PALM BIODIESEL IN AMAZONAS: DEVELOPMENT AND ECONOMIC INTEGRATION

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ABSTRACT

The quality of life of a region ultimately depends on its economic development, measured by factors like employment, income and education. Since the beginning, the state of Amazonas has searched for an economic development alternative. However, the attempts of development have resulted only in short cycles. The goal of this paper is to examine the possibility to generate an endogenous development cycle from the production of palm biodiesel in Amazonas. Palm oil biodiesel in Amazonas may provide employment and income for the population, since the use of biodiesel in power generators will prevent the lack of energy. Besides these benefits, the cultivation of palm would restore the devastated forest areas and also would reduce the greenhouse effect. Additionally, palm oil production would increase the generation of energy that would improve the population health and education.

Keywords: Palm. Elaeis guineensis. Palm Oil Biodiesel. Economic Development.

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1. INTRODUCTION

The Amazon Forest has one of the biggest natural reservation of the world, the most part is located in Brazilian territory, covering the States of Amazonas, Acre, Pará Rondônia, Amapá, Roraima, part the State of Tocantins, Mato Grosso and Maranhão. This entire region is called Amazônia Legal. These States have low population density, due to the forest, which becomes an obstacle to the emergence of new markets and, thereby, destabilize the economic development of this region.

The State of Amazonas also presents an economic activity concentrated in Manaus, the capital of the State, and presents high costs of transportation due the distance from its main markets in the southeast of Brazil. The natural resources and the characteristics of Amazonas State, had led to the development of three process of economic growth in the region. The first process was called "drogas do sertão" and happened between 1616 and 1750. The second, known as the rubber cycle, occurred between 1870 and 1947. And the third process, which occurs until now: the Manaus Free Trade Zone, which started in 1957. Although these processes have happened in all Amazon regions, this paper is dedicated to State of Amazonas, which has the majority of Amazon forest.

The economic phases occurred in State of Amazonas shows the historical difficulty to promote a sustainable and widespread regional development in this region. There are factors that contribute to the restrictions, as the distance from main domestic markets, the rivers that sometimes are not navigable, the difficulty of land transportation between the regions and the lack of electricity. However, the lack of electricity is the main obstacle to economic growth and social development of this population, because this is fundamental to establish the trade, the industry and the development of human capital. Also, the lack of electricity generates digital exclusion and prevents that the hospitals to work properly. Approximately 10% of households in the North of the country have no access to electricity (PNAD, 2006). So, the demand of palm biodiesel is gradually increased to generate electricity to attend the population far from the central pole. Thus, the palm biodiesel has been the one of the alternatives to generate electricity in Amazonas due to the agroclimatic suitability and the significant demand to generate electricity.

So, this paper pretends to evaluate the palm production as an alternative to the regional development of Amazonas, being economically sustainable and wide in spatial terms as well as in capacity to absorb the labor force existing in this region, also allowing the preservation of the forest. There are some elements that must be in the planning of Amazonas development, which are: *i)* the scope and spatial capillarity of the economic activities; *ii)* the ability to be reconciled with the forest, including the job matter; iii*)* and, finally, to generate energy widely in the State. With these elements, the question is: Could be the production of biodiesel from palm oil the economic process that would allow the regional economic development of State of Amazonas?

This paper tries to answer this question. Specifically, the goal of this paper is to analyze the possibility of generate sustainable economic development to Amazonas from the production of palm biodiesel. The advantages of palm biodiesel are: "it does not emit harmful gases into the atmosphere, it is not toxic to animals and plants, it is not flammable, it is equivalent to the diesel in energetic density, consumption and is renewable energy source" (PARENTE apud MIRANDA; MOURA, 2003, p.8). It is worth to note that the palm oil allows the generation of wide range of products from the process, like manufacture of margarines, cookies, pasta, powder for ice cream, oil to cook, animal feed, detergents, glycerin, cosmetics, biodiesel and others. With these possibilities, the demand for palm oil has grown strongly in recent years. The production is encouraged, since palm oil has higher productivity compared to soybean, canola and sunflower. Also, there is a possibility to be implemented in all the State, resulting in decentralized development and is intensive in labor force.

