Promotion of Jatropha in agroforestry systems in San Martín, Peru

Evaluation report

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July 2011

This report forms part of a meta-evaluation as carried out for 6 Jatropha projects as financed by HIVOS worldwide. A comprehensive report including the evaluation of all these projects will be published separately.

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Content

1. Introduction

Over the last few years HIVOS has engaged in various biofuel programmes, basically using *Jatropha curcas*, but also other oil crops. These programmes have the intention to provide additional cash income for the farmers who grow the crops and may have additional features, such as adapting engines, converting the pure plant oil into bio-diesel, or even wider goals such as dynamising the local economy. HIVOS so far has started 7 pilot projects: in Mozambique (with FACT Foundation), Tanzania (TATEDO), Uganda (VEDCO), Zambia (NorthWestern BioPower Ltd.), Zimbabwe (Environment Africa), Honduras (Gota Verde project with STRO) and Peru (with CEDISA).

Biofuels however have also been widely criticized for several reasons, such as negative impacts on food security, land grabbing issues, deforestation, social conflicts, amongst others. HIVOS is aware of these criticisms and in 2008 established criteria to be fulfilled before engaging in biofuel projects. It also established that no new pilots would be started before having more insights in the outcome of these pilots. Several years have passed now and HIVOS feels it is time to evaluate its first experiences in biofuels, with the following objectives:

- To see if the introduction and processing of these crops have brought the farmers the expected additional income;
- To see if any positive changes in the local economy have taken place or;
- To establish that actually people are worse of than before and only suffer negative consequences of the introduction of these crops.

In this framework, a meta evaluation was started, covering six of the above-mentioned projects (the VEDCO project in Uganda is at such an incipient stage that it was decided not to include it in this evaluation).

SNV Peru was asked to accompany the evaluation of the CEDISA project in the San Martin region, Peru. This report presents the outcome of this evaluation. It should be understood as an independent evaluation report, contributing to the meta-evaluation as carried out for all 6 projects by Sona Prakash, international consultant hired by HIVOS for the meta-evaluation as a whole. In that sense, this report is intended to be complementary to the integrated report as prepared by Sona Prakash. Therefore, this report highlights the specific local context of the project as executed by CEDISA, the relation with other actors in the value chain, etc, in the end coming to conclusions taking into account this local context.

2. Objectives

According to the Terms of Reference for the Meta Evaluation as a whole, the objectives of this specific project evaluation would be to answer the following questions:

- Impact: Has/have the organization(s) in charge of the programme generated benefits for the biofuel crop producers (M/F) or to dynamise the local economy, through promotion, support to production, marketing and other activities?
- Effectiveness: Where the strategies of the organization(s) effective? This includes the institutional or organizational set-up of the programme(s).
- What have been the direct outputs of the programme in terms of production volume and number of men and women reached?
- What have been the total costs of the programme so far and what have been the total benefits to direct beneficiaries in terms of money?
- What other outcomes has the programme had for the direct beneficiaries? Distinguish, where relevant, between male and female beneficiaries.

- What have been the positive or negative consequences for other population categories in the region? Distinguish, where relevant, between men and women.

Afterwards, in the Meta Evaluation, the idea is to compare the findings for the six analysed projects worldwide, in order to distill best practices and to present some notions as to the sustainability and future prospects of the promoted biofuel related activities (recommendations).

3. Methodology

In the preparation phase, the evaluation framework as established by Sona Prakash, was traduced to Spanish and revised with the CEDISA project team, in order to have all information at hand during the field visit of Sona. Together with the project team and according to the suggestions made by HIVOS and Sona, a program was elaborated for the evaluation visit (see Annex I). Furthermore, project documentation was revised, including the project proposal, adjusted proposal and year reports.

During the evaluation visit, from 11-16 May 2011, meetings and interviews were conducted with the CEDISA project team, with farmer groups involved in the project and with relevant stakeholders in the value chain that are related to the CEDISA project, including representatives of research institutes, government and private sector. Names and contact details (with hyperlink) of interviewed people are included in Annex I. Together with the project team and involved stakeholders, field visits were realized, both to plantations as installed with the CEDISA project, but also to the installations of INIA (agricultural research institute involved in Jatropha since 2006) and plantations of companies operating in San Martín, as such to achieve a broader picture and evaluate the CEDISA project while comparing experiences with other Jatropha initiatives in the same region.

In the interviews, emphasis was put on the evaluation framework and related questions as established by Sona Prakash, lead consultant for the Meta Evaluation, complemented with specific questions related to critical issues as identified by SNV. This is also reflected in the structure of this report and particularly in the analyses (chapter 5). As SNV has been involved since the start in the regional biofuels program as promoted by the Regional Government of San Martín, providing advisory services to the different actors that form part of the "*Mesa Técnica de Biocombustibles*" (a public-private platform aimed at a sustainable and inclusive development of the biofuel sector; platform which includes CEDISA), lessons learned on the way were taking into account while realizing this evaluation. Furthermore, we considered our experiences with biofuels and Jatropha projects in other countries, as such to frame the CEDISA project in a broader context, which we feel in this case is necessary for proper evaluation.

4. Context

The Peruvian government strongly promotes the production and commercialization of biofuels, through regulatory frameworks that followed the *Ley de Promoción del Mercado de Biocombustibles* (Ley N° 28054), which was approved in 2003, in the end defining (in 2007) obligatory blending at national level of biodiesel (2% from 2009; 5% from 2011) and ethanol (7.8% from 2010). On the other hand, Jatropha was formally declared of "National Interest" for production of biodiesel in the Amazon.

As a result of that and during the world wide *boom* in biofuels, several biofuels initiatives started in the country, both in ethanol and biodiesel. With regard to biodiesel, several production plants were installed in the country (main ones: Industrias del Espino, see photo; Pure Biofuels; Heaven Petroleum Operators), with a total biodiesel production capacity of 270,000 ton/year (Palmas del Espino, 2010). At the same time, various initiatives started in the country for production of biofuel feedstock, such as Jatropha. With regard to biodiesel, the announced blending targets were implemented as foreseen, with current blending of 5% biodiesel in all diesel sold in the country. Although national production exists, the majority of this biodiesel has been imported from the US, Ecuador and Argentina (with no Jatropha biodiesel being produced so far). With regard to ethanol, the 7.8% target was only implemented in some regions in the northern coast (Piura, Lambayeque, Tumbes), applying sugar cane ethanol produced in Peru, and an adjusted schedule was proposed for gradual implementation in the whole country.

In 2008, the Regional Government of San Martin (GORESAM) initiated a regional Biofuels Program (PROBIOSAM), with funding for investigation and promotion of Jatropha in already deforested, degraded areas, as a means to provide productive alternatives to small-scale farmers, while seeking environmental sustainability. In the framework of this program, formalized in September 2008 (but in fact with several activities already starting in 2007), a public-private platform of local organizations was created (the *Mesa Técnica de Biocombustibles* de San Martín), as a platform for knowledge exchange and promotion of policies to assure a sustainable and inclusive development of the biofuel sector.

As such, when CEDISA started it´s project in 2009, several other Jatropha initiatives were already being implemented in the San Martín region, such as the following:

- INIA (*Instituto Nacional para Innovación Agraria*, part of the Ministry of Agriculture): Jatropha investigation program financed by the Regional Government of San Martin - GORESAM (following investigations of INIA in Jatropha that started in February 2007). The investigation program (still in development) includes plant breeding, crop management, pests and diseases management, amongst others.
- DRASAM (*Dirección Regional de Agricultura de San Martín*, part of the regional government): Jatropha promotion program, also financed by the Regional Government of San Martin - GORESAM), providing inputs, capacity building and technical assistance to small farmers, while facilitating strategic alliances between farmers organizations and companies for inclusive business development.
- DED (now GiZ) project financed by Common Fund for Commodities (CFC), aimed at creating a local Jatropha value chain for use of straight vegetable oil (PPO) in converted vehicles for local transport. The project (with subprojects in Peru and Honduras) included the installation of an oil extraction plant with a cooperative in the village of Leoncio Prado (two hours away from the CEDISA project area).

- Several company initiatives, such as Agrobiofuels Perú (Peruvian company with experience from Brasil), VWP Latino América (German company allied to DED project), Onasor del Oriente (local company) and Francisco Tello Perú (part of Grupo Tello, Spanish company with biodiesel plant near Madrid); mainly aiming at validation of crop management and productivity (initial stage) but with plans to scale up.

Jatropha investigation and promotion in San Martin: research plots from INIA (left) and commercial development by Agrobiofuels Perú (right).

During the years, these initiatives matured while others were added (such as Verdal and LS Biofuels), creating a portfolio of over 10 different Jatropha projects in the San Martin region (see table beneath). All these initiatives work together and exchange knowledge and experiences through the *Mesa Técnica de Biocombustibles*, in a joint effort to consolidate the Jatropha value chain while validating management practices of Jatropha plantations, including control of pests and diseases, pruning techniques, harvesting, post-harvesting, use of sub products, etc. The *Mesa Técnica* is presided by a representative of the private sector, in this case Francisco Tello Perú (part of Grupo Tello), whereas the secretariat is held by DRASAM and INIA. Other members are the Department of Economic Development and the Direction of Energy of the Regional Government of San Martin, companies such as Palmas del Espino (part of Grupo Romero), Agrobiofuels Perú, Verdal, local NGOs such as CEDISA and development cooperation such as the CFC-DED project and SNV. Furthermore, farmers organizations participate in the Mesa (such as the Leoncio Prado cooperative and Jatropha farmer groups from Chazuta and Bajo Mayo), while also research and technical education institutes have been participating in several meetings. The group operates as an open space for knowledge development and sharing, in which any actor is free to participate. Several workshops were organized open to all public, including students from local universities such as UNALM.

Obviously, the presence of other Jatropha initiatives in San Martin has been beneficial for the CEDISA project, as the project could build on already developed knowledge on the crop. Furthermore, through the institutions, agronomists and other technical staff present in the *Mesa Técnica*, feedback was provided for joint learning and making adjustments in crop management techniques where needed on the way. Indeed, in the initial stage of the project, capacity building of the CEDISA project team was provided by professionals of INIA, while assistance was also provided during project execution (also with technical staff from the companies), for example in suggesting solutions for plagues and diseases. As such, the CEDISA project could take advantage of lessons learned before, and avoid mis-management (that occurred in the first Jatropha projects in the region, for example with new plagues for which solutions still needed to be looked for).

On the other hand, the presence of all these other Jatropha initiatives in the same region, explains the somehow limited focus of the CEDISA project in itself. No attention has been given (yet) to oil extraction, biodiesel production or use of sub-products, as these are issues other actors in the *Mesa Técnica* are taking care of, and to which the CEDISA team is connected.

It is difficult to come to a reliable number of total hectares of Jatropha installed in San Martín, as these plantations are scattered, not always with exact area measured, while part of the plantations have been abandoned already, both by some companies and small farmers, due to

several reasons which will be explained later on. However, updated calculations come to an estimated total of around 800 hectares installed, in very diverse conditions. 100 ha of these have been installed with the CEDISA project, 60 ha of which has been with additional support from the DRASAM project (see table beneath).

