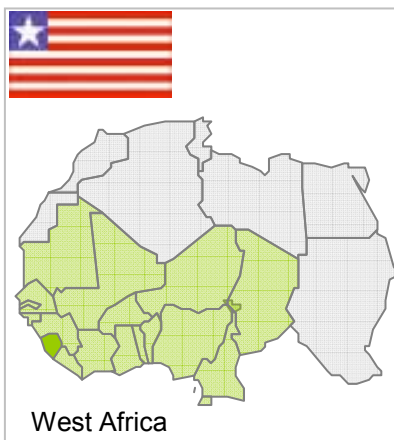


### Sierra Leone

☐ Jatropha exists    ☐ Jatropha locally used    ☐ Commercially farmed

Jatropha has been reported to not exist in Sierra Leone. However, project development plans have been reported by country experts but could not be confirmed so far.

## 4-2 Africa – Liberia and Ivory Coast

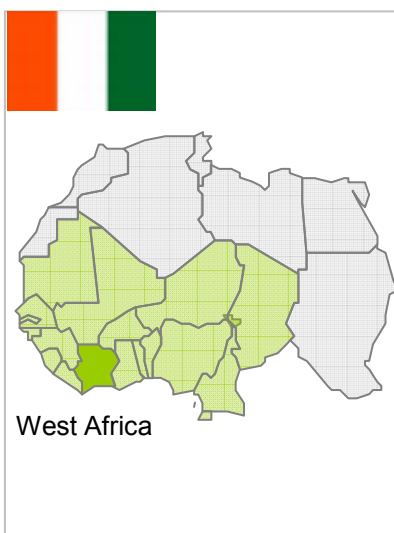


### Liberia

☐ Jatropha exists   ☐ Jatropha locally used   ☐ Commercially farmed

Jatropha has been reported not to exist in Liberia.

Nevertheless, country experts have reported project development plans, which could not be confirmed so far.



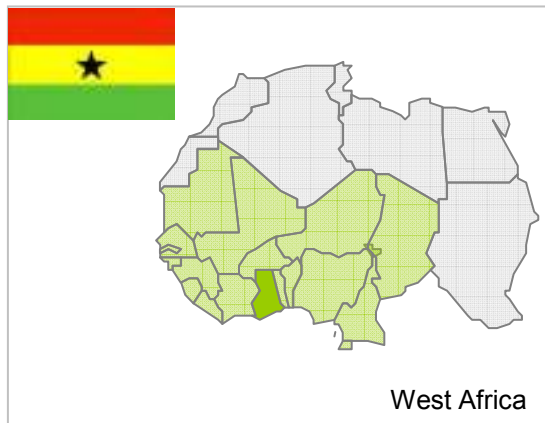
### Ivory Coast

☒ Jatropha exists   ☐ Jatropha locally used   ☐ Commercially farmed

**Policies:** The government is not directly supporting Jatropha at present due to post-war priorities, but has expressed interest in doing so in the future.

**Projects:** Jatropha can be found frequently throughout the country. No large-scale Jatropha projects are existing at present, but plans for such undertakings have been reported. There is a 30 hectare pilot plantation set up by the company NextPlanet in 2007. The pilot is used for research on different cultivation techniques.

## 4-2 Africa – Ghana



### Summary & Comments

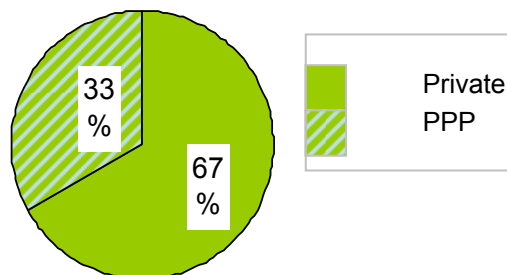
Ghana has a very favourable climate for Jatropha development. The plant grows throughout the country without being cultivated. Several foreign companies have invested in Jatropha projects and are currently setting up plantations. Some are already harvesting. Nevertheless, Jatropha oil is not being sold yet.

At the moment, Jatropha seeds are being collected from non-cultivated Jatropha trees. Experts estimate that large scale Jatropha plantations will soon be vitally important to Ghana.

### Scale of Jatropha Cultivation

	Expert Estimate	Projects identified
current	5,700 ha	2,020 ha
2010	220,000 ha	150,050 ha
2015	600,000 ha	805,100 ha

### Project Ownership



### Government Programs

#### Jatropha / Biofuel Legislation

The government is currently discussing a biofuel legislation with mandatory blending (percentage still being discussed). An Energy Commission and an Energy Fund to improve the country's supply has been set up. However, no legislation has been decided upon yet.

### NGO-Initiatives

The EPA (Environmental Protection Agency, [www.epa.gov](http://www.epa.gov)) as well as the GTZ (Deutsche Gesellschaft für Technische Zusammenarbeit, [www.gtz.de](http://www.gtz.de)) are active in Ghana. According to our data, the largest project is currently run by a Norwegian biofuel company in partnership with a local subsidiary company.

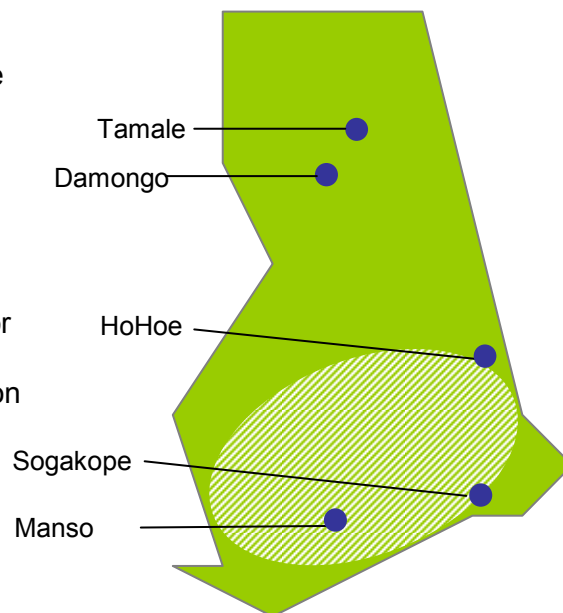
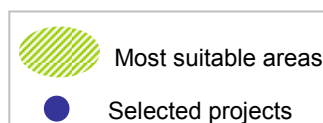
### Incentives for foreign investors

The government of Ghana is encouraging foreign investment through tax incentives. The Ghana Investment Promotion Center (GIPC; [www.gipc.org.gh](http://www.gipc.org.gh)) provides support for investors. Additionally, large areas of land are made accessible to investors by the government, especially in the northern parts of Ghana.

## 4-2 Africa – Ghana

### Regional Distribution

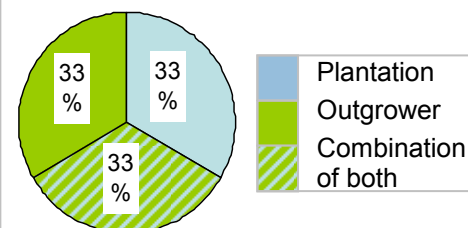
The climatic conditions throughout Ghana are suitable for planting Jatropha. The northern part consists of semi-arid regions with hardly any trees. The southern part, especially towards the coast, has more annual precipitation and is especially favourable for plantations. However, more space is available for cultivation in the northern area.



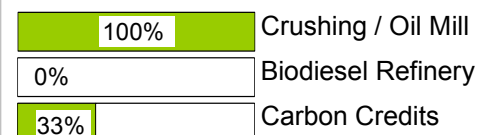
### Project Evaluation

- All projects plant Jatropha on land which has not been used for other purposes and thus does not compete with food production. This, together with the better availability of land, leads to plantations being established in the northern regions, regardless of the less favourable climatic conditions.
- Fertilisation takes place in 67% of the projects. Mostly, the Jatropha seed cake is used. Other fertilizers, organic as well as chemical, are currently being tested at small research farms.
- Although different irrigation models are being tested, irrigation is not prevalent. All projects use intercropping as a cultivation method. Pruning is also prevalent.

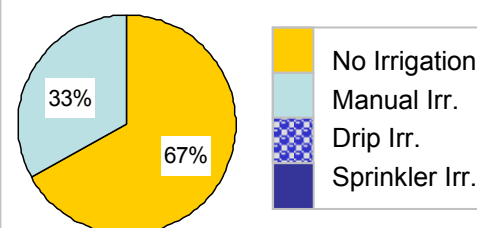
### Plantation Model



### Value Chain Elements



### Irrigation Models






### Prices

Seeds ( per kg /dry)	2 \$
Labour (per day)	3 \$
Diesel at pump	1 \$



6 experts interviewed  
3 projects analysed

## 4-2 Africa – Ghana



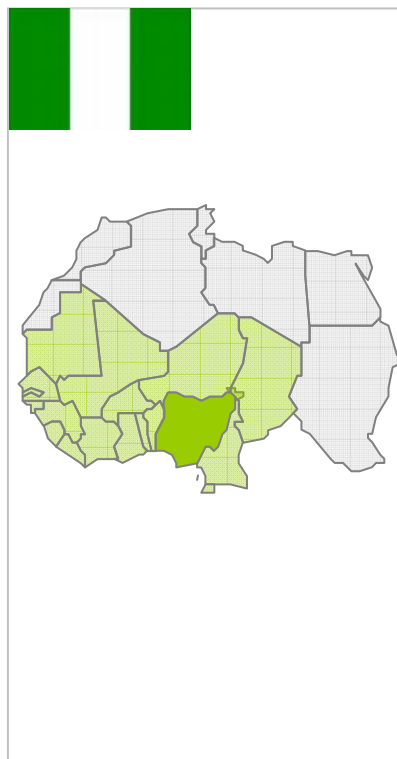
Project	Source	Type	Project Location	Ha (2008)	Ha (2015)
BioFuel Africa Ltd-Ghana/ BioFuel AS-Norway	1		3 project sites: region of Tamale, Sogakope & HoHoe	2,000	800,000
InWent & Energiebau Solarstromsysteme	1		Damongo	< 20	100
Symboil	1/3		Manso (Western Ghana)	0	5,000

<b>Acreage non-disclosed projects</b>	0	0
<b>Total</b>	<b>2,020</b>	<b>805,100</b>

-  Commercial project
-  Non-commercial project

- 1 Interview / Questionnaire with project representative
- 2 Interview / Questionnaire with external project expert
- 3 Public sources

## 4-2 Africa – Nigeria



### Nigeria

☒ Jatropha exists    ☒ Jatropha locally used    ☒ Commercially farmed

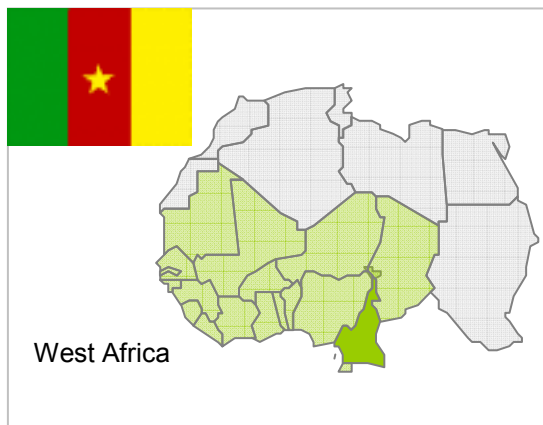
**Policies:** No legislation has been passed yet, but the government is strongly supporting investment schemes as well as capacity building. The support varies slightly throughout the respective Nigerian states. As a targeted acreage of Jatropha cultivation for the year 2010, 100,000 ha have been stated by an expert. Also, a guaranteed price is reported to have been introduced through the state-owned Nigeria National Petroleum Corporation.

**Projects:** A main player in Jatropha development in Nigeria is Green Shield of Nations (<http://www.greenshieldofnations.org>), an NGO focusing on rural electrification in 11 states in the arid north. Jatropha is also planted in form of hedges as protection against desertification in some of these states.

Other identified projects have just started in 2008 and are still in the process of being established. An international Jatropha conference held in April 2008 is hoped to spur project development.



## 4-2 Africa – Cameroon



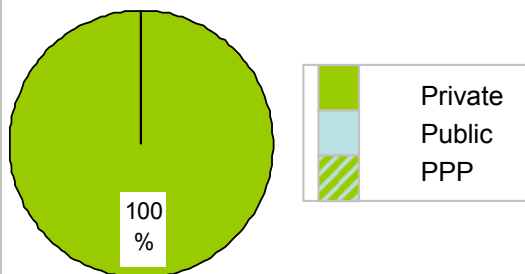
### Summary & Comments

Jatropha grows also outside cultivated plantations in Cameroon, but has only been used for plantation schemes in the last few years. Jatropha oil is not used in Cameroon yet, but some plantations have already harvested the nuts. The potential of the plant is largely recognised, especially since the climatic conditions in Cameroon are suitable and there is sufficient land available for cultivation. However, production is still in its infancy and is progressing slowly due to challenges in infrastructure and organisation. Thus, large scale cultivation still remains a future goal.

### Scale of Jatropha Cultivation

	Expert Estimate	Projects identified
current	1,000 ha	3,000 ha
2010	8,300 ha	10,000 ha
2015	13,500 ha	20,000 ha

### Project Ownership



### Government Programs

Government regulations concerning biofuels or Jatropha are currently being discussed.

No special investment schemes exist at the moment, but there are tax incentives for Agroindustrial companies which export 80% of their products.

Capacity building is being created in the form of sensitisation programs within the context of renewable energy and rural electrification.

### Incentives for foreign investors

Foreign investment is promoted in all economic sectors of Cameroon through the Investment Code of 2002, which guarantees 100% foreign shareholding, capital transfer with no restrictions and tax incentives.

The government is explicitly inviting foreign firms such as D1-BP Fuel Crops to explore the field of Jatropha in Cameroon.

### NGO-Initiatives

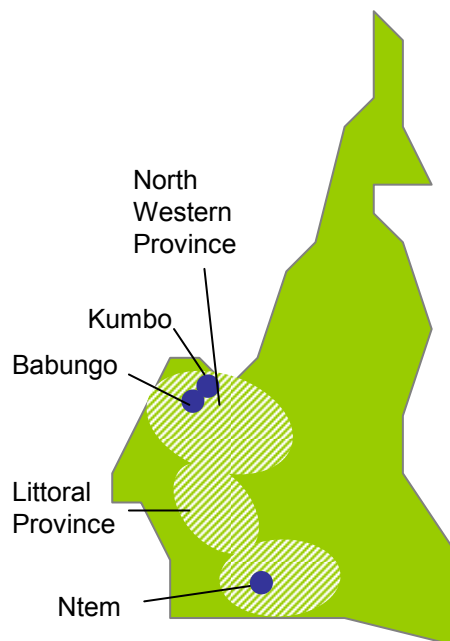
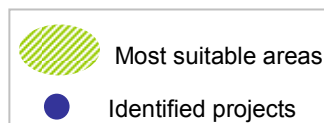
Several non-governmental organizations are promoting Jatropha in Cameroon, for example the GREENERY Association (<http://www.greenerly-cm.org/index.html>) that establishes links between smallholder farmers and commercial operations.

## 4-2 Africa – Cameroon

### Regional Distribution

Jatropha can potentially be grown in all areas of Cameroon. The northern part of Cameroon with its savannah regions is significantly dryer and hotter than the rest of the country. Thus, plantations there would be less promising with regard to harvest yield.

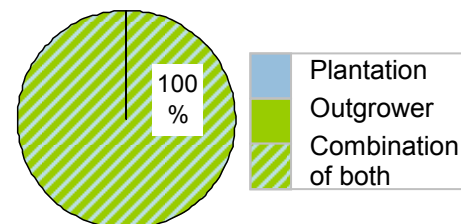
Most of the identified projects are located in the north-western province, which is very suitable for Jatropha cultivation.



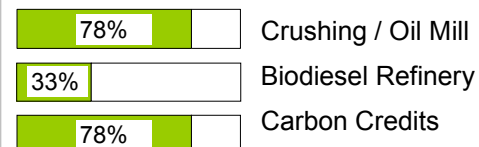
### Project Evaluation

- All projects identified use nurseries to obtain their Jatropha bushes. One project is working with bees for pollination.
- Irrigation methods are still being established. Almost no irrigation takes place; if it does, manual irrigation schemes prevail. Intercropping as well as fertilisation is reported to be used by half of the projects.
- All projects plan to set up their own oil milling facilities. None of them is planning to set up their own refinery yet.
- All of the projects are growing Jatropha in medium to rich soil on land which in 50% of the cases has not been used before.
- 75% of the projects plan to use carbon credits, mainly CDM under the UNFCCC scheme.

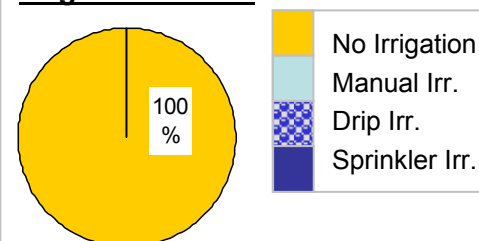
### Plantation Model



### Value Chain Elements



### Irrigation Models



### Prices

Seeds (per kg /dry)	0.5 \$
Labour (per day)	3 \$
Diesel at pump	1.4 \$

4 experts interviewed  
4 projects analysed

## 4-2 Africa – Cameroon



Project	Source	Type	Project Location	Ha (2008)	Ha (2015)
GIC-MAPER	1		Littoral Province	0	10,000
FairTradeFuel	1		North West Province (Mbohnso)	2,000	
Greenery Associated	1		North West Province, Kumbo	1,000	30,000
Aleri Integrated Farms CIG	1		Ntem (South Province) & Babungo (North West Province)	20	60
<b>Acreage non-disclosed projects</b>				5	15,000
<b>Total</b>				<b>3,025</b>	<b>57,060</b>




- Commercial project
- Non-commercial project

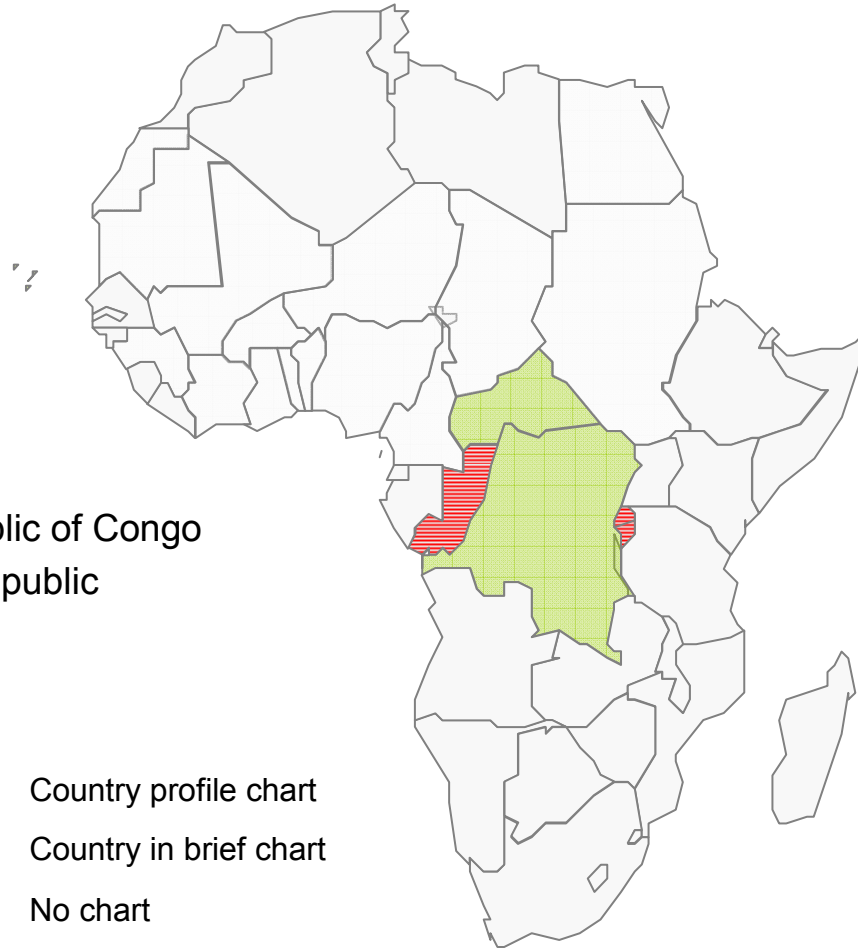
- 1 Interview / Questionnaire with project representative
- 2 Interview / Questionnaire with external project expert
- 3 Public sources

## 4-2 Africa – Central Africa

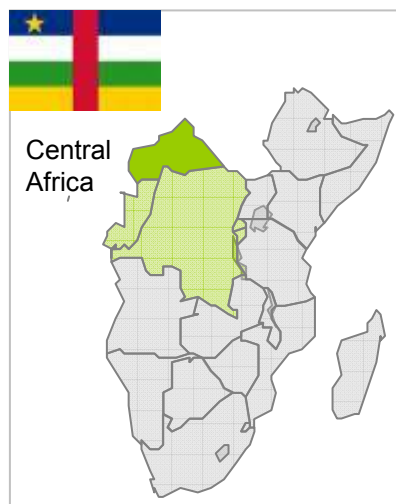
### Country Index

Democratic Republic of Congo  
Central African Republic

-  Country profile chart
-  Country in brief chart
-  No chart



## 4-2 Africa – Central African Republic & DR Congo

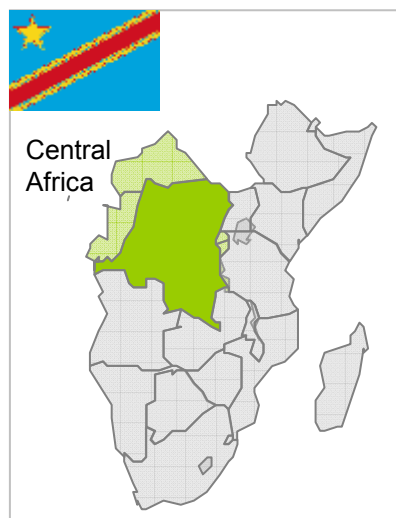


### Central African Republic

☒ Jatropha exists ☒ Jatropha locally used ☐ Commercially farmed

**Policies:** The government of the Central African Republic is not supporting Jatropha.

**Projects:** The main use of Jatropha in the Central African Republic to date is the collection of wildly growing seeds and the direct local use, for example for medical purposes. Very few pilot plantations are being established at the moment.



### Democratic Republic of Congo

☒ Jatropha exists ☐ Jatropha locally used ☐ Commercially farmed

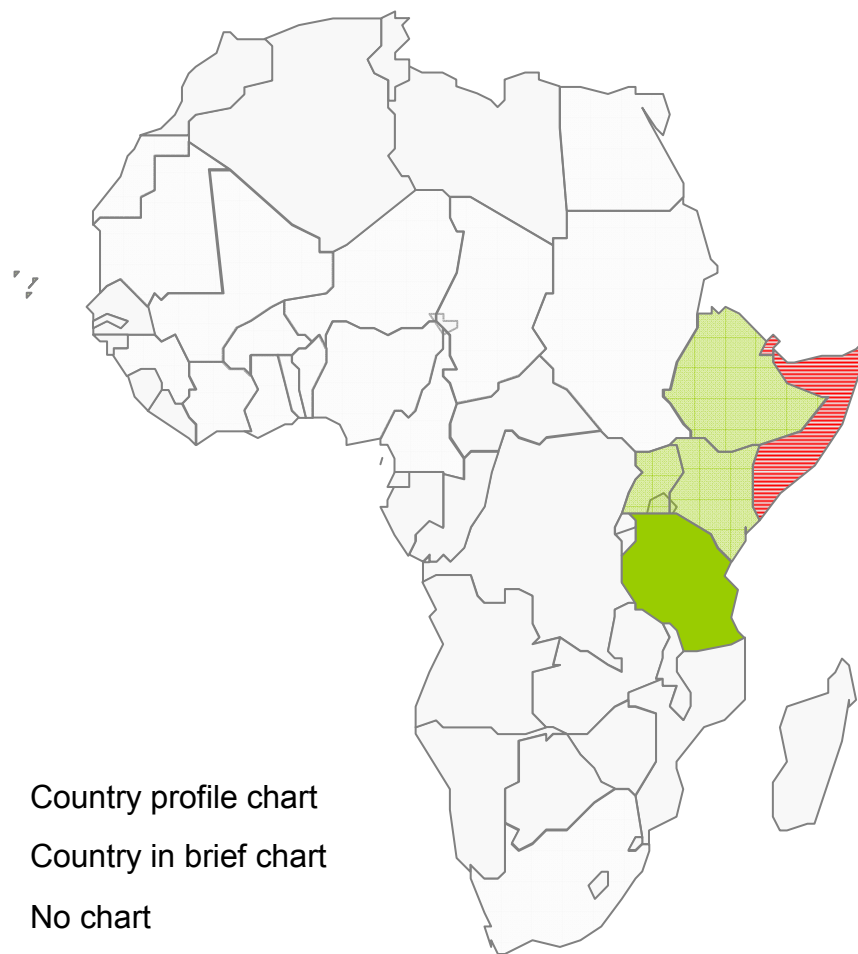
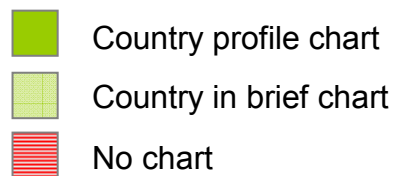
**Policies:** No specific policy on jatropha has been reported

**Projects:** The climate for jatropha is very favourable to cultivate jatropha in Central Africa; however, no projects could be identified. Jatropha does not seem to play a significant role as a future industry in the Democratic Republic of Congo. As Jatropha yields less than oil palms, Jatropha will not be a major energy crop in regions where oil palms could be cultivated.