In order to present the results obtained with this research, this paper is structured in 4 sections. The first one is about the history and the economy of Amazonas, the second deals with the policies for the development of Amazon region, the third is about the palm oil, while the fourth presents the conclusions.

2. THE ECONOMY OF AMAZONAS

This section presents the economic formation of the state of Amazonas and the current stage of the economy. It is separated in two main parts. The first discusses the three phases of economic growth in Amazonas, since the colonization until the formation of Manaus Free Trade Zone, while the second examines the current economic structure of the state.

2.1. History of Amazonas – The Phases of Economic Growth

The state of Amazonas has been through three main phases of economic growth: the so-called "drogas do sertão" period, the rubber cycle and, finally, the Manaus Free Trade Zone. The first, happened due to the Portuguese colonization in Amazon, when they began to exercise a commercial monopoly of the extractive colonial products which is called "drogas do sertão" – cloves, cinnamon, pepper, annatto, cashew-nut and others. Thus, as Portugal transformed the region in a colony of exploration, consequence of mercantilist policies, there was "few chances to promote economic and social development aimed at the regional interests" (SOARES, 2005, p. 123).

During the first phase, the region was unable to find a development path, since the goal of the settlers was just exploring. Moreover, this market was focused on the external sector and there was no development of other activities, besides the extraction of "drogas do sertão" from the hinterland in region.

The second phase of economic growth was a result of the Industrial Revolution and the discovery of the latex, which impacted the world economy and were crucial in development of the local economy. This phase is known as the as the Cycle of Rubber and took place between 1870 and 1947.

Latex comes from rubber trees native to the Amazon forest and at the peak of production, the rubber trees only existed in the region, which resulted in the monopoly of rubber production by Amazon for a certain period of time. Thus, the income from the production of latex was extremely high and concentrated in the hands of a few producers. The lack of planning and economic development prospects of production, meant that the regional elite spends their resources on building monuments like the Amazon Theater (Manaus) and "Teatro da Paz" (Belém).

Meanwhile, since 1876, Great Britain started to growth rubber trees on a large and commercial scale in Malaysia, Ceylon and Africa, with low production costs and high productivity.

This process resulted in an expansion of world production, declining the price of rubber in the international market (SOARES, 2005). This fact caused the reduction of competiveness of domestic production, bringing an economic crisis to the Amazon region, despite the attempts of the Brazilian government to stimulate the national rubber industry. The first was the "Rubber Defense Plan," in 1912, by which the federal government allocated resources to the region to maintain production, improvement of social conditions, in addition to reducing taxes on rubber. However, in 1914 the government suspended these incentives and, once again, the region went into economic stagnation.

In the 1940s, there was an attempt to recover the rubber production, due to the Second World War. However, the increase in production required more employees than was available in the region, leading the federal government to create a service to attract workers to the region, bringing 48 thousand people from Northeast to work in Amazon (SOARES apud ANDRADE, 2008). However, after the Second World War, the demand slowed down and a new period of economic crisis reaches the Amazon region. In summary, despite the great wealth created during the rubber, the loss of competitiveness and inefficient policies to promote economic development have been fatal for the region, which now suffers the consequences.

The last phase of economic growth began with the creation of Manaus Free Trade Zone, in 1957. The goal was to promote economic development and the occupation of the Amazon region. First, the Manaus Free Trade Zone was created as a Tax Free Port. This initial goal was extended until 1967, when the military government redesigned the model to create the industrial, commercial and agricultural sectors by providing tax incentives for 30 years, aiming to occupy and develop the western Amazon region - Acre, Amazonas, Rondônia, Roraima, and the cities of Macapá and Santana, Amapa - thus protecting it from possible enemies (SUPRAMA, 2009).