Table 1. Jatropha initiatives in the San Martin region

#	Initiative	Area installed (ha)	Area proyected (ha)	Private company (ha)	Small producers (ha)	Investigation (ha)
1	VWP Latino America SAC	**45**	250	45		
2	Cooperativa Leoncio Prado (proyecto CFC-DED)	**80**	100		80	
3	Onasor del Oriente	**8**	1500	8		
4	Francisco Tello Perú Sac (Grupo Tello)	**20**	80000	20		
5	Agrobiofuels Perú SAC	**70**	300	70		
6	Empresa Agraria Azucarera Andahuasi	**5**	5000	5		
7	Greenfuels	**0**	100000			
8	Abundant Biofuels	**0**	100000			
9	LS Biofuels*	**0**	30000			
10	Verdal**	**302**	30000	302		
11	Proyecto Investigación INIA	**20**	30			20
12	Proyecto Promoción DRASAM***	**115**	1000		115	
13	Proyecto Sistemas Agroforestales CEDISA	**100**	180		100	
14	Proyecto Agencias Agrarias GTZ	**12**	10		12	
15	Agricultores Independientes	**20**	-		20	
Total		**797**	**348,370**	**450**	**327**	**20**

* LS Biofuels, with support of the Jatropha promotion program as implemented by DRASAM, identified areas and negotiated with (small and intermediate) farmers to start a 600 ha piloto in 2011, with private capital financing from US. Nothing installed yet.

** Verdal is planning to install a total of 1,200 ha in 2011 (of which 306 ha already installed, in three separate locations in the same intervention area: Santo Illo (57), Molan (117+70+16) and Quinillayco (42 ha). Until next year they plan to install a total of 2,500 ha, including initiatives with small-holders for which they developped a business plan for 500 ha modules. For identifying areas, organization and articulation of farmers, they count with support from the DRASAM program.

*** The Jatropha promotion program of the Regional Government of San Martin (executed by DRASAM) supports a total of 221 ha of Jatropha as installed with small farmers. 115 of these were also installed with the DRASAM program. In addition, the program supports 34 ha as installed by farmers associated to the Leoncio Prado cooperative (CFC-DED project), 60 ha of the Bajo Mayo farmers (CEDISA project) and 12 ha as installed with financing of GTZ.

Source: own elaboration, based on information provided by the different projects / companies and as consolidated in the Mesa Técnica de Biocombustibles de San Martín. Updated version: May 2011.

5. Analysis

Like any new crop, Jatropha needs to follow a systematic approach in order to achieve the productivity necessary to make it a viable crop and a valid business alternative (both for small holders and companies): a crucial triangle for success between genetics, environment (adaptation to local conditions) and adequate crop management. This basic rule has been violated seriously in the past few years, and is one of the main reasons for the failures encountered in the majority of Jatropha projects worldwide and for the actual scepticism with regard to this new crop[1]. In this chapter, these aspects will be evaluated for the case of San

[1] This was confirmed during this year's World Biofuels Martkets forum (Rotterdam, 22-24 March 2011), particularly in presentations by Quinvita, company that originated from a management buy-out of selected assets of the former D1 Oils Plant Science Ltd activities. D1 Oils invested 14M Euros in Jatropha knowledge development (breeding, agronomy, processing) since 2006 and although it failed tremendously with its plantation development department (at some point claiming to have a total of more than 200,000 ha installed in several countries in Asia and Africa, of which little is left or in very poor conditions), reason for main shareholder BP to back out, in plant science it is considered as one of the leading companies in Jatropha breeding and crop management worldwide.

Martin and the CEDISA project, in addition to other crucial factors, such as harvesting, post-harvesting, labour and market conditions.

5.1. Genetic material used

As demonstrated with other crops, genetic selection and improvement needs to be done, adapted to areas suitable for the crop, in order to optimize plant characteristics and maximize yields for Jatropha.

It is generally accepted that genetic material from the centre of origin of Jatropha (Central America: mainly Guatemala and Mexico) should be included, in order to have the most ample and diverse base for plant breeding. Leading actors in Jatropha breeding such as SG Biofuels (US company based in Guatemala), EMBRAPA (Brazilian state agency for agricultural research), SAGARPA-INIFAB (Mexican state agency for agricultural research) and Quinvita (company with breeding station in Cape Verde) are engaged in that. Nevertheless, successful plant breading takes several years, for which only some hybrids have been developed so far, and a lot of improvement is still pending.

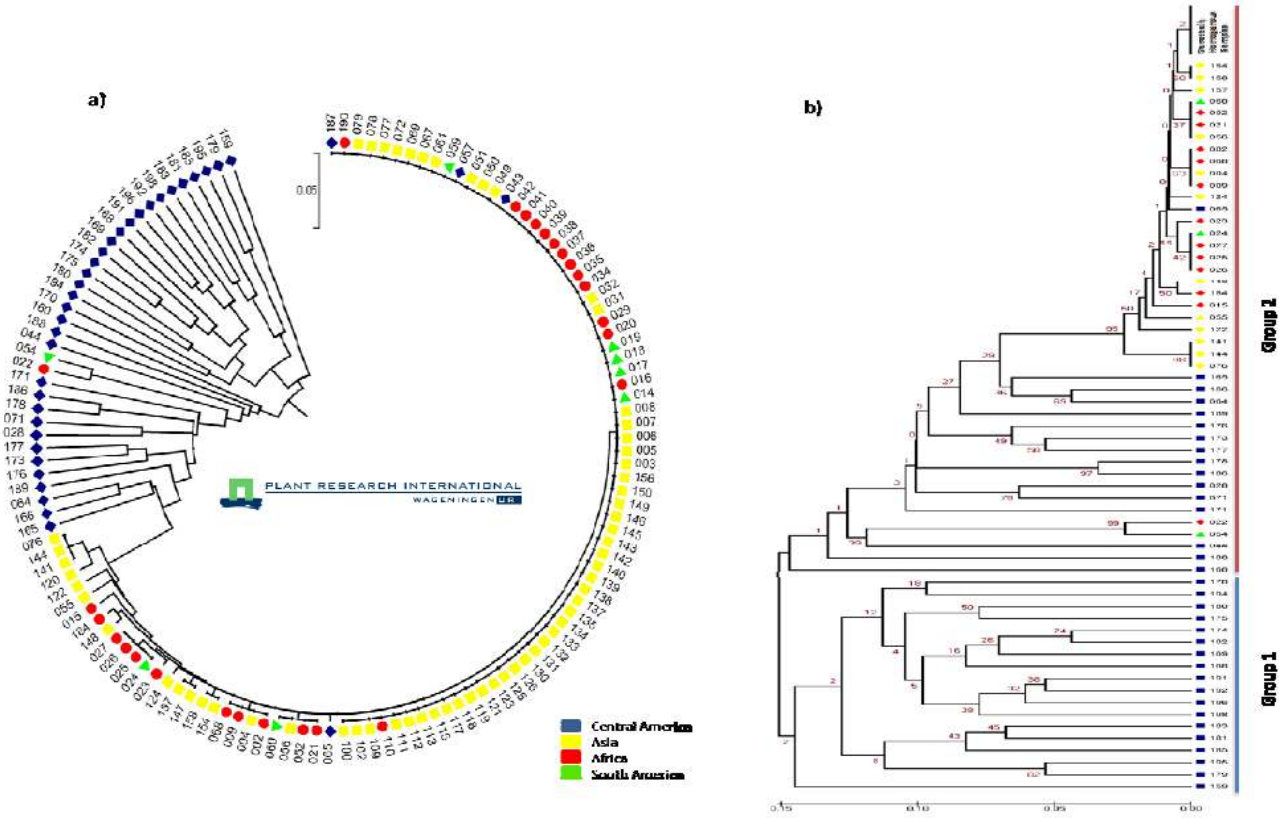


Figure 1. Analysis of genetic diversity of Jatropha accessions worldwide. The investigation included 6 accessions from San Martin as facilitated by SNV in coordination with INIA (in 2007); one of these materials ("Totorillayco") was used as seed in the CEDISA project. The study confirms Central America (blue dots) as being the centre of genetic diversity, while genetic material sent from San Martin was found to be quite homogenous[2]. Source: Jongschaap & Van Loo, 2009.

[2] In addition, the San Martin seeds were found to be relatively big, with average oil content (23.53–29.30% in the seed, 36.80-43.80% in the kernel) and good oil quality (C18:1 and C18:2 varying between 71.57 and 78.07 %).

In San Martín, particularly the experimental station "El Porvenir" of INIA has been working on this issue, starting in 2007, but initially only taking into account local accessions of Jatropha (from San Martin and other regions in the country). Some crossbreeding has been done with local Jatropha accessions (starting in 2008), but meanwhile, evaluations and experiments of INIA also include genetic material from Mexico, Honduras (including Cape Verde hybrid), Brazil and India, amongst others. However, reduced financial resources of INIA limit the extent of these efforts and definitely are not as advanced as institutions like EMBRAPA (Brazil) or SAGARPA-INIFAB (Mexico).

At the time when the CEDISA project started, "Totorillayco" (local seed precedent from a village nearby Juan Guerra, 20 km from Tarapoto) was identified by INIA as the most suitable material to work with, as it proved to have relatively good productivity (seed production) and oil content per seed, compared to other local material; see figure 2 and Annex 2. As such, this genetic material was used with all farmers linked to the CEDISA project, similar to other initiatives (see table 1) that used the same material. The experiences with this material are still good, but from the described above it will be clear that significant improvement is still foreseen considering other plant material and the potential of genetic breeding.

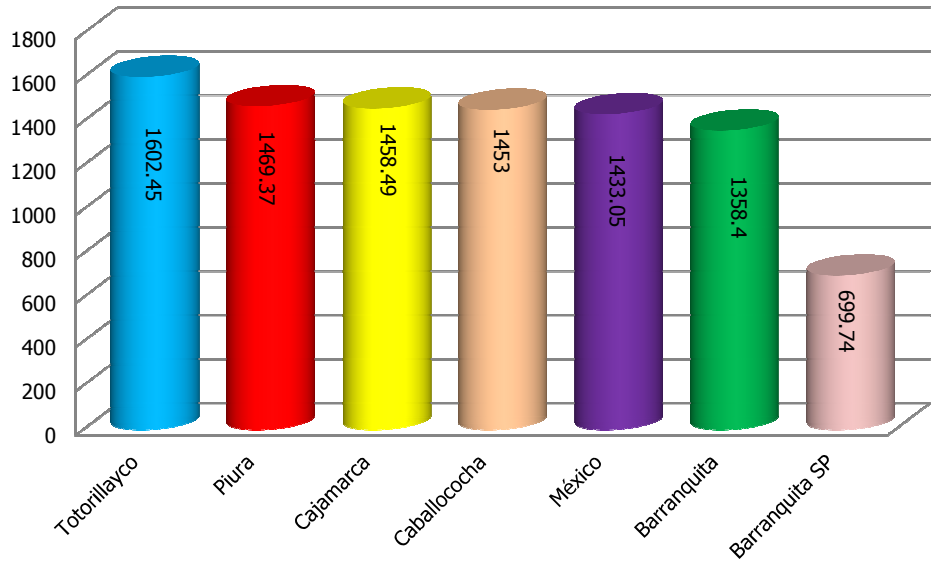


Figure 2. Productivity of Jatropha during the first year of production (dry seed, in kg/ha) as analysed by INIA during 2009 for different accessions. Relatively good productivity was noted with the "Totorillayco" accession. Together with its good adaptability to local conditions, it was selected as the seed to use in several Jatropha initiatives in San Martin, including the CEDISA project. Source: Echeverría, 2010.

5.2. Site selection: adaptation to local conditions

Suitability criteria for Jatropha development were established in a macro-zoning study for Jatropha in San Martin as issued by SNV in 2007-2008; see Annex 2 for summarized information. The criteria were established based on existing literature and by expert judgement of local agronomists (particularly INIA), taking into account local conditions. This zoning study and suitability criteria were analysed by the CEDISA team when selecting their intervention area.

The CEDISA project was implemented with 100 farmers in the villages of Solo, San Antonio, San Miguel, Pukallpa and Maceda (in the province of Lamas, Bajo Mayo); farmers with which CEDISA had been working before in earlier projects, such as an agroforestry project with cotton, coffee and forestry species, in 1991-1995. These

farmers in average possess 9 ha (varying between 5 and 20 ha), of which they have 3-4 ha in production; the rest is in general abandoned, degraded land.

