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Does Local Development Exist? Sustainability of Artisanal Agri-Industry of Jatropha Seeds in Yucatan

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Abstract

This study seeks to analyze the benefits, as well as the likely risks of cultivating Jatropha *curcas* in small production units of rain fed lands in Yucatán. In order to analyze the possible development of local artisanal agri-industry in the context of policies related to biofuels in Mexico, interviews with key informants were made to identify the agricultural potential of *Jatropha c.* in monoculture and associated crops. Its cultivation and using for biodiesel in the country will be possible as long as it not implies competition with crops for family consumption and it not represents an environmental degradation factor. Production of *Jatropha c.* on small areas could be a productive choice if public policies are established to promote biodiesel production and its use in national industry.

Keywords: Local development, sustainability, Jatropha curcas

Introduction

Jatropha c. is a native tree from Mexico and Central America, which seeds (with 40-50% of oil and 25% of protein) are used as food for the population in Veracruz, Morelos and Puebla regions. In these States from México non-toxic varieties for human consumption have been used for several generations.

Jatropha c. oil can be used directly as fuel or to produce soap and biodiesel. The secondary products (shell of the fruit and paste) are used to elaborate pesticides, fertilizers and livestock food. In addition, its sap is used to heal wounds and other skin diseases, making it highly desirable as medicinal plant.

Mainly, *Jatropha c.* has been established in commercial plantations in monoculture; however, its harnessing on small surface through live fences in association with other crops represents a productive option that would allow to small producers to achieve an additional benefit with seed local exploitations, oil and other derivatives.

The objective of this study was to identify opportunities and risks for the establishment of *Jatropha c.* in rain fed land in Yucatan and to analyze sustainability of small agri-industry

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locally, with bioenergy public policies as reference. Interviews with key informants were subsequently conducted and their answers and statements allowed the comparison between production experiences in elsewhere in the world.

Policy for agri-fuels in the world

In recent years, many countries have focused their energy policies to reduce the dependence of fossil fuels industry, and to prevent a greater environmental crisis caused by the dominant economic model. Policies include the identification and development of alternative sources of energy that allow the partial substitution of fossil fuels demand as well as the reduction of the emission of greenhouse gases that cause global warming.

Societies in industrialized countries have a high demand of energy due to their lifestyle (Rodriguez, 2011). They have an excessive expenditure of energy in order to maintain their high level of comfort, but in detriment of the environment. This expenditure of energy puts on risk sustainability processes and survival activities for other social groups in the rest of the world.

The document "Biomass and agriculture, sustainability, markets and policies" published by the Organisation for Economic Cooperation and Development (OECD) in 2004 promotes among its members the establishment of policies that give an opportunity to the agriculture as an activity which generates energy through biofuels (OECD, 2004).

In 2005, the International Energy Agency (IEA) published the document "Biofuels for transport: An International Perspective" related to the potential use of bio-fuels for motor vehicles in developed countries (IEA, 2005).

Likewise, in 2009, the OECD published the document "The Bioeconomy to 2030-designing a Policy Agenda", which integrates potential benefits of agriculture to modern economy and encourages the research and production of biofuels. It also tries to influence to Governments to adopt policies to favor the participation of their countries to the bioeconomy. In other words, bioeconomy can be understood as a model of sustainable management of agricultural resources and biotechnology to benefit the society (OECD, 2009).

In 2010, following the same trend to promote biofuels, the World Bank published the document "Biofuels, Markets, Targets and Impacts". It considers that the offer of ethanol and biodiesel in developed and developing nations is steadily increasing, due to the establishment of public policies on this matter (World Bank, 2010).

Similarly, the document "Bioenergy Development, Issues and impacts for poverty and natural resource management", published in 2010 by the World Bank, asserts that bioenergy production will be a competitive energy supply in countries with significant resources of biomass (World Bank, 2010).

Jointly, the OECD, the IEA and United Nations Development Programme (UNDP) (2010) published a document "Does Energy Poverty, How to make modern energy universal access? It sums up the Objectives of Millenium, thinking and policies to be implemented in member countries: "Using clean energy to reduce emissions of greenhouse gasses and global warming".

Reduction in the use of energy derived from petroleum is the result of a concern, especially from developed countries to prevent the depletion of fossil fuels.

If agri-fuels were established without planning, it might imply sustainability risks for the society and the environment (Coello and Castro, 2008). However, when they are settled in a planned way, they might turn into an alternative to reduce oil dependence and a productive option to generate income to producers and investors, as well as for smallholders who do not participate in subsistence agriculture. Finally, it’s important to add that they have a reduced potential to be a full response to shortage of petroleum products, due to the limited availability of land for their establishment.