In spite the Manaus Trade Free Zone has been created to develop the entire western of Amazon region, this goal was not achieved in a broad sense. It was able to create employment and income, but concentrated only in the capital of the State Manaus, therefore was unable to develop the totality of the region. Although it has not met the objective of promoting regional development in a broad sense, the Manaus Trade Free Zone is still the only option that had a lasting success. Due to lack of alternatives for the region, the end of the Manaus Free Zone, which was original scheduled for 1997, was extended until 2023.

2.2. The Current Economy of Amazonia

The state of Amazonas' GDP reached R$ 39.166 billion, in 2006, the 14th position in the national ranking of 27 Brazilian states, detaining only 1.65% of country's GDP. This shows that Amazonas, despite its biological diversity and large territory, has not found a path to sustainable development. The capital of the State, Manaus, is the richest city in the state, with its GDP reaching R$ 31.916 billion - equivalent to 81.49% of the state's GDP, followed by Coari with R$ 1.235 billion, equivalent to 3.15% of the state's GDP. According to Freitas (2009), these two cities concentrate most of the state income because the poles of development of the state are located there, the industrial pole in Manaus and the natural gas in Coari. This huge income concentration in these two cities results in a high poverty rate in the state.

According to data from SEPLAN (2004), only Manaus and Coari were above the poverty line in the state, while the remaining 96.8% cities were below that line. The poverty line, as suggested by the Human Development Report in 1997, is defined by a value that is less or equal to US$ 2.00 per capita per day. In Brazilian currency (real), the line of poverty was calculated as R$ 5.86 per capita per day. Coari is the first in the raking, with R$ 13.60 and Manaus is the second with R$ 8.83, with all the other cities below this line. Just to give an idea of the poverty of the other cities, the third with highest income per capita was *Careiro da Várzea*, with a value of R$ 2.84, well below the poverty line (FREITAS, 2006).

Nowadays, the economy of Amazonas is driven by the Manaus Free Trade Zone, which has three poles: the industrial, commercial and agricultural. But the most important for the state is the industrial pole that is called *Pólo Industrial de Manaus (PIM)*. This is considered one of the most modern in Latin America, generating about 95 thousand jobs (data of 2006), including many sectors as electronics, watchmaker, motorcycles and bicycles (SUFRAMA, 2009).

Regarding agriculture, the state produces, according to IBGE (2007), only 16 agricultural products. They are: banana, coconut-the-bay, palm, guarana, orange, lemon, papaya, mango, passion fruit, tangerine, pineapple, rice, beans, cassava, watermelon and corn. The one with higher production is cassava, with 678,420 tons per year, while banana is second, with 235,242 tons per year.

Thus, it is possible to conclude that despite the state presenting a range of biodiversity from the forest and a vast territory, it has been unable to bring development for most of the cities of the state. This delay in development is caused by: *i)* many rivers in the region, not navigable in some seasons, which hamper the transport, *ii)* the distance from the central poles of the country, *iii)* lack of infrastructure of the State, and, *iv)* lack of an alternative that attend all the State, including the regions that are distant from the capital, generating income and quality of life for the population.

3. GOVERNMENT POLICIES

This section presents the Federal and State Public Policies that encourage production of biodiesel in the state of Amazonas. This analysis begins with a brief description of the National Policy of Regional Development to evaluate policies aimed to develop the region and to see how this is associated with the National Program of Production and Use of Biodiesel and with the state's Program of Biodiesel.

3.1. National Policy of Regional Development

The Federal Government, aiming to reduce the regional disparities, especially between the North/Northeast/Midwest and South/Southeast regions, created the National Policy of Regional Development on February 22, 2007, which aimed to enable the potential for development, exploring the diversity of each region. The main objective of this policy is to reduce the regional inequalities. Its implementation resulted in some achievements, like the recreation of the Superintendence of Development of Amazon (SUDAM) and the Superintendence of Development of Northeast (SUDENE). Although SUDAM has been criticized by corruption cases[4], it is an institution that allows extending the actions of the Union to promote the development of the Amazon.