The areas selected for Jatropha planting in general comply with the criteria as mentioned in Annex 2, with slightly undulating, sloping, clay soils. Water stagnation problems were not suffered (due to the slopes), however it should be said that slope (15-30%) and pH (between 6.5 and 7.5 as measured with 6 soil samples) is suboptimal.

Jatropha plantations as installed in the Bajo Mayo area in the framework of the CEDISA project.

In general, the Jatropha plantations (with associated crops and in agroforestry system) were installed in areas degraded to a certain extent, in order to prevent further degradation: sometimes already abandoned land (*shapumbales, cashucshales*), sometimes fields with low productivity maize. However, it was assured that not the worst of land was used (such as very acid soils). Amongst others, nitrogen fixation plants were applied (such as peanut) in that sense also contributing to soil recovery.

When the first Jatropha initiatives started, including the CEDISA project, limited information was still available on suitability criteria for Jatropha development on a commercial basis. Still until this date, new insights are being discussed in that sense. An example is the need (or not) for a clearly marked seasonality for the crop (dry season, rainy season). This indeed seems an important factor for optimizing the production cycle of the plant (and achieving well defined harvesting periods), but in the initial stage was not recognized as such by local agronomists. Instead, the presence of (irregular) rains throughout the year was seen as an advantage, providing the opportunity to produce seeds year-round. However, both prolonged dry periods and excess of rainfall (as other stress generating factors such as excessive use of pesticides) prove to cause defoliation of the Jatropha plants, as such affecting flowering and in the end, production levels throughout the year. Although in part these problems can be managed (by water harvesting and draining, respectively) this implies additional investment and care on behalf of the farmers (more than they are used to with other crops), which is often a bridge too far. Also in the case of the CEDISA project, a serious draught (October 2009 – January 2010) minimized production levels, not only of Jatropha, but also associated crops, such as peanut (went down from 600 to 100 kg/ha) and maize (from 800 to 400 or in some cases no production at all).

5.3. Plantation design

During the course of 2009 and 2010, a total of 100 ha was installed through the CEDISA project, with 100 farmers from 5 different villages, in the same area (Bajo Mayo) with similar biophysical characteristics.

Table 2. Location and amount of hectares installed in the CEDISA project, in agroforestry system with associated annual crops and forest species (source: CEDISA, 2011)

N°	Community	Jatropha agroforestry system installed (ha)		Total	Components of the system	
		2009	2010		Anual crops	Permanent forest species
1	Solo	19	7	26	Peanut, Beans, Maize, Cassava, Coriander, Pineapple	Piñon (Jatropha), Bolaina, Capirona, Cacapana, Shaina.
2	San Miguel	25	4	29		
3	Pucallpa	0	14	14		
4	San Antonio del Rio Mayo	16	8	24		
5	Maceda	0	7	7		
	Total Ha	**60**	**40**	**100**		

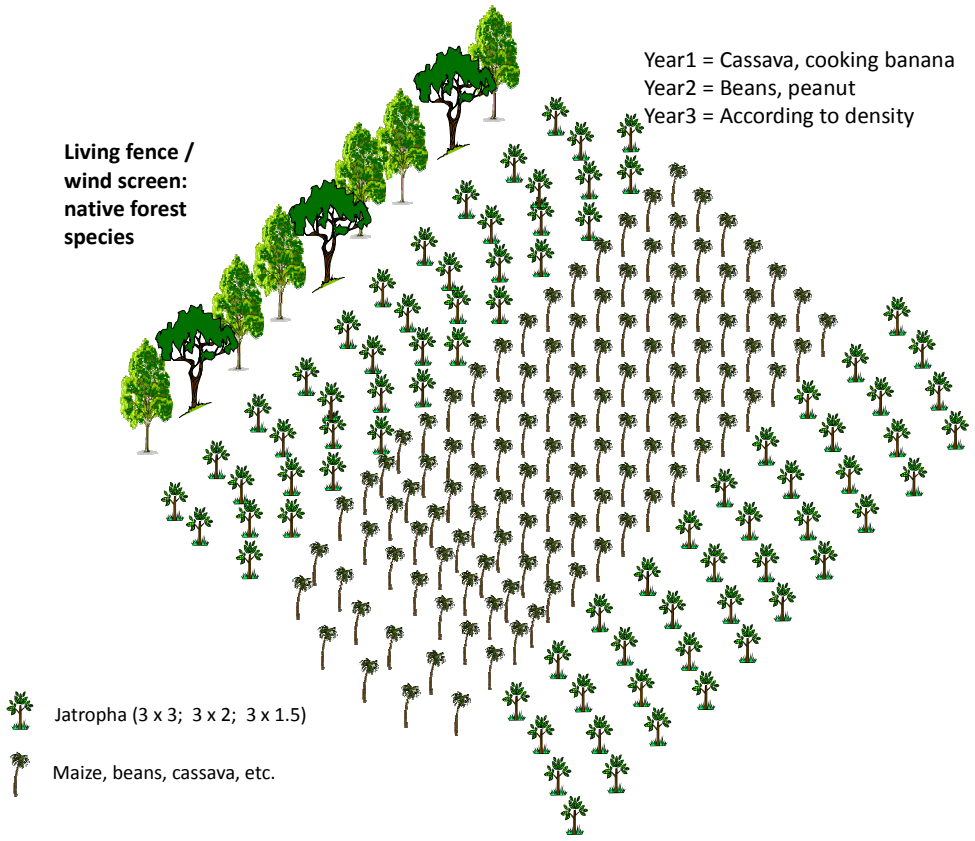


Figure 3. Jatropha agroforestry system as promoted by the CEDISA project. Source: CEDISA, 2011.

Like other initiatives with Jatropha and small-holders in the San Martin region, an integrated system with associated annual food crops was applied, incorporating peanut, beans, maize, cassava, coriander and pineapple. The innovation in the CEDISA project consisted in the incorporation of forestry species in the system, on the borders of the Jatropha plot, with native species such as Bolaina, Capirona, Cacapana and Shaina (species with no dense canopies, as such to limit shading impact). Seedlings for both Jatropha and the reforestation species were provided by the project, as well as the seeds for the annual crops.

For Jatropha, in general a spacing of 3x2 was promoted, following best practices from INIA. In INIA, a range spacing experiments were done (3x4, 2x3, 2x2, 2x0.5). Also companies have come to 3x2 or 4x3 as most convenient in the circumstances of San Martin (Agrobiofuels Perú changing their initial design of 2x2 to 4x2, cutting down half of their rows installed). However, flexibility in spacing was taken into account in the case of the CEDISA project, according to preferences of farmers to plant associated crops in between. In general, associated crops between Jatropha rows are considered for the first two years of Jatropha production only. However, in the years thereafter production of food crops is assured through strips in the same field (see figure 3).

Note: although an interesting concept, the combination with forest species might cause a negative impact in Jatropha productivity due to shading (along the borders where the trees have been planted). This was corroborated during field visits, demonstrating reduced plant development along the borders due to shading of forest species. With some annual feed crops competence might also be an issue (not only due to shading but also for competition with nutrients), particularly with maize (due to its height), whereas peanut and beans are a better combination (reduced height, nitrogen-fixation characteristics). Cassava is known to attract plagues and diseases to Jatropha, as they are from the same family, which makes it less suitable as an associated crop with Jatropha.

5.4. Crop management

Through investigation of INIA since 2007, together with other members of the *Mesa Técnica de Biocombustibles*, CEDISA could build on the knowledge already generated in terms of plantation design, crop management, pruning techniques, control of plagues and diseases, etc. The project team received capacity building by INIA and technical assistance from the different members of the *Mesa Técnica*, including SNV. This knowledge was transferred to the farmers through capacity building sessions and continuous technical assistance by the 3 technical staff involved of the CEDISA, in certain occasions accompanied by experts from allied institutions such as the DRASAM Jatropha promotion project, Grupo Tello, among others.

Production in the area takes place under rain fed conditions, without additional irrigation. Traditional management is being applied, with low technical input. Some tools (particularly for pruning) were provided to the farmers. Only in the first year (2009) fertilization was applied (with co-financing of DRASAM), due to budget cuts in 2010. Aiming at a significant number of productive branches (20-30), pruning consisted of the following, according to best practices of INIA:

- Pinching off the tops of the plants, after some three months in the field (40 cm plant height).

- Pruning of branches of adult plants (45 days afterwards approximately, but depending on maturation of the plant).
- Maintenance pruning every year.

This general pruning scheme (adapted to local circumstances and according to maturation of the plant) resulted from evaluation of several pruning practices and trials in INIA. In general, the first year after planting Jatropha is used to shape a good-structured plant, with significant amount of productive branches. Although a limited amount of fruit production is achieved already in this first year, harvesting generally is considered from the second year onwards.

Main problems encountered by the CEDISA team were the following:

- **Weeds**: Strong incidence of weeds, affecting crop development and productivity of Jatropha (due to competence for nutrients, shading). Although weeding frequency should be about six times a year in this area, budget only allowed for three times (with chopping-knife, the traditional tool for this purpose).
- **Plagues and diseases**: in the case of the CEDISA project, main problem appeared to be the cutting ant ("hormiga curuhuinsi", *Atta cephalotes*), particularly in the initial stage of plantation development where the losses due to ant attacks can be disastrous. By controlled production of seedlings and transplantation of relative robust plants, the effects of this plague were minimized. Although some incidence was also found of "cigarritas verdes" (*Empoasca sp.*) and "ácaro blanco/hialino" (*Polyphagotarsonemus latus*), species that suck the leaves and therefore affect healthy development of the plant, these (for now) have not been a serious problem according to the CEDISA team. This might be explained by the agroforestry system applied, in which the diversification contributes to control of plagues and diseases. On the other hand, impact might be seen from the second year onwards, which has been the case in other (older) Jatropha plantations in the San Martin, where particularly the two before-mentioned plagues caused a serious impact on plant development, aborting production. Meanwhile, INIA identified the plagues and diseases related to Jatropha in San Martin (over 20 in total), and identified biological control (12 species) for the most serious ones. Most common diseases were also identified, in addition to practices for integrated plagues and diseases management, with measures easy to be applied by local farmers (Orihuela *et al.*, 2010). This knowledge was also transferred to the CEDISA team.
- **No compliance of the farmers** with respect to the technical criteria as specified by the technical staff. Although crop management practices and corrective measures were indicated and explained to the farmers with participative capacity building techniques, these were not always adapted by the farmers, due to lack of experience/tradition in semi-intensive crop management. Fertilization was not always applied either, logistics influencing in that sense (a lot of fields uphill, hampering transport of the fertilizer to the fields). It should be noted also that the type of farmers the project is working with, in part are native communities and farmers that in general apply low-tech production techniques. Education level is generally limited to primary school in these communities (with a significant part, particularly women, not even concluding primary school), as such limiting the possibilities to adapt and apply new knowledge.
- **Climate change:** As in San Martin in general, also in the project area of CEDISA an extended and intensive dry period (no rains at all during October 2009 – January 2010) caused serious production losses in all crops, including Jatropha. Losses in other crops (peanut: reduced from 600 to 100 kg/ha; maize: reduced from 800 to 400 kg/ha in general; information from CEDISA team) might illustrate these losses. No adaptation measures were established for these draughts. Although complementary irrigation would be needed in those circumstances, lack of experience or tradition in that sense, in addition to costs, hamper the implementation of these measures; on the other hand, Jatropha

companies start experimenting with irrigation in San Martin. The changes in climate (extended dry periods, increased irregularity in frequency of rains) are reported frequently the last years in San Martin and affect seriously the productivity of several crops. In Jatropha the impact might be stronger, as the crop seems to react stronger on stress situations than other crops (with rapid defoliation and aborting the production cycle), as confirmed by local agronomists from INIA and other Jatropha initiatives (see also paragraph 5.2 on this issue).