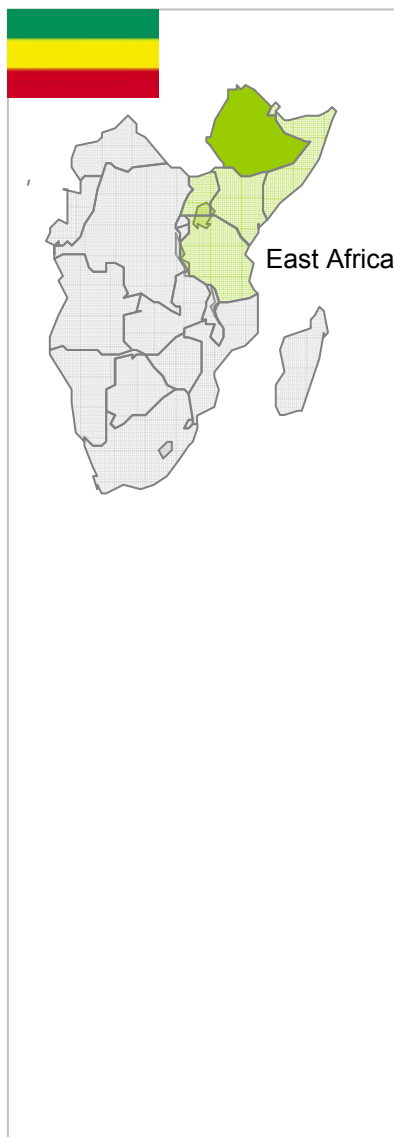
## 4-2 Africa – East Africa

### Country Index

Ethiopia  
Uganda  
Kenya  
Tanzania



## 4-2 Africa – Ethiopia



### Ethiopia

☒ Jatropha exists   ☐ Jatropha locally used   ☒ Commercially farmed

**Policies:** Government actively encourages the cultivation of Jatropha. A Biofuels Program has been introduced - specifically including Jatropha - in order to further the independence of the country from oil imports. It designates marginal land for Jatropha cultivation. Government officials of the Ministry of Mines and Energy report that a biofuel legislation for blending fuel (benzene and ethanol) will come into force mid 2008.

Foreign direct investment into biofuel production is actively encouraged through furthering land access, enabling bank loans, through tax incentives as well as through technical assistance for farmers.

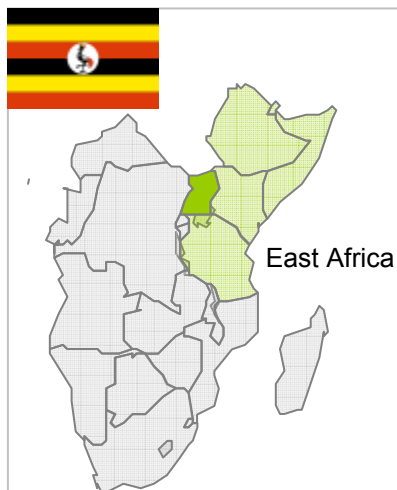
Jatropha cultivation is expected to improve food availability through bio-oil run irrigation and food-drying schemes as well as fertilisation with seed cake. Intercropping with food crops is reportedly mandatory.

**Projects:** The Government has identified almost 24 million ha of land suitable for Jatropha and Palm Tree cultivation in the states Oromia, Benishangul Gumuz, Gambella, Somali, Amhara Southern Nations, Nationalities and Peoples Region (SNNPR) and Tigray and Afar Regional states. Oromia has the largest land suitable for bio-fuel development with 17.2 million ha. The land is, according to the government, neither used for farming nor for grazing.

Country experts estimate the current land under Jatropha cultivation as 1,700 ha. This number is very likely to rise significantly as several foreign investors have applied for or already secured land titles. According to public sources, five Jatropha projects have already gone operational. Among the major investors are, according to public sources, Sunbiofuels, Global Energy and BioX Group.



## 4-2 Africa – Uganda



### Uganda

☒ Jatropha exists    ☒ Jatropha locally used    ☒ Commercially farmed

**Policies:** The Government is reported to intend a detailed study on biofuel plantations, production, use as well as down-streaming issues. A fuel-legislation exists for a 20% blend of biofuels – it is currently not enforced.

**Projects:** No substantial Jatropha cultivation or biofuel production is taking place in Uganda at present, but country experts report potential.

Three projects have been identified – all of them private undertakings.

(1) One project set up in 2008 is planning to expand to 14,500 ha in 2010.

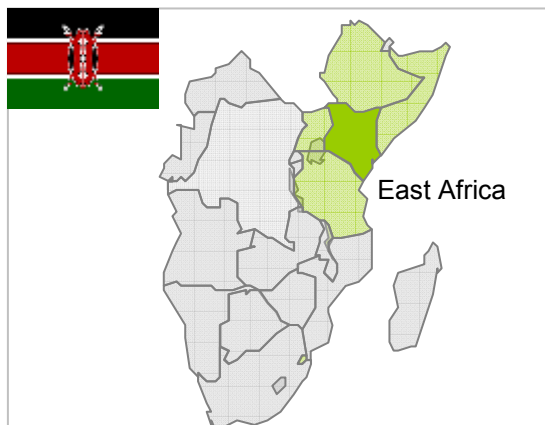
(2) The company EA Uganda Ltd. has set up a test plantation of 1-2 ha in 2007 in the Mukono District and on two further farms in Moyo District (West Nile Province). If promising yields are achieved, an oil expeller will be purchased for 2008/09 for test production. Biodiesel production is planned for 2010/2012 with various expellers in West Nile Province.

Jatropha products to be used are plant oil, shells and residue for compost and methane gas production. Project partners are the Makerere University and the GTZ Uganda for developing capacity in oil expelling and use of residue. Research activities are to be included in the project in future, focusing on the identification of high yielding plants, fertilisation requirements, pruning, spacing and intercropping.

(3) According to recent public sources, the private company Royal Van Zanten has set up a 40 ha Jatropha plantation in Mukono District and runs outgrower schemes with vanilla farmers (intercropping) in the districts of Mukono, Kayunga, Jinja, Iganga, Kamuli and Bugiri.



## 4-2 Africa – Kenya



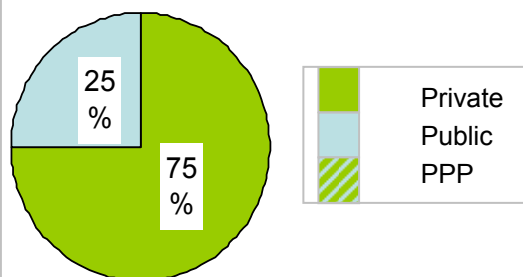
### Summary & Comments

Country experts see great potential for investors, due to the favourable climate and Kenya's long-standing experience as a producer of high quality agricultural products such as tea and coffee. The Government is currently working on support schemes and actively encourages foreign direct investment. However, the lack of a guaranteed market, processing outfits and extension services for farmers are current obstacles for investment. Experts say, that research results (on seeds quality, cultivation techniques and good social & environmental practice) should be made more easily available for farmers.

### Scale of Jatropha Cultivation

	Expert Estimate	Projects identified
current	4,480 ha	780 ha
2010	21,000 ha	362,530 ha
2015	152,600 ha	416,650 ha

### Project Ownership



### Government Programs

#### **Jatropha / Biofuel Legislation**

Jatropha cultivation is not yet directly supported. The Government is currently drafting a biofuel strategy.

A national Task Force on Jatropha cultivation has been set up under PIEA's (Petroleum Institute of East Africa) lead. It reportedly focuses on the interests of small and large scale Jatropha growers, will manage the entry of biofuels into the local market and study options in the carbon market (sale of carbon credits & local certification).

#### **Barriers for Investment**

The country has, according to experts, not yet devised and implemented a comprehensive framework to encourage Jatropha investment as well as to protect consumer rights, communities and the environment.

#### **NGO-Initiatives**

Green Africa Foundation set up a pilot project. Focal point for foreign investors (BIWAKO), Vanilla-Jatropha Development Foundation, UNDP, private investors

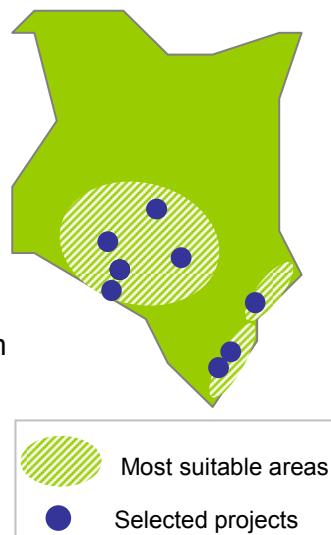
## 4-2 Africa – Kenya

### Regional Distribution

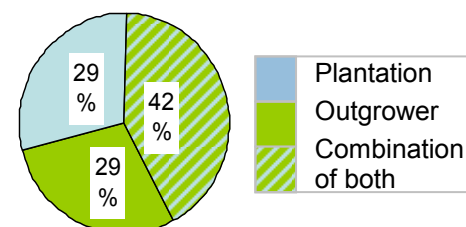
Jatropha is well known in Kenya – it is actively cultivated for use in the energy and transport sector (biodiesel, plant oil, biogas) and for local use (soap production).

Jatropha is mainly grown in Kenya's Highland Region where the most fertile soils and a temperate climate prevail. It is also cultivated in the southern coastal region which shows a warm and humid climate. Rainfall is seasonal with most rain occurring from April-June and short rains from October-December.

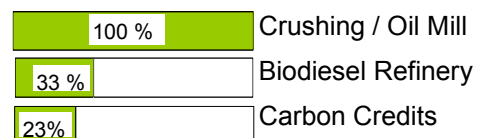
Districts where Jatropha is reported to exist or to be cultivated include Kitui, Thika, Namanga, Kajiado, Nakuru, Marakwet, Naivasha, Meru as well as Ukambani, Laikipia and Sabaki.



### Plantation Model

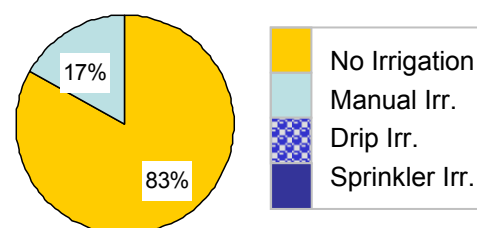


### Value Chain Elements\*



\*Estimates / Project Information

### Irrigation Models



### Prices








Seeds (per kg /dry)	\$0.16-2.5
Labour (per day)	\$1.54
Diesel at pump	\$1.54



5 experts interviewed  
8 projects analysed

### Project Evaluation

- In Kenya, small-scale cultivation of Jatropha (<5 ha) and pilot plantations play the most important role today. Country experts expect a significant growth of medium-scale plantations (<1,000 ha) and a slight increase of large-scale cultivation (> 1,000 ha).
- Plantations with intercropping schemes and those set up for reforestation purposes are frequently reported.
- The majority of projects analysed (75%) are privately owned. However, approximately 60% are not-for-profit schemes. Most projects are devised as a combination of plantation and outgrower schemes.

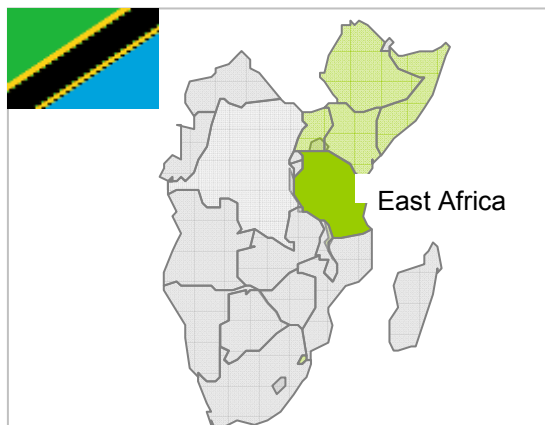
## 4-2 Africa – Kenya

Project	Source	Type	Project Location	Ha (2008)	Ha (2015)
Green Africa Foundation	3		Kitui District	400	-
Green Power	3		Isenya & neighbouring districts	200	6,000
Africa Energy Ltd.	1		- not specified -	100	10,000
UNDP GEF	1		Mawindi and Kwane District (Coast)	70	240
Nyumbani Village	3		Kitui District	10	-
Biwako Bio-Laboratory, Hydronet Energy Company Ltd. and Green Africa Foundation	3		- not specified -	0	75,000
World Agroforestry Centre - Research	1		- not specified -	-	-
<b>Acreage non-disclosed projects</b>				0	325,410
<b>Total</b>				<b>780</b>	<b>416,650</b>

-  Commercial project  
 Non-commercial project

- 1 Interview / Questionnaire with project representative  
2 Interview / Questionnaire with external project expert  
3 Public sources

## 4-2 Africa – Tanzania



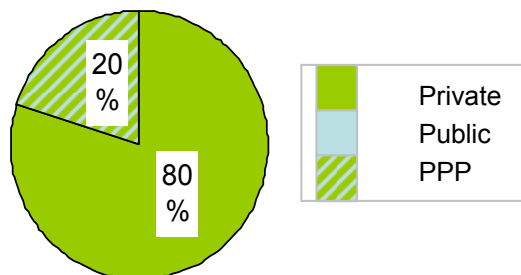
### Summary & Comments

Compared to other South and East African countries, Tanzania appears advanced in number and acreage of projects. Country experts assume a large potential for Jatropha cultivation in Tanzania – a view shared by project owners, who predominantly give ambitious plans for growth until 2015. The investment climate is regarded as very advantageous. Especially foreign direct investment is actively encouraged through the Tanzanian Investment Centre, facilitating land acquisition and administrative processes. Financial incentives regarding taxes and duties are given for investors.

### Scale of Jatropha Cultivation

	Expert Estimate	Projects identified
current	11,714 ha	17,640 ha
2010	34,286 ha	69,870 ha
2015	116,000 ha	620,110 ha

### Project Ownership



### Government Programs

At present, Tanzania is lacking clearly defined quality standards for biofuel and a clear regulation for the sale of Jatropha biofuels, according to country experts.

### Other means of support

The Tanzania Investment Centre maintains a database of suitable land for Jatropha. It offers a one-stop shop to facilitate land acquisition as well as permitting and registration processes. Advantageous tax and duty conditions are offered. The Tanzania Investment Act (1997) grants investors full rights to buy and sell land.

### Infrastructure Improvement

The Government has earmarked funding for infrastructure development, as weak infrastructure has been reported to hinder project development.

### NGO-Initiatives

There are several NGOs involved in Jatropha cultivation and promotion. The most prominent are Kakute Ltd. and TATEDO. Country experts also mention WEDECA, TAF, FAIDA MaLi as main non-governmental players. The majority of projects is privately owned.

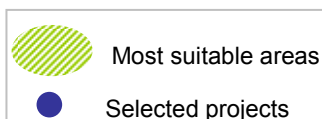
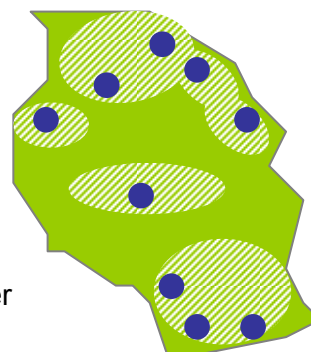
## 4-2 Africa – Tanzania

### Regional Distribution

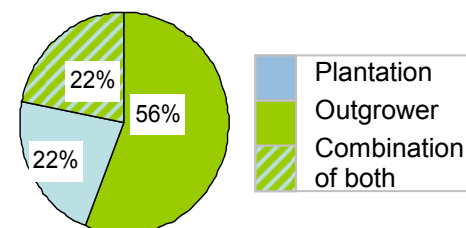
Almost all regions in Tanzania feature a climate that is well suited for Jatropha cultivation. Projects were mainly identified in the northern and southern part of the country.

Biannual rainy seasons are found along the northern coast and in the north-western highlands along the Kenyan border, with rains from November to December and February to May. In the latter region, temperate climate prevails.

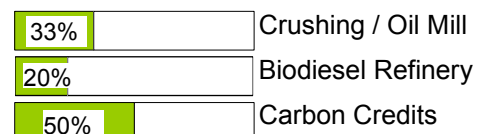
The central and southern coastal regions have a warmer and more humid climate with rains from March to June. In the central plateau regions the climate is arid with moderate temperatures in the south-western areas.



### Plantation Model

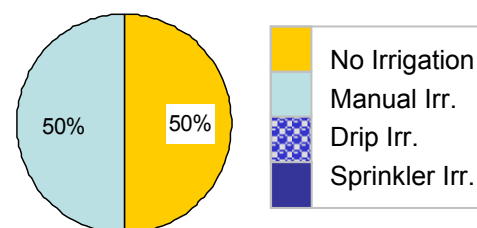


### Value Chain Elements\*



\*Estimates/ Project Information

### Irrigation Models



### Prices

Seeds (per kg /dry)	\$0.1 - 0.18
Labour (per day)	\$1 - 2.5
Diesel at pump	\$1.4










8 experts interviewed  
9 projects analysed

### Project Evaluation



- The large majority (80%) of projects identified is privately owned and profit-oriented. Contracting outgrowers is the most dominant scheme. Some projects combine this scheme with plantations.
- Only a third of Jatropha projects include seed crushing into their project; even less aim at Biodiesel production.
- Research activities are generally low, but reported to be stepped up with focus on high yield species, fertilisation and cultivation techniques.
- Irrigation (mainly manual) is used by more than half of the projects.
- Weak infrastructure appears to pose problems to project development.

## 4-2 Africa – Tanzania



Project	Source	Type	Project Location	Ha (2008)	Ha (2015)
PROKON	1		Not disclosed	-	-
Diligent Energy Systems	1			3,000	200,000
SafiAnzania	1		Not disclosed	-	-
Not disclosed	3		Not disclosed	300	-
Kilimanjaro Biofuels	3		Central region	160	-
KAKUTE	1			150	800
InfEnergy Ltd.	1			20	-
Kikuletwa	1		Tanga / Pwani Region	10	-
Sun Biofuels	2		Not disclosed	-	-

<b>Acreage non-disclosed projects</b>	14,000	419,310
<b>Total</b>	<b>17,640</b>	<b>620,110</b>

-  Commercial project
-  Non-commercial project

- 1 Interview / Questionnaire with project representative
- 2 Interview / Questionnaire with external project expert
- 3 Public sources

## 4-2 Africa – Southern Africa and Madagascar

### Country Index

Angola

Namibia

South Africa

Botswana

Zimbabwe

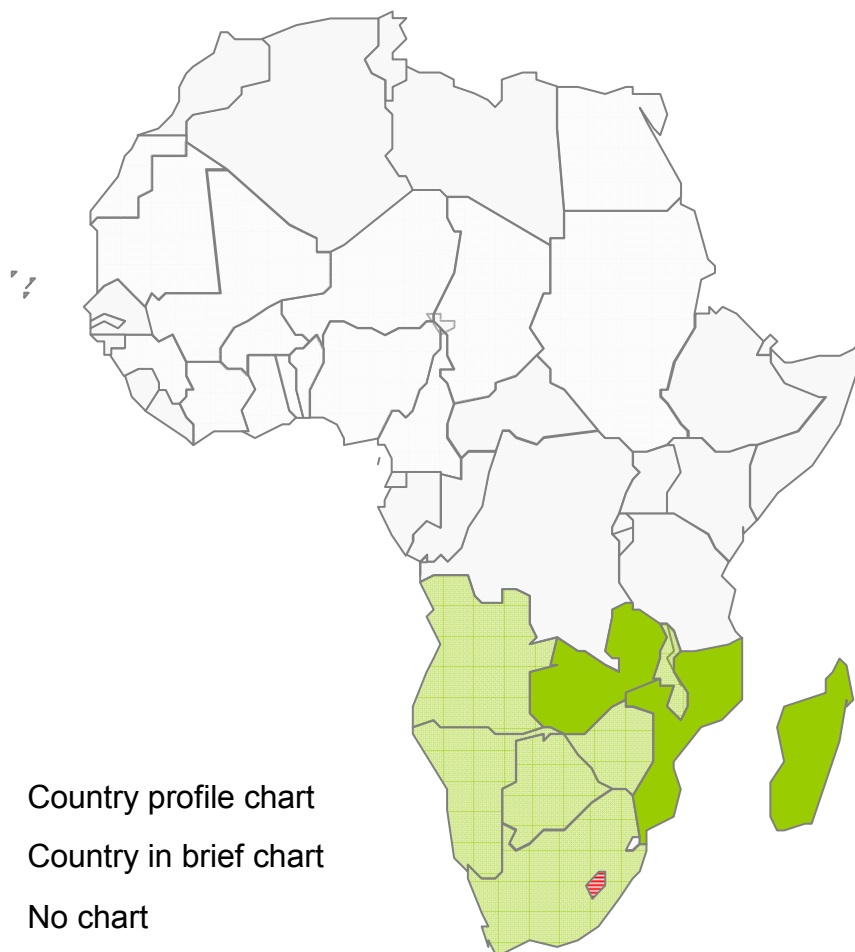
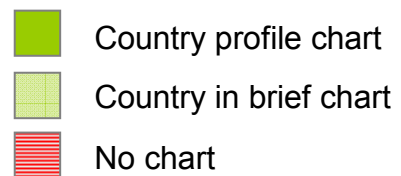
**Zambia**

Malawi

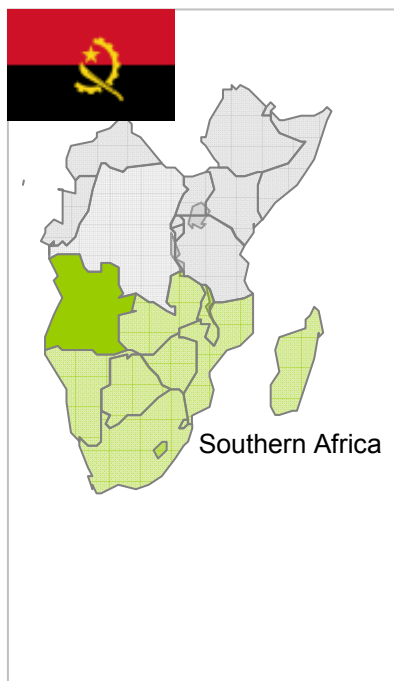
**Mozambique**

Swasiland

**Madagascar**



## 4-2 Africa – Angola



### Angola

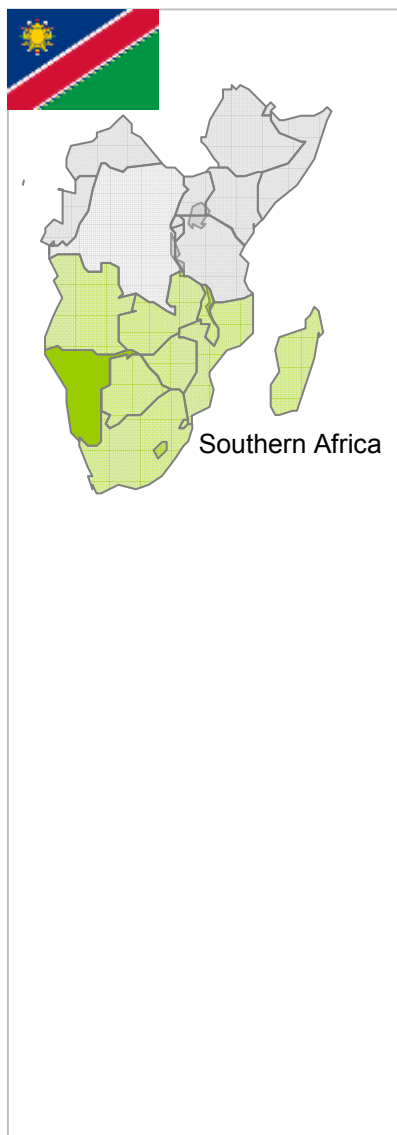
☒ Jatropha exists   ☐ Jatropha locally used   ☒ Commercially farmed

**Policies:** At present, there is no legislation or governmental program supporting biofuels or the cultivation of respective crops. In March 2008, the Ministry of Agriculture and Rural Development invited stakeholders for bio-energy to participate in a workshop. The results of the workshop are meant to serve as input for the drafting of a National Strategy on Biofuels.

**Projects:** Country experts interviewed were not aware of Jatropha cultivation in Angola. Internet sources suggest large-scale cultivation plans of biofuel crops by the Portuguese company GALP Energy and the Angolan Oil company Sonangol. However, it could not be established whether the cultivation plans included Jatropha. Also, the information could not be confirmed otherwise.



## 4-2 Africa – Namibia



### Namibia

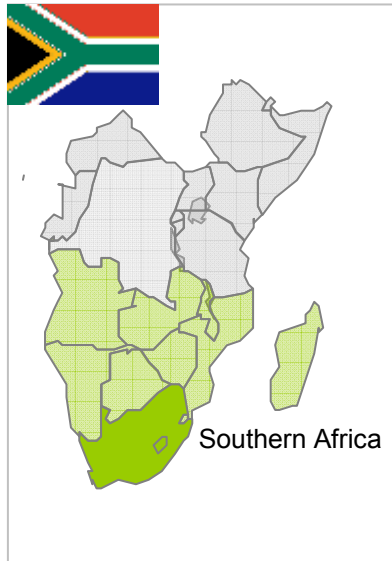
☒ Jatropha exists   ☐ Jatropha locally used   ☒ Commercially farmed

**Policies:** So far, no governmental policy or legislation on Jatropha or biofuels exists. The Government, however, has expressed its intent to promote biofuels in future and has conducted a survey, which identified Jatropha as the most viable of biofuel crops. The Government target for Jatropha cultivation was set at 63,000 ha until 2013.