3.1.1. Superintendence of Development of Amazon – SUDAM

The SUDAM was established in 1966 with the objective to promote the development of the Amazon region by granting tax incentives to cor-

4 Brazilian Federal Police investigated cases of corruption in SUDAM and discovered that the diverted value reached approximately 360 million of reais. After three years (1999-2001) of investigations by the Federal Police, SUDAM was closed on 2 May, 2001 (OLTRAMARI, 2001).

porations that carry out projects aimed at economic development in the Amazon. At that year, the population of the Amazon was one inhabitant per km^2 - the largest demographic vacuum in the world - with the lowest per capita income of the country (SUDAM, 1980, p.10). The reduction or elimination of these problems were the focus of plans for promoting the development of the region.

SUDAM did significant investments in infrastructure, such as transport, communication systems, power generation and sanitation. In the communication sector was implemented the telecommunications systems of the Amazon - by Embratel, which provided the connection between the Amazon and the rest of the country and the world.

In terms of generating and distributing electricity, the power and the distribution network was increased with the implementation of the hydroelectric plants of Curuá Una, Santarém, and Coaracy Nunes, in Amapá. But these investments were much lower than necessary, so that the use of electric generators, diesel powered, to assist the rural and isolated populations are widely used in the state.

Despite the achievements elaborated through this institution, the Federal Government closed this institution in 2001, due to signs of widespread corruption. However, this institution was recreated in 2007, through the National Policy of Regional Development, aiming at promoting an endogenous and sustainable development and integration of the productive base in the economy. To ensure compliance with the goals and objectives of SUDAM for the year 2009, this institution, in line with the Ministry of National Integration, developed a plan, which includes several programs and actions determined by the Ministry of National Integration. These plans involved the Union's resources of approximately 24 million. However, from this amount, only 6.7 million were directed to actions which resulted in the development of the Amazon region, showing the lack of focus on the actions that could lead to economic growth in the region.

SUDAM has a partnership with the United Nations Development Programme (UNDP) that resulted in the elaboration of relevant projects to the Amazon region. One is a project that examines the capacity of the Network to Conservation and Use of Genetic Resources in Amazon – GENAMAZ. This was created as an essential part of a set of strategies SUDAM, aiming the importance of biodiversity in the Amazon, about the need for knowledge of the regional reality through research and policy, and also aiming technological and organizational alternatives which fit to the ecology of the Amazon (DUARTE, 1996).

A study based on the cooperation between SUDAM and PNUD, through GENAMAZ project, called "Raw Material Market: Natural Dyes (Cosmetic, Food Industry), Conserving and Flavorings, Bio-Insecticides and Vegetables and Essential oils (cosmetics and oleo chemical)" examined some vegetable oils, such as.. açaí, peanuts, andiroba, bacaba, bacuri, Brazil nut, rapeseed, cupuaçu, palm, sesame, sunflower, maharaja, olive, patauá, soybeans, tucumã and *C. pyrenoidosa* (algae). This study concluded that among all the Amazon oils, the palm is the oil that offers greatest possibility of industrial exploitation, because there are many uses of this oil. It also showed that the domestic production is not sufficient to attend domestic demand and the country has to import from Malaysia, the biggest producer of palm oil in the world (MAIMOM, 2000).

Thus, SUDAM also is turning the attention to the cultivation of oilseeds that are very important to the region in terms of generation of employment and income. Moreover, SUDAM destine financial resources, through the Finalistic program for the Ecological Economic Zoning, which can be used to projects with the goal of occupy some regions and implant the oilseeds in Amazon.

Next, it presents the Sustainable Amazon Plan, which is part of National Policy of Regional Development too.

3.1.2. Sustainable Amazon Plan (PAS)

In 2003, there were discussions between the governors of the states of Acre, Amapá, Amazonas, Rondônia and Roraima and Ministers concerning the importance to reduce regional inequalities in the Amazon region. The goal of this police is the implementation of a development model in the Amazon region involving the enhancement of socio-cultural and natural heritage, focusing on generating income and employment, in reducing social inequalities, in the viability of dynamic activities and sustainable use of resources from the forest.