5.5. Harvesting

Jatropha harvesting is best done when the fruits are between yellow and brown, as oil content of the seeds is best at that moment, and acidity levels are still low (see Annex 4). Harvesting is a matter of concern in Jatropha projects, as a significant amount of labour is needed when harvesting manually. Jatropha harvesting is particularly labour intensive, due to unequal maturation of fruits along the branches (with mature and fresh fruits at the same time), as such requiring selective harvesting and coming back with determined frequency (generally every 2 weeks) during harvesting periods, elevating significantly the harvesting costs.

The latter has induced several companies in Latin America (particularly in Honduras, Brazil and Argentina) to engage with mechanical harvesting, validating technologies to reduce Jatropha harvesting costs. An example is AGROIPSA, a Honduran company that provided its 1,200 ha of Jatropha as testing fields of the harvester as developed by BEI International, after which they bought the harvester. BEI's "Jatropha Wave Picking Mechanism" claims to harvest up to 2.5 acres per hour or a more than 1 hectare per hour depending on field conditions, claiming to replace 80 workers that would be needed to achieve the same efficiency.

Jatropha harvester of BEI International, as being applied by AGROIPSA, company specialized in Jatropha development, Choluteca, Honduras (Photos: Martijn Veen, November 2010).

Due to the initial investment costs (USD 180,000; claimed to be recovered in 6 years for a 250 ha plantation), it is clear that mechanical harvesting is an option for companies (and perhaps well-organized cooperatives), but not for small farmers; even less when considering the generally sloping conditions in which they operate (and in which the harvesting machines will not be able to enter).

That said, Jatropha harvesting in San Martin is done manually (for now) and efforts are undertaken to improve harvesting efficiency, creating pools of specialized harvesters within farmers groups, with some specialized tools such as adapted harvesting baskets (promoted by the Jatropha promotion project as executed by DRASAM). Until improvements are achieved, harvesting efficiency is still very low. According to information of the CEDISA team, farmers of the Bajo Mayo area invested 4 hours with 4 workers to harvest fruits to an equivalent of 50 kg of dry seed; another 4 hours with 4 workers were needed to do the de-husking (manually in this case). With the actual price

the farmers receive for the seeds in San Martin (0.70 Peruvian soles per kg of dry seed; corresponding with USD 0.27 approx.), it is clear that it makes not so much of an attractive business for the farmers: earning USD 3.4 as a daily wage by selling their product (significantly below the minimum wage varying between USD 7-9), and not even taking into account the investment realized to install and maintain the plantation, nor transportation of the product to the market (in this case assumed by the CEDISA team).

5.6. Post-harvest

After harvesting, next step is de-husking, for which several technologies have been developed and validated for Jatropha. Also in the San Martin region, several technologies have been tested, including a model derived from the Jatropha de-husker as developed in the 1990´s in Nicaragua (Tempate project). This model, adapted by the CFC-DED project in Leoncio Prado (a 2 hours' drive from the CEDISA project area), was developed for fresh fruit and did not work satisfactory with dried fruit, the product eventually delivered by the farmers. This model was therefore abandoned in San Martin.

De-husker as observed in Nicaragua (Tempate project) and replicated in San Martin by the CFC-DED project. After crushing the fruits, separation of seeds and husks is done by a rotating shaft with wire netting through which the seeds fall down while the husks accumulate at the end (Photos: Martijn Veen, August 2008).

Experiments were done with a Brazilian de-husker (brought to San Martín by company Agrobiofuels Perú), similar to a coffee de-husker, which later was adapted by the DRASAM project, working together with a local technical education institute in Tarapoto. It is this latter model, cracking dried fruit and separating the seeds from the husks using a blowing mechanism, that is now being promoted by the Jatropha promotion project led by DRASAM. The machine has a capacity of 100 kg/hour, achieves a separation efficiency of 97% and local production cost amounts 4,500 Peruvian Soles (USD 1,600 approximately). One of these machines (including some additional tools for post-harvesting) is also being delivered by DRASAM to the farmers associated to the CEDISA project, and will be placed in the village of Solo. Meanwhile however, the farmers in the project area have been doing the de-husking manually, with the lack of efficiency and resulting frustrations as explained in the previous chapter.

The product as delivered by the farmers in the CEDISA project area, is limited in this case to Jatropha fruits and dried seeds. No further processing of Jatropha is done by the farmers in this area, and was not promoted either by the CEDISA project. In part, this was influenced by the fact that other actors in the value chain were already taking care of this (technology development, oil extraction, use of sub-products); actors working together in the *Mesa Técnica de Biocombustibles* and with which the CEDISA team is collaborating. On the other, it was also due to the reduced level of organization of the farmers in this specific project area, traditional low-tech production practices combined with reduced capacities and entrepreneurial aspirations, related to low education levels (primary education, and not concluded in a lot of cases).

Seed production of the farmers was sold to the Jatropha cooperative in Leoncio Prado, Francisco Tello Perú and Reforesta Perú, those taking care of further processing and use as planting material, respectively (see chapter 5.10).

De-husking machines as being applied in San Martin. To the left, a model from Brazil as introduced in San Martin by Agrobiofuels Peru and replicated by a local technological institute, issues by DRASAM. To the right, the Universal Nut Sheller as developed by The Full Belly Project (US) for manual use at farm level by small-holders (photo from Honduras but soon will be introduced in San Martin).

5.7. Productivity

Productivity figures of Jatropha vary widely worldwide, and the same applies for the San Martin region (see also Annex 5). The "El Porvenir" experimental station of INIA, in Juan Guerra, claims to have achieved a maximum of 3,125 kg/plant (dry seed) in the third year (second year of production). With the density generally applied and as promoted by INIA (3x2), theoretically this would imply a productivity potential of 5.2 tons/ha. However, such amounts per hectare were never measured in San Martin. Agrobiofuels Perú reports 400-600 kg/ha of dry seed (and maximums of 700-800 kg/ha) in the second year (first year of production), with a total of 7.4 tons harvested. Figures of Francisco Tello Perú are similar, reporting 400 kg/ha in the second year (and 170 kg/ha in first three months of third year). This is in well-managed, uniform plantations with fertilization (both organic and chemical) and in rainfed conditions; 600-1100 mm (sometimes heavy rains, irregular intervals), 4 months dry period, production during 8 months.

In the case of the farmers linked to the CEDISA project, exact productivity figures lack (as harvesting was not done completely), but estimates from the farmers and CEDISA team come to 100 kg/ha of dry seed for a period of 9 months (second year; first year of production). However, the farmers harvested less, as low prices combined with elevated harvesting costs provided no incentive to harvest all yield / the entire plantation. In a lot of cases, no harvest was registered. In total, 13 farmers (out of the 60 that entered in 2009) came to harvesting (during January-May 2010), yielding a total of 700 kg. As the income generated by selling the seeds did not cover for the cost of labour (see also chapter 5.5), no further harvesting was done. The farmers preferred to give attention to their traditional market crops, such as maize, beans and peanut.

5.8. Labour

Jatropha is a labour intensive crop. Whereas this was seen at first as an important benefit of Jatropha (generating significant amounts of labour and an additional source of income for small-holders), it has evolved into a serious bottleneck in making Jatropha a viable business, due to elevated labour costs; see also chapter 5.5 where this is illustrated for harvesting in the CEDISA project. Although labour costs in certain regions (particularly in Africa) might still be relatively low, in the Americas, including Peru and the San Martin region, this is not the case; with a daily wage of 20-25 Peruvian soles (USD 7-9 approximately) for unskilled labour in the agricultural sector of San Martin (including the CEDISA project area, however this used to be 15 Soles just a few years ago). Therefore, efforts are made to reduce labour, by making labour processes more efficient (for example in harvesting) or by replacing labour due to mechanization (for example in de-husking and harvesting) or chemical applications (to reduce weeding costs).

In the case of the CEDISA project, the Jatropha production process is labour intensive, as all activities are implemented using hand labour. Particularly when considering the (still) low productivity and low value of the product, it makes Jatropha an unattractive option compared to other crops (see Annex 6). Although a de-husking machine is foreseen to be implemented in Solo (donated by the DRASAM project), until now even this activity was realized by hand, elevating production costs to such an extent that it is economically no viable (see chapters 5.5 and 5.6).

5.9. Logistics

Logistics is an important factor in evaluating the CEDISA project. On the one hand, the project area is nearby Tarapoto (half hour drive by paved road) and as such, close to the local markets at present (Tarapoto and Leoncio Prado; the latter 2 hours further away). However, the different Jatropha fields in general have difficult access, with steep slopes, in which all transport from field to village is done with horses and or man power. The fields are dispersed, and often a long walking distance from the paved road. This affected on the project, as input such as fertilizer was not always brought to the fields. It also generated an extra barrier for the farmers to harvest and to bring their (low value) harvests to the village. Furthermore, it complicated technical assistance in the plots further away. Capacity building sessions were generally done in the villages (along the paved road), as such not generating inconveniences. Harvest was generally gathered at village level and collected by the CEDISA team to facilitate commercialization to Tarapoto

/ Leoncio Prado, due to the small quantities that inhibited companies to recollect the harvest in the villages themselves.

5.10. Markets

The Jatropha market is in plain development yet, with large fluctuations in prices being offered for Jatropha seed. In general, prices are significantly higher when used for planting (often temporary, ad-hoc markets), whereas the oil extraction market is more stable, but with lower prices, determined mainly by fluctuating prices of crude oil.

Jatropha production in San Martin is oriented for now to local buyers, this offering the most practical means for commercializing the still small quantities of Jatropha seed and oil. The oil is oriented for use in vehicles converted to straight vegetable oil (with a conversion kit from Elsbett, Germany; cost: USD 1,200), of which 3 units were installed in San Martin; 2 in pick-up trucks of DRASAM (2011; see photo beneath), 1 in a transport truck of the Jatropha farmers' cooperative in Leoncio Prado (2009); 700 gallons/year would be needed per vehicle. DRASAM buys the oil at the local price of diesel: 12.50 Peruvian Soles per gallon in May 2011 (USD 4.50 approx). In 2009-2010, the Leoncio Prado cooperative produced 800 gallons of Jatropha oil. It is aimed for to promote further use of the diesel-to-SVO conversion kits in the transport sector (with adapted local technology to make it cheaper; aiming at less than USD 200 per kit), as such to further promote local Jatropha markets.

Local market development around Jatropha in San Martin is oriented towards the use of vegetable oil in converted vehicles. To the left: Jatropha oil extraction plant as installed with a farmers´cooperative in Leoncio Prado (CFC-DED project, German cooperation; photo was taken during inauguration act, December 2008). To the right: One of the diesel vehicles from DRASAM converted to straight vegetable oil, in this case transporting Jatropha farmers during a capacity building event (May 2011).

Apart from its use in converted vehicles, a minor part of the Jatropha oil was sold for biocide production (demonstrated to effectively control 4 plagues), an interesting niche market due to the more elevated prices (18 Peruvian Soles per gallon of oil; USD 6.5 approx). Use of the vegetable oil for biodiesel production is also considered as an option for the future, as well as commercialization at national level (present biodiesel producers; larger market due to obligatory blending in Peru; see chapter 4) and international level, with local company contacts established with markets in Spain, Italy and US. It seems however that local end markets are the best option (with also a biodiesel producer present in the local market; Industrias del Espino), due to tax exonerations when commercializing end products within the Amazon, and logistical issues.