The Agronomic Board of Namibia sees biofuel crops confined to the north-eastern part of the country, where annual precipitation is relatively high and where large tracks of land are available. The regions Kavango and Caprivi are named as promising for Jatropha cultivation. The Agronomic Board sees potential problems for the development of a biofuels industry in the competition for land, security of tenure in communal areas and the risk of further land degradation. Several applications for land use for biofuel crops have been received – however, the Agribank of Namibia has not yet granted any loans for such projects.

**Projects:** A number of small-scale projects have been identified, either in order to provide an alternative energy source for own consumption on farms or for forestation purposes. Country experts estimate current acreage as 10-30 ha, mainly on former wasteland. Manual irrigation is reported to be the most prevalent scheme. There exist plans for large-scale cultivation of Jatropha. Two projects are expected to start in 2008, with ambitious targets aiming at 100,000 ha (year 2010) and 300,000 ha (year 2015). One downside for project development is that the Government has not yet set up a NDA (National Designation Authority) which is required by UNFCCC for the accreditation process for CDM Credits.

## 4-2 Africa – South Africa



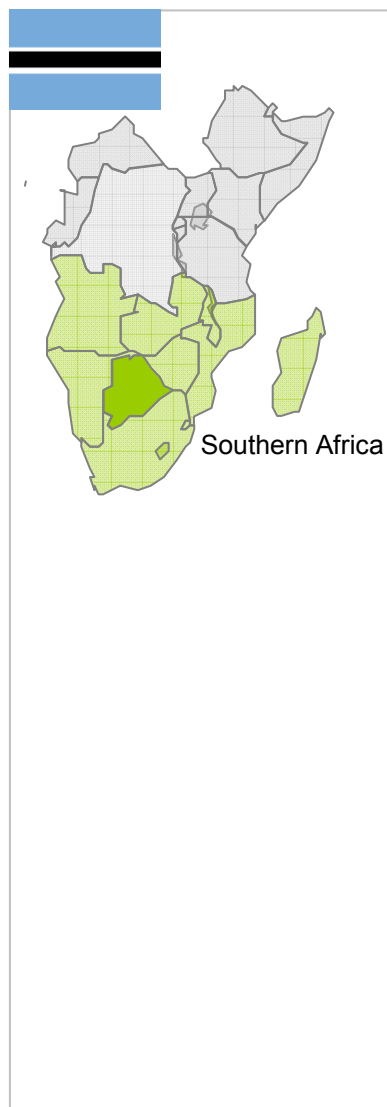
### South Africa

☒ Jatropha exists   ☐ Jatropha locally used   ☐ Commercially farmed

**Policies:** The Government of South Africa has declared Jatropha an invasive species. Thus, Jatropha is specifically excluded from any governmental support until at least 2013. Cultivation as a commercial crop is banned. However, there are a number of miniscule local pilots currently implemented through non-governmental organisations. South Africa regularly hosts biofuel conferences where the potential of Jatropha as an energy crop for Southern Africa is part of the agenda.

**Projects:** Country experts estimate that currently 400 ha are farmed with Jatropha in South Africa. They see a great potential for the cultivation of the crop on degraded lands.

## 4-2 Africa – Botswana



### Botswana

☒ Jatropha exists   ☐ Jatropha locally used   ☐ Commercially farmed

**Policies:** Botswana has not yet established bio-energy policies and strategies. However, the Government commissioned a feasibility-study in June 2006 on the perspectives of biofuels in Botswana, which recommended *Jatropha curcas* as one suitable option besides sweet sorghum. They could be grown in the Central District of the country, where land is available for these crops. It is suggested that the fuel could only be economically competitive if current levies were reduced by 75%.

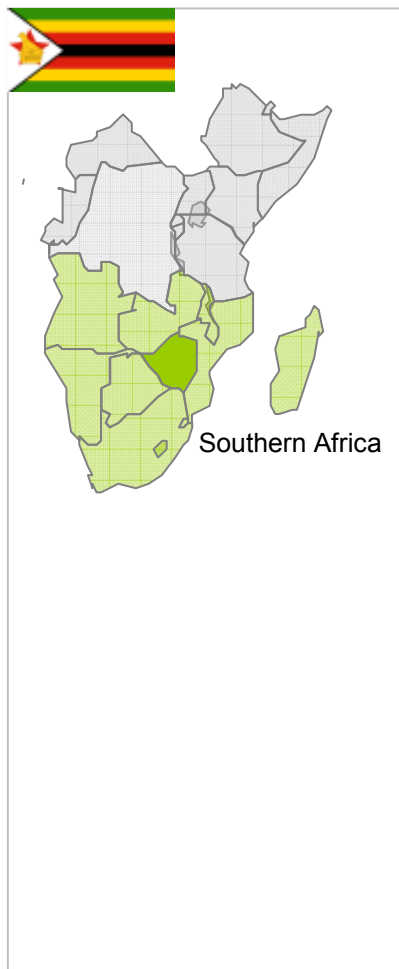
The Ministry of Energy is currently preparing an international conference on liquid biofuels and the part they play for development to be held in 2008. A draft policy on liquid biofuels is expected to be presented there for discussion. The focus will presumably be on the promotion of sustainable land use and harvesting of biomass energy.

**Projects:** No major Jatropha cultivations are currently reported for Botswana. This finding is in line with country expert views: Current acreage is given as zero. No estimate for the future development of cultivation is provided.

One pilot project has been set-up by SEDICHEM since 2006 as a public-private-partnership.

The general agro-climatic conditions in Botswana are reported to be advantageous for Jatropha cultivation. Problems with legal matters, bureaucracy or corruption were mentioned.

## 4-2 Africa – Zimbabwe



### Zimbabwe

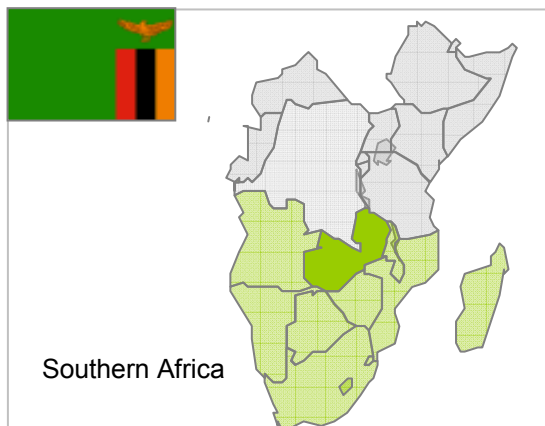
- ☒ Jatropha exists   ☒ Jatropha locally used   ☒ Commercially farmed

**Policies:** Since 2005, the Government of Zimbabwe has strongly promoted the cultivation of Jatropha as an alternative source of diesel in order to overcome the frequent fuel shortages in the country. The Ministry of Energy and Power Development as well as the National Oil Company of Zimbabwe (NOCZIM) were put in charge of the government program. A Jatropha Growers and Bio-fuels Association was founded to provide information and technology to farmers. All farmers with more the 5 ha of land are allowed to participate in the scheme. Cultivation must be on degraded land only, in order to not impair food production.

The Government target is to produce 10% of the country's fuel demand through Jatropha until 2010. All districts are expected to set up Jatropha schemes and to produce seeds until 2010. The Government said it would set aside 40,000 ha of land for Jatropha production. Seedlings are provided by NOCZIM and the Forestry Commission.

**Projects:** Current acreage is still low despite the strong Government support. Country experts estimate a current 6,000 ha under Jatropha cultivation. However, projects identified in this study amount to 107 ha. Jatropha is reported to grow well in Matabele Land and Masvingo region.

## 4-2 Africa – Zambia



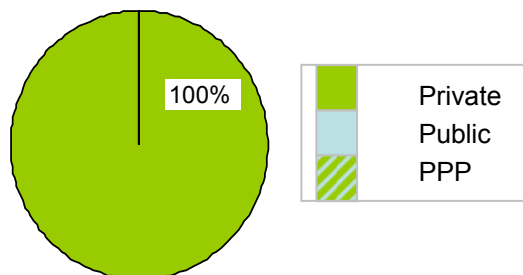
### Summary & Comments

Opportunities for Jatropha cultivation and Biofuel production are considered very promising, as a lot of unused land and degraded bush land is available. The climate is advantageous. It is regarded as well as a possible means of rural poverty alleviation. Local experts estimate a swift increase of cultivation from currently ~6,000 ha to ~155,000 ha in 2015. Whether this potential can be realised apparently depends on the Governments' decision to allow large-scale cultivation and to implement a comprehensive program for Biofuel production and sale. Reportedly, the Government is currently studying the potential toxicity of Jatropha to soils and might curtail cultivation.

### Scale of Jatropha Cultivation

	Expert Estimate	Projects identified
current	6,125 ha	35,222 ha
2010	49,000 ha	78,792 ha
2015	134,250 ha	154,692 ha

### Project Ownership



### Government Programs

#### Jatropha / Biofuel Legislation

No specific governmental program or legislation on Jatropha or Biofuels currently exists. The Government has set up a Task Force Committee on Renewable Energy, composed of members of ministries and business representatives. It is working on targets, incentive schemes and capacity building programs for the Biofuels industry.

#### Governmental Target

One expert mentions a target of 150,000 ha for 2015.

### Other means of support

Investment is promoted through various regulations, support with negotiations for land titles and project facilitation through funds.

#### Barriers for Jatropha investments

Mainly import restrictions on seeds as well as slow and uncertain land tenure processes.

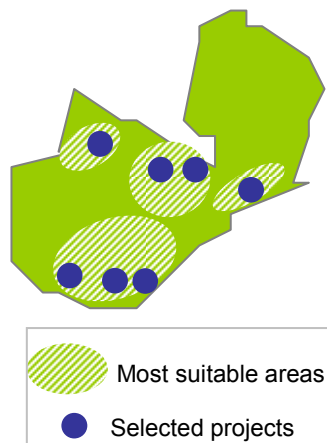
#### NGO-Initiatives

Reportedly, the Biofuels Association of Zambia, SNV (Dutch development agency), FOSUP and DAPP Foundation work on Jatropha.

## 4-2 Africa – Zambia

### Regional Distribution

Jatropha hedges are well known in the regions bordering Mozambique as protection against cattle. In the Southern Province near Lake Kariba, Jatropha plants have been introduced by Zambian workers returning from Zimbabwe. Projects have been identified mainly in western and central regions. Due to the higher altitude of most of Zambia, the climate is mainly temperate. High temperatures are found only in the valleys of the Zambezi, Luangwa and Kafue and the shores of lakes Tanganyika, Mweru and Bangweulu.

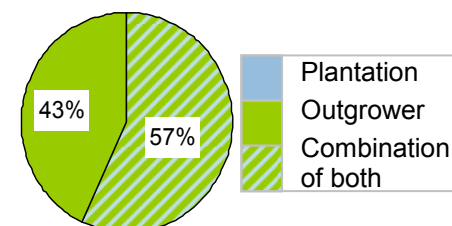


There are three distinct seasons with wide variations in temperature and precipitation. The cool season is from May-August; October has highest temperatures. The main rainy season with heavy tropical storms lasts from mid-November-April. Northern and north-western provinces see more rain than the south.

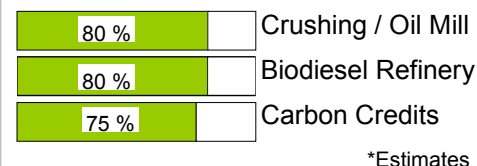
### Project Evaluation

- Cultivation of Jatropha is mostly done through smallholder farmers and to far lesser extent in medium- to large-scale plantations.
- All projects identified are privately owned; About 85% are profit-oriented.
- Jatropha plantations do not play a major part: projects mainly rely on outgrower schemes or a combined outgrower-plantation scheme.
- Projects are well embedded in local structures with over 80% of projects implemented with local partners.
- Value-creating steps such as outgrowing, seed crushing and biodiesel production are included into the great majority of projects.
- Use of Carbon credits from voluntary schemes or of CDM is common.

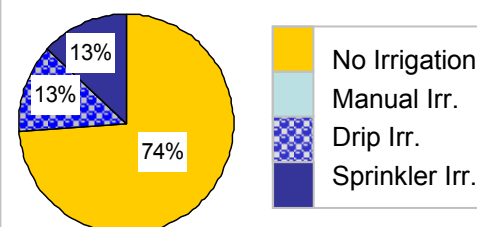
### Plantation Model



### Value Chain Elements\*



### Irrigation Models










### Prices



Seeds (per kg /dry)	\$ 0.17
Labour (per day)	\$ 2.65
Diesel at pump	\$ 1.65

6 experts interviewed  
6 projects analysed



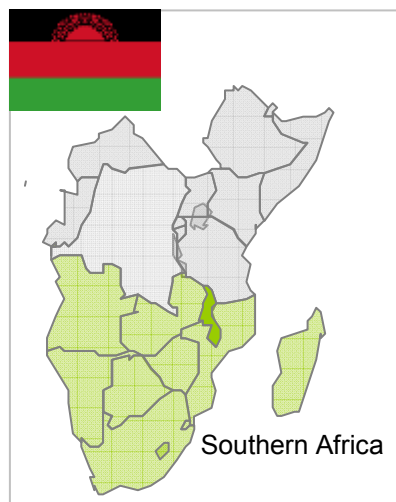
## 4-2 Africa – Zambia

Project	Source	Type	Project Location	Ha (2008)	Ha (2015)
D1-BP Fuel Crops	1		Not disclosed	25,525	-
Marli Investments	1		Kabwe District	8,500	21,000
Sherriff Estates	1		Not disclosed	10	2,000
Jatrafuel	1		Not disclosed	0	100,000
Oval Biofuels	3		Mulungushi Plantation, nurseries in Central, South-West and North-West	-	5,000
DAPP Foundation	1		Chibombe District	-	-
Not disclosed	3		Not disclosed	-	-
<b>Acreage non-disclosed projects</b>				1,187	26,692
<b>Total</b>				<b>35,222</b>	<b>154,692</b>

-  Commercial project  
 Non-commercial project

- 1 Interview / Questionnaire with project representative  
2 Interview / Questionnaire with external project expert  
3 Public sources

## 4-2 Africa – Malawi



### Malawi

- ☒ Jatropha exists    ☒ Jatropha locally used    ☒ Commercially farmed

**Policies:** A legislation on biofuels already exists in Malawi, focusing on ethanol. It is currently opened up to include Jatropha and other biofuel crops. A Government task force has been set up with representatives from the Departments of Energy, Forestry and Agriculture. Jatropha must be grown on degraded land or as fences to prevent impediment of food production.

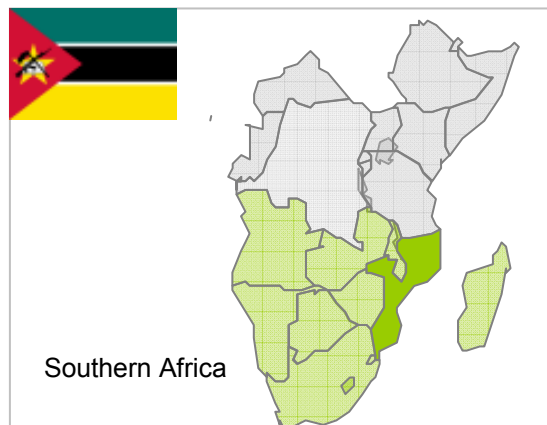
**Projects:** Jatropha (locally Msatsimanga) is frequently planted as hedges - mainly Dedza and Ntcheu Districts. For commercial exploitation, small-scale plantations with intercropping and plantations of up to 1,000 ha are the prevailing schemes.

Country experts report 1,500 ha to be currently farmed and expect a growth to 84,000 ha and 226,000 ha (2010 and 2015 respectively). Several small-to-medium sized projects with a total current acreage of 4,500 ha have been identified. They are predominantly privately owned and commercial outgrower schemes - sometimes in combination with plantations. Main Jatropha products are plant oil (biodiesel, pure plant oil, soap production) and seed cake. Cultivation is reported to be low maintenance with no irrigation and few fertilisation.

The largest project identified (2,000 ha) is operated by Bio Energy Resources Ltd. near Salina and in the Nkhotakota area. Biodiesel Agriculture Association currently cultivates 200 ha; Green Biopower cultivates 150 ha. Plans for a large-scale outgrower program are reported for Stancom Tobacco Ltd. The organisation C3 set up an outgrower scheme and nurseries near Salina. Social and environmental projects are conducted by DAPP and Active Aid (Lower Shire District).



## 4-2 Africa – Mozambique



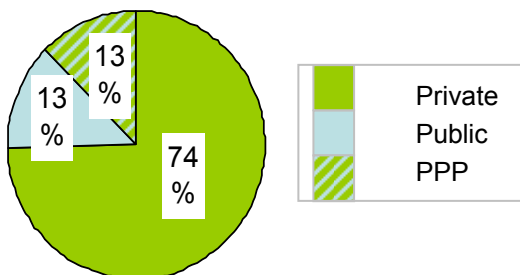
### Summary & Comments

The climatic and political situation in Mozambique is in general considered favourable for commercial Jatropha cultivation. Local experts suggest a significant increase in Jatropha cultivation to 170,000 ha by 2015. Project owners as well state optimistic plans for growth – especially for commercial plantations. The Government is in general regarded as open for Jatropha investments. But since it was “flooded” with large numbers of land requests of up to 1 million ha, land approval processes have reportedly been put on hold since mid 2007. A land survey is currently being prepared to identify land suitable for biofuel crops. Priority is given to food production.

### Scale of Jatropha Cultivation

	Expert Estimate	Projects identified
current	7,000 ha	7,887 ha
2010	35,000 ha	33,715 ha
2015	170,000 ha	405,415 ha

### Project Ownership



### Government Programs

#### **Jatropha / Biofuel Legislation**

No specific governmental program or legislation supporting Jatropha cultivation exists.

#### **Other means of support**

Country experts report that the Government is in generally supportive towards Jatropha. A Jatropha Task Force has been set up. Land acquisition was facilitated until mid 2007. Reportedly, ~35,000 ha have been set aside for biofuel projects, mainly in the provinces Gaza, Inhambane, Sofala and Nampula. The Province of Nampula apparently set targets for Jatropha cultivation.

### **Barriers for Jatropha investments**

Due to a huge amount of requests for land for Jatropha cultivation, the Government put processes for land approval on hold. It is currently conducting a land survey to identify suitable marginal land. This is to ensure that no conflict with food production occurs.

### **NGO-Initiatives**

GTZ and Technoserve provide biofuel / Jatropha surveys until mid 2008. Main Jatropha players mentioned are: ESV Bio Africa, Energem, Enerterra, C3 and ADPP/ Fact Foundation.

## 4-2 Africa – Mozambique

### Regional Distribution

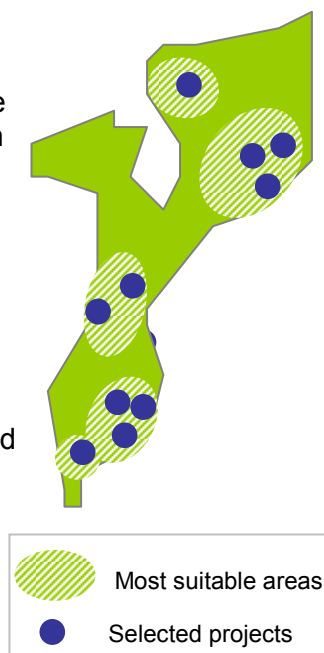
The vast majority of Jatropha projects is found in the southern provinces Inhambane and Gaza, the central provinces Sofala and Manica as well as in the Northern Provinces of Nampula.

Climatic features in these regions are reported advantageous for Jatropha cultivation, especially the sandy soils of Inhambane and Gaza.

Some local experts reported a lower growth rate for Jatropha on sites in the central-western area, which may be related to soil characteristics.

Mozambique has two distinct seasons – a wet and warm period from October-March and a dry and cooler season from April-September.

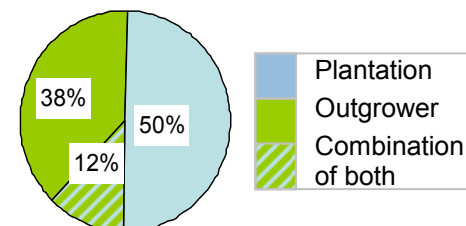
The northern-central and northern regions see more rainfall than the southern areas (including Inhambane Province). The interior uplands have cooler temperatures than the coastal regions.



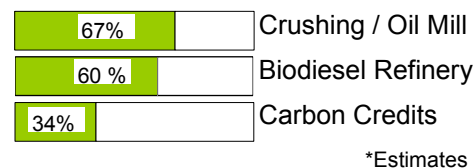
### Project Evaluation

- Smallholder schemes dominate, followed by commercial plantations <1,000 ha and pilot plantations. In the next five years, medium to large-scale plantations are expected to increase significantly.
- 75% of projects identified are privately owned; 86% are profit-oriented.
- Jatropha products related to the international and domestic transport and energy market are given highest importance.
- Most projects include seed crushing and biodiesel production.
- Cultivation schemes are mainly high-maintenance with mostly manual irrigation and also drip irrigation schemes. Fertilisation prevails.
- Participation rate in the Carbon Market is low – Mozambique still lacks institutions required by UNFCCC for awarding credits under CDM.

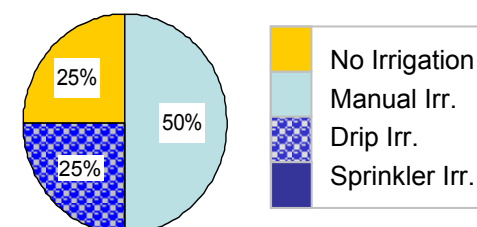
### Plantation Model



### Value Chain Elements\*



### Irrigation Models

















### Prices

Seeds (per kg /dry)	\$0.05-1.2
Labour (per day)	\$1-2
Diesel at pump	\$1.48

8 experts interviewed  
12 projects analysed

## 4-2 Africa – Mozambique

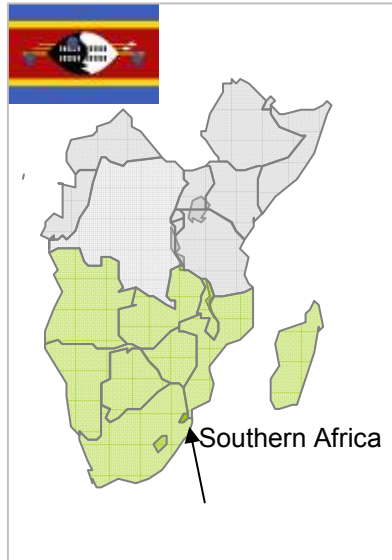
Project	Source	Type	Project Location	Ha (2008)	Ha (2015)
Energem de Mozambique	1		Bilene, Gaza Province	1,000	60,000
C3	2		Inhambane Province	1,000	-
Government of Nampula Province Scheme	3		Nampula Province	215	-
EnerTerra	1		Nampula & Sofala Province	100	50,000
Elaion Africa LDA	2		Sofala Province	-	-
Eagle Farm	1		Niassa Province	-	-
Not disclosed	3		Inhambane Province	3,000	31,000
ADPP / Fact Foundation	1		Sofala Province	-	-
Chinese Investor (not disclosed) – project plan	1		Nampula Province	0	250,000
ESV Bio Africa	2		Inhambane Province	-	-
EnviroTrade	3		Chimoio, Manica Province	0	-
Sun Biofuels	2		not disclosed	-	-

-  Commercial project  
 Non-commercial project

- 1 Interview / Questionnaire with project representative  
 2 Interview / Questionnaire with external project expert  
 3 Public sources

<b>Acreage non-disclosed projects</b>	2,572	14,415
<b>Total</b>	<b>7,887</b>	<b>405,415</b>

## 4-2 Africa – Swaziland



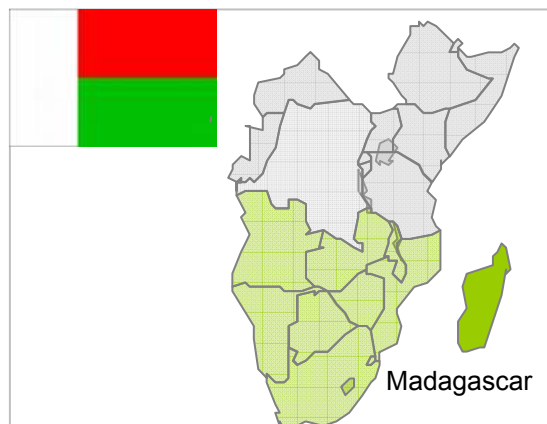
### Swaziland

☒ Jatropha exists   ☐ Jatropha locally used   ☒ Commercially farmed

**Policies:** No government policy or legislation on Jatropha or biofuel in general exists at present. The Government is said to be still formulating a policy to regulate the planting and processing of Jatropha in the country.

**Projects:** There are currently 7,386 hectares cultivated with Jatropha by a joint venture between D1-BP Fuel Crops and NING Group.