However, an important issue until now neglected, is related to the lack of energy. The inadequate supply of energy has been a problem for the development of inland regions in Amazonas, in the absence of an electric grid, the population use electric generators by diesel. PAS presents two alternatives to distribute electricity to all regions of the Amazon, which are "the use of gas from Urucu and from country neighbors, and use of biomass so far neglected, as in the case of biodiesel" (Miragaya, 2004, p.74).

In a newspaper report published in 2007 by the site of the National Congress, which called "Governor wants biodiesel crops to the Amazonas", it is possible to note the importance given by the government authorities to the cultivation of biodiesel in the state, as a way to recover degraded areas and to sell it the carbon market, from the Kyoto Protocol. However, there is the highlight of Vanessa Grazziotin – president of Amazon Commission - lamenting that PAS has not established concrete goals that can beneficiate the oil palm plantation in Amazonas.

Homma (2005) emphasizes that all public policies for the Amazon region should be directed to the deforested areas (it calls second nature), which comprises 67 million hectares, according to data of 2004. However, if these areas are used for agricultural production aimed at the foreign market, this area should increase. And moreover, the cost also tends to increase due to the difficulty of transport in the Amazon region. However, the focuses of the suggestions of Homma (2005) are aimed to prevent deforestation in the Amazon. Rebello and Homma (2005) show that high rates of deforestation in the Amazon only tend to increase due to the transition of world agriculture in regions such as the Cerrado and the Amazon. This transition will result in further depletion of land suitable for agriculture in temperate zones, in the development of various types of soybeans and livestock systems for hot and humid regions; and, also, the reduction of financial subsidies from the U.S.A and Europe for this sector. Thus, they argue, can be considered the Ecological Economic Zoning (EEZ) as a breakthrough in the planning of land use. Thus, the EEZ is of extreme importance to the occupation of the Amazon. Recognizing this importance, SUDAM created a specific program that provides financial resources for the occupation of the Amazon region.

However, the EEZ may bring economic social and environmental risks in function of the possibilities of pests and diseases with the introduction of intensive cultivation and technological changes, and others.

With the problems that the Amazon faces about economic development and the difficulty to finding an alternative that attend the population (including inland communities), the biodiesel from palm oil would be one that could provide increases in employment and in income, quality of life and, consequently, economic development. In addition, it may recover degraded areas.

As seen, SUDAM grants fiscal and financial incentives to promote development, and also has a partnership with the United Nations Development Programme (UNDP). This partnership resulted in production of some studies, about biodiversity in the Amazon region, including oilseeds, such as oil palm, that in the Amazonas is conducted by the company *Embrapa Amazônia Ocidental*. Although PAS, unfortunately, does not have concrete goals to the Amazon region, the government of Amazonas seeks to promote the cultivation of oil palm, in view of efforts in preparing projects in an attempt to implement oil palm.

3.2. National program for production and use of biodiesel and the state of Amazonas

Since 2005, Brazil has focused in biodiesel, initially by the creation of the National Program for Production and Use of Biodiesel (PNPB). This program was created by the Federal Government, which has the goal to establish the production and use of biodiesel, in order to promote social inclusion and regional development by generating employment and income (BIODIESEL, 2009).

The actual launch of the Plan was held on December 6, 2004, with the following guidelines: *i)* to introduce biodiesel in the energy matrix sustainably to diversify sources of energy, increasing the share of renewable and energy security of the country; *ii)* to generate employment and income focused on the field (family farm), by production of oilseeds; *iii)* to reduce regional differences, focusing on the poorest regions such as North, Northeast and Semi-arid*; iv)* to reduce the emission of pollutants (and, consequently, reduce the spends of "troubles of pollution"); *v)* to reduce imports of diesel; *vi)* to grant tax incentives and to implement public policies aimed at poor regions and producers; *vii)* to establish flexible rules to allow the use of a variety of raw materials.