Markets (all at local level, in San Martin) the CEDISA project has been involved with are the following:

- Leoncio Prado cooperative (oil extraction plant): 0.70 Peruvian Soles per kg dry seed (60% of production was sold to them, for oil extraction). It is hoped for that prices might go up to 1.00 Peruvian Soles per kg dry seed (with increased

prices for crude oil); price which is already paid to farmers associated to the cooperative, as an incentive. 0.70 Peruvian Soles per kg corresponds with a price of USD 250 per ton dry seed, which is relatively high when compared with international prices for Jatropha seed (up to USD 200, generally).

- Francisco Tello Perú (Jatropha development company with funds from Spain): 0.50 Peruvian Soles per kg dry seed (20% of production was sold to them, for oil extraction / testing). They recently elevated to 0.70 Peruvian Soles, following the price as offered by the Leoncio Prado cooperative and justified by increased prices for crude oil.
- Reforesta Perú (local company specialized in seedlings production): 2.00 Peruvian Soles per kg dry seed (20% of production was sold to them, for producing seedlings); a temporary market.

Companies starting plantations in San Martin, such as VERDAL and LS Biofuels, are interesting temporary market options too, offering between 7 and 10 Peruvian Soles per kg dry seed, respectively (unselected seeds, but a convenient option for companies as the seeds are adapted to the local environment). For now however, farmers of the CEDISA project have not been selling to these companies yet.

5.11. Alliances

Strategic alliances have been key to the CEDISA project, due to the presence of several actors involved in the Jatropha value chain in San Martin, as explained in chapter 4. Indeed, CEDISA sought active collaboration with actors like DRASAM (co-financing for inputs, technical assistance), Francisco Tello Perú (technical assistance, market access; both with specific agreements signed with CEDISA), INIA, the Leoncio Prado cooperative, VERDAL and LS Biofuels. Although helpful and contributing to the objectives and sustainability of the CEDISA project, collaboration sometimes did not turn out as expected, for example due to cut-backs in funding of DRASAM and a reduced role of Francisco Tello Perú when their plans for installing a biodiesel plant were postponed, now concentrating on validating/improving Jatropha management, productivity and profitability (no up-scaling yet), while assuring market for the farmers already engaged in Jatropha and providing capacity building to them.

Capacity building of Jatropha farmers through alliances of CEDISA with other members in the Mesa Técnica de Biocombustibles. To the left: farmers of the Bajo Mayo area participate in a capacity building event organized by DRASAM together with INIA (May 2011). To the right: closure of technical assistance day with participation of technical staff of Francisco Tello Perú (June 2010).

CEDISA continues to look for strategic alliances for technical assistance and additional funding to assure continued support to the farmers associated to the project, as the project would need more time to consolidate and validate Jatropha as a valid option (or not) for the farmers. Interest exists from companies such as VERDAL and LS Biofuels,

with proposals from VERDAL to cover for wages, technical assistance and inputs, but no agreements have been achieved so far. Frustrating factors are the lack of trust, elevated risks (contracts with long term commitments and land as guarantee; uncertainties related to a new crop), logistical issues and plantation management practices of the farmers that differ from the model as foreseen by the company.

5.12. Costs and income

As might be expected from the described above (elevated production costs and low productivity of a low-value product), the income generation perspectives of Jatropha have not been positive so far. However, this was mitigated in the CEDISA project by applying an integrated agroforestry system, developing Jatropha with associated food crops and forestry species. Particularly the associated food crops improved the economic balance for the farmers; whereas the forestry species promise to deliver income increase in the future (harvesting of fast-growing wood species is feasible after 5 years).

The average income generated per farmer (1 ha) through the agroforestry system is estimated at -775 Peruvian Soles (a loss of USD 246 approx.) in the year of installation (2009; with higher costs), and 1,150 Peruvian Soles (USD 402 approx.) in 2010 (reduced costs; maintenance). Those are averages for the group of 60 farmers the project started with in Solo, San Miguel and San Antonio del Río Mayo. Jatropha played a negligible role in income generation, with 50 kg harvest per farmer/hectare in average in 2010 (taking only into account those farmers who actually harvested Jatropha; 13 out of 60), corresponding with 35 Peruvian Soles; USD 12 approximately, on a yearly basis. The crops that contributed most to income generation were beans, peanut, coriander, cotton and maize. See Annex 6 for further detail.

It should be noted that if the Jatropha would not have been installed with associated crops, the financial balance would have been negative in both years. This exercise is presented in Annex 7 (losses of USD 1,015 and USD 486 in 2009 and 2010 respectively). This underlines the importance of applying associated crops with small-holders, as such to reduce risks, diversify income and to mitigate costs for Jatropha by applying labour that serves for other crops at the same time. Although productivity is expected to increase over time (supposedly achieving its peak in production in the 5th year), serious doubts remain if Jatropha indeed at some point will be able to contribute to increased income, when produced under the conditions as present in the CEDISA project. As it seems so far, a lot is still needed (increased productivity, reduced costs, improved market conditions) to make Jatropha a viable option for the farmers involved.

6. Conclusions

Due to the low market price for Jatropha seed, combined with elevated production costs (mainly due to the intensive labour needed) and lower productivity than foreseen, Jatropha is still no valid business alternative, neither for companies, nor for farmers such as those associated to the CEDISA project. The quick cost-benefit analysis as done for harvesting in chapter 5.5, illustrates this clearly; it makes no sense to invest USD 7-9 (harvesting and de-husking) for receiving USD 3.4 (product value) in return.

The implemented system by CEDISA, with associated food crops and forestry species, assured some compensation and additional income for the farmers in the second year (2010), thus motivating the farmers not to abandon Jatropha. However, the current state of the plantations, level of maintenance (with some exceptions) and the reduced number of farmers that made the effort to harvest (13 out of 60 farmers in 2010, in only a part of their plots), is not promising. The low market prices for a high input product (elevated production costs, losses instead of profit) are key for this lack of interest or priority on behalf of the farmers.

Although the nature of the project was explained to the farmers from the start (validating a new crop, increased productivity and profitability on the long term) it was proved to be difficult for the farmers to invest their time in a crop not guaranteeing income (and that indeed generated losses in the first two years). The farmers tend to prioritize crops that have proven to be a viable source of income or subsistence for them (in this case for example they prioritized maize, beans and peanut; at the expense of Jatropha). With the actual market prices of Sacha Inchi (Inca peanut), that elevated from 0.70 Peruvian Soles per kg a few years ago to 8.00 Peruvian Soles per kg at present, risk exist that the farmers will permanently abandon Jatropha and switch to this other permanent crop suitable for their areas; with which they already have some experience and that provides far better market perspectives for them. The latter is actually happening already with some farmers in the project.

In order to be successful with Jatropha, an integrated approach is needed, considering adequate selection of intervention areas (with suitable biophysical, logistic, socio-economic and cultural conditions), adequate crop management, processing and market conditions. In addition, genetic breeding adapted to local conditions is considered to be crucial to improve productivity and crop performance (resistance to plagues, uniform maturation, etc).

Everything depends on oil price and the value of (sub)products. It is clear that to make Jatropha work, we should look for options beyond the Jatropha oil: detoxification of the seedcake for animal feed, production of organic fertilizer, soap, briquettes, biogas, ethanol, carbon credits due to reforestation, and so on.

As such, R&D should be prioritized in the Jatropha sector, instead of up-scaling Jatropha while the above is still to be defined. Doing all this requires significant investments, which probably only (bigger) companies will be able to make (such is the case with some leading companies in the sector, such as La Fabril in Ecuador, and Agroipsa in Honduras), or research institutes with strong state funding (such as EMBRAPA in Brazil). The actors working together on Jatropha development in the San Martin region and as articulated through the *Mesa Tecnica de Biocombustibles*, are making a remarkable combined effort also (unique when compared to other countries), with several companies, government agencies, research institutes and NGOs collaborating in a joint effort to validate Jatropha. Question is if sufficient financing will maintain to be available to eventually achieve the goal.

Validation of the crop and participative research with farmers might be a valid option; however it should be assured that the risk and investments are not covered by them, but by assistance programs from government, private sector or international cooperation, starting small and scaling up when it has proven to be a viable business. Expert opinions vary (see for example presentations from Quinvita and JOil during World Biofuels Markets 2011), but this might take still some 3-4 years.

Literature

Echeverría, R., 2010. Avances de investigación en cultivos agroenergéticos. Instituto Nacional de Innovación Agraria (INIA) - Estación Experimental "El Porvenir", Juan Guerra, San Martín, Perú.

Garay, R., 2010. Avances, experiencias y producción de biodiesel en el cultivo de piñón. Instituto Nacional de Innovación Agraria (INIA) - Estación Experimental "El Porvenir", Juan Guerra, San Martín, Perú.

Jongschaap, R.E.E., van Loo, E.N., 2009. Fact sheet on 200 Jatropha curcas accessions from different regions in the world. Global Jatropha curcas Evaluation Programme (2006-2010). Plant Research International BV, Wageningen, the Netherlands.

Orihuela, P. & Sanchez, V.H., 2010. Identificación de plagas, controladores biológicos y enfermedades en el cultivo de Piñón blanco (*Jatropha curcas*). Instituto Nacional de Innovación Agraria (INIA) - Estación Experimental "El Porvenir", Juan Guerra, San Martín, Perú.

Palmas del Espino, 2010. Biodiesel de Palma aceitera en proyectos de la Amazonía. Presentación en IV Congreso sobre Energías Renovables y Biocombustibles (COBER), Lima, Perú.

Ramirez, 2008. Cultivos para la producción sostenible de biocombustibles: Una alternative para la generación de empleos e ingresos. Modulo I: Piñón. SNV Servicio Holandés de Cooperación al Desarrollo, Tegucigalpa, Honduras.

Tang, M., Trujillo, R., Mercado, A. y Veen, M., 2008. Identificación de zonas potenciales para el cultivo de Piñón blanco en la región San Martín. SNV Servicio Holandés de Cooperación al Desarrollo con AMPA, Tarapoto, Perú.

Annexes

Annex 1. Evaluation programme

Final version of the evaluation programme as realized, including contact information (email directions) of the people interviewed.