## 4-2 Africa – Madagascar



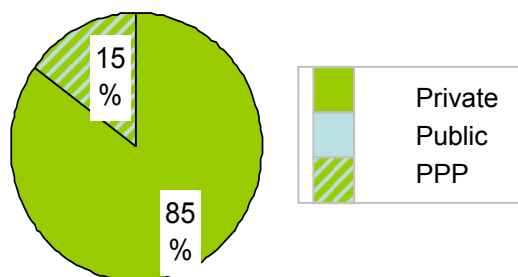
### Summary & Comments

Many regions throughout Madagascar have very favourable conditions for cultivating Jatropha. Today it is commercially farmed, although most projects are operating on a pilot scale. D1-BP Fuel Crops and GEM Biofuels, which is listed at the AIM stock market in London, operate in Madagascar. A further nine commercial ventures have been identified in the course of this study. It is expected that Madagascar will be a major Jatropha oil producer in the future, even though the experts we have interviewed estimate considerably lower figures than the total acreage calculated on basis of project data.

### Scale of Jatropha Cultivation

	Expert Estimate	Projects identified
current	20,000 ha	35,910 ha
2010	100,000 ha	276,000 ha
2015	500,000 ha	570,500 ha

### Project Ownership



### Government Programs

#### **Jatropha / Biofuel Legislation**

The Madagascan government is currently drafting a Biofuel Law which will introduce a mandatory blending of biodiesel into the diesel market. The government also seeks to establish a market for B100 biodiesel.

#### **Government Target on Jatropha**

There are no specific targets defined with regard to Jatropha.

#### **Other means of support**

Field test trials to identify the best cultivation methods are currently undertaken by FOFIFA.

### **Barriers for Jatropha investments**

No specific barriers have been reported. However, owing to complex administration, obtaining land contracts can be a lengthy procedure.

### **NGO-Initiatives**

There are several NGO initiatives exploring the potential to integrate Jatropha in soil erosion protection schemes and to generate income for smallholders. These include PLAE, ERI and BAMEX, a small business supporting program financed by USAID.

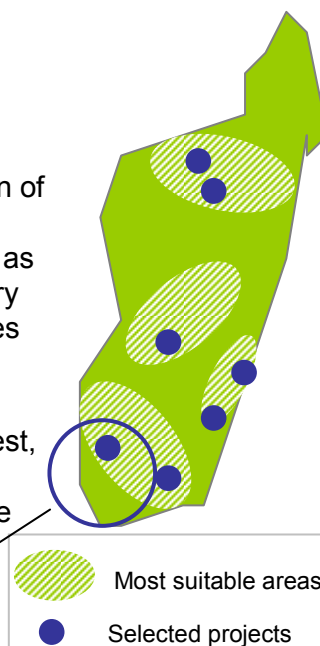
## 4-2 Africa – Madagascar

### Regional Distribution

**Jatropha** is well known in Madagascar. The Portuguese are assumed to have introduced *Jatropha curcas* to many parts throughout Madagascar during colonial times for production of soap. Local medicinal use or use for lighting is also known. In the north-east, *Jatropha* is used as a supporting tree in vanilla plantations. In the dry south-western part an endemic *Jatropha* species exists – *Jatropha mahafaliensis* – which is also suitable for oil production.

The best climatic conditions are found in the west, and on the east coast with the highest rain intensity. Problems are poor infrastructure in the west and *Jatropha* competing with palm oil production on the east coast.

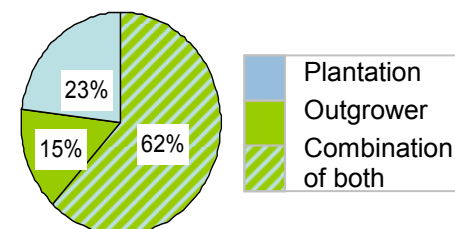
*Jatropha mahafaliensis*  
as native variety



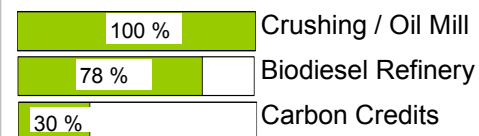
### Project Evaluation

- Seed collection from uncultivated plants, outgrower schemes with smallholder farmers and plantation models all play a significant role. Very often, different plantation models are combined.
- Most industrial *Jatropha* oil producers and project developers aim to refine the oil into biodiesel to service domestic and international markets.
- Low-input farming models currently prevail. The vast majority of projects currently have, or plan to have, only manual or no irrigation during the dry winter season.

### Plantation Model

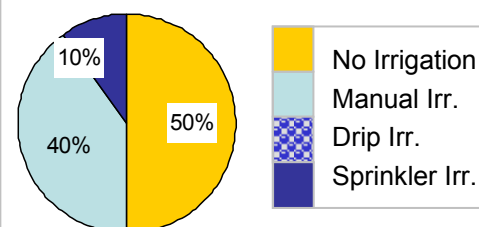


### Value Chain Elements\*



\*Expert Estimates

### Irrigation Models













### Prices



Seeds (per kg /dry)	\$0,12-0,24
Labour (per day)	\$2,00-3,00
Diesel at pump	\$1,40

5 experts interviewed  
13 projects analysed

## 4-2 Africa – Madagascar







Project	Source	Type	Project Location	Ha (2008)	Ha (2015)
D1-BP Fuel Crops	2/3		Different locations	-	-
GEM Biofuels	2/3		South West (Tuliar region)	30,000	200,000
TOM Investment - MMF	2/3		South West	500	100,000
J+J Group	2/3		South East	0	25,000
NEO - new ecologic oil	2/3		Bongolova	0	30,000
Avana Group	1		Analamanga	0	10,000
Flora EcoPower AG (FEP)	3		- not specified -	100	-
ERI - EcoRegional Initiatives	2/3		Fianaratsua / Alaotra Mangoro	680	-
JatroGreen	2/3		Region Ambalavao	200	3,000
JSL Biofuels Analavory (GEXSI)	1		Analavory	300	300

-  Commercial project
-  Non-commercial project



- 1 Interview / Questionnaire with project representative
- 2 Interview / Questionnaire with external project expert
- 3 Public sources

## 4-2 Africa – Madagascar



Project	Source	Type	Project Location	Ha (2008)	Ha (2015)
Bio Energy Invest	3		Mahajanga Region	130	2,500
J-Oils	1		Northern Madagascar	0	30,000
John Bizeray	2/3		South East Madagascar	0	40,000
Oji Paper Group	2/3		East Madagascar	0	30,000

<b>Acreage non-disclosed projects</b>	4,000	100,000
<b>Total</b>	<b>35,910</b>	<b>570,500</b>

-  Commercial project  
 Non-commercial project

- 1 Interview / Questionnaire with project representative  
2 Interview / Questionnaire with external project expert  
3 Public sources



## 4 Results on Global Level



**4-1 Latin America**

**4-2 Africa**

**4-3 Asia**

## 4-3 Asia – Regional Overview



### General observations

**Scale of cultivation:**

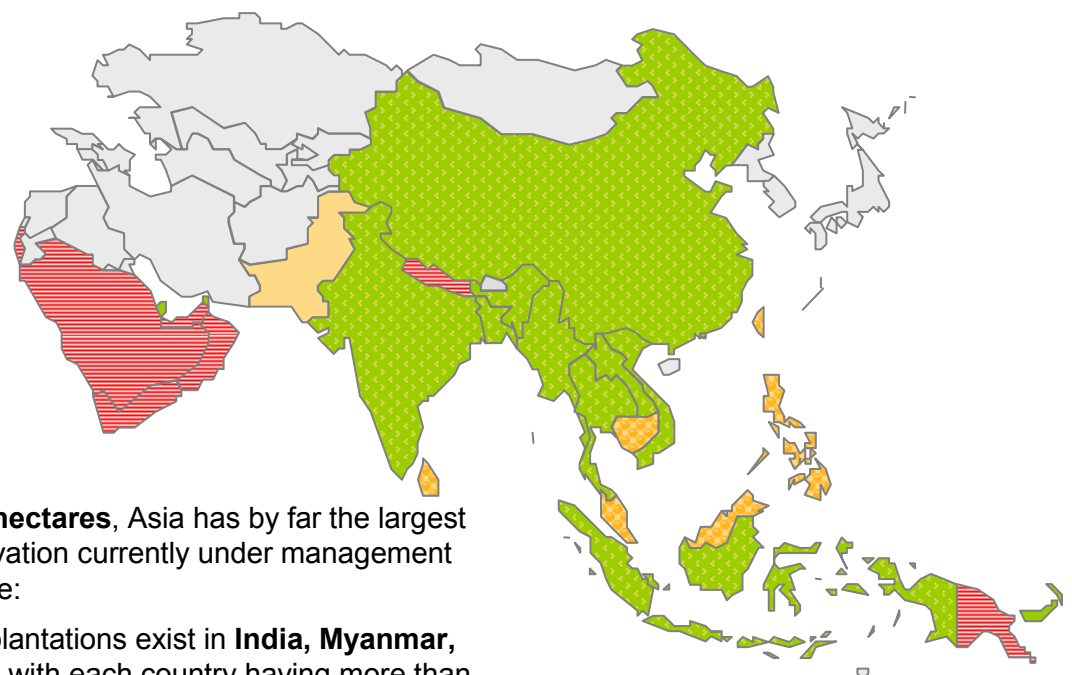
2008: **910,000 ha\***

2015: **9.2 million ha\*\***

Number of projects identified: 104

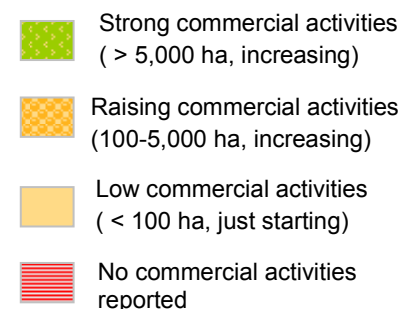
\* Projects identified

\*\*Expert Country Estimates



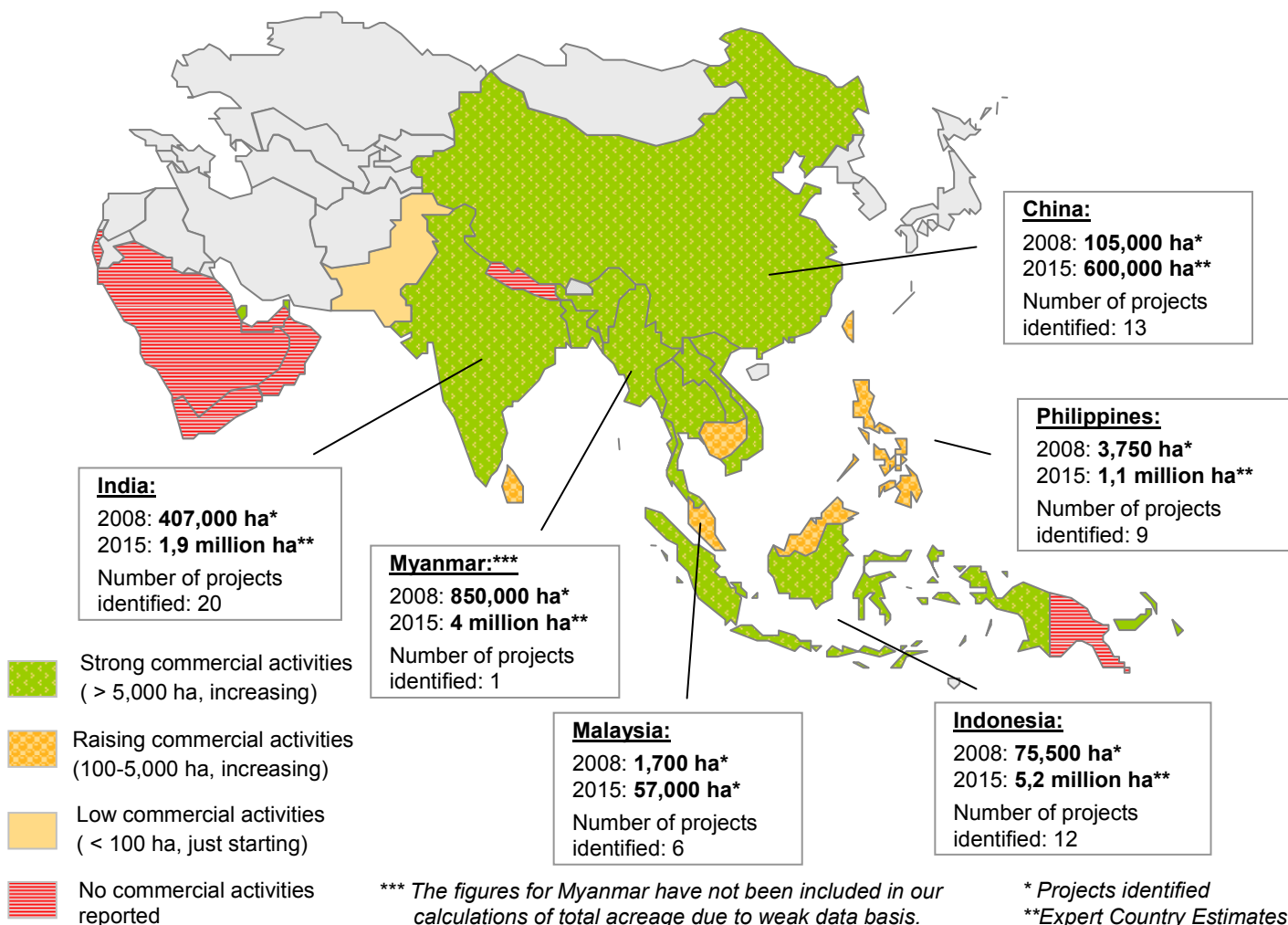
With more than **900,000 hectares**, Asia has by far the largest acreage of Jatropha cultivation currently under management worldwide. Key findings are:

- The largest Jatropha plantations exist in **India, Myanmar, China** and **Indonesia**, with each country having more than 50,000 ha under cultivation today.
- The greatest projects are **government initiated**; they include pro-poor support schemes in India to rehabilitate waste lands, village programs in Lao and Myanmar as well as plantations developed by the largest national oil companies in China.
- It is expected that large investments will take place in the future; the total acreage will increase according to experts' estimates up to **9.2 million hectares** in the next 7 years.



## 4-3 Asia – Regional Overview

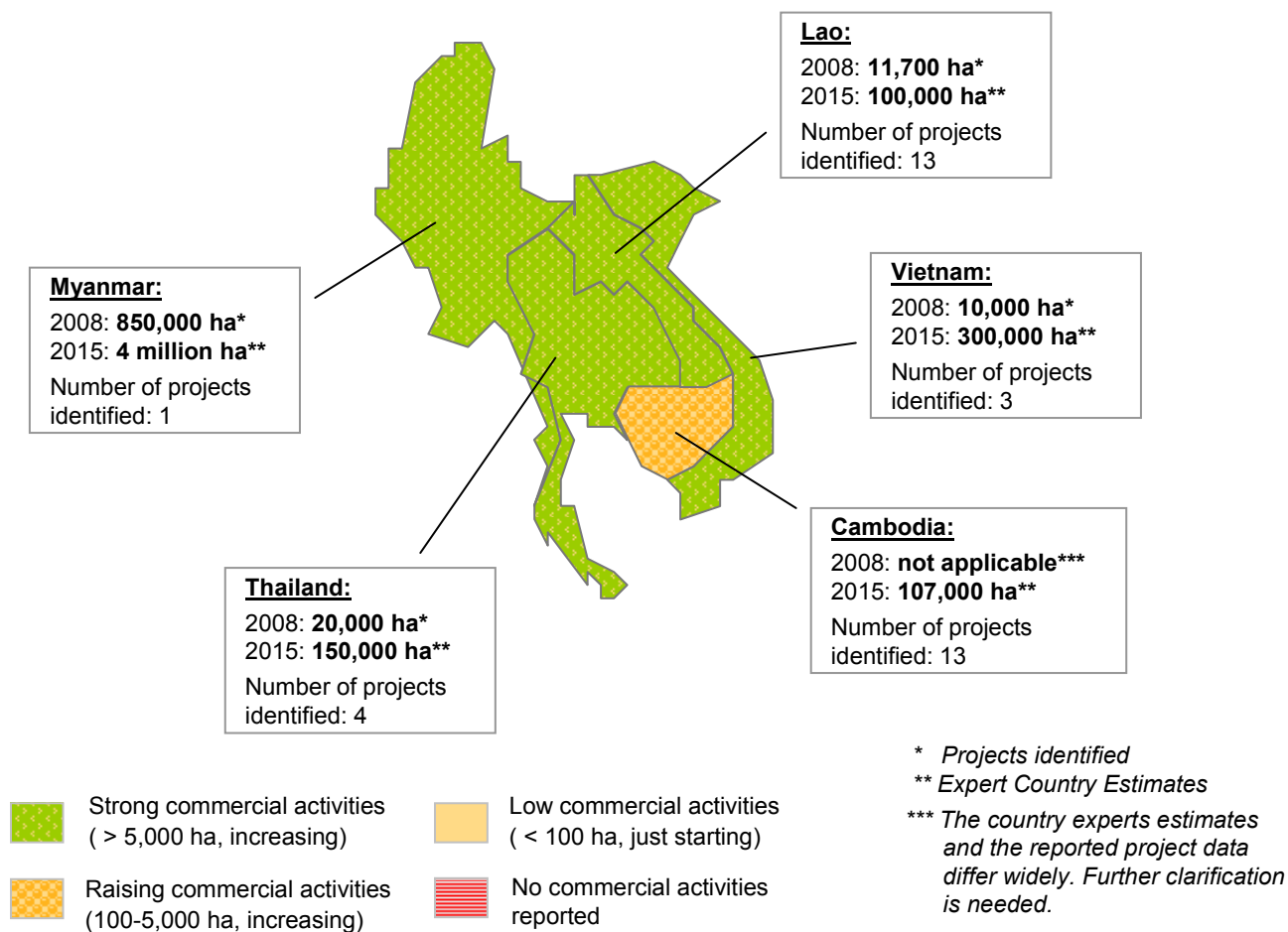
### Total acreage of selected countries (2008, 2015)



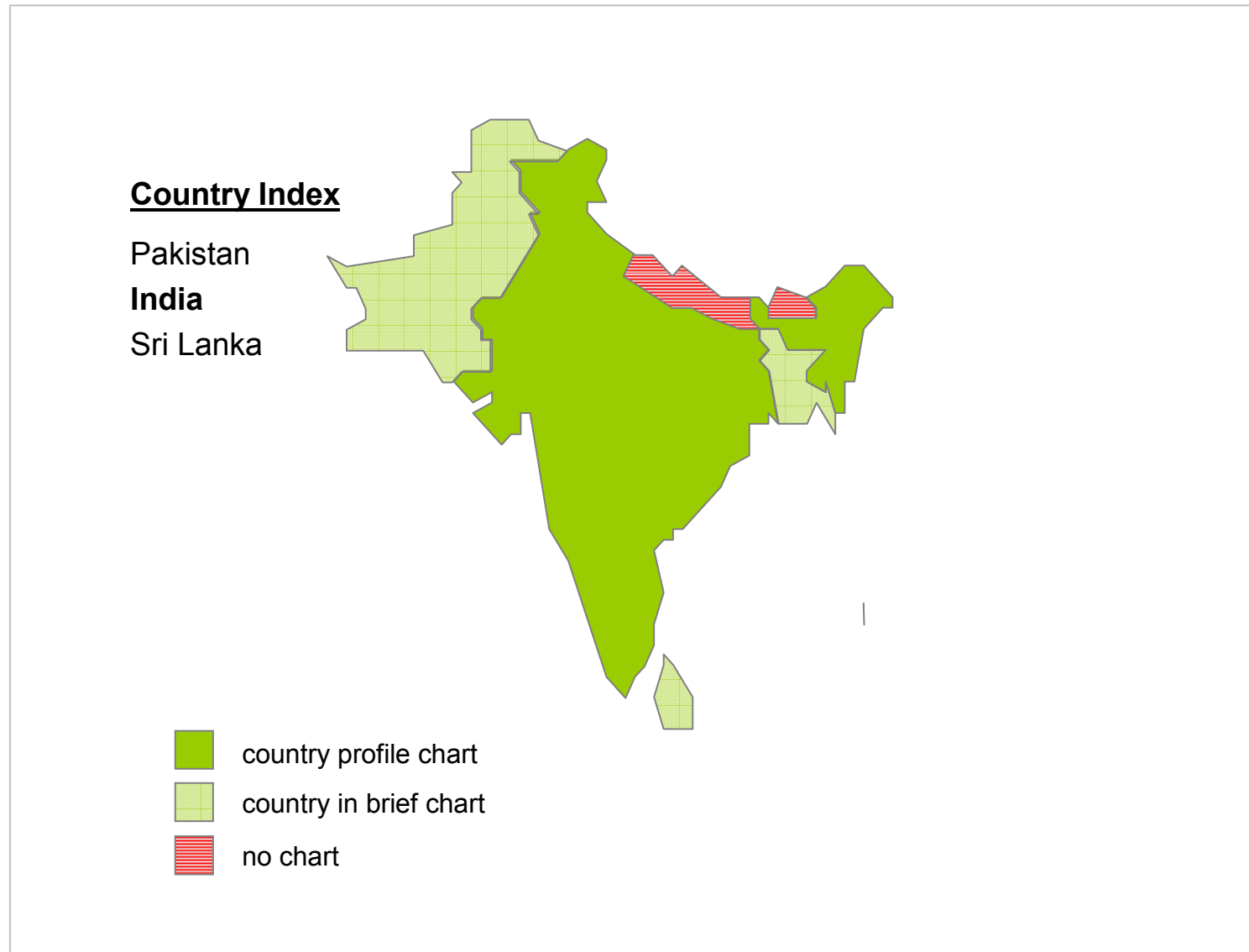
## 4-3 Asia – Regional Overview

### Total acreage of selected countries (2008, 2015)

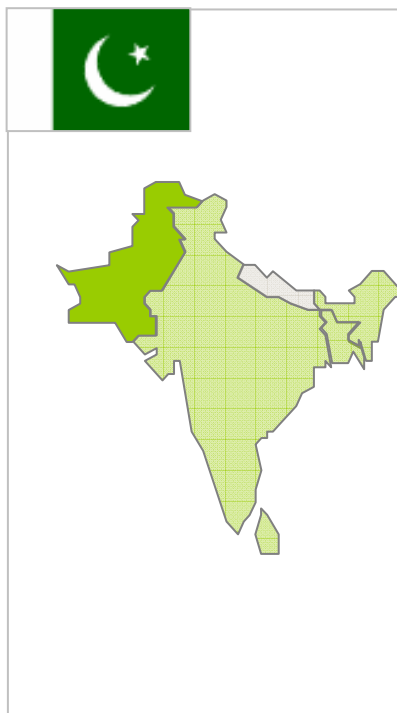
#### Greater Mekong Region



## 4-3 Asia – Indian Sub-Continent



## 4-3 Asia – Pakistan



### Pakistan

☐ Jatropha exists   ☐ Jatropha locally used   ☐ Commercially farmed

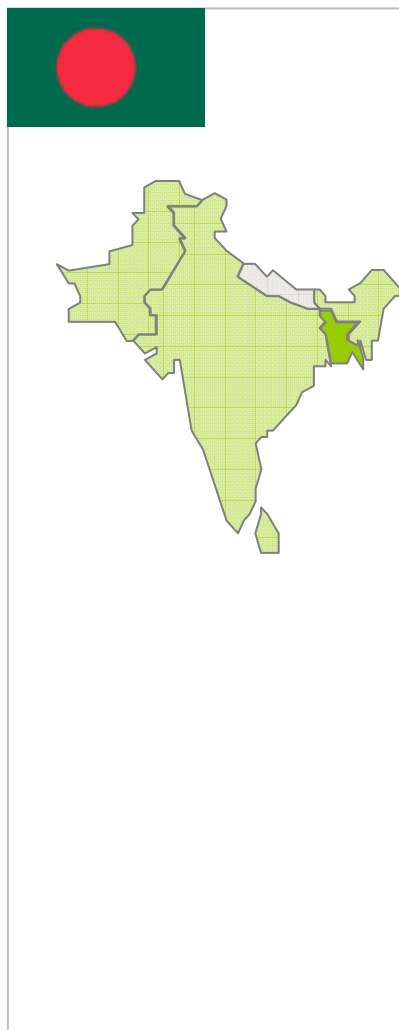
#### **Policies:**

No Jatropha-specific program or legislation exists in Pakistan at present. The Government introduced the “Alternative Energy Development Board” (AEDB) in 2003. The main objective of the Board is to promote and encourage the development of renewable energy. The target mentioned is a 10% share of renewable energy in the overall energy mix of Pakistan. Foreign investment is said to be encouraged.

Additionally, a Biofuel task force has been reported to investigate the potential for the production of biofuel from biomass.

**Projects:** No direct contact could be established to a Jatropha project in Pakistan to confirm information from public sources. These mention a project plan for cultivating 16,000 ha with Jatropha. Jatropha nurseries are reportedly to be set up.

## 4-3 Asia – Bangladesh



### Bangladesh

☒ Jatropha exists    ☐ Jatropha locally used    ☒ Commercially farmed

Jatropha curcas, which is known as kala arenda in Bangladesh was brought to Asia by the Portuguese.

**Policies:** At present, no Jatropha-specific legislation or support program exists in Bangladesh. The government reportedly announced in mid 2006 the plan to promote cultivation of Jatropha for the production of biodiesel in order to reduce the country's dependence on imported petroleum fuels. An inter-ministerial meeting on the prospect of Jatropha cultivation was held, chaired by the national advisor for Energy and Mineral Resources.