Public policy for agri-fuels in Mexico

The legal framework that justifies the searching for alternative sources of bioenergy in Mexico is The Law for Use of Renewable Energies and Financing of Energy Transition (2008), which determines mechanisms for changing an energy system based on fossil fuels to a system that promotes renewable energy sources, including biofuels (LAERFTE, 2008).

The publishing of the Law for Promotion and Development of Bioenergy (LPDB) (2008) creates the principles to promote sustainable development in rural areas through the production and use of the bioenergy, in order to enable the population to reach a better living standard. This is consistent to the policies implemented by developed and some undeveloped countries for bioenergy production, along with recommendations of international organisms such as United Nations (2007), Economic Commission for Latin America and the Caribbean (ECLAC) (2011) and World Bank (2010).

The Law for Promotion and Development of Bioenergy in Article 1, subparagraph I, indicates the duty to "Promote production of inputs for bioenergy from agricultural and forestry activities, algae, biotechnology processes and enzyme of the Mexican countryside, without risking the safety and food sovereignty of the country, in accordance with the Articles 178 and 179 of the Sustainable Rural Development Law (2012).

The Section II of the same article from the Law, indicates that it ought "to develop production, marketing and the efficient use of bioenergy to contribute to the reactivation of the rural sector, to foster the generation of employments and a better quality of life for the population; specifically those people who live in high and very high marginality". Finally, in paragraph III, it points out the duty of "promoting, in terms of the Law of planning, regional development in disadvantaged rural communities".

According to the Regulation of the LPDB (2009), risk of food scarcity in rural areas by use and exploitation of biofuels must be avoided. Particularly, regulation has reaffirmed that marginal areas (eroded, abandoned, with low fertility and non-use) is where the *Jatropha c.* could be established for commercial monoculture.

Through the Inter-secretarial Strategy of Bioenergetics (EIB) created in 2009, the Federal Government has included agricultural, environmental, social and economic aspects that should be considered for developing bioenergy systems in the country. This strategy seeks to provide a development based on policies and programs that will be needed to order sustainable development of bioenergetics industry in Mexico (EIB, 2009).

Program of Introduction to Bioenergetics, from Secretary of Energy (SENER) was published in 2008, and the Program of Sustainable Production of Inputs for Bioenergy and Scientific and Technological Development (PROINBIOS), from Secretary of Agriculture, Livestock, Fisheries and Food (SAGARPA) was published in (2009). Both programs seek to guide and join efforts to get the best use and development of the bioenergetics.

Program of Introduction to Bioenergetics of the Secretary of Energy considers three strategic lines of biofuels promotion: a) Promoting available information of various aspects of production chains and consumption, b) Promoting research at laboratory level and economic studies through a specialized group in biofuels, c) Promoting partnerships between society actors and Government for development of biofuels according to the multidisciplinary nature of the bioenergy systems (SENER, 2008).

These three actions have been replicated in each State from Mexico; public and private institutions have created working teams in bioenergy to conduct research, to disseminate information related to biofuels and to promote their development.

The Program of Sustainable Production of Inputs for Bioenergy and Scientific and Technological Development (SAGARPA, 2009) considers five strategic lines:

I. Developing an information system. Establishment an information system in

short term with access through the internet to facilitate decision-making of the actors of the bioenergy chain.
II. Promoting research, development and technology transfer for the production of biomass.
III. Encouraging partnerships in the chain that would allow development of an integrated and competitive agro-industry, by encouraging the creation of societies.

IV. Generating market certainty. Establishment of production and biomass commercialization schemes in mid and in long term, for give certainty to farmers.

V. Promoting production of supplies (increasing capacities and production). Supporting the development of investment projects to meet the supplies demand in a competitive and sustainable manner, taking advantage of production diversification, which allows the rising of the living standard of rural society.

These governmental actions have congruence with the international policies that encourage the establishment of biofuels, which seeks to create commercial network and global services to make a maximum use of resources for bioenergy production.

Biofuels in Mexico

In Mexico *Jatropha curcas* commercial crop had its beginning in 2008. The first settlements took place in Chiapas with the purpose of producing biodiesel for local public transport use. In 2008, the Institute of Bioenergetics and Alternative Energy (IBEA) delivered *Jatropha c.* seeds and M$2,000/ha (two thousand mexican pesos per hectar) on loan to producers enrolled in the project. In the same year, it was proposed to support participating farmers with a one-time-payment of M$6,310/ha, from ProArbol Program for paying $2,000/ha destined for planting and maintaining costs of the plantations. It was estimated that from productive stability of plantation (3rd year), producers may earn an income of $16,000 to $35,000/ha annually (Valero, *et al.,* 2011).