DÍA	HORARIO	ACTIVIDAD	PARTICIPANTES
11/05/11	3:00 a 6:00 pm.	Reunión de presentación y evaluación de avances con el Equipo Técnico del Proyecto: Ray Paredes, James Mendoza, Queny Pinedo. Se sumó Cesar Chappa, hasta el año pasado coordinador del proyecto.	Equipo Técnico del Proyecto, Max Rengifo & Martha del Castillo (CEDISA), Martijn Veen (SNV), Sona Prakash (evaluadora)
12/05/11	9:00 am. a 1:00 pm.	- Visita de campo: 01 parcela instalada el 2009 y 01 parcela instalada el 2010. - Reunión con grupo de productores (15 personas), localidad de Maceda - Reunión con representantes de las Asociaciones de Productores de Piñón Blanco; integrantes de las localidades de Solo, San Miguel y San Antonio	Equipo Técnico del Proyecto & Max Rengifo (CEDISA), productores, comuneros, representantes de las asociaciones de productores, Martijn Veen (SNV), Sona Prakash
	1:00 pm a 6:00 pm.	Receso (evaluadora se encontró mal de salud)	
13/05/11	9:00 am. a 1:00 pm.	- Visita de campo a plantaciones de la empresa Agrobiofuels Perú (Juan Guerra); reunión con agrónomo responsable de la empresa: Claudio Llajahuanca - Visita a Estación Experimental "El Porvenir", INIA (Juan Guerra). Informe de avances de investigación; visita a parcelas y laboratorio. Responsables: Ronald Echeverría, Aida Valles, Richer Garay	Equipo Técnico del Proyecto, Max Rengifo & Martha del Castillo (CEDISA), Claudio Llajahuanca (empresa), Ronald Echeverría, Aida Valles & Richer Garay (INIA), Martijn Veen (SNV), Sona Prakash
		Receso	
	4:00 a 6:00 pm.	Reunión con representantes de: - Proyecto Promoción Piñón de la DRASAM: Ing. Felix Campos (coordinador). - Cooperativa Agraria de Leoncio Prado (planta extracción de aceite): Darvin Gil Ríos (gerente).	Equipo Técnico del Proyecto (CEDISA), Felix Campos (DRASAM), Darvin Gil (cooperativa), Martijn Veen (SNV), Sona Prakash
14/05/11	9:00 am. a 2:00 pm.	Reunión de evaluación con equipo técnico en CEDISA	Equipo Técnico del Proyecto, Max Rengifo & Martha del Castillo (CEDISA), Martijn Veen (SNV), Sona Prakash
	Tarde	Libre	
16/05/11	9:00 a 1:00 pm.	Visita de campo a las instalaciones (vivero, plantaciones) de la empresa VERDAL (Winge); reunión con Francesco Signorelli, gerente general de la empresa.	Equipo Técnico del Proyecto & Max Rengifo (CEDISA), Francesco Signorelli (VERDAL), Martijn Veen (SNV), Sona Prakash
	5:00 a 7:00 pm	Reunión con representantes de la empresa Francisco Tello Perú (parte del Grupo Tello): Marco Polo Arango (responsable pos-cosecha) y Juan Manuel Ramirez (agrónomo)	Equipo Técnico del Proyecto (CEDISA), representantes de Grupo Tello, Martijn Veen (SNV), Sona Prakash
	7:00 a 10:00 pm	Cena de cierre con el equipo del proyecto	Equipo Técnico del Proyecto, Max Rengifo & Martha del Castillo (CEDISA), Martijn Veen (SNV), Sona Prakash

Annex 2. Oil content of analyzed Jatropha material

Oil content of analysed Jatropha material, including local accessions (from San Martin and other regions in Peru) and from other countries (Mexico, Honduras, Nicaragua, Brazil and India). Analyses issues by INIA and executed in laboratories of Palmas del Espino. Source: Echeverría, 2010.

ACCESSION	SEED		KERNEL	
	% Humedad	% aceite	% Humedad	% de Aceite
E1 TOTORILLAYCO	4,58	0,10	4,87	45,38
E2 JAEN	4,44	0,19	5,39	41,18
E3 CAJAMARCA	4,66	0,14	5,26	39,22
E4 CABALLOCOCHA	4,55	0,09	4,72	44,15
E5 PIURA	4,23	0,15	4,95	44,47
E6 BARRANQUITA	4,96	0,08	5,01	46,26
E7 ESLABON	4,56	0,09	5,03	44,34
E8 SISA	4,22	0,07	5,01	44,70
E9 NAZARETH	4,73	0,07	5,29	44,59
E10 VILLA PRADO	4,99	0,08	5,25	44,86
E11 MEXICO I	4,98	0,08	4,98	48,88
E 13 CONTAMANA	4,59	0,09	4,99	44,95
E16 CABO VERDE	4,74	0,10	4,59	47,65
BAGUA	4,72	0,16	4,22	51,35
E12 MEXICO II	11,42	1,57	6,92	52,28
E14 INDIA I	12,98	1,07	12,41	50,69
E15 INDIA II	13,69	1,16	8,67	47,39
E17 YURIMAGUAS	13,36	0,78	8,68	47,26
E 118 PISCOYACU	12,76	0,88	7,36	50,13
E 19 BRASIL	12,72	0,63	10,61	37,37
E 20 YORO	13,21	1,1	6,18	56,94
E 21 PIÑON ROJO + CABO VERDE	12,67	0,61	7,38	51,6
E22 CUÑUMBUQUE				
E 23 SHATUYACU	12,07	0,62	6,28	52,48
E24 MAYOPAMPA	12,09	0,60	7,24	47,18
E25 PIÑÓN ROJO + TOTORILLAYCO				
E26 GUARUMA	11,74	1,85	6,25	55,89

Annex 3. Potential areas for Jatropha production in San Martin

Evaluation of potential areas for Jatropha production, based on biophysical suitability criteria (see next page). From: Tang et al., 2008. The CEDISA project area is marked with a red circle.

Mapa N° 01. Zonas potenciales desde la perspectiva biofísica para el cultivo de Piñón blanco en la región San Martín.

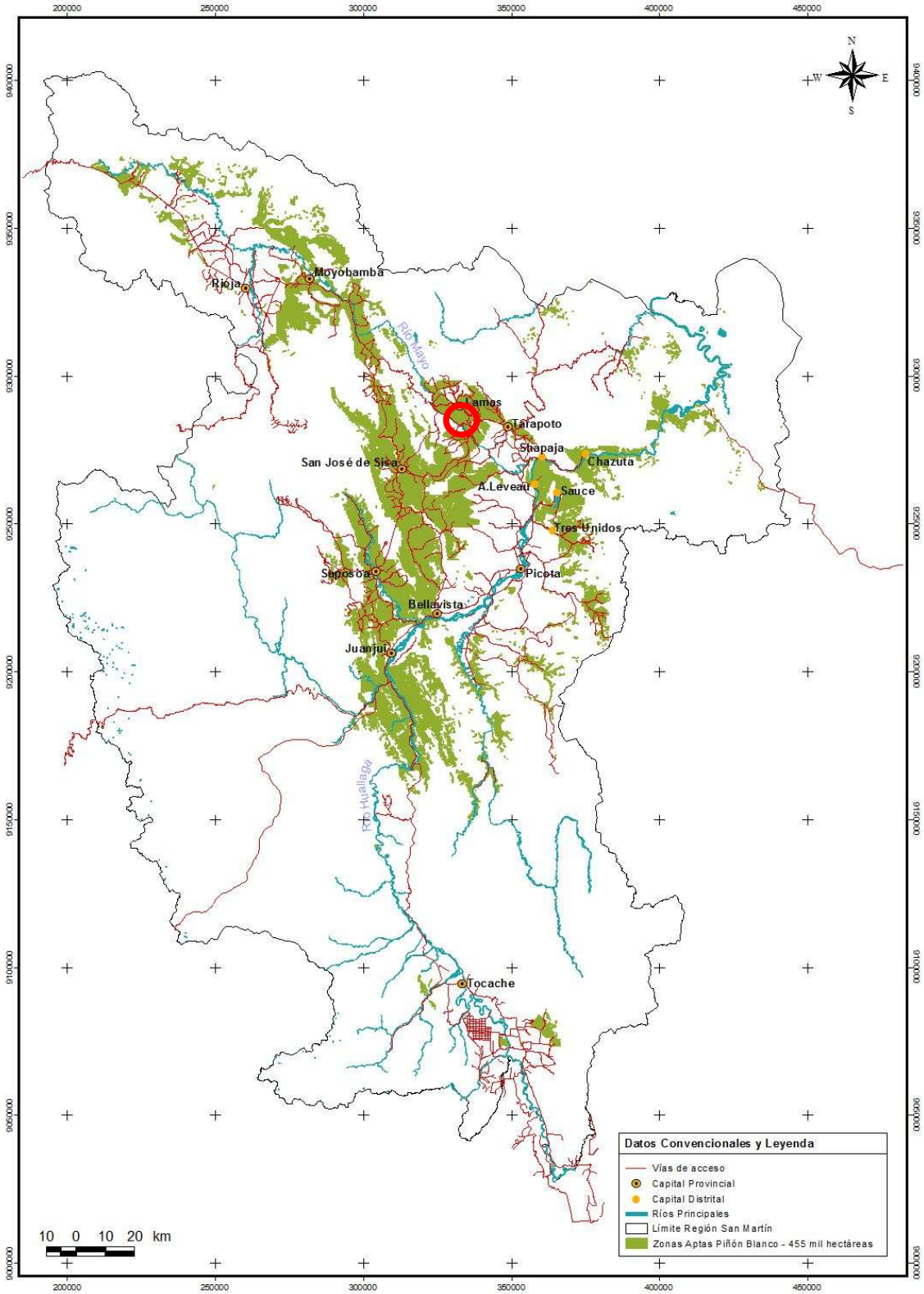


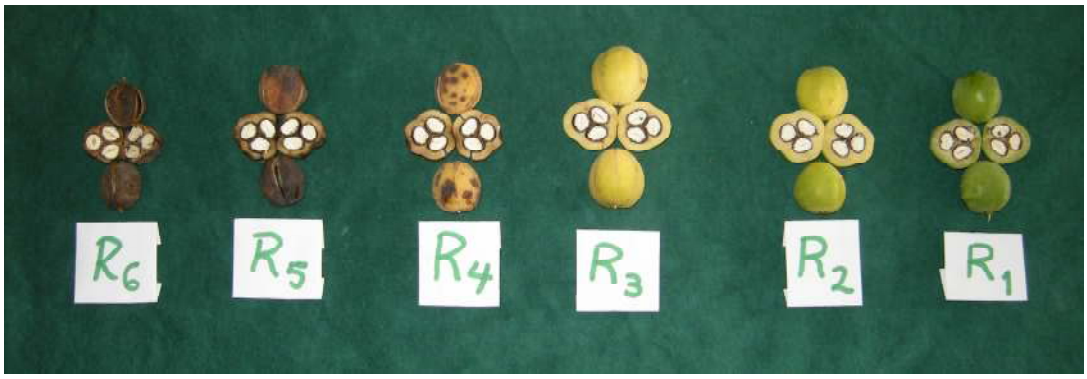
Table 3.1. Ranking of suitability criteria for identifying potential areas for Jatropha production in the San Martin region (Tang et al., 2008)

Variables Biofísicas	Rangos Aceptables	Valoración Potencial
Altitud	Menor a 600 msnm	Alto
	600 a 1200 msnm	Medio
Pendiente	3% a 8%	Alto
	9% a 16%	Medio
	17% a 30%	Bajo
Relieve	Suave - Ondulado	Alto
	Fuertemente Ondulado	Medio
	Colinado	Bajo
Precipitación Promedio Anual	Menor a 800 mm*	Bajo
	800 a 1200 mm	Alto
	1200 a 1600 mm	Medio
	1600 a 2000 mm	Bajo
Temperatura Promedio Anual	24°C – 26°C	Alto
	20°C – 23°C	Medio

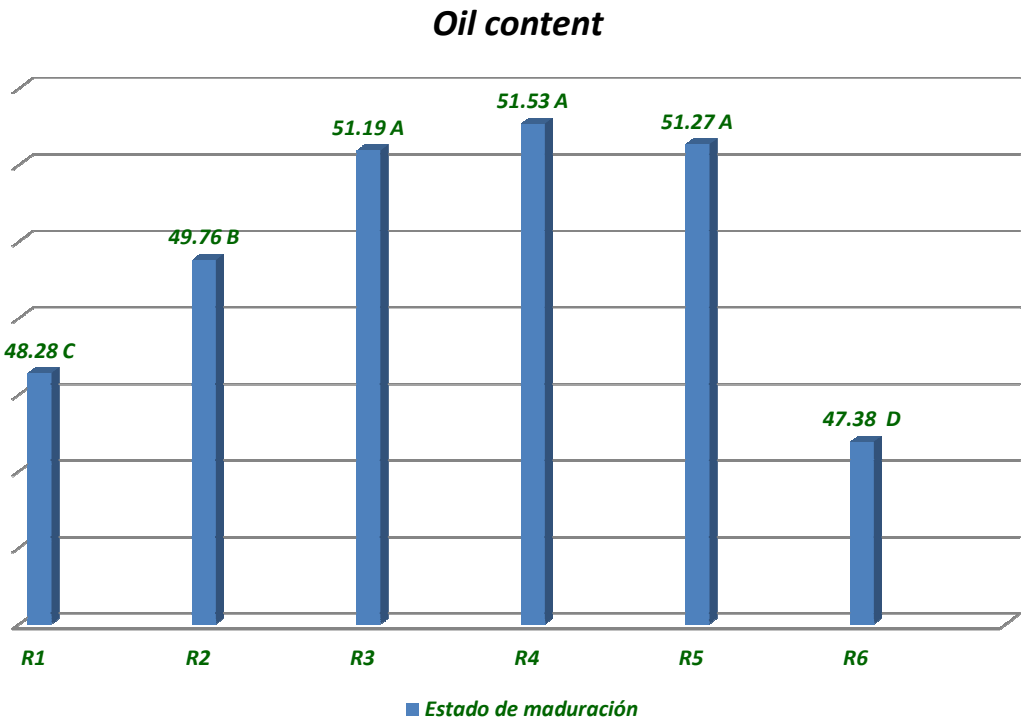
Variables Biofísicas	Rangos Aceptables	Valoración Potencial
pH Suelo	5 a 7	Alto
	Menor a 5	Medio
	Mayor de 7	Bajo
Textura Suelo	Franco Limoso	Alto
	Franco Arcilloso	Medio
	Franco Arenoso	Bajo
Profundidad Suelo	Mayor a 60 cm	Muy Alto
	40 a 60 cm	Alto
	Menor de 40 cm	Bajo
Vegetación	Áreas Deforestadas	Con Potencial
	Cobertura Boscosa	Sin Potencial
*Requiere riego. Área No considerada en el modelo.		
Fuente: Reuniones de Trabajo para la priorización y validación de las variables biofísicas relevantes.		