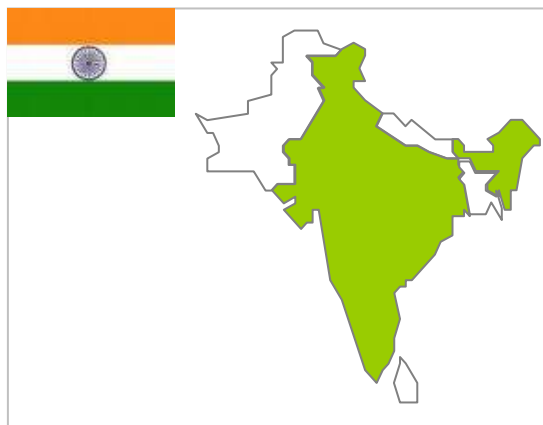
**Policies:** Few projects were identified through public sources, but could not be confirmed otherwise.

The Indian company Biodiesel Technologies has apparently set up a 8,000 ha Jatropha project, which includes production of plant oil.

Public sources from 2007 mention that a 710 ha plantation of Jatropha has been set up by James Finlay Tea company on unused and fallow land. The aim of the project is to produce biodiesel. The setting up of the plantation apparently followed a small pilot cultivation of Jatropha which gave promising results.

Further tea estates in the greater Sylhet region reportedly launched the commercial cultivation of Jatropha Curcas – also on unused land.

## 4-3 Asia – India



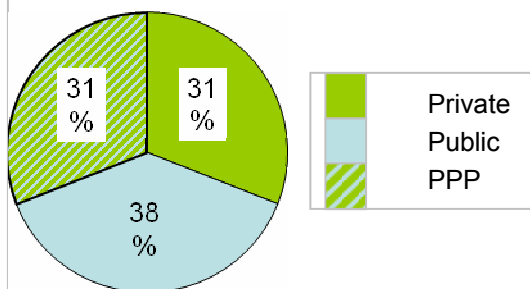
### Summary & Comments

India is a first-mover with regard to actively farming Jatropha as feedstock for biofuel production. It is estimated that almost half a million hectares have been planted. The first governmental policies on Jatropha were introduced as early as 2003. Today, Jatropha production is supported by almost all Indian State Governments through guaranteed purchasing schemes. Their aim is to integrate the rural poor into the biofuel value chain while rehabilitating waste lands. Major research programs on Jatropha are located in India. India has been targeted by major international biofuel corporations for investments in Jatropha plantations.

### Scale of Jatropha Cultivation

	Expert Estimate	Projects identified
current	497,881 ha	407,635 ha
2010	1,179,760 ha	1,455,363 ha
2015	1,861,833 ha	5,479,765 ha

### Project Ownership



### Government Programs Biofuel Legislation

The Indian government is currently devising a biofuel policy draft, targeting a 5% biodiesel blend by 2012 (and 10% by 2017). In January 2006 public sector oil companies announced that they would pay a guaranteed purchase price of 25 Rupees (US\$ 0.56) per liter to biodiesel producers. A Biodiesel Credit Bank will coordinate activities relating to Carbon Credits of biofuel projects. In addition, the Indian government offers biofuel producers tax exemptions or reductions, for example on VAT and sales tax.

### Government Policy on Jatropha

The Indian Government targeted 400,000 ha for the demonstration phase in 2006/07 and is aiming to have planted 11.2 million ha with Jatropha by 2012. Support mechanisms under the National Employment Guarantee Schemes include Comprehensive Land Development Program (CLDP); Drought Prone Area Program (DPAP); Watershed Development Fund (WDF), and National Food for Work Programme (NFWP)

### NGO-Initiatives

There are many NGOs working at a local & national level.



## 4-3 Asia – India

### Regional Distribution

#### Uttaranchal

2008 – 350 ha  
2012 – 200,000 ha  
Guarantee Price – 0.14 US\$

#### Haryana

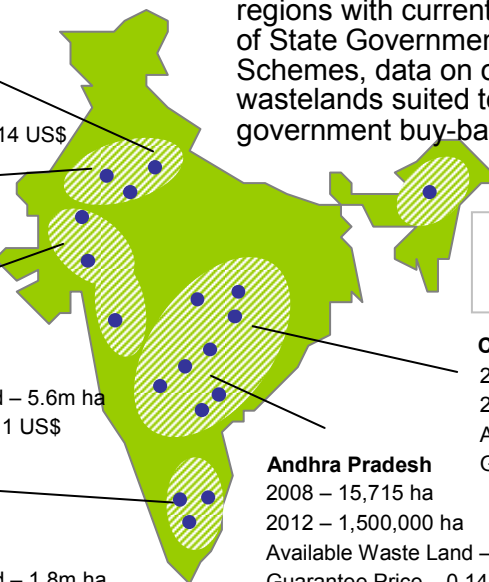
2008 – 328 ha  
2012 – 20,000 ha

#### Rajasthan

2008 – 33,000 ha  
2012 – 220,000 ha  
Available Waste Land – 5.6m ha  
Guarantee Price - 0.11 US\$

#### Tamil Nadu

2008 – 20,277 ha  
2012 – 100,000  
Available Waste Land – 1.8m ha  
Guarantee Price - 0.12 US\$



This diagram represents selected regions with current and future targets of State Governmental Jatropha Schemes, data on official estimates of wastelands suited to Jatropha, and government buy-back schemes.

Most suitable areas  
Selected projects

#### Chhattisgarh

2008 – 84,000 ha  
2012 – 1,000,000 ha  
Available Waste Land: 1m ha  
Guarantee Price – 0.13 US\$

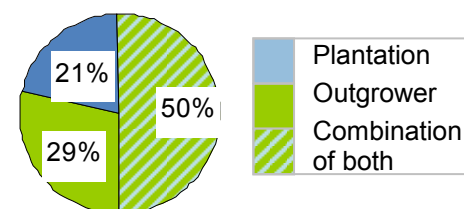
#### Andhra Pradesh

2008 – 15,715 ha  
2012 – 1,500,000 ha  
Available Waste Land – 4.4m ha  
Guarantee Price – 0.14 US\$

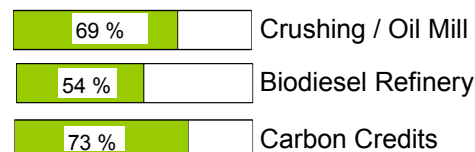
### Project Evaluation

- According to data received, 60% of the projects cultivate Jatropha partially or totally on waste lands not suitable for agricultural production. 92% of the projects include outgrower schemes.
- Country experts suggest that either no or manual irrigation is used. However, more than 60% of the projects report some use of irrigation.
- The government pursues a policy of guaranteed prices. However, the projects analysed usually sold seeds at higher prices. The seeds were sold to research projects or nurseries.
- In a 5 year forecast, experts see a continued high importance of wild seed collection and of small-scale research or farming operations of less than 5 ha (75% of total anticipated production).

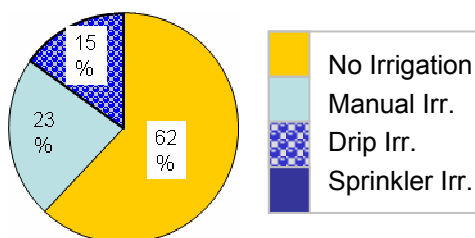
### Plantation Model



### Value Chain Elements



### Irrigation Models















### Prices



Seeds (per kg /dry)	0.22 US\$
Labour (per day)	2.23 US\$
Diesel at pump	0.88 US\$

17 experts interviewed  
25 projects analysed











## 4-3 Asia – India



Project	Source	Type	Project Location	Ha (2008)	Ha (2015)
D1-BP Fuel Crops & Williamson Magor	1		North East India	62,455	
D1-BP Fuel Crops	1		South India	5,922	
D1-BP Fuel Crops	1		(other regions)	26,693	
Andhra Pradesh State	3		In 8 Districts, Andhra Pradesh	15,715	1,500,000
Mission Biofuels	1		Tamil Nadu, Karnataka, Maharashtra, Andhra Pradesh and Orissa	40,000	260,000
NOVOD – ICRISAT	1		District of Ranga Reddy, Andhra Pradesh	400	
ICRISAT – RSAD	1		Districts Medak and Kurnool, Andhra Pradesh	200	
Southern Online Biotechnologies (SBT) – ICRISAT – GTZ	1		District of Nalgonda, Andhra Pradesh	25	
BP – TERI	3		Andhra Pradesh and Chhattisgarh		8,000
Naturol Bioenergy Ltd	1		Andhra Pradesh	1,000	100,000
Land Lab Bio-tech	1		Karnatak	2,000	25,000
Dr. MGR Jatropha bio-diesel Project, Tamil Nadu	1		Village of Sattur, Tamil Nadu		4,000

- 1 Interview / Questionnaire with project representative  
 2 Interview / Questionnaire with external project expert  
 3 Public sources

 Commercial project  
 Non-commercial project

## 4-3 Asia – India

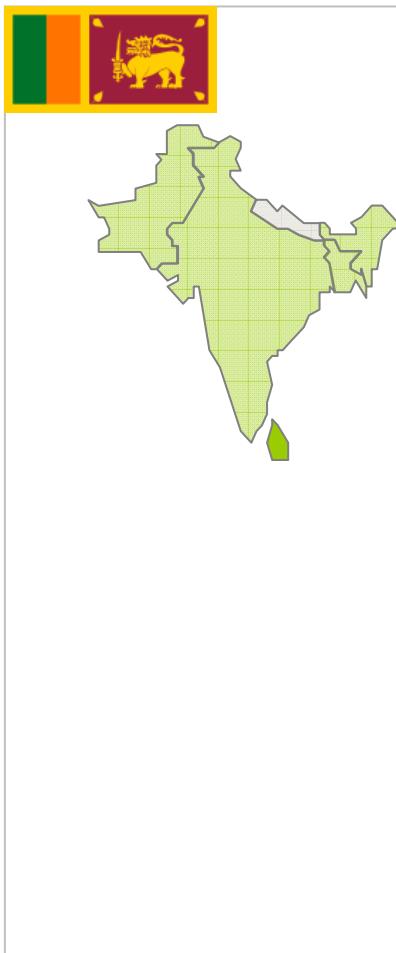
Project	Source	Type	Project Location	Ha (2008)	Ha (2015)
Pandian Estates Private Limited	1		District of Madurai, Tamil Nadu	50	165
V. Bakthavatchalam	3		District of Coimbatore, Tamil Nadu	168	
Green Oil Energy Sciences Private Limited	1		Not known	50	10,000
State Uttaranchal Biofuels Board	3		Uttaranchal	350	200,000
State Government Haryana	3		Haryana	328	20,000
Chhattisgarh Bio-Fuel Development Authority	3		Chhattisgarh	84,000	1,000,000
Society for Rural Initiatives for Promotion of Herbals	3		Rajasthan	33,000	220,000
Indian Oil Corporation (Gujart)	3		Gujarat	80	
Noble Horticulture Farm	3		Maharashtra	120	610
Department of Biotechnology of India	2		New Delhi	200	

-  Commercial project  
 Non-commercial project

- 1 Interview / Questionnaire with project representative  
2 Interview / Questionnaire with external project expert  
3 Public sources

<b>Acreage non-disclosed projects</b>	134,879	2,001,073
<b>Total</b>	<b>407,635</b>	<b>5,479,765</b>

## 4-3 Asia – Sri Lanka



### Sri Lanka

☒ Jatropha exists    ☐ Jatropha locally used    ☒ Commercially farmed

**Policies:** A Jatropha-specific legislation or government program does not exist at present. However, the Government of Sri Lanka is currently studying the feasibility of cultivating Jatropha on marginal state land in order to produce bio-diesel, according to public sources. Jatropha is said to be recognised as a most efficient source of biodiesel.

The Strategic Enterprise Management Agency (SEMA) is reportedly trying to identify about 10,000 ha of unused land suitable for Jatropha cultivation, for instance unproductive plantation lands. Officials mention land in the north of Puttalam and in the Mannar basin as well as in the eastern province. SEMA is looking for partnerships with the private sector for project development.

**Projects:** Very few projects or project plans have been identified in Sri Lanka, mainly private, profit-oriented undertakings working in cooperation with local farmers or small local companies. Plans for a medium to large-scale project on an unused plantation have been reported by an international investor company.

In 2003, a two-year research project with focus on income generation for rural women's groups was conducted in T'wila, in the south of Sri Lanka.

## 4-3 Asia – Mekong Region

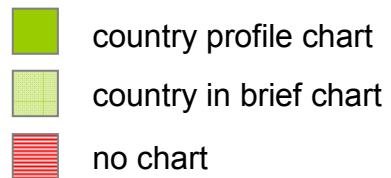
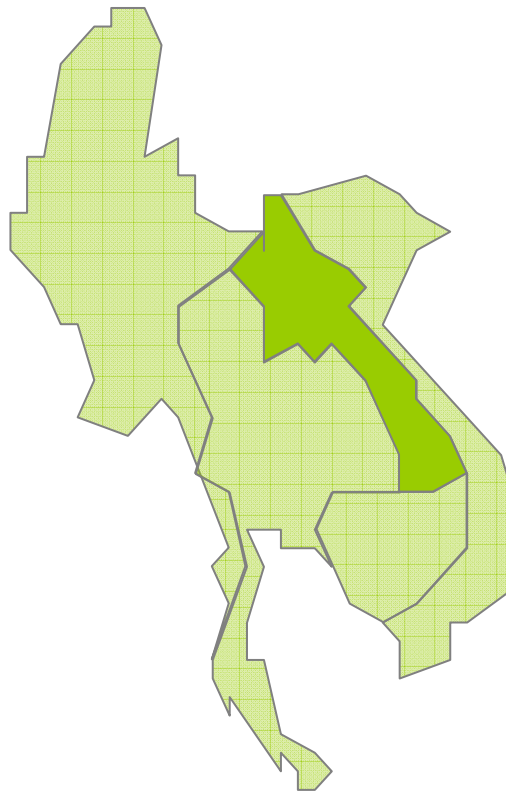
### Country Index

Myamar

**Lao**

Cambodia

Vietnam



## 4-3 Asia – Myanmar



### Myanmar



Jatropha exists



Jatropha locally used



Commercially farmed

**Policies:** The military regime in Myanmar pursues ambitious and aggressive plans to make use of Jatropha to decrease the dependence on foreign imports of oil. The Jatropha program has been initiated by the Myanmar Ministry of Agriculture and Irrigation in 2005. It is reported that a total acreage of 850,000 ha is currently planted by local villagers throughout the country.

The Ministry has announced plans to increase biofuel processing capacity in 2008, and to expand Jatropha cultivation to over three million hectares. The target for 2010 is 4 million hectares. According to public officials, Myanmar has about 6.41 million hectares of land suitable for growing Jatropha.

**Projects:** Field missions from FAO and other agencies reported that the quality of plantations which have been seen, were very poor. Apparently, due to a lack of agronomic expertise, the cultivation of Jatropha has been enforced by the military regime also in regions not suited for Jatropha.

A 2008 report by the Ethnic Community Development Forum shows the devastating effects of this initiative. The report can be downloaded under: [http://www.terraper.org/file\\_upload/BiofuelbyDecree.pdf](http://www.terraper.org/file_upload/BiofuelbyDecree.pdf)

**Market:** Domestic energy and transport sector.

## 4-3 Asia – Thailand



### Thailand



Jatropha exists



Jatropha locally used



Commercially farmed

**Policies:** Biodiesel is still an emerging sector in Thailand, but is reported to grow rapidly. The Thai government reportedly is very supportive of and optimistic about the potential of biofuels for Thailand. It is currently implementing a land zoning support scheme.

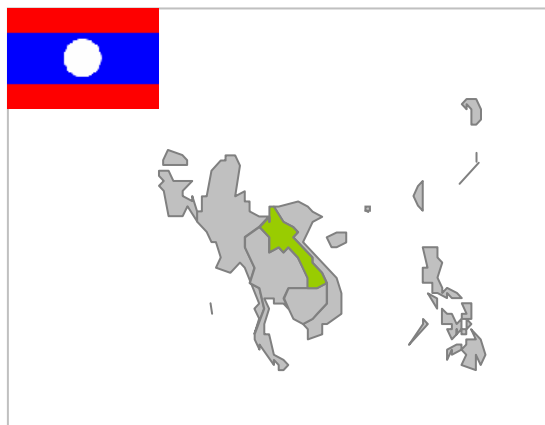
A legislation has been passed to phase in B10 (10 % Biodiesel in diesel) on a nationwide basis by 2011. A National Biofuel Committee has been established to provide financial and other support to local farmers. This will be done via a network of universities and various ministries including Ministry of Finance, Agriculture, Energy, Industry and Science & Technology. Grants have been offered to research institutions for the in-depth study of all aspects concerning Jatropha cultivation.

The Ministry of Energy has set a target of 150,000 ha of Jatropha cultivation for 2012. Also, a biodiesel production capacity of 8.5 million liters/ per day is targeted for 2012.

**Projects:** Currently, projects with a total acreage of 19,878 ha have been identified. The major players include Bioenergy Development Co. Ltd. and Equitech. About two thirds of the identified projects are private projects.

**Market:** Domestic biodiesel refinery and biogas from press cake.

## 4-3 Asia – Lao



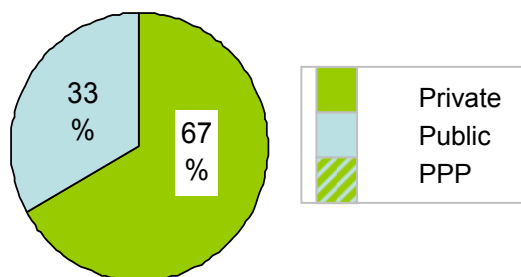
### Summary & Comments

Jatropha grows in almost any region in Lao and is commonly used as hedges in villages. It has been identified by the government as the plant with the highest potential for biodiesel. With only 48% of the population having access to electricity, Jatropha is expected to further effective and affordable electricity generation in rural areas. A cohesive national policy on bio-fuels has yet to be developed. However, government policies and regulations already point at the promotion of biofuel crops. Concern has been expressed by country experts that with an increasing investment in Jatropha projects in Lao, “slash and burn” agriculture may become more frequent.

### Scale of Jatropha Cultivation

	Expert Estimate	Projects identified
current	8,190 ha	11,751 ha
2010	35,000 ha	45,381 ha
2015	100,000 ha	105,411 ha

### Project Ownership



### Government Programs

#### Jatropha / Biofuel Legislation

At present, Lao PDR does not have any specific decrees or regulations to manage the production and use of biofuel. However, many government policies and regulations promote the production of alternative fuels such as biodiesel and ethanol.

The Ministry of Energy (MEM) drafted a policy for the promotion of biofuel production in Lao which address goals, targets, issues and strategic objectives. It has not become an official policy yet.

#### Government Targets on Jatropha

The draft policy by MEM – which is yet to be approved – suggests a 5%-share of biofuels in total fuel consumption to be achieved by 2015. Fossil fuel consumption is to be reduced by 5% from 2010 onwards.

#### Barriers for Jatropha investments

Land availability for large scale plantations for many companies.

#### NGO-Initiatives

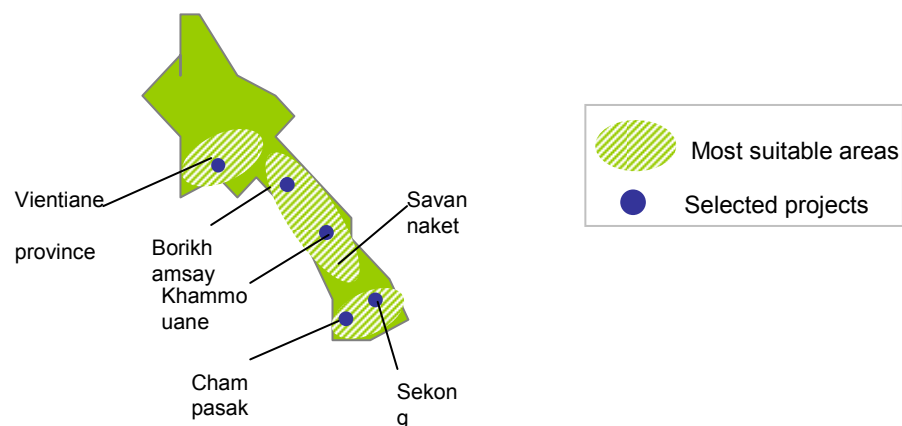
NUOL, LPOPA, AAHP, TPLPA, SNV, VECO, Triangle, CIDSE



## 4-3 Asia – Lao

### Regional Distribution

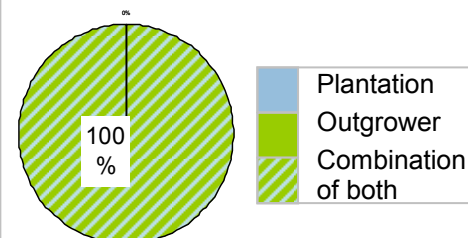
Jatropha is reported to grow well in the central and southern regions of Lao. The main cultivation area includes Vientiane Province, Xieng Khouan Province, Borikhamsay Province, Khammouane Province and Savannakhet Province in central Lao, as well as the Champasak province and Sekong Province in the south.



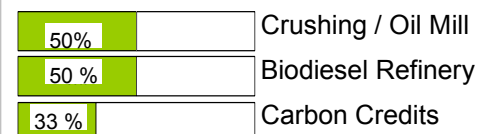
### Project Evaluation

- Intercropping and pruning are the most widely used cultivation techniques. According to country experts, one third of projects apply irrigation, root cutting and fertilisation.
- Half of the projects identified report that they aim to set up their own oil milling facilities and biodiesel refinery.
- Carbon credits play a less important role. Only one project states that it targets CDM credits under the UNFCCC scheme.
- The majority of projects identified are developed on wasteland.
- Sustainability policies are not frequently mentioned by project owners.

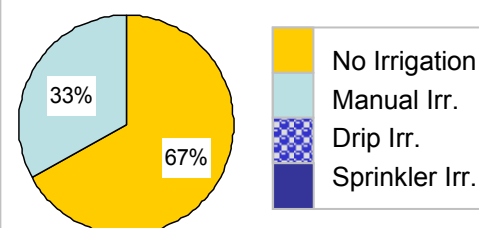
### Plantation Model



### Value Chain Elements



### Irrigation Models















### Prices

Seeds ( per kg /dry)	\$0.58-1.16
Labour (per day)	\$2.31-3.47
Diesel at pump	\$0.81-1.21

8 experts interviewed  
13 projects analysed

## 4-3 Asia – Lao

Project	Source	Type	Project Location	Ha (2008)	Ha (2015)
Lao Institute for Renewable Energy (LIRE)	1		Wat Nark Village, Vientiane Province	10	50
Rivertime Plantations	1			0*	---
FRC/TAISEI Japan	3		Nakhanthoung V. Saythany D.	10	---
Kolao Group	1		Nathe Village, Saythany, Dong Village	2,106	---
AEC/French Company	1		Namhum V. Nasaithong D.	150	---
Mrs. Deth Saysompheng/ Mr. Chamlong	1		Huaila V. Sangthong D.	50	---
Mr. Khamsing Sihathep	1		Nasaithong D.	150	---
J and P Company	3		Sayabury	1,200	---
Y and P Company	3		Bolikhamstay	112	---
Italian Group	3		Bolikhamstay	100	---
Champassak	3		Champassak	1,400	---
Equitech (LAO) Co. Ltd.	1			6,380	10,000
Mr Kavin/Mr. Khampha	1		Pakngum and Kasy	83	---

 Non-commercial  Commercial

- 1 Interview / Questionnaire with project representative  
 2 Interview / Questionnaire with external project expert  
 3 Public sources

<b>Acreage non-disclosed projects</b>	---	95,361
<b>Total</b>	<b>11,751</b>	<b>105,411</b>

## 4-3 Asia – Cambodia



### Cambodia

☒ Jatropha exists   ☐ Jatropha locally used   ☒ Commercially farmed

**Policies:** The Royal Government of Cambodia (RGC) reportedly has not undertaken any significant steps to stimulate or promote the cultivation of biofuel crops or the production of biodiesel.

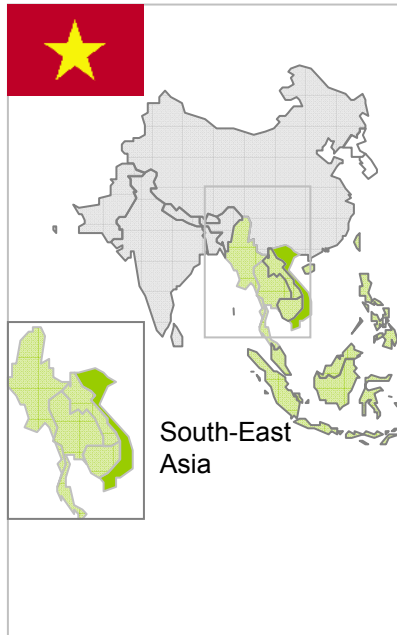
However, RGC has launched a series of discussions to address the development of renewable sources of energy. Currently the underlining government policy of promoting alternative renewable energy is linked with the strategy for poverty reduction. The major objective is to promote electrification of and energy supply for rural areas.

Some country experts believe that a guaranteed market and price for Jatropha products would serve as a useful incentive for the cultivation of Jatropha and the establishment of biodiesel production facilities.