The IBEA disappeared the same year and the Bioenergetics Societies Union of Chiapas (USB) was created. The project was briefly under their control, because in the same year it came under control of the Institute for the Encouragement of Tropical Agriculture (IFAT), and afterward the Institute of Tropical Agricultural Productive Reconversion (IRPAT) was created (Valero, *et al.,* 2011).

The constant transformation of responsible institutions for this project caused confusion to the producers and delayed technical assistance, which brought with it a poor handling of the plantations and high yields were delayed.

In 2009, around 3,000 producers in 166 locations of 16 municipalities in Centro, Frailesca, Sierra and Istmo regions from Chiapas began the construction of a biofuels plant in Tapachula City with an investment of $14.5 million for the project, using colombian technology (Valero *et al*., 2011).

For 2011, there were about 2,700 producers at 16 municipalities with 10,000 hectares of *Jatropha c.* in Chiapas. Several producers have withdrawn activity, due in part to the lack of support in technical assistance, research, subsidies and credit to increase yield of *Jatropha c.* seeds on plantations (Valero *et al*., 2011).

Policy instruments aimed to the promotion of biofuels still are emerging, as well as being uncertain the trade of the *Jatropha c.* oil in the country, since only large companies have links abroad to sell it.

As it will discuss later, production systems of inputs for bioenergy in general, must be coherent with the population local needs and integral use of natural resources.

Sustainable development of the agricultural sector

Regarding to the policies planning in different countries of the world, it considers environmental destruction, climate change and

population needs to promote various bioenergy projects, which generate jobs and income for the local economy, although sometimes this is accomplished in detriment of their environmental conditions (Jiwan, 2008; Kucharz, 2008) and food scarcity for population (Riechmann, 2008; Roa, 2008).

Risks attached to the establishment of agri-fuels in self-consumption production lands might cause food shortage and famine to the local families. In this context, sustainable development can be defined as the sustainability of the human race on the planet, based on conservation dynamic and rescue of the living beings (Bustillo and Martinez, 2008).

Sustainable development model seeks the rational use of the natural resources based on three main components: 1) Social welfare, reflected in actions of health, education, housing, security, and human rights protection; 2) ecological preservation, with conservation of water, air, soil, plants and animals, 3) economic development, involving creation of jobs, generation and distribution of wealth, as well as public policies to foster these (Alcocer, 2007).

Sustainable development emerges as a response to critics about implementation of unilateral development models mainly focused on economic growth, causing environmental degradation. The lack of comprehensive development policies hinders the conservation and rational use of natural resources, causing poverty and marginalization in a large part of the population, mainly in underdeveloped countries.

On one hand, the economicist approach centralizes needs and desires of men by perceiving nature as a means of exploitation and as an instrument to improve people life quality. This approach not considered a scenario of scarce resources, which generates depletion, environmental pollution and social inequality (Bustillo and Martinez, 2008).

On the other hand, ecological approach considers that there is a shortage of natural resources due to biophysical constraints imposed by the environment. The principle that operates in this model is that economical production requires a constant flow of matter and energy, so it is advisable to reduce that ecologically flow (Bustillo and Martinez, 2008).

Sustainable development integrates two approaches, the economic and the ecological, generating a complementary model that allows coordination among different actors who seek to link social needs, as well as scientific and technological knowledge to political actions by promoting comprehensive development of society and environment.

Sustainable development has been widely criticized, nevertheless it has created a debate regarding how countries must conceive and promote national development. In other words, how should be a comprehensive vision of the problematic presented in different spheres of Government and society, by paying attention to its impact on living standards of population in general and of the vulnerable population in particular.

Sustainable model, although pragmatically limited, attempts to reconsider and seek to assign greater importance to social and environmental areas, which had been relegated to second place in favor of economic growth; causing current problems of climate change, environmental degradation and poverty in the world.

Sustainability of small agri-industry of *Jatropha c.* seeds in Yucatan

In Mexico, cultivation of *Jatropha c.* for biodiesel production is still incipient. Production of biodiesel on a commercial scale is not economically feasible yet due to high costs implied by oil transformation process (SEMARNAT, 2008).

Only a few States have important *Jatropha c.* plantings, excelling Chiapas, Veracruz, Michoacan, Sinaloa and Yucatan, whose oil production is mainly intended for supplying private companies demand for exportation, leaving aside industry uses and national market.