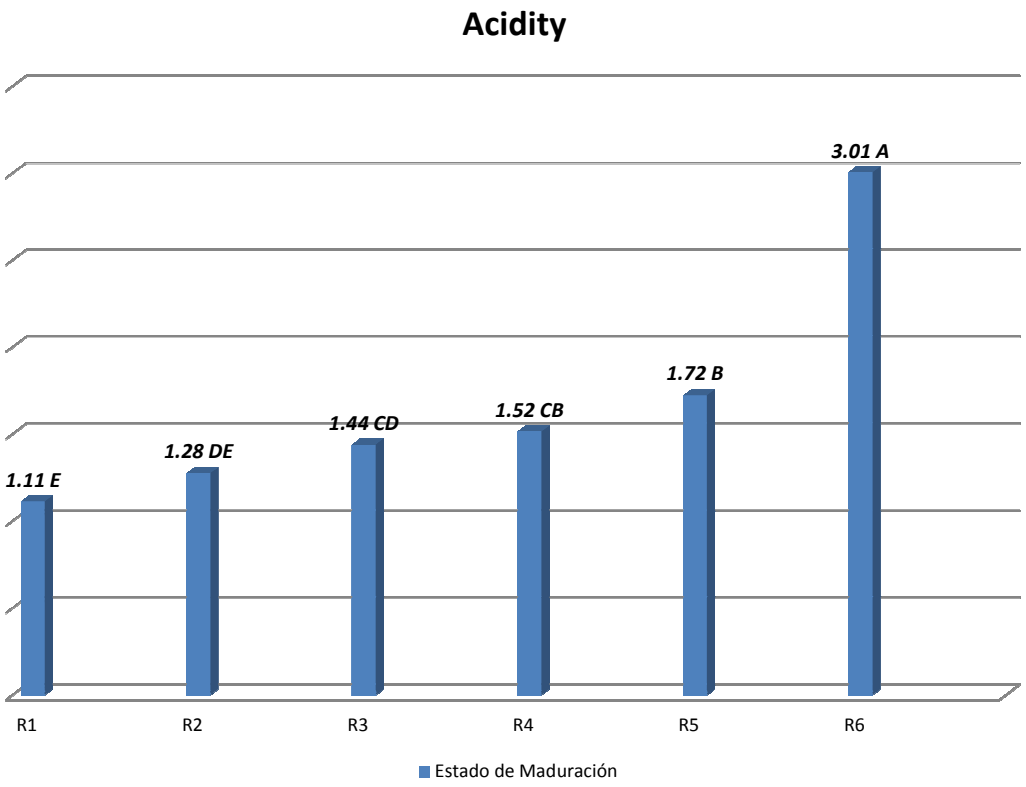
Annex 4. Oil content and acidity of Jatropha seeds, for different stages of maturation of Jatropha fruits

Evaluation as executed by the "El Porvenir" experimental station of INIA, Juan Guerra (source: Garay, 2010)



R1: Verde
R2: Pintón o semi maduro
R3: Maduro
R4: Sobre maduro
R5: Semi seco
R6: Seco




Acidity
3.01 A
1.72 B
1.52 CB
1.44 CD
1.28 DE
1.11 E
R1
R2
R3
R4
R5
R6
Estado de Maduración

Annex 5. Jatropha productivity figures

Jatropha productivity as analysed for different projects around the world, and compared with productivity in San Martin. Own elaboration. Actualized version, June 2011.

Rendimientos por hectárea de Piñón blanco (*Jatropha Curcas*)

Comparación de iniciativas en diferentes países

(Rendimientos de cosecha de semillas secas en toneladas por ha)

País y condiciones del cultivo		Año 1	Año 2	Año 3	Año 4	Año 5	Año 6	Comentarios
Brazil, 833 plantas (6x2; intercropping). Irrigación por goteo (Mattana Saturnino, 2005)	[x]	**0.335**						Datos extraidos de: SNV CA, 2008: Cultivos para la producción sostenible de biocombustibles. Modulo I: Piñón
India. 1667 plantas, suelos marginales. A los 2.5 años (Gosch, 2007)	[x]			**1.45**				
India. 833 plantas, tierra con altos nutrientes y precipitación de 800 mm. (Patolia)	[x]		**1.27**					
India. 1200 plantas, se asumen datos para tierras no utilizadas	[e]	0.444	1.1	1.3	1.556	1.556		
Guatemala. 2500 plantas, tecnificado (selecc, viveros, etc) sin irrigación	[x]			**5.9**				
Guatemala. 2500 plantas, tecnificado (selecc, viveros, etc) con irrigación	[x]			**9.3**				
Guatemala. 2500 plantas, tecnificado (selecc, viveros, etc) fertilizantes, irrigación 800 mm 6 meses, y precipitación 4,000 mm 6 meses. (Barillas, Octagon S.A)	[x]	**1.25**						
México, 1111 plantas. Un rendimiento promedio con buenos suelos y precipitacion de 900-1200 mm	[e]			3.34	4	5		
6 a 8 TM fruto fresco/ha (*) (Handbook of Energy Crops)	[e]					0.9-1.2		
Indonesia 2500 plantas. Precipitación 2000 mm y suelos ricos en materia orgánica	[x]	**4-5**						
Nicaragua. Mejores tierras (N. Foidl)	[x]				**4.5**			
Perú (San Martín, Amazonía), 1666 plantas (3x2), paquete completo de fertiziliación, etc; sin riego (1000-2000 mm precipitación).	[ex]	0.5	3.2	4.9	6.2	7.6	9.0	Información de la Mesa Técnica de Biocombustibles de San Martín; contrarrestado con experiencias de Centro América. Escenario optimista. INIA ha alcanzado 3.125 kg/planta (año 3), pero como máximo.
Honduras (Comayagua), 2500 plantas, paquete completo, sin riego	[ex]	0.93	2.32	3.52	4.45	5.47	6.58	Datos del estudio de factibilidad para el cultivo de Jatropha en Comayagua, Honduras, elaborado por Erazo Consultores (empresa del Director General de AGROIPSA), contratado por SNV y DINANT. Basado en experiencias con el cultivo en las 1200 ha de plantación de Agroipsa.
Colombia (Vichada), 2000 plantas, condiciones trópicales, 2000 mm de precipitación, con fertilización.	[ex]	0.32	0.96	3.70	9.00	14.00		Comunicación personal, Juan José Morales Ceballos. Datos de 12 hectáreas de testigo de más de 7 años de cultivadas, las cuales tienen sembradas 2X2, 3X3, 2,5X2,5. Con abonamiento de quimicos y otros con organicos. Tanto siembra
Colombia (Vichada), 1850 plantas	[x]						**12.0**	directa como siembra en vivero. Temperatura en el día oscila entre 33 y 36 grados
Brazil, 833 plantas (6x2; intercropping).	[e]	0.2	0.7	1.5	2.0			Datos de presentación de Mike Lu, ABPPM, en evento Jatropha Markets, México
Ecuador, 2000 plantas (2x2.5), con riego tecnificado (500 mm/año) y fertilización	[x]	**2.2**						Experiencia de la empresa La Fabril (cliente de SNV); cifra es el promedio medido en 30 ha de plantación, sembrada en noviembre 2008 con "semilla elite", y cosechas hasta noviembre 2009. (Mientras tanto, desarrollaron segunda generación de semillas donde ya a los 4 meses ha empezado la fructificación uniforme).
Honduras , Gota Verde	[x]				**0.4**			
Perú, Lambayeque, Motupe (CFC-DED)	[x]		**4.0**					
Perú, San Martín (Agrobiofuels); 2x2, producido en secano, con fertilización	[x]	**0.4-0.6**						Y máximos de 0.7-0.8 TM/ha. Pronostico que maneja la empresa: 7-8 TM/ha (año 5).
Perú, San Martín (CEDISA); 3x2, producido en secano, sistemas agroforestales en comunidades	[x]	**0.1**						9 meses

(*) Se convirtió el fruto fresco a semilla seca a una relación 15% (este porcentaje depende del grado de madurez en que fue cosechado el fruto

[e] Los datos se basan en estimaciones y cálculos de los autores

[x] Los datos se basan en observaciones experimentales (reclamadas)

[ex] Los datos de basan en observaciones experimentales (para los primeros 1.5-2 años, generalmente), con estimaciones y cálculos para los siguientes años.