**Projects:** A significant number of private foreign investors has been identified, that aim at establishing large-scale Jatropha plantations. These are mainly from Singapore, South Korea, Malaysia, Japan and Thailand. Reportedly, these already have 160,000 ha under cultivation, a number which could not be confirmed and have been questioned by the country experts we have interviewed. Project owners and investors state an ambitious target of ~500,000 ha of Jatropha to be cultivated in total by 2015.

**Market:** The main market reported to be targeted is the domestic and international biodiesel market.

## 4-3 Asia – Vietnam



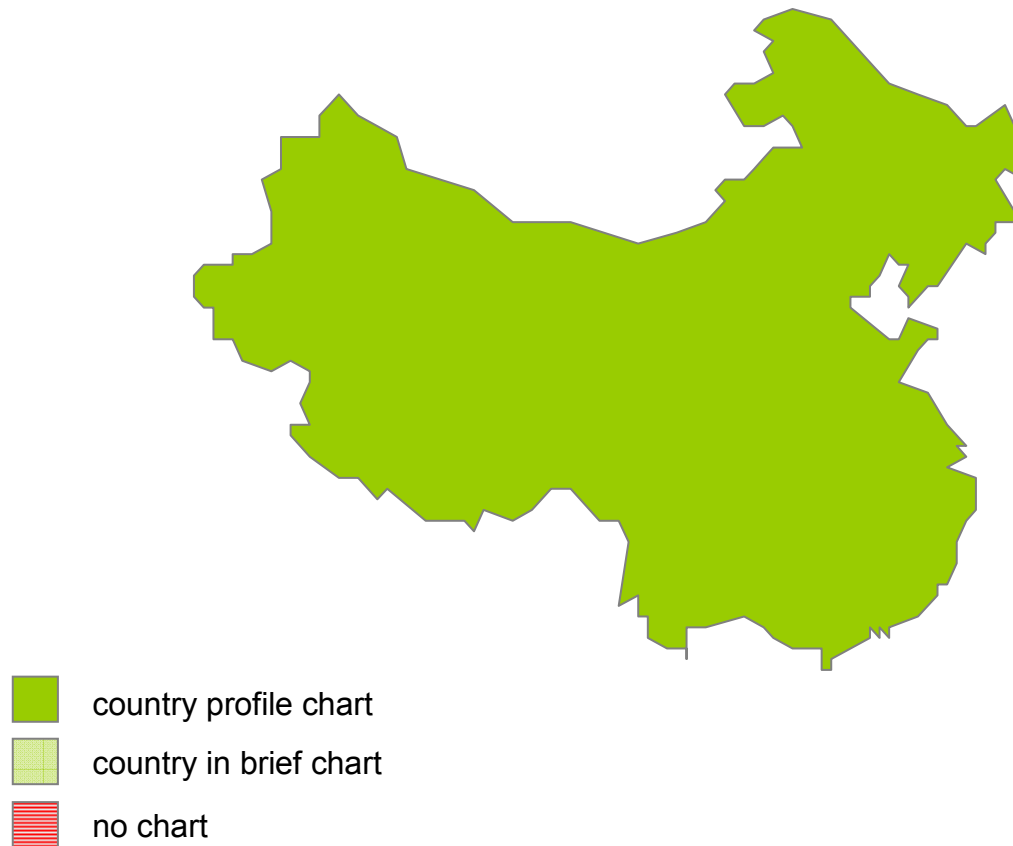
### Vietnam

☒ Jatropha exists   ☐ Jatropha locally used   ☒ Commercially farmed

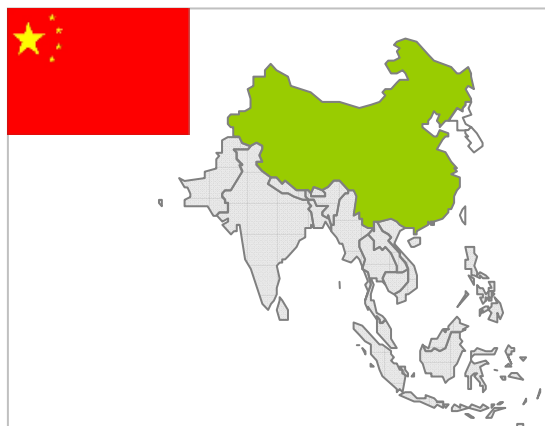
**Policies:** Vietnam's policy towards biomass energy apparently does not place the focus on domestic development and production of biofuels. So far, country experts are not aware of a specific governmental unit that is responsible for the biofuel sector. Some companies have reported long waiting times (several months) for governmental approval of their biomass products.

**Projects:** HCM City-based Institute for Tropical Biology undertook a pilot research project on Jatropha. The identified acreage of jatropha in Vietnam is currently 10,000 ha. Major players are Jatoil and Mang Den Sai gon Joint Stock Company. Eco-Carbone has stated plans to set up a partnership scheme with local farmers and communities to cultivate a minimum of 30,000 ha with Jatropha.

## 4-3 Asia – China



## 4-3 Asia – China



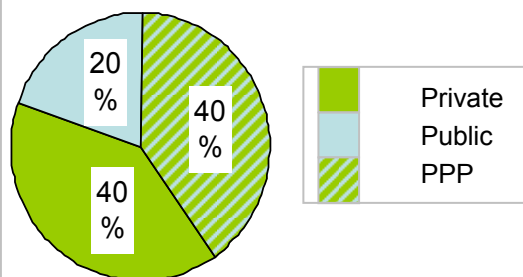
### Summary & Comments

China is one of the world's leading biofuel producers. Especially Jatropha has become an important biofuel crop in recent years – mainly as climatic conditions in the southwest of China are favourable and labour is available at low cost. Some of the leading oil companies such as the Chinese state-owned oil company CNOOC have invested into Jatropha projects. The government has highlighted the importance of biofuel production in legislation and policies. Relevant policies and subsidies specifically for Jatropha are expected for the coming years.

### Scale of Jatropha Cultivation

	Expert Estimate	Projects identified
current	229,980 ha	105,251 ha
2010	456,260 ha	161,651 ha
2015	597,260 ha	706,604 ha

### Project Ownership



### Government Programs

#### **Jatropha / Biofuel Legislation**

The government actively encourages the cultivation of biodiesel crops through the Chinese Renewable Energy Development Group. Supportive policies include tax reduction, loss and raw material subsidy as well as demonstration projects. However, Jatropha is not highlighted in the legislation.

#### **Other means of support**

The government identified suitable areas for Jatropha cultivation in an industry development seminar in November 2006 in Beijing. The Forest Ministry will provide financial and technological support.

### **Government Targets**

The government has set a target for biofuel production capacities of 1,24 million tonnes to be achieved by 2010.

#### **Barriers for Jatropha investments**

Lack of integrated value chain limits the development of the Jatropha industry. Large scale land availability is expected to become an issue.

#### **NGO-Initiatives**

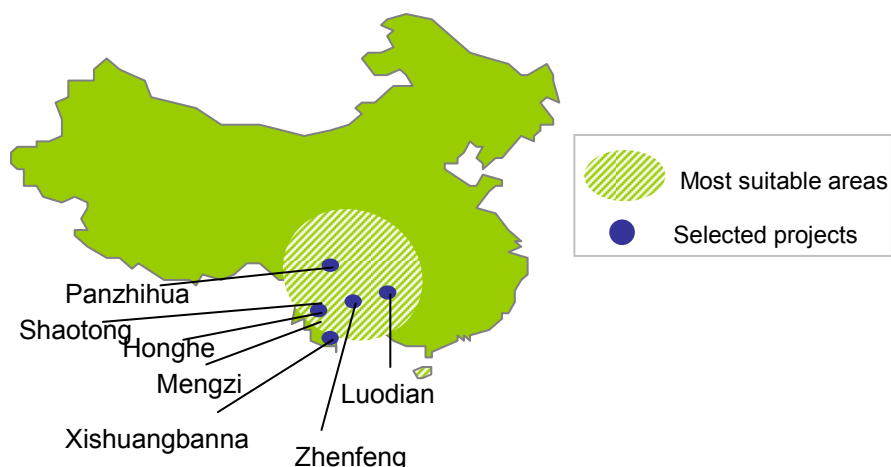
Country experts mention Sichuan University, Guizhou University, Chinese Academy of Science and UNDP.

## 4-3 Asia – China

### Regional Distribution

The south-western regions of China are reported to be most suitable for Jatropha due to their advantageous climate.

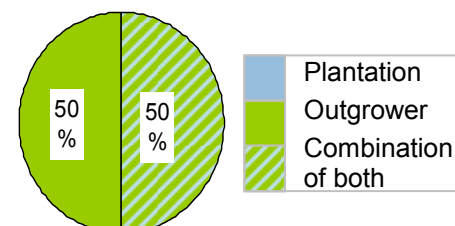
Most Jatropha projects are found in the provinces Sichuan, Yunnan and Guizhou.



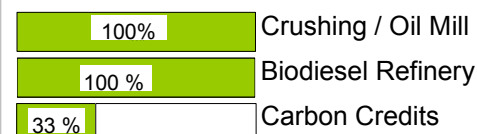
### Project Evaluation

- The vast majority of projects are commercial undertakings (~90 %) with a private (40%) or PPP (40%) background.
- The major part of projects report the use of pruning and fertilisation. If irrigation is used, country experts report mainly drip and to a far lesser extent sprinkler irrigation schemes.
- Most of the projects aim to set up their own oil milling facilities and biodiesel refineries. Carbon credits apparently are less important.
- Sustainability policies are reported to exist for most of the projects.
- The majority of current projects are estimated to be pilots or medium-scale plantations (<1000 ha). Numbers for pilots are believed to decrease; medium and large-scale plantations (>1000 ha) will increase.

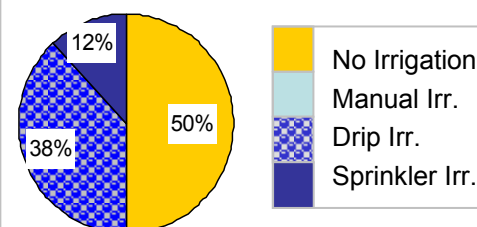
### Plantation Model



### Value Chain Elements



### Irrigation Models



### Prices

Seeds ( per kg /dry)	\$0.21-2.85
Labour (per day)	\$5.7-14.26
Diesel at pump	\$0.57-0.77

11 experts interviewed  
13 projects analysed

## 4-3 Asia – China



Project	Source	Type	Project Location	Ha (2008)	Ha (2015)
Panzhihua Jatropha Biodiesel Industry Development, Baker Biofuel Company (USA)	1		Panzhihua, Sichuan Province	10,000	135,000
Forestry Ministry of LuoDian County	1		Luodian, Guizhou Province	8,600	15,000
Yunnan Shenyu New Energy Co. Ltd	2/3		Honghe, Yunnan Province	20,000	150,000
Sunshine Technology	1		Honghe, Yunan Province	10,000	---
Chinese Academy of Science-South China Botanical Garden	1		Guangzhou Province, Xishuangbanna, Yunan Province	1	---
Shaotong Forest Ministry, ECO—CSRBONE(France), Sichuan Yangtze River Tech Co. Ltd	3		Shaotong County, Yunan Province	20,000	---
China National Petroleum Corporation (CNPC)	2/3		Sichuan, Yunan Province	0	40,000
CNOOC	1		Hainan Province	0	200,000



Commercial project







Non-commercial project



- 1 Interview / Questionnaire with project representative
- 2 Interview / Questionnaire with external project expert
- 3 Public sources



## 4-3 Asia – China

Project	Source	Type	Project Location	Ha (2008)	Ha (2015)
COFCO	2/3		Guizhou Province	0	---
Biodiesel Manufacturing Company (UK)	2/3		Guangxi Province	0	30,000
Cobra Biodiesel, University of Science and Technology, Beijing	1			10	10,000
Yunnan Plant Oil Group and German Energy Strategy Consulting Company	2/3		Yunnan Province	0	50,000-70,000

<b>Acreage non-disclosed projects</b>	36,640	66,641
<b>Total</b>	<b>105,251</b>	<b>706,641</b>

-  Commercial project
-  Non-commercial project

- 1 Interview / Questionnaire with project representative
- 2 Interview / Questionnaire with external project expert
- 3 Public sources

## 4-3 Asia – South-East Asia and Pacific

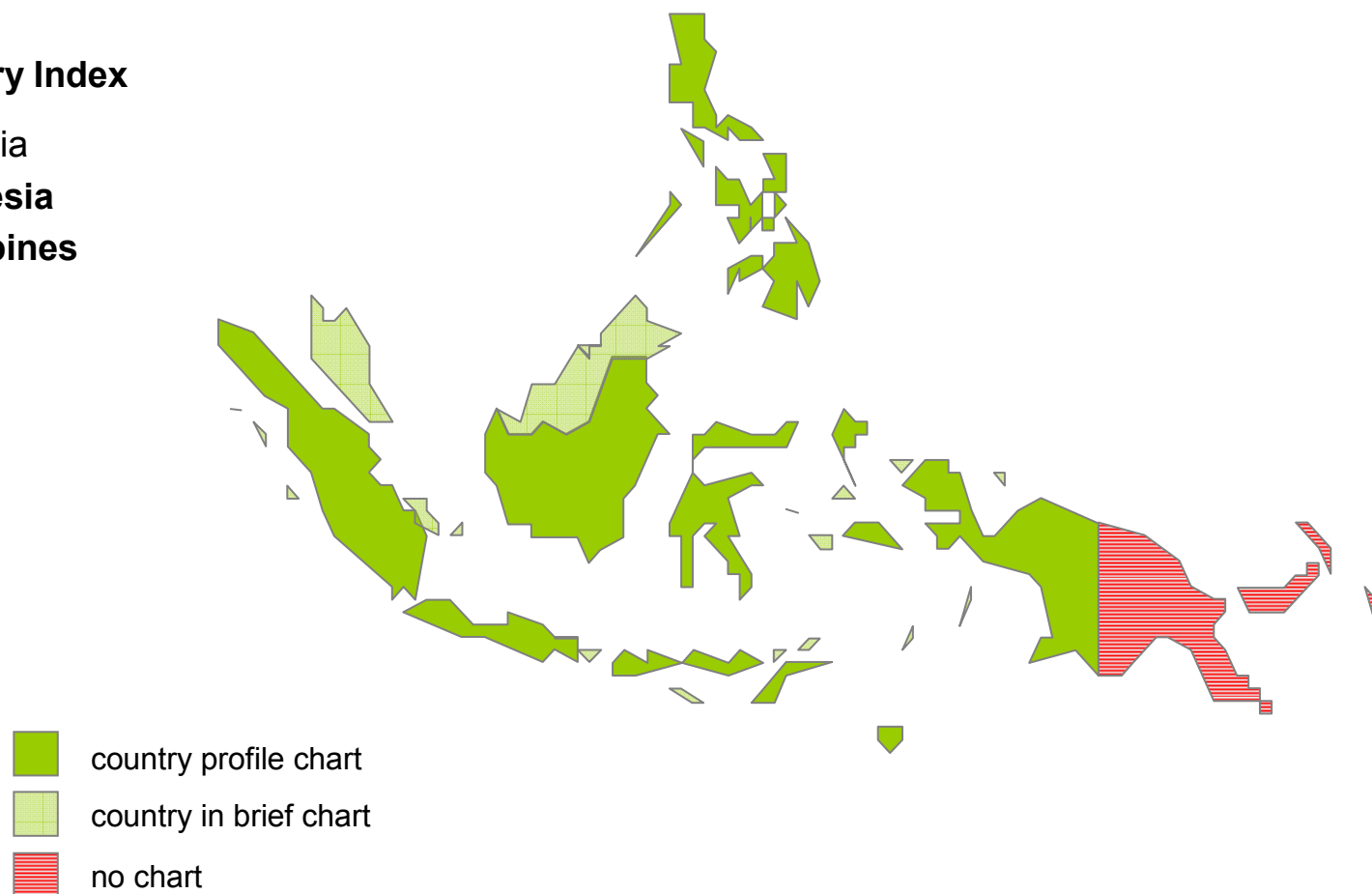


### Country Index

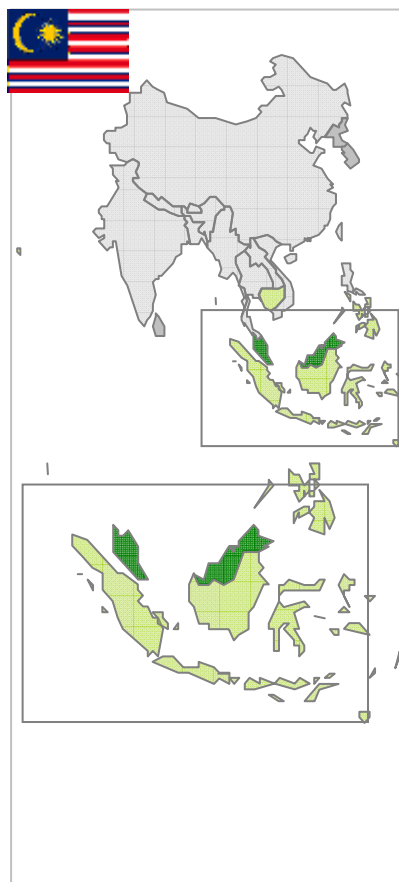
Malaysia

**Indonesia**

**Philippines**



## 4-3 Asia – Malaysia



### Malaysia

☒ Jatropha exists ☐ Jatropha locally used ☒ Commercially farmed

**Policies:** At present, no policy or legislation specifically supporting Jatropha cultivation exists, but is reported to be currently drafted.

So far, the development of Jatropha cultivation has been comparatively slow and project activities are still on a low level. Most projects have only been set up recently and are mainly run and owned by foreign companies, with few exceptions.

The main reason for the reluctant development are apparently high costs for land acquisition (compared with neighbouring states) and a shortage of low-cost labour. Country expert report that small-scale farmers have not yet started to grow Jatropha.

**Projects:** A total current acreage of 1,712 ha has been identified. Project owners state plans to increase the cultivation scale to a total of 57,601 ha by 2015. The Ministry of Plantation of Industries and Commodities is undertaking a Jatropha pilot research project for which 300 ha have been allocated. Some international, leading oil company report plans to develop Jatropha projects in Malaysia. A few local private companies have engaged in Jatropha cultivation scaling from 400 ha to 1000 ha.

## 4-3 Asia – Indonesia



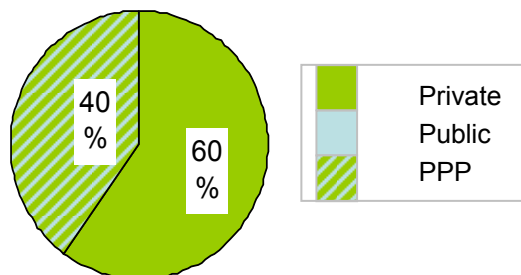
### Summary & Comments

Indonesia is one of the leading Jatropha producers worldwide. Several experts expect Indonesia to be the first country to place significant quantities of Jatropha biofuels on the market. Some of the leading international Jatropha oil companies are currently investing in Indonesia. They reportedly aim mainly to establish large-scale plantations and outgrower schemes. More than 25 million ha, an area larger than the United Kingdom, are believed to be suitable for Jatropha cultivation. However, in regions that are favourable for palm plantations, Jatropha seems a less attractive option.

### Scale of Jatropha Cultivation

	Expert Estimate	Projects identified
current	188,333 ha	75,671 ha
2010	1,767,143 ha	1,160,871 ha
2015	5,184,167 ha	7,036,951 ha

### Project Ownership



### Government Programs

#### **Jatropha / Biofuel Legislation**

The government supports Jatropha within its strategic plan to develop biofuels as an alternative to conventional fuel sources. It has installed a national team for biofuel development (Tim Nasional Bahan Bakar Nabati or Timnas BBN). No government purchasing policy or guaranteed prices have been reported.

#### **Other Means of Support**

The government supports companies that grow Jatropha through low-interest loans. Research programs also receive support.

### Government Targets on Jatropha

The government has set a target of 2 million ha to be cultivated with Jatropha by 2010. Biofuels are to contribute with 5% to the total energy mix by 2025.

#### **Barriers for Jatropha Investments**

In several areas, Jatropha competes with palm oil plantations which are economically more attractive.

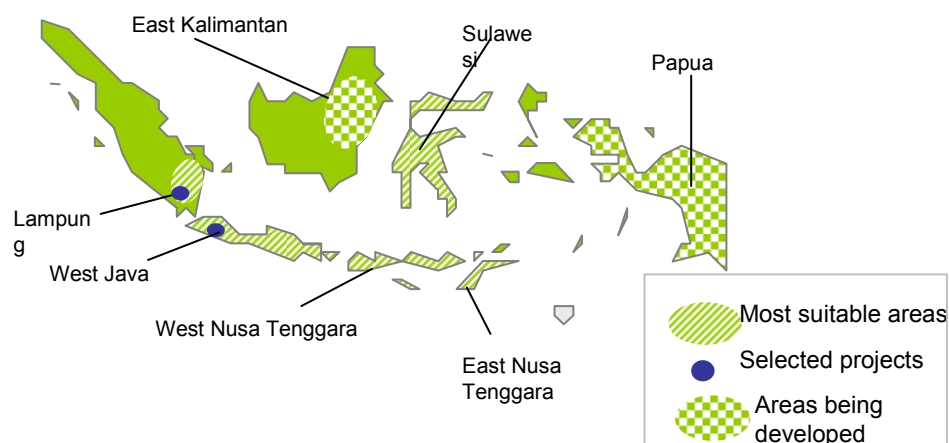
#### **NGO-Initiatives**

Sinarmas, Bakrie, Rekayasa Industri, Indonesia Biodiesel Forum

## 4-3 Asia – Indonesia

### Regional Distribution

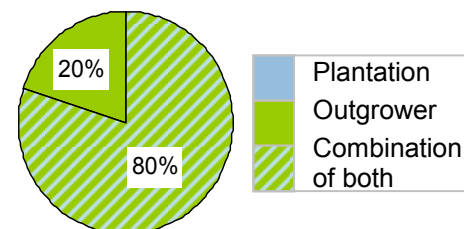
At present, Jatropha plantations are found in West Nusa Tenggara, East Nusa Tenggara, West Java, Lampung and Sulawesi. More plantations are reported to be developed in East Kalimantan and Papua in the coming year.



### Project Evaluation

- 60% of projects are privately owned and more than 80% profit-oriented.
- Fertilisation is widely used as a cultivation technique. A majority of the projects apply pruning, root treatment and intercropping. Half of the projects use irrigation. Country experts suggest manual irrigation as the predominant scheme.
- Most projects aim to set up their own oil milling facilities and biodiesel refinery. The use of carbon credits is comparatively high (75% of projects) – mostly CDM credits under the UNFCCC scheme.
- According to project owners identified, the large majority of projects are developed on non-agricultural and waste land.
- Sustainability policies exist for most of the projects.

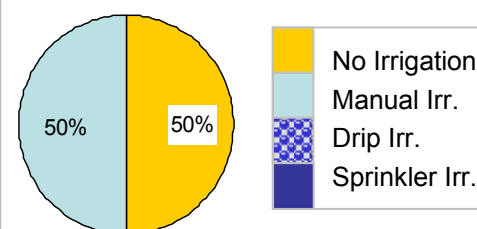
### Plantation Model



### Value Chain Elements



### Irrigation Models















### Prices

Seeds ( per kg /dry)	\$0.1-0.44
Labour (per day)	\$2-4
Diesel at pump	\$0.49-0.93

10 experts interviewed  
12 projects analysed

## 4-3 Asia – Indonesia

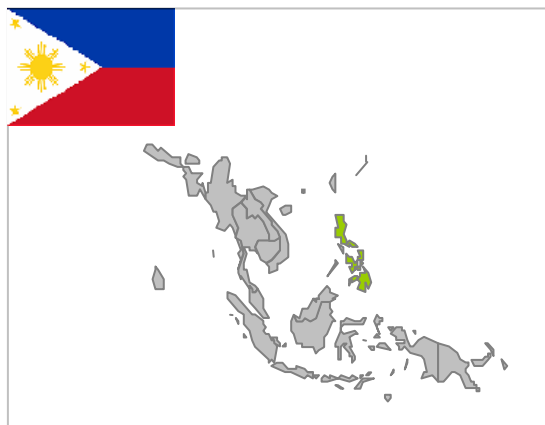
Project	Source	Type	Project Location	Ha (2008)	Ha (2015)
National Federation of Rural Cooperative Jatropha Project	1		All over Indonesia	5,000	5,000,000
Jatohil, Biodiesel Austindo	1		Provinces of Lampung and Nusa Tenggara Timur (NTT)	1,000	200,000
D1-BP Crop Fuels Ltd.	1			39,400	---
PT. Kreatif Energi Indonesia	1			300	---
Biogreen Energy Sdn. Bhd, Malaysia	1			600	300,000
Enhanced Biofuels Technologies Pvt Ltd	3			0	500,000
PT Rajawali Nusantara Indonesia (RNI)	3		Indonesia, central, west and east Java	10,000	100,000
China Agro-Technology Ltd.	3			20,000	197,680
Sinopec China	3		Papua and East Kalimantan	0	---
CARE	1			300	500
Asia Pacific Biofuel Corporation	1		P.T.Sugico Graha	0*(tbc)	700,000
SBRC, Surfactant and Bioenergy Research Centre, Bogor Agricultural University	1			50	---

 Non-commercial     Commercial

- 1 Interview / Questionnaire with project representative
- 2 Interview / Questionnaire with external project expert
- 3 Public sources

<b>Acreage non-disclosed projects</b>	-	38,721
<b>Total</b>	<b>75,671</b>	<b>7,036,951</b>

## 4-3 Asia – The Philippines



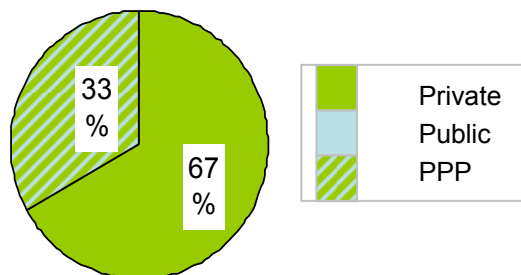
### Summary & Comments

Jatropha is commercially farmed in the Philippines and actively promoted for energy use by the Government. All local government units are expected to develop their own Jatropha farming areas and to set up biofuel standards. The government is very supportive in aspects of finance, research and land availability. The state-owned company PNOC-AFC has invested into Jatropha, with the goal of establishing large scale plantations. However, consolidating land after years of subdivision may pose a problem, according to country experts.