One month after, on January 13, 2005, the Law 11,097 was published introducing the biodiesel into the Brazilian energy matrix, establishing the compulsory addition of a minimum percentage of biodiesel to diesel around 2% for the year 2008 and 5% for 2013, which was anticipated in October 2009, to start in January 2010. The regulatory function of the National Agency of Petroleum, Natural Gas and Biofuels (ANP) was also set. However, according to ANP, since 1 July, 2009, became compulsory mixing 4% of biodiesel (also called B4) into diesel oil consumed in Brazil. This fact will result in a saving of R$ 900 million a year due to the decrease in imports of diesel oil and the reduction of CO_2 emissions in 3%, which will lead to a decrease of 1.2 million tons in CO_2 emissions (ANP, 2009).

As explained in the PNPB guidelines, there are tax incentives for the production of biofuels that are stipulated in Decrees nº 5,297/04 and nº 5,457/05. This reductions or exemptions of federal taxes on fuels vary depending on the region, the category, the producer and the raw material. In the North, for example, there is a 100% reduction of federal taxes if the biodiesel production from palm oil comes from a family farm. If you do not use the raw material from family farms, this tax deduction is only 32%. And if you use the family farms, but not the culture of oil palm in the North, that deduction is 68% (RODRIGUES, 2007). The same happened for biodiesel from castor oil in the Northeast or Semiarid.

To enjoy the tax incentives, the producer must have the Social Fuel Seal. This Seal is granted only if the producer purchase a minimum of:

- 50% of oil from the family farm in the Northeast or Semiarid;
- 30% oil of family farming in South and Southeast;
- 10% oil of family farming in the North.

The State of Amazonas formalized the participation in the PNPB through the Secretary of State and Science (SECT), creating the **State Program of Biodiesel (PEB)** in 2004. The objective of this Program is aligned with PNPB, because the goal is contribute to the development of alternative technologies for the production and use of biodiesel, seeking sustainable energy in the state with social inclusion, and generating development (AMAZONAS, 2009). Inside the PEB, it has two lines of research: *i)* **Biodiesel Program to the Amazon: Native Oilseeds** (in partnership with National Institute of Amazonian Research – *INPA* and Federal University of Amazonas – *UFAM*) and *ii)* **Biodiesel Program to the Amazon: Palm** (in partnership with *Embrapa Amazônia* Ocidental).

In Biodiesel Program to the Amazon: Palm, there are the companies: Brazilian Company of Agricultural Research (EMBRAPA); Amazon Institute of Technology (EST/UEA); Federal University of Amazonas (UFAM); Military Engineering Institute (IME); Foundation Center of Analysis, Research and Technological Innovation (FUCAPI) and National Institute of Amazonian Research (INPA). Despite all of these institutes taking part of the development of the Program, the companies that are in prominence in this Program are the EMBRAPA and the IME. From this program, both companies installed an experimental station in Urubu river with a pilot plant to produce 1,500 liters of biodiesel per batch. Despite the small production, it has "improved the efficiency of data processing, routing and testing of different catalysts" (SOARES, 2008a, p.157).

Thus, it can be conclude that the Federal Government becomes very present in the Amazon, regarding to economic and social development for the region, through SUDAM and PAS, as well as their agencies and institutes, like EMBRAPA and IME.

SUDAM operates in the state through fiscal and financial incentives. However, in 2004, the accountability of SUDAM showed that was not allocated resources for EMBRAPA, which conducts research on biodiesel from palm oil in the Amazonas. However, it can check that the State Government focus in economic development, by the biodiesel production, demonstrated in the study of State Government for deployment of 30 thousand hectares of oil palm in 1995. And in 2008, the attempted to introduce of oil palm in the degraded areas of the state. It is clear the compromise of the Amazonas Government by means of state policies for biodiesel with the participation of state and federal institutions, in order to study and develop the oil palm cultivation in the state.

4. THE *ELAEIS GUINEENSIS* - PALM

This section presents a brief analysis of the general characteristics of oil palm, the varieties, the production process, transport, storage, and the regions suitable and unsuitable for planting. The second section presents the consumer markets. The third, presents the palm biodiesel. And finally, the last section presents the potential impacts from the production of palm oil and biodiesel for the regional development on the state of Amazonas.