Despite being originally from Yucatan Peninsula, *Jatropha c.* is an unknown plant for the majority of the population, as well as their potential to achieve the benefits already

described. Its cultivation in small area in Yucatán does not exist, while in other States it has already been established for commercialization purpose.

Small producers can be benefited by the establishment of *Jatropha c.*, considering that its cultivation can be carried out on lands without agricultural use or with limited productivity.
According to the experts' point of view, it is quite feasible to reach a yield of 500 kg in rain fed conditions per hectare in monoculture. However, it is very difficult to achieve 1000 kg/ha due to soil and weather conditions in Yucatan, unless its cultivation process includes irrigation and mechanized soil preparation.

Crop of *Jatropha c.* in Yucatán can be established in two production systems: monoculture, which production would be directed to its marketing; and association of crops, which production would be directed to marketing and local harnessing. In lands not committed to self-consumption, *Jatropha c.* can be interleaved with crops such as beans, squash and chili, by considering appropriate distances between crops to avoid competition and to achieve acceptable yield.

In addition, *Jatropha c.* can be used as living fence to integrate it to local agro-ecosystems. The living fences system would allow self-consumption-production in the rest of the agricultural land; therefore, family self-supply crops would not be displaced, and the food necessities would not be affected.

The producers might be benefited not only by the establishment of *Jatropha c.* around maize crop to prevent transit of animal, but also to collect seed for consume it or to extract oil useful as fuel or for soap production.

Discussions

Energetic policies at international and national levels impulse the establishment of projects focused on bioenergy production. These projects are oriented to produce raw material to satisfy biofuels industry needs.

Jatropha c. yields is the main query, according to agri-ecological potential that have regions of Mexico, due to yields found about 420 to 573 kg of seed per hectare (Felix, 2009). In addition, Ariza and Lele (2010) claim that in conditions of non-irrigated lands at India it has been reached only 450 kg/ha;
Other authors in contrast, point out the possibility of reaching a production greater than 1,000 kg per hectare in non-irrigated lands (Falasca and Ulberich, 2008), and even up to 5 ton of seed per hectare (Toral, *et al*., 2008).

For most of experts in Yucatan, *Jatropha c.* can help to improve physical, chemical and biological condition of degraded soils, because it contributes with organic matter and provides protection against wind and water erosion.

This crop can be established in soils with sparse vegetation, as lands in disuse, mainly with plants obtained from seeds, which have a primary root that allows nutrients extraction at greater depth.
Moreover, this root provides great support to the plant, contrary to what happens to the plants obtained from cuttings, which produce secondary roots; these roots grow at little depth and provide few nutrients to the soil surface.

In general, *Jatropha c.* crop will continue in expansion, constituting itself as an important alternative source of energy. Biodiesel obtained of *Jatropha c.* oil could be blended with fossil diesel.

Therefore, it is expected that market in Mexico of *Jatropha c.* seed grows in a near future. Likewise, it presents a business opportunity for paste and fruit peel of *Jatropha c.*, with potential to be used respectively, as livestock food and as fertilizer. It is convenient to create and to strengthen producers associations for to collect raw material of small and medium producers, in order to negotiate sale volumes and prices with buyers and intermediaries.

It is very important that bioenergy projects not remove natural vegetation for establish crops as *Jatropha c.* only to receive government subsidies. The exploitation of these lands through commercial plantations endangers natural ecosystems. In terms of environmental

protection, law forbids to remove vegetation for agri-fuels establishment (Regulation of LPDB, 2009). Agri-fuels should be a response to environmental, economic and social problems, and not the root or cause of environmental deterioration and loss of biodiversity.

Conclusions

Energy policies in Mexico are oriented promoting commercial development of biofuels. Different studies generated by international agencies coincide with internal politics of the country, regarding to the need of finding alternative energy sources that can be a substitute of fossil fuels and promoting sustainable development at national, regional and local levels.

Biodiesel production of *Jatropha c.* on a commercial scale might be feasible on the country, if public policies are implemented in order to carry out more research in field and lab for to reduce production costs of biodiesel, to increase subsidies and facilities for small producers and to promote the cultivation in the rural sector.

In case of spaces directed to subsistence agriculture it is recommended to set *Jatropha c.* as living fences. It is possible to glimpse an opportunity to achieve a sustained harnessing of *Jatropha c*.

Agri-fuels establishments should not generate a negative impact either on environment or in life quality of settled population in surroundings. Then, it should search that *Jatropha c.* agroecosystems accomplish with purpose of environmental regeneration and sustainability in long term.

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