### Scale of Jatropha Cultivation

	Expert Estimate	Projects identified
current	3,833 ha	3,774 ha
2010	245,000 ha	23,009ha
2015	1,073,333 ha	1,382,609 ha

### Project Ownership



### Government Programs

#### **Jatropha / Biofuel Legislation**

The Biofuels Law of 2006 supports biofuel plantation through a favorable investment climate. It provides financial support like agro-industrial and cooperative loans. Government funding has been provided for research on Jatropha variety selection, cultivation management, intercropping, and land use at discounted lease rates. Jatropha is also included in the anti-poverty alleviation program. The National Biofuels Board was established to help develop biofuel production.

#### **Government Targets on Jatropha**

The government target is reported as 700,000 ha cultivated by 2010.

#### **Barriers for Jatropha investments**

The main challenge is the difficulty in consolidating land after years of Land Reform subdivision. Slow investment inflow and limited capital investment may be another issue for Jatropha development.

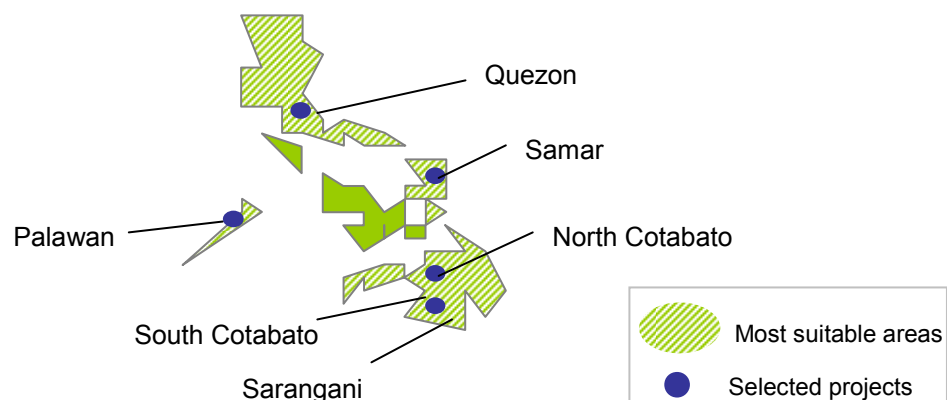
#### **NGO-Initiatives**

USAID, Samasa Consortium, Angelo King Foundation, The Philippine Jatropha Association

## 4-3 Asia – The Philippines

### Regional Distribution

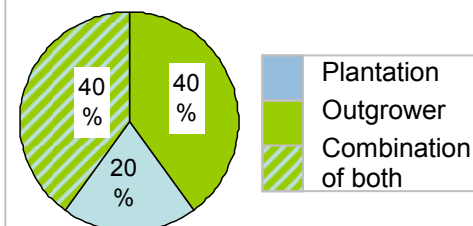
Jatropha is grown widely across the Philippines. The Luzon region in the north, the Mindanao region in the south as well as the Eastern Visayas and Palawan Island in the central Philippines apparently have favourable climatic and soil conditions for Jatropha production.



### Project Evaluation

- All projects identified apply pruning, fertilisation and intercropping as cultivation techniques. Half of the projects use root treatment and irrigation.
- Country experts report a lower rate of irrigation, mainly through manual schemes.
- Three quarters of the projects aim to set up oil milling facilities and biodiesel refineries.
- Use of carbon credits is common with 50% of projects participating in the UNFCCC schemes (CDM/NFCCC scheme) or voluntary schemes.
- The majority of projects identified are being developed on waste land.
- Sustainability policies are reported for most of the projects.

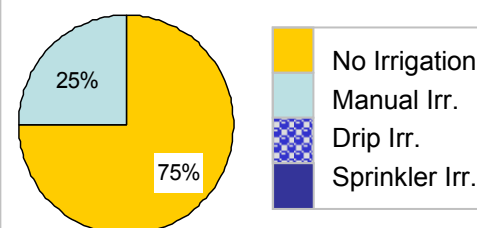
### Plantation Model



### Value Chain Elements



### Irrigation Models











### Prices

Seeds ( per kg /dry)	\$0.12-0.85
Labour (per day)	\$4.85-6.8
Diesel at pump	\$0.85-0.92

7 experts interviewed  
9 projects analysed



## 4-3 Asia – The Philippines

Project	Source	Type	Project Location	Ha (2008)	Ha (2015)
Lacto Asia Pacific Corporation	1			300	20,000
Green Eight Industries Inc.	1		Not disclosed	-	-
PNOC Alternative Fuels Corporation	1		islands of Palawan and Mindanao	800	700,000
Biogreen Energy Sdn. Bhd, Malaysia	1			50	100,000
Agricultural Systms Cluster	1			15	500
Asia-Pacific Biofuels Corporation	1		South Cotabato, Glan, Sarangani Province, Mulanay, Quezon	0*	60,000
Abundant Biofuels Corporation	3		Lumad lands on the island of Mindanao	0	480,000
Korean International Bio (KIBio) 2007 Corp	3		Samar	300	5,000
<b>Acreage non-disclosed projects</b>				2,309	17,109
<b>Total</b>				<b>3,774</b>	<b>1,382,609</b>

 Commercial project

 Non-commercial project

- 1 Interview / Questionnaire with project representative
- 2 Interview / Questionnaire with external project expert
- 3 Public sources

### Content

- 1 Management Summary**
- 2 Background and Methodology of the Study**
- 3 Results on a Global Level**
- 4 Results on Regional on Country Level**
- 5 Case Studies on Jatropha Projects**

## 5 Jatropha Case Studies



### Case Studies selected

The case studies were selected after consultations with WWF. The selection is based on the rationale to include each of the following project parameters by at least one of the projects presented:

- (1) **Regions:** Asia, Africa, Latin America
- (2) **Project Type:** for-profit, not-for-profit
- (3) **Project Size:** small-scale, large-scale

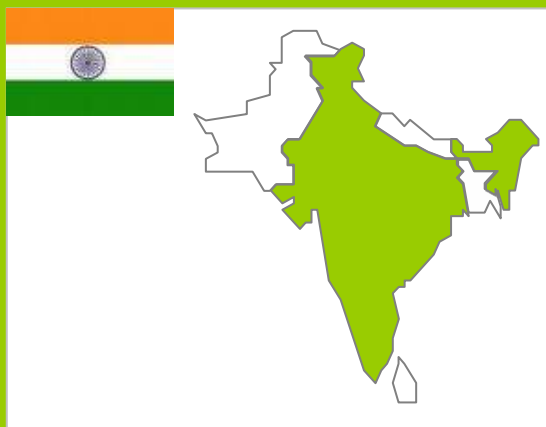
Nr	Region	Country	Project Type	Organization	Project Size (ha)
1	Asia	India	Commercial	D1-BP Fuel Crops & Williamson Magor	Large
2	Asia	India	Not-for-profit	ICRISAT / NOVOD	Small
3	Asia	Lao	Not-for-profit	Lao Institute for Rural Energy (LIRE)	Small
4	Africa	Ghana	Commercial	BioFuel Africa Ltd.	Large
5	Africa	Zambia	Commercial	Marli Invest	Medium
6	Latin America	Nicaragua	Not-for-profit	Proyecto Tempate	Small

### Disclaimer

The case studies have been prepared on basis of interviews and questionnaires with project representatives. The aim of the case studies is to present different plantation models chosen by the project developers, and to highlight lessons learnt.

In the short period of time available, it was not possible to conduct in-depth research on each project. We therefore recommend the reader to take these case studies as a starting point for further discussion, and possibly further analysis based on field research and interviews with a broad range of stakeholders.

## 5 Jatropha Case Studies



**India**

**D1-BP Fuel Crops &  
Williamson Magor**



### In a Nutshell

#### Project Size

Current 62,455 ha

2010 // 200,000 ha

2015 // 200,000 ha

#### Project Scheme

Outgrower Scheme

#### Project Ownership

- ☒ Private  
☐ Public  
☐ Private-public Partnership

**Project Start:** 2004

### Location & Ownership

<b>Location</b>	India
<b>Project Developer</b>	D1-BP Fuel Crops in cooperation with their partner Williamson Magor
<b>Contact Person</b>	Steve Douty - <a href="mailto:s.douty@d1bpfuelcrops.com">s.douty@d1bpfuelcrops.com</a>

### General Overview

**The company:** D1-BP Fuel Crops, based in the UK, is a 50:50 Joint Venture between BP and D1 Oils. The company aims to produce bio-diesel feedstock through *Jatropha Curcas* (and other non edible oil seeds). D1-BP Fuel Crops formed joint venture with Williamson Magor, Indians largest team company, for operations in Eastern and North-Eastern India.

**The project:** In its Joint Venture with Williamson Magor, D1-BP Fuel Crops has cultivated *Jatropha* on 62,000 ha since 2005; a further 50,000 ha are targeted for 2008-09.

D1-BP Fuel Crops & Williamson Magor in India works mainly with outgrowers. The company provides a wide range of technical services regarding the plantation and farming of *Jatropha curcas*, leveraging its expertise in other regions world-wide and the exclusive global R&D tie-up of D1-BP Fuel Crops with D1 Oils.





Photo: © George Jaworski 2007

### Natural Conditions

#### Elevation



400 m - 1,500 m  
above sea level

#### Temperature



4 - 35 °Celsius  
min/max in different  
locations

#### Rainfall



1,800-2,800 mm  
annual average  
in different locations

#### Soil Quality

- ☐ high  
☒ medium  
☒ poor

### Project Design

D1 Fuel Crops & Williamson Magor provides to its outgrowers an at-cost supply of advantaged seedlings from suitably located nurseries. In return, a performance-based “buy-back” scheme covering the complete harvest has been agreed with the growers. D1-BP Fuel Crops & Williamson Magor works with farmers’ cooperatives, women self-help-groups and contracts farmers also directly. Intercropping is a frequent method to increase the benefits for the rural poor.

D1-BPs Fuel Crops & Williamson Magor work leverages the Indian State governments’ promotion schemes for Jatropha plantation to fight rural poverty.

### Cultivation Details

#### Geographic Conditions

The project locations differ strongly in their climatic conditions. The northeastern regions close to the Himalayan mountains receive up to 2,800 mm of rain annually, whereas many other regions receive less than 1,000 mm per year.

#### Planting Method

Use of seedlings which are produced in seedbed nurseries close to farmers.

#### Cultivation & Maintenance

D1-BP Fuel Crops & Williamson Magor develop nutrient and integrated pest management systems for the different sites.

#### Origin of Seeds

Local source

#### Spacing

Usually between  
1,600 – 2,500  
plants per ha

#### Irrigation

- ☒ No Irrigation  
☐ Manual Irrigation  
☐ Drip Irrigation  
☐ Sprinkler Irrigation



Photo: © George Jaworski 2007

### Market Features

#### **Expected Yield**

2-3 kg dry seeds / tree

#### **Price of Diesel at pump**

0.82 \$

#### **Labour Costs**

1.98 \$ / day and person

#### **Use of Carbon Credits**

- ☒ none  
☐ CDM  
☐ Voluntary market

### Sustainability

#### **Food versus Fuel - Policy**

The entire land under cultivation was either wasteland or underutilized agricultural land that have not being cultivated for the last 5 years. The project thus does not have any adverse impact on food security. On the contrary, D1-BP Fuel Crops & Williamson Magor actively encourages intercropping with food crops.

#### **Social Activities**

As an example, D1-BP Fuel Crops & Williamson Magor is building a strong network of Women's Self Help Groups for grain collection and first level value addition in the rural community.

#### **Carbon Offset**

No carbon credits are currently generated; the company liaises with international agencies to further work on carbon credit mechanisms.

### Value Chain

D1-BP Fuel Crops & Williamson Magor's business model covers the whole value chain, from seedling production to sales of biodiesel. The company seeks to seize economies of scale in production: A medium sized oil expelling unit with solvent extraction (100 tons/day) will service between 5,000 – 15,000 hectares of mature plantation. Several of these could fuel a biodiesel refinery, with the smallest of the units having a capacity of 35,000 metric tons of crude oil. As of today, no oil has been produced yet (apart from test trials).

### Jatropha Research

Research activities are conducted by D1 Oils that is one of D1-BP Fuel Crops' joint venture parents. In India, D1 Oils is developing research partnerships, among others, with the International Crop Research Institute for the Semi-Arid Tropics (ICRISAT) as well as with the Tamilnadu Agriculture University. In addition, BP has a research project with the Tata Energy Research Institute (TERI), focusing on schemes that integrate smallholder farmers.





Photo: © George Jaworski 2007



Photo: © George Jaworski 2007

### Main Challenges

**Secure finance  
for outgrowers  
until first  
harvest**

**Stakeholder  
Communication**

**Convergence of  
various  
government and  
support  
schemes**

### Lessons learned – Good & Bad Practice

The access to finance for the growers involved in the various plantations to bridge the time until Jatropha yields its first harvest proved to be difficult. The viability of the different models still need to be demonstrated.

It has shown to be difficult to raise awareness and/or to educate the different stakeholders involved in the Jatropha value chain on issues such as food vs. fuel, carbon footprint of bio-fuel and the intelligent use of biomass. This holds true also with regard to political communication as there are many separate ministries involved in Jatropha (Agriculture, Rural Development, New and Renewable Energy, Finance, Petroleum).

There are different government schemes as well as specific support schemes for Jatropha; it is not always easy to match these government programs with the outgrower schemes designed by D1-BP Fuel Crops & Williamsor Magor. Another issue is the lack of formally adopted policy on biofuels, together with concessions to support jatropha industry.

## 5 Jatropha Case Studies



**India**  
**ICRISAT – NOVOD Project**



### In a Nutshell

#### Project Size

Current	300 ha
2010	300 ha
2015	300 ha

#### Project Scheme

Self-help Groups

#### Project Ownership

- ☐ Private
- ☒ Public
- ☐ Private-public Partnership

**Project Start:** 2005

### Location & Ownership

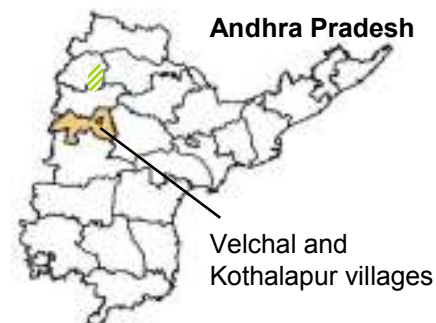
<b>Location</b>	India, Andhra Pradesh Province
<b>Project Developer</b>	ICRISAT – International Crop Research Institute for the Semi-Arid Tropics (Patancheru, India) NOVOD – National Oilseeds and Vegetable Oils Development Board
<b>Contact Person</b>	<b>Dr. SP. Wani</b> s.wani@cgiar.org

### General Overview

**Organisation.** ICRISAT is an international agronomic research center which aims to apply science to improve the livelihoods of those who live in disadvantaged regions of the semi-arid tropics. In 2005, ICRISAT-India, supported by the State Government of Andhra Pradesh and the National Oilseeds and Vegetable Oils Development Board (NOVOD) started projects to promote sustainable biofuels in Andhra Pradesh.

**The Project.** The ICRISAT project provides land, financing and coaching to local Self-Help Groups (SHGs) to cultivate Jatropha. The project supports 10 SHGs of 8 people each. It finances the groups until their own harvest generates revenue. As part of the scheme, a proportion of the income is allocated to a micro-savings scheme. The project benefits from the Government buy-back policy, offering 14 US Cent per kg of dry seeds.

**Target.** The aim of ICRISAT is to test organisational and institutional models for Jatropha cultivation that benefit the rural poor and can be replicated throughout the semi-arid tropics. The aim is to provide good practice for the Government.





### Project Development


#### Project Status and Outlook

The project started in July 2005. ICRISAT organised agricultural labourers to form Self-Help Groups. A 300 ha model plantation on common property in the villages Velchal and Kothalapur in the Ranga Reddy District of Andhra Pradesh was implemented. ICRISAT strengthened local community structures by establishing a bio-fuel committee which included the District Administrator, Village Assembly members and local NGOs. Decision about critical issues, such as work conditions and remuneration, have been settled by group consensus.

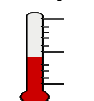
The project is designed as a low-input, low-maintenance scheme which will be easy to replicate.

### Natural Conditions


#### Elevation

 400 m  
above sea level

#### Temperature

 28-30 °Celsius  
annual average

#### Rainfall

 750 mm  
annual average

#### Soil Quality

- ☐ high  
☐ medium  
☒ poor

### Cultivation Details

#### Geographic Conditions

The area receives an average of 750 mm rainfall per annum. The annual average is 28–30 °C, however temperatures can range between 20–45 °C depending on the season. The soils are lateric, with shallow profiles and a high degree of degradation. The landscape is hilly, with small shrubs and sheet rocks.

#### Planting Method

The nurseries are maintained by the SHGs. Where soil quality allows, the plants are intercropped with other rain fed crops like castor and millet to ensure food security.

#### Cultivation & Maintenance

The land is mainly rain fed. However, during transplantation the SGHs used manual irrigation. Farm yard manure was applied as fertilizer on the young plants.

#### Origin of Seeds

Local source (Seed material provided by ICRISAT)

#### Spacing

Jatropha: 2x2 m  
Pongamia: 4x4 m

#### Irrigation

- ☒ No Irrigation  
☒ Manual Irrigation only for nursery  
☐ Drip Irrigation  
☐ Sprinkler Irrigation

## 5 Case Study: India – ICRISAT- NOVOD Project



Photo: ICRISAT

### Market Features

#### Expected Yield

1.3 -1.7 kg dry seeds / tree

#### Price of Diesel at pump

0.81 \$ (Andhra Pradesh)

#### Labour Costs

2.48 \$ per day and person

#### Use of Carbon Credits currently being assessed

- ☒ none  
☐ CDM  
☐ Voluntary market

### Research & Sustainability Issues

#### Research Activities

1. ICRISAT has formed a consortium with NOVOD to evaluate Jatropha germ-plasma in India. It is also actively involved in research to improve agronomic practices for Jatropha cultivation.
2. ICRISAT conducts capacity building for local communities to integrate them into the bio-fuel value chain and to foster rural development.

**Sustainability.** The project is designed to re-cultivate marginal land with advanced soil erosion and provide maximum benefits to SHGs.

### Value Chain

1. **Seedling production:** The model poses a great potential to engage women. As part of the project, SHGs of women receive training in Jatropha nurseries. This will lead to enhanced participation of women in the village economy and provide family income during off-seasons. In the ICRISAT-NOVOD project, women SHG's received **0.12 \$** per seedling.
2. **Seed collection:** This is also a source of income for women in rural areas. ICRISAT has ensured equal wages for women and men (2.48 \$ per day).
3. **Seed sales:** The Government of Andhra Pradesh offers a guaranteed price for Jatropha seed at 0.14 US\$ per kg.

**Use of oil**                      Mainly for local refineries – domestic market

**Use of press cake**              Applied as fertilizer on Jatropha fields by farmers

**Main clients**                      Southern Online Biotechnologies (SBT), biodiesel producer



Photo: ICRISAT

**Jatropha intercropping  
with Sorghum**

Photo: ICRISAT

**Jatropha affected by  
caterpillars****Main Challenges**

**Who will monitor the plantations and the SHGs after the pilot ends?**

**How to ensure effective cooperation and local ownership?**

**How to successfully apply pest control in a low-input farming model?**

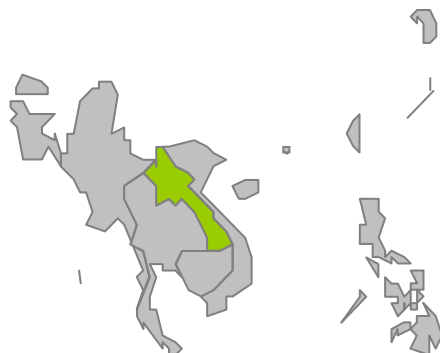
**Lessons learned – Good & Bad Practice**

The SHGs are monitored by ICRISAT and local NGOs. The groups are homogeneous and work without problems. According to the draft policy, community or revenue land plantations will receive financial assistance for up to three years. However, the question arises who will monitor these plantations and SHGs from 3<sup>rd</sup> year onwards. There is a possibility that SHGs may lose interest in pooling resources if revenue does not meet expectations. This may be the case as the yields are uncertain.

Success largely depends on trust. Effective co-operation between the local parties, for example the district administrator, farmers, revenue officers, NGOs and village level institutions, is vital. ICRISAT organised regular meetings with the local community to disseminate the government policies on sustainable biofuel promotion and rural development .

There have been problems with leaf minor and caterpillars. It proved to be difficult to establish an efficient pest control within a low maintenance farming model. Besides, it is difficult to get all SHGs involved in pest control which can lead to cross-contamination between the different cultivation blocks.

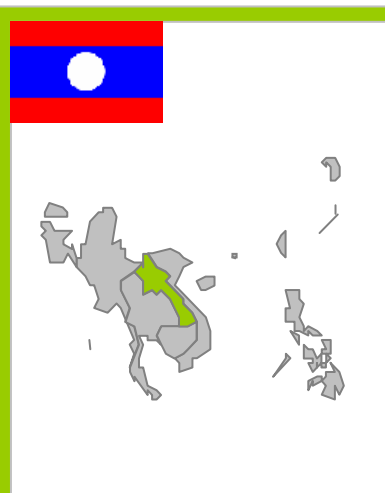
## 5 Jatropha Case Studies



**Lao**

**LIRE – Lao Institute for  
Rural Energy**





### In a Nutshell

#### Project Size

Current 10 ha

2010 20 ha

2015 50 ha

#### Project Scheme

Plantation & Outgrower

#### Project Ownership

- ☐ Private
- ☒ Public
- ☐ Private-public Partnership

**Project Start:** 2006

### Location & Ownership

<b>Location</b>	Lao, Vientiane Province
<b>Contact Person</b>	Jakob Rietzler jakob@lao-ire.org
<b>Project Developer</b>	Lao Institute for Renewable Energy (LIRE)

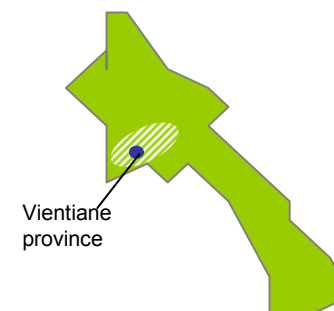
### General Overview

**The Organisation:** LIRE is a non-profit institution which brings together experts from Lao and around the world. The mission of LIRE is to explore, develop and sustain efforts for making Lao develop its own renewable energy sector.

**Background:** The electricity grid in Lao is concentrated mainly in towns and cities.

Many people living in remote villages have no access to electricity. The average annual electricity consumption per capita is 135 kWh, compared to a global average of 2,490 kWh. Only 48% of the population have access to the electricity grid.

**The Project:** In 2006 LIRE initiated projects and began to explore the potential of Jatropha as a source of biofuel in Lao. A set of research project proposals that encompassed the whole chain was formulated. LIRE established test-fields in Wat Nark village, Vientiane Province and at the Dongkhamxang Agriculture Technical School. As well as agriculture studies, studies on processing the seed into biofuel were carried out, and the results were published on the homepage.






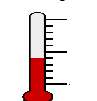


### Natural Conditions


#### Elevation

 300-1,500 m  
above sea level

#### Temperature

 25°Celsius  
annual average

#### Rainfall

 1,500mm  
annual average

#### Soil Quality

- ☐ high  
☒ medium  
☐ poor

### Project Design

#### Operation Model:

LIRE will carry out its 10 point Jatropha program in the coming years. The focus will be placed on agricultural topics. The target beneficiaries are private companies, NGOs, governmental institutes and communities lacking reliable, sustainable and affordable energy supplies in rural areas of Laos.

#### Future Outlook:

The project generates solutions for successful utilisation of Jatropha as an energy crop. LIRE wants to provide solutions and independent research results for interested parties and involved stakeholders. A major aim is to explore if it is possible for the cultivation and utilisation of Jatropha to generate income and development for rural farmers in Laos.

### Cultivation Details

#### Geographic Conditions

The climatic condition are favourable. The rainy season lasts from May to September (approximately 1400 mm). Jatropha can be harvested between May and November.

#### Planting Method

Transplanting seedlings or cuttings and direct seeding.

#### Cultivation & Maintenance

Every kind of plantation and crop management will be observed and explored, including irrigation, pruning, intercropping and breeding.