AÑO	Sin riego			Con riego		
	bajo	Normal	alto	bajo	Normal	alto
1	0.1	0.25	0.4	0.75	1.25	2.5
2	0.5	1.00	1.5	1	1.5	3
3	0.75	1.25	1.75	4.25	5	5
4	0.9	1.75	2.25	5.25	6.25	8
5	1.1	2.00	2.75	5.25	8	12.5

Fuente: Centre for Jatropha Promotion & Biodiesel

Annex 6. Labour input, costs and income of Jatropha agroforestry system as implemented by CEDISA

Analysis of costs and income for 1 ha agroforestry system with Jatropha, as implemented by CEDISA in the villages of Solo, San Miguel and San Antonio del Río Mayo; San Martin, Peru. Data are presented for 1 ha, as an average of a total of 60 beneficiaries. Source: CEDISA, 2010

Proyecto "Promoción de la jatropa curcas en sistemas agroforestales en laderas de la Región San Martín" 2009 - Analisis económico de un Sistema Agroforestal con Piñón Blanco (Jatropha Curcas)

Región : San Martín
Provincia : Lamas
Comunidades : San Miguel, Solo y San Antonio del Río Ma
Cultivo : Piñón Blanco bajo un sistema agroforesta
Nivel de Tecnologia : Operaciones Manuales
Unidad Ejecutora : CEDISA
Tipo de suelo : Franco Arcilloso
Distanciamiento del Piñón : 3x1.5, 3x2, 3x3

Profundidad de suelo: 50 - 80
Total Beneficiarios : 60 agric. beneficiarios
Promedio : 1 Ha/agricultor
Tipo de cambio : 2009: S/ 3.15 /US$
Tipo de cambio : 2010: S/ 2.86 /US$
Densidad de siembra : 1,111 plantas por Ha
Pendiente Promedio : 20%

ACTIVIDAD	2009					2010				
	Uni.	Cant.	Precio S/.	Valor total S/	%	Uni.	Cant.	Precio	Valor total S/	%
I. Total Egreso				**9045.0**	**100**				**5131.0**	**100**
1.1. Mano de Obra				**6465.0**	**71.5**				**4725.0**	**92.1**
1.1.1. Preparacion de Terreno				**1590.0**					**1170.0**	
Roso	J.	0	15.00	0.0		J.	0	0.00	0.0	
Tumba/Picacheo	J.	12	15.00	180.0		J.	0	0.00	0.0	
Quema	J.	3	15.00	45.0		J.	0	0.00	0.0	
Alineamiento y Estaqueado para plantacion de Piñon	J.	8	15.00	120.0		J.	0	0.00	0.0	
Poseado para plantones de piñon	J.	5	15.00	75.0		J.	0	0.00	0.0	
Alineamiento, Poseado de Sp. Forestales	J.	1	15.00	15.0		J.	0	0.00	0.0	
Podas del piñon	J.	1	15.00	15.0		J.	2	15.00	30.0	
Abonamiento	J.	16	15.00	240.0		J.	16	15.00	240.0	
Deshierbo (04)	J.	60	15.00	900.0		J.	60	15.00	900.0	
1.1.2. Siembra				**2130.0**					**1500.0**	
Frejol	J.	50	15.00	750.0		J.	30	15.00	450.0	
Maiz	J.	40	15.00	600.0		J.	30	15.00	450.0	
Mani	J.	30	15.00	450.0		J.	30	15.00	450.0	
Culantro	J.	10	15.00	150.0		J.	10	15.00	150.0	
Algodón	J.	8	15.00	120.0		J.	0	0.00	0.0	
Plantones de piñon	J.	3	15.00	45.0		J.	0	15.00	0.0	
Sp. Forestales	J.	1	15.00	15.0		J.	0	15.00	0.0	
1.1.3 Cosecha				**2325.0**					**1815.0**	
Frejol	J.	50	15.00	750.0		J.	40	15.00	600.0	
Maíz	J.	40	15.00	600.0		J.	40	15.00	600.0	
Mani	J.	30	15.00	450.0		J.	10	15.00	150.0	
Culantro	J.	20	15.00	300.0		J.	20	15.00	300.0	
Algodón	J.	12	15.00	180.0		J.	0	0.00	0.0	
Piñon (incluye desgranado)	J.	0	15.00	0.0		J.	10	15.00	150.0	
Leña	J.	2	15.00	30.0		J.	1	15.00	15.0	
Sp. Forestales	J.	1	15.00	15.0		J.	0	15.00	0.0	

ACTIVIDAD	2009					2010				
	Uni.	Cant.	Precio S/.	Valor total S/	%	Uni.	Cant.	Precio	Valor total S/	%
1.1.4. Transporte				**420.0**					**240.0**	
Semilla de frejol de la chacra a la comunidad, mercado tarapoto.	J.	4	15.00	60.0		J.	3	15.00	45.0	
Semilla de maíz de la chacra a la comunidad.	J.	7	15.00	105.0		J.	5	15.00	75.0	
Semilla de mani de la chacra a la comunidad.	J.	3	15.00	45.0		J.	2	15.00	30.0	
Semilla de Culantro	J.	3	15.00	45.0		J.	3	15.00	45.0	
Semilla de Piñon	J.	1	15.00	15.0		J.	1	15.00	15.0	
Algodón	J.	4	15.00	60.0		J.	0	0.00	0.0	
Plantones de piñon de la comunidad a campo definitivo	J.	2	15.00	30.0		J.	0	0.00	0.0	
Plantones de Sp. Forestales de la comunidad a campo definitivo	J.	1	15.00	15.0		J.	0	0.00	0.0	
Abono inkafe 20-20-20	J.	1	15.00	15.0		J.	1	15.00	15.0	
Transporte de leña de chagra a Pueblo	J.	2	15.00	30.0		J.	1	15.00	15.0	
Sp. Forestales.	J.	2	0.00	0.0		J.	0	0.00	0.0	
1.2. Insumos				**2502.0**	**27.7**				**344.0**	**6.7**
Semilla de Frejol	Kg.	50	6.00	300.0		Kg.	20	6	120.0	
Semilla de Maiz	Kg.	50	1.00	50.0		Kg.	20	1	20.0	
Semilla de Maní	Kg.	50	6.00	300.0		Kg.	20	6	120.0	
Semilla de Culantro	Kg.	25	7.00	175.0		Kg.	10	7	70.0	
Semilla de Algodón	Kg.	2	2.00	4.0		Kg.	0	0	0.0	
Plantones de Piñon	Uni.	1111	1.00	1111.0		Uni.	0	0	0.0	
Plantones de Sp. Forestales	Uni.	200	1.00	200.0		Uni.	0	0	0.0	
Guano de Isla	Uni.	2	116.00	232.0		Uni.	0	0	0.0	
Inka fer 20 - 20 -20	Uni	2	58.00	116.0		Uni	2	0	0.0	
Tifón	Uni.	2	7.00	14.0		Uni.	2	7	14.0	
1.3. Equipos y Herramientas				**78.0**	**0.9**				**62.0**	**1.2**
Machetes L-A	Uni.	2	15.00	30.0		Uni.	2	15	30.0	
Valeriana	Uni.	2	16.00	32.0		Uni.	2	16	32.0	
Poceador	Uni.	1	16.00	16.0		Uni.	0	0	0.0	
II. Valor Buro de la Producción (Ingreso)				**8270.0**	**100**				**6281.0**	**100**
Frejol	Kg.	800	3.50	2800.0		Kg.	700	3.50	2450.0	
Maiz	Kg.	1700	0.60	1020.0		Kg.	1100	0.60	660.0	
Culantro	Kg.	500	2.50	1250.0		Kg.	350	2.50	875.0	
Mani (cascara)	Kg.	600	3.50	2100.0		Kg.	400	3.50	1400.0	
Algodón	Kg.	750	1.20	900.0		Kg.	655	1.20	786.0	
Piñon	Kg.	50	0.70	35.0		Kg.	50	0.70	35.0	
Leña	Tercio	33	5.00	165.0		Tercio	15	5.00	75.0	
Madera (caibro, solera)	Uni.	0	0.00	0.0		uni.	0	0.00	0.0	

ITEMS/AÑOS	2009	2010
Egresos	9045.0	5131.0
Ingresos	8270.0	6281.0
Ing. Netos	**-775.0**	**1150.0**
Ing. Netos $	**-246.03**	**402.1**

Ojo: El cultivo de jatropha para el año 2009 se cosechó solo de 5 personas promedio de 50 kilogramos por Hectárea, básicamente en la zona de San Miguel del río Mayo. Para el año 2010 se cosecharon de 13 personas promedio de 50 kilogramos por Hectárea distribuidos en las tres comunidades (San Antonio, Solo, San Miguel).

Annex 7. Costs and income of Jatropha as monoculture

Analysis of costs and income for 1 ha of Jatropha, as this would have been implemented under the same conditions as in the CEDISA project, but as a monoculture (without associated crops or forestry species). Reference costs: CEDISA, 2010

Proyecto "Promoción de la jatropa curcas en sistemas agroforestales en laderas de la Región San Martín" 2009 - Analisis económico - caso si hubiera sido una plantación de monocultivo de Piñón Blanco (Jatropha Curcas)

Región	: San Martín	**Profundidad de suelo:**	50 - 80
Provincia	: Lamas	**Total Beneficiarios**	: 60 agric. beneficiarios
Comunidades	: San Miguel, Solo y San Antonio del Río Ma	**Promedio**	: 1 Ha/agricultor
Cultivo	: Piñón Blanco bajo un sistema agroforesta	**Tipo de cambio**	: 2009: S/ 3.15 /US$
Nivel de Tecnologia	: Operaciones Manuales	**Tipo de cambio**	: 2010: S/ 2.86 /US$
Unidad Ejecutora	: CEDISA	**Densidad de siembra**	: 1,111 plantas por Ha
Tipo de suelo	: Franco Arcilloso	**Pendiente Promedio**	: 20%
Distanciamiento del Piñón	: 3x1.5, 3x2, 3x3		

ACTIVIDAD	2009					2010				
	Uni.	Cant.	Precio S/.	Valor total S/	%	Uni.	Cant.	Precio	Valor total S/	%
I. Total Egreso				**3231.0**	**100**				**1426.0**	**100**
1.1. Mano de Obra				**1680.0**	**52.0**				**1350.0**	**94.7**
1.1.1. Preparacion de Terreno				**1575.0**					**1170.0**	
Roso	J.	0	15.00	0.0		J.	0	0.00	0.0	
Tumba/Picacheo	J.	12	15.00	180.0		J.	0	0.00	0.0	
Quema	J.	3	15.00	45.0		J.	0	0.00	0.0	
Alineamiento y Estaqueado para plantacion de Piñon	J.	8	15.00	120.0		J.	0	0.00	0.0	
Poseado para plantones de piñon	J.	5	15.00	75.0		J.	0	0.00	0.0	
Podas del piñon	J.	1	15.00	15.0		J.	2	15.00	30.0	
Abonamiento	J.	16	15.00	240.0		J.	16	15.00	240.0	
Deshierbo (04)	J.	60	15.00	900.0		J.	60	15.00	900.0	
1.1.2. Siembra				**45.0**					**0.0**	
Plantones de piñon	J.	3	15.00	45.0		J.	0	15.00	0.0	
1.1.3 Cosecha				**0.0**					**150.0**	
Piñon (incluye desgranado)	J.	0	15.00	0.0		J.	10	15.00	150.0	
1.1.4. Transporte				**60.0**					**30.0**	
Semilla de Piñon	J.	1	15.00	15.0		J.	1	15.00	15.0	
Plantones de piñon de la comunidad a campo definitivo	J.	2	15.00	30.0		J.	0	0.00	0.0	
Abono inkafe 20-20-20	J.	1	15.00	15.0		J.	1	15.00	15.0	
1.2. Insumos				**1473.0**	**45.6**				**14.0**	**1.0**
Plantones de Piñon	Uni.	1111	1.00	1111.0		Uni.	0	0	0.0	
Guano de Isla	Uni.	2	116.00	232.0		Uni.	0	0	0.0	
Inka fer 20 - 20 -20	Uni	2	58.00	116.0		Uni	2	0	0.0	
Tifón	Uni.	2	7.00	14.0		Uni.	2	7	14.0	
1.3. Equipos y Herramientas				**78.0**	**2.4**				**62.0**	**4.3**
Machetes L-A	Uni.	2	15.00	30.0		Uni.	2	15	30.0	
Valeriana	Uni.	2	16.00	32.0		Uni.	2	16	32.0	
Poceador	Uni.	1	16.00	16.0		Uni.	0	0	0.0	
II. Valor Buro de la Producción (Ingreso)				**35.0**	**100**				**35.0**	**100**
Piñon	Kg.	50	0.70	35.0		Kg.	50	0.70	35.0	

ITEMS/AÑOS	2009	2010
Egresos	3231.0	1426.0
Ingresos	35.0	35.0
Ing. Netos	**-3196.0**	**-1391.0**
Ing. Netos $	**-1014.6**	**-486.4**

Ojo: El cultivo de jatropha para el año 2009 se cosechó solo de 5 personas promedio de 50 kilogramos por Hectárea, básicamente en la zona de San Miguel del río Mayo. Para el año 2010 se cosecharon de 13 personas promedio de 50 kilogramos por Hectárea distribuidos en las tres comunidades (San Antonio, Solo, San Miguel).