#### Origin of Seeds

local and foreign source

#### Spacing

2,500-3,333 plants  
are planted per ha

#### Irrigation

- ☒ No Irrigation  
☐ Manual Irrigation  
☐ Drip Irrigation  
☐ Sprinkler Irrigation



Photo: LIRE

### Market Features

#### **Expected Yield**

1.5 kg dry seeds / tree

#### **Price of Diesel at pump**

1.16 \$

#### **Labour Costs**

2.31 \$ per day and person

#### **Use of Carbon Credits**

☒ none

☐ CDM

☐ Voluntary market

### Jatropha Research

#### **Research Activities**

LIRE has a 10-step program to develop a biofuel capability in Laos using the oil from the Jatropha plant. These projects are: 1. Germplasm and propagation techniques for various purposes. 2. Mapping suitable areas for planting and logistics for various operational approaches. 3. Plantation management. 4. Decentralized village level production. 5. Hot oil extraction. 6. Transesterification and producing Biodiesel for normal diesel motors. 7. Refining and producing standard biofuel for modified diesel motors. 8. Cold oil extraction and producing green biofuel for modified diesel motors. 9. Motor technology for various applications. 10. Profitable use of press cakes.

### Value Chain

#### **Key markets:**

No Biofuel market has been established in Lao PDR yet. Most of the seeds are sold to Thailand, China and Vietnam for propagation purposes. Dealing with seed material is the only market so far.

#### **Key product:**

Independent research results.

#### **By-products:**

Improved seed material.

### Sustainability Policy

#### **Social Activities & Partners**

Private companies, NGOs, governmentall institutes and other organisations.

#### **Carbon Offset**

None.



Photo: LIRE

Active farming of Jatropha

**Main Challenges****Achieving sound agriculture results****Lessons learned – Good & Bad Practice**

Jatropha has not been domesticated yet. Breeding actions take a very long time. However quick improvements can be achieved by selection work.

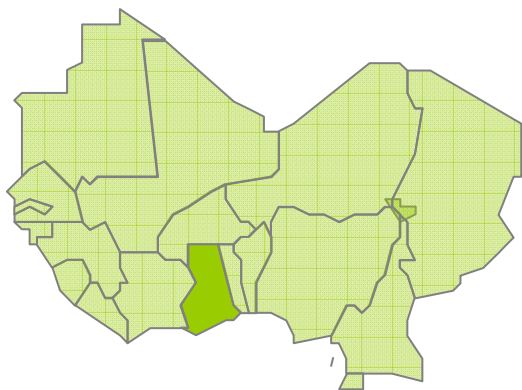
**Building up local networks  
Land use conflicts**

Cooperation with universities and other stakeholders builds trust and facilitates conflict resolution.

**Pests and Diseases**

Funghae, root diseases and insects have been encountered. Pest control is deemed necessary, as for any other crop.

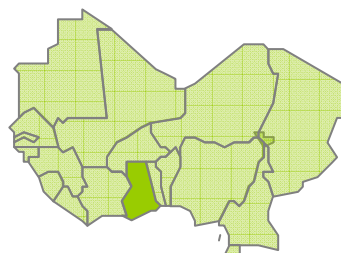
## 5 Jatropha Case Studies



**Ghana**

**BioFuel Africa Ltd.**

## 5 Case Study: Ghana – BioFuel Africa Ltd.



West Africa

### In a Nutshell

#### Project Size

Current 2,000 ha

2010 150,000 ha

2015 800,000 ha

#### Project Scheme

Plantation & Outgrowers

#### Project Ownership

- ☒ Private
- ☐ Public
- ☐ Private-public Partnership

**Project Start:** 2005

### Location & Ownership

**Location** Ghana

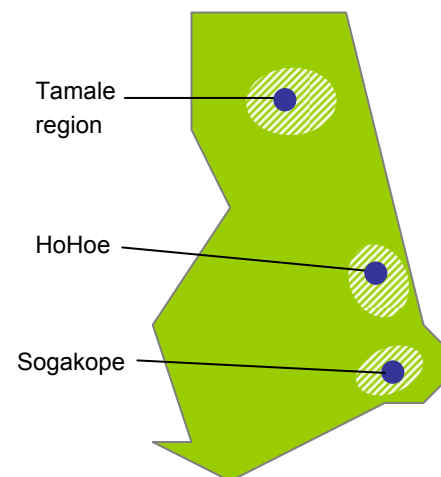
**Project Developer** **BioFuel AS – Norway** in cooperation with **BioFuel Africa Ltd. - Ghana**

### General Overview

BioFuel AS is a privately owned Norwegian company selling biodiesel in the European market. The company has established partnerships with refineries, transporting and distributing companies as well as farmers and fish producers and is operating based on this network.

In 2005, the company started a Jatropha project in Ghana together with its subsidiary company BioFuel Africa Ltd. in order to broaden its sales spectrum.

Initially, 2 hectares of Jatropha were planted as a pilot providing seeds for further plantations. Currently, the company has planted 2,000 hectares of Jatropha for commercial purposes and is planning to expand to 800,000 hectares by 2015. A nursery of 100 hectares as well as a test farm of 850 hectares are located at Sogakope, using the nearby river for irrigation.







© www.biofuel.no

### Natural Conditions


#### Elevation

 160 m  
above sea level

#### Temperature

 28 °Celsius  
annual average

#### Rainfall

 1,100 mm  
annual average

#### Soil Quality

- ☐ high  
☒ medium  
☒ poor

### Project Design

#### Sustainability

BioFuel AS is emphasizing its strong focus on sustainability. The land which is used for cultivation has been abandoned, so that Jatropha does not compete with food production. Furthermore, a buffer zone of at least 500 metres is kept if there are small farming plots next to the plantations. The company is conducting a baseline study as well as individual environmental impact assessments for each project site. A main goal is to search for non-chemical disease and pest control methods such as intercropping. To involve the local social communities, the company has set up a community board consisting of members both from the company and the local communities. The company has set up a fund for local projects such as medical centres. Those projects will be proposed by the local community and decided by the community board.

### Cultivation Details

#### Geographic Conditions

The geographic conditions on the 3 project sites differ. Especially the Tamala region is much dryer than the other 2 sites and has been chosen due to the availability of land and labour in the northern parts of Ghana.

#### Planting Method

The project consists of a nursery, a test farm and plantation sites. 4,000 plants are planted per hectare.

#### Cultivation & Maintenance

In order to keep the plants healthy and lead to high harvesting yields, the company is using several cultivations techniques. These include intercropping, pruning, root treatment, irrigation and fertilization with Jatropha seed cake.

#### Origin of Seeds

India & local  
source

#### Spacing

4,000 plants / ha

#### Irrigation

Different types are being tested, currently used are:

- ☒ No Irrigation  
☒ Manual Irrigation  
☐ Drip Irrigation  
☐ Sprinkler Irrigation

## 5 Case Study: Ghana – BioFuel Africa Ltd.



© www.biofuel.no

### Market Features

#### **Expected Yield**

2600 kg crude oil /  
hectare each year

#### **Price of Diesel at pump**

1 \$

#### **Labour Costs**

3 \$ per day and person

#### **Use of Carbon Credits**

- ☐ none  
☒ CDM  
☒ Voluntary market

### Jatropha Research

#### **Research Activities**

BioFuel AS is running a test farm in Sogakope, near to Tema, Ghana's most important seaport. The company is testing 8 different types of Jatropha under various conditions. Tested are different fertilizers – organic (including the seed cake received from own plantations) as well as chemical, irrigation schemes, planting and harvesting methods.

#### **Research Results**

The results are analysed in terms of yield per bush and will determine the characteristics of the plantations, but are still in the process of examination.

### Value Chain

The company has not set up own biodiesel refineries, but is planning to sell the crude Jatropha oil. Plantation is carried out with machinery such as tractors, ploughs and harrows, which have been sent from Norway to Ghana in January 2007 and are used for all 3 project sites.

The harvested Jatropha nuts have been mainly used for further plantations so far. They will also be crushed in local oil presses, which have been already set up. The thus obtained crude Jatropha oil will be transported to the markets.

#### **Use of oil**

The crude oil as the company's core product will be sold on the domestic market as well as on an international level.

#### **Use of press cake**

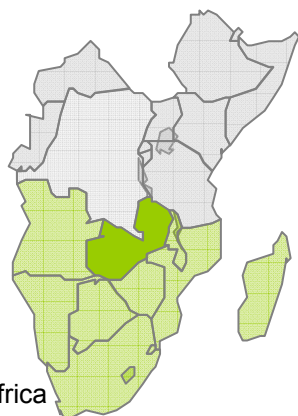
The Jatropha press cake will be used as a fertilizer on the company's own plantation sites and also be sold to local farmers. The company is currently researching a way to treat the press cake so that it will not be poisonous any more and can be sold for further purposes such as fish food.



	Main Challenges	Lessons learned – Good & Bad Practice
 <p>© www.biofuel.no</p> <p>First plowing</p>	<p><b>Integration of local employees into the organisation</b></p>	<p>BioFuel AS works to a large extent with local employees. This has been challenging due to cultural differences and a lack of educational expertise of the local Ghanaians. To cope with this problem, BioFuel AS has established a training system based on the knowledge of the 15 Norwegian project members, who pass on the expertise. Each new employee has to pass an educational program before starting to work for the company. The program includes practical training with machinery and tools as well as specialised knowledge regarding for instance species of trees and bushes.</p>
 <p>© www.biofuel.no</p> <p>Project Site</p>	<p><b>Pests</b></p>	<p>The company has encountered problems with beetles as well as with grasshoppers eating up the leaves of the Jatropha bushes. Experience has shown that beetles can be kept away without hurting the plants by spraying the leaves with soap water, while solutions against the grasshoppers are still to be found.</p>
	<p><b>Land use</b></p>	<p>BioFuel Africa was criticised by a local NGO for questionable procedures of land acquisition and for destructing forests which are used by the local population (see: <a href="http://www.wrm.org.uy/subjects/agrofuels/Biofuel_Northern_Ghana.pdf">http://www.wrm.org.uy/subjects/agrofuels/Biofuel_Northern_Ghana.pdf</a>). BioFuel Africa claims that the report has been drafted by a disappointed local consultant who had not been contracted, and that only a few trees were accidentally cut down. The company is willing to lay open all documentation, and invites NGOs to visit the project.</p>



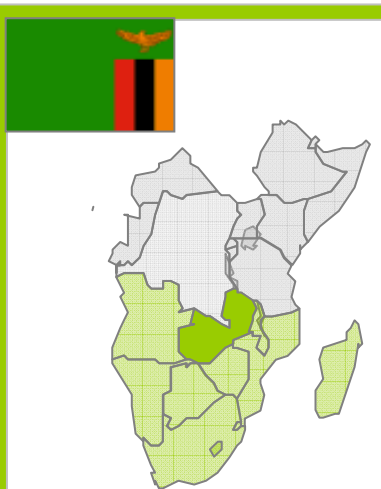
## 5 Jatropha Case Studies



Southern Africa

**Zambia**

**Marli Investments**



### In a Nutshell

#### Project Size

Current 8,500 ha

2010 17,000ha

2015 21,000 ha

#### Project Scheme

Outgrower & Plantation Scheme

#### Project Ownership

☒ Private

☐ Public

☐ Private-public Partnership

**Project Start:** 2004

### Location & Ownership

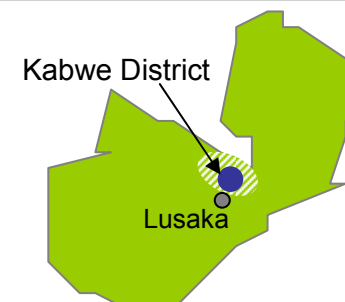
**Location** Zambia, Central Province / Kabwe, Kapiri Mponshi and Chibomo District

**Contact Person** Hekkie Grobler, marlinvestment@yahoo.com

**Project Developer** Marli Investments

### General Overview

**The Organisation:** Marli Investments is a private Zambian based agro-company, that has been involved in biofuel production and Jatropha cultivation since 2004.



**The Project:** The outgrower scheme was set up in 2004 in the three districts Kabwe, Kapiri Mponshi and Chibombo. All of them are located in the Central Province, north of Lusaka.

The scheme currently involves 25,000 farmers to which Marli Investments hands out Jatropha seeds and provides technical assistance.

Marli Investments set up its own nurseries and also used stems to quick-start the setting-up of the plantation. Since 2004, the acreage cultivated has grown to a current 8,500 ha.

First seeds were harvested in 2006 and used for the own nurseries to enlarge the plantation base.



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### Natural Conditions

#### Elevation



~1,200 m  
above sea level

#### Temperature



20°Celsius  
annual average

#### Rainfall



900 mm  
annual average

#### Soil Quality

- ☐ high  
☒ medium  
☐ poor

### Project Design

#### Operation Model:

Marli Investment provides seeds and technical expertise on the management of the crop up to maturity stage to the farmers involved in the outgrower scheme. The company works directly with the farmers without middle-men.

#### Future Outlook:

Marli Investment sees good opportunities to double the acreage cultivated under their scheme until 2010. In 2015, 21,000 ha are expected to be farmed. A processing plant is planned to be set up in Kabwe District to produce biodiesel and glycerine. Marli aims at producing blended fuel by mixing biodiesel with conventional fuel. The main business partner is to be Zambia's only oil refinery, the Indeni Petroleum Refinery in Ndola.

### Cultivation Details

#### Geographic Conditions

Due to altitude of central Zambia, the climate is mainly temperate and thus favourable for Jatropha cultivation. There are three distinct seasons with wide variations in temperature and precipitation. The cool season is from May-August; October is driest with highest temperatures. The main rainy season with heavy tropical storms lasts from mid November-April.

#### Planting Method

Transplanting seedlings or cuttings and direct seeding.

#### Cultivation & Maintenance

Cultivation techniques include pruning and intercropping with food crops.

#### Origin of Seeds

from local source

#### Spacing

1,000 plants are  
planted per ha

#### Irrigation

- ☒ No Irrigation  
☐ Manual Irrigation  
☐ Drip Irrigation  
☐ Sprinkler Irrigation



### Market Features

#### **Expected Yield**

5 tonnes dry seeds / ha

#### **Price of Diesel at pump**

1.7 \$

#### **Labour Costs**

~ 2 \$ per day and person

#### **Carbon Credits targeted**

- ☐ None
- ☒ CDM
- ☐ Voluntary market

### Jatropha Research

#### **Research Activities**

Marli is continuously working with small scale farmers to develop best practice for Jatropha farming. As the outgrower schemes are located in different parts of the country, Marli has the opportunity to analyse the properties and the potential of regionally differentiated cultivation techniques. Farmers are encouraged to adopt the most advantageous practices. There is also a well established cooperation between Marli Investments and other project developers in the country. Additionally, government institutions are conducting research on various aspects of Jatropha cultivation, from which projects benefit.

### Value Chain

#### **Key markets:**

The domestic biofuel market is targeted as first priority. The international market may be included at a later stage.

#### **Key product:**

Apart from seed production, the portfolio of Marli Investments includes seed crushing.

#### **By-products:**

Currently, seed cake is the main by-product. In the long run and at full production rate, the project will use seed cakes for fertilisation and biogas production.


### Sustainability Policy

#### **Social Activities & Partners**

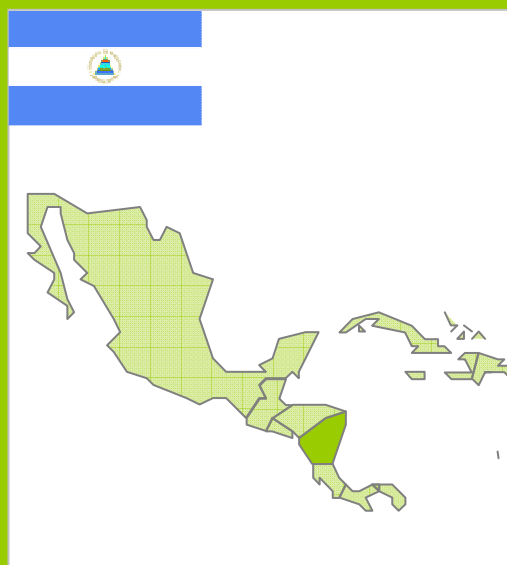
The project is well embedded into local community structures. Smallholder farmers benefit from intercropping of Jatropha with food crops and are able to generate additional income.

#### **Carbon Offset**

The project targets Carbon Credits under the UNFCCC Scheme. The process, however, is very complex and although the government actively supports projects in the application process, so far neither Marli nor other Jatropha projects have reportedly received CDM credits.

	Main Challenges	Lessons learned – Good & Bad Practice
 <p>© GEXSI LLP</p>	<p><b>Lack of clear blending ratios: Manufacturers' product warranties may become invalid</b></p>	<p>Blending ratios have not been clarified by the government as yet. They pose a very complex technical problem, as the specifications of the manufacturers of equipment for the biofuel production and blending process need to be followed strictly, in order to maintain product warranties. Marli Investments is awaiting further clarification and is currently focusing on plantation development to secure feed stock supplies.</p>
	<p><b>Policy issue: Specification on the new biofuel policy in Zambia is pending</b></p>	<p>Zambia has only in November 2007 approved a bio fuel policy. Workshops on specifications and implementation of the new policy commenced in December 2007. At present, project owners are awaiting clear national biofuel targets and further specifications.</p>
	<p><b>Financial issues: Difficult access to funds for biofuel production and fuel blending equipment</b></p>	<p>Costs of plant and machinery needed for biofuel production and fuel blending are high and a deterrent for project owners to enlarge the scope of their operation.</p> <p>Additionally, the issue of funding poses a hindrance as financial institutions are cautious about lending money to green field projects.</p>

## 5 Jatropha Case Studies



### Nicaragua Proyecto Tempate

## 5 Case Study: Nicaragua – Proyecto Tempate



### In a Nutshell

#### Project Size

1999 1,000 ha

Current 0 ha

#### Project Scheme

Outgrower Scheme

#### Project Ownership

- ☐ Private
- ☐ Public
- ☒ Private-public Partnership

**Project Start:** 1990

### Location & Ownership

**Location** Nicaragua, León Department

**Project Developer** **PETRONIC**, in cooperation with the Austrian Government

### General Overview

This 1,000 ha project started in 1990 and ended in 1999. It was a joint undertaking by the Nicaraguan and Austrian Governments. Technical assistance was provided by the Universidad Nacional de Ingeniería and the consulting company Sucher and Holzer.



León Department

The objective was to plant 1,000 ha with *Jatropha* and establish a biodiesel refinery in order to produce up to 8,000\* tons of dry seeds per year and 2,500\* tons of biodiesel. The project was located in the department of León in western Nicaragua. Most of the land used was either degraded or waste land which had previously been used for farming cotton.

The project had following main objectives:

- Substitute imported fossil fuels by locally produced biodiesel.
- Reforest lands degraded by intensive agricultural use.
- Create rural employment.
- Supply raw materials for national production of fodder to reduce imports.


*\*expected production range between 5,000-8,000 tons of seeds and 1,000-2,500 tons of biodiesel depending on the source consulted.*

## 5 Case Study: Nicaragua – Proyecto Tempate

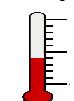


### Natural Conditions


#### Elevation

 30 – 150 m  
above sea level

#### Temperature

 27 °Celsius  
annual average

#### Rainfall

 1,800 mm  
annual average

#### Soil Quality

- ☐ high  
☒ medium  
☒ poor

### Project Design

#### Cultivation Model

The soil was prepared before plantations started. Small farmers were in charge of maintenance. Common practices were pruning and weeding. After the fourth year, maintenance levels decreased because farmers lost interest due to not sufficient productivity and yield levels.

#### Sustainability

The key objectives were reforestation and fighting erosion on highly degraded land. A high proportion of the land was marginal or waste land that had been used intensively by the cotton industry.

### Cultivation Details

#### Geographic Conditions

The project was located in a sub tropical region with temperatures ranging from 25 ° to 32 °C, with a rainy season from May to October and a dry season from November to April.

#### Planting Method

Seedlings were raised in nurseries.

#### Cultivation & Maintenance

The soil was well prepared by ploughing and fertilisation before the plantations were established. Maintenance practices were weeding, fertilisation, pruning and pest control.

#### Origin of Seeds

Local origin and  
Cape Verde

#### Spacing

1,100 plants were  
planted by hectare

#### Irrigation

- ☒ No Irrigation  
☐ Manual Irrigation  
☐ Drip Irrigation  
☐ Sprinkler Irrigation





### Market Features

#### **Expected Yield**

4.5 kg dry seeds / tree

#### **Price of Diesel at pump**

0.26 \$ (1995)

#### **Labour Costs**

1 \$ per day and person  
(1995)

#### **Use of Carbon Credits**

☒ none

☐ CDM

☐ Voluntary market

### Jatropha Research

#### **Research Activities**

Research was conducted by the Universidad Nacional de Ingeniería (UNI) in cooperation with the Universidad Nacional Autónoma de Nicaragua and the University of Graz (Austria)

The main areas of research were breeding, oil extraction, transesterification into biodiesel and detoxification of press cake.

#### **Research Results**

The UNI developed a procedure at laboratory level for the detoxification of the press cake.

### Value Chain

The main objective of this project was to produce biodiesel to substitute 0.31% of diesel imports. An important aspect of the project was to commercialise the by-products to create additional, sustainable revenues. These by-products included glycerin, fodder obtained by detoxifying the press cake, an organic insecticide and an organic fertilizer.

#### **Use of oil**

Biodiesel production

#### **Use of press cake**

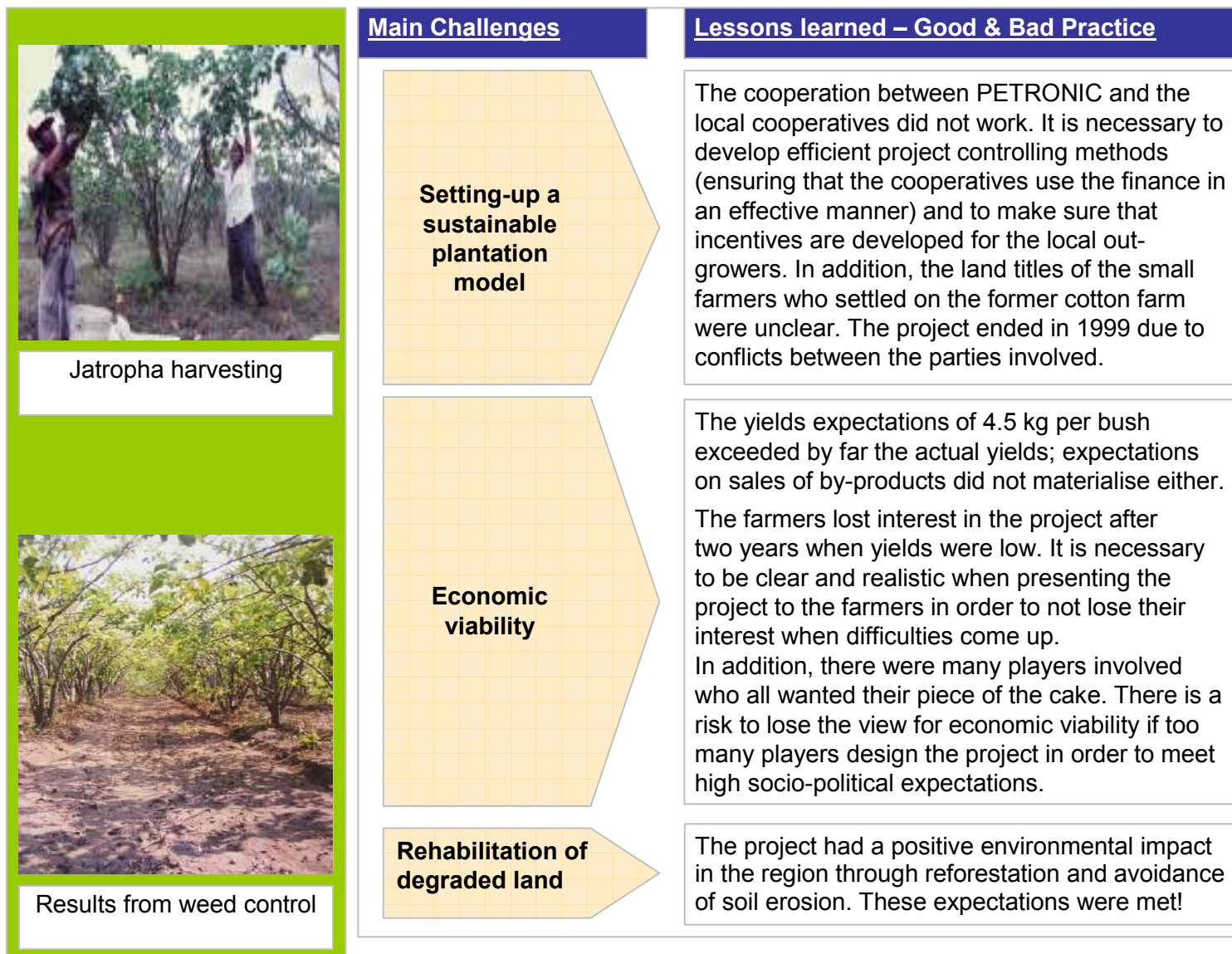
Fertilizer, fuel, fodder (planned)

#### **Other by-products**

Glycerine, insecticide

#### **Main clients**

Biodiesel refinery located in León.





## The Global Exchange for Social Investment – GEXSI

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