4.1. Aspects of Palm Oil Production

The *Elaeis guineensis*, the popularly palm oil, is from Africa that was introduced in Brazil for the African slaves in the XVII century. The palm can reach 15 meters height and its leaves until one meter height. The flowers are clustered in bunches and has the color cream-yellow. The most important, the fruits are small and hard little nuts (SEAGRI/BA, 2009).

The palm production begins from the 3rd or 4th year and remains between the 25th and the 30th year. The period of greatest productivity is the 6th and the 10th year (EMBRAPA, 2002). The acquisition of seeds germinated can be obtained in EMBRAPA, which realize searches with several species of palm, that has as objective to adequacy and yield maximization of this plant for Amazon region (the seed most appropriate for the large scale production is **Tenera**). After the seeds acquisition, they should be planted and left in the nursery for one year. In short, the productive process presents the following steps:

- **Year 0**: the tree remains in the nursery about 14 to 18 months, being careful as manual weed, fertilization, drainage, irrigation and plant care. But even with these precautions, there is an average loss of 15% to 20% of seedlings. In this first period, each hectare supports about 18.000 seedlings (SANTOS, 2008a);

- **1st Year**: growing is done in the field and each tree should be placed with a triangular distance of 9 meters between them. So, one hectare can growth 143 palm trees.

- **2nd e 3rd Year:** non-productive period, which is dedicated cultivation care as pruning of leaves and fertilization – that demand 6kgs to 10kgs of fertilizers, by year, by plant, with potassium-based fertilizers and phosphorus. This process is realized by hand and permanently during all palm productive life.

- **4th year on:** destiny to the harvest during all year, with highest concentration in the months from October to January. The harvest has been made by hand and the agriculturist works with a kind of spear to loosen the bunch of palm.

The employment for the cultivation is on average a family for each 7 hectares. If was considered that the palm offer a production with a good distribution during the year (do not present production peaks), the employment keeps stable during the productive period (SANTOS, 2008a, p.198).

Regarding edaphoclimatic conditions, according to Furlan Junior *et al.* (2006), the palm tree needs locals with the following characteristics: **Rainfall**: rain with 2000 mm/year, with regular distribution during the year. This is the most important parameter that will define the success or not of the palm culture; **Insolation**: should be superior to 2.000 hours per year, with a good distribution during the year. Down luminosity have a bad influence in the content of oil, compromising the quality of the vegetal oil; **Temperature**: the medium temperature is between 24ºC to 28ºC and the minimum temperature can be not inferior of 18ºC.; **Humidity**: the exigency is that relative humidity varies between 75% and 90%; **Topography**: the land should be flat or with a small declivity; **Land**: adapts to acid soils and require pH between 4 to 6. The poor soil, as Amazon, can be corrected by fertilization.

According Santos (2008a), the most suitable region for palm cultivation is located in west side of Amazonas state. Therefore, it is possible to assert that the western half of state should be the region most benefited with palm oil production. Considering this culture is one that allows the recovery of degraded soil by deforestation and is labor intensive, it is possible to conclude that the intensive production of this culture can promote an endogenous development of the region.

4.2. Industrialization Process

After harvesting, the transport of bunches to the agro industry (which transforms raw material in palm oil, palm kernel oil and palm kernel cake) is accomplished by agricultural tractors equipped with metal bucket lined with plastic, with bunches of palm bagged. It is important to emphasize that the transport and storage have to occur quickly (maximum of 24 hours after harvest, because after this time it increases the fatty acids in the crude oil).

In agroindustry, the improvement process is conducted in a shed, which are sterilized by cooking by steam from a boiler. This procedure is realized in order to eliminate the enzymes, releasing the fruits of curls, soften the pulp (to facilitate extraction of oil) and shrinking, in part, the seed (or kernel) to facilitate the separation of its shell (PARENTE, 2003).

After sterilization, the bunches go into the *rotary thresher* in order to loosen the fruits. Thus, the empty bunches are send to planting, arranged around the palm tree for fertilization. After, the fruits are sent by conveyor to the *digester*, it is moistened, kneaded and heated to a temperature of 95°C. After this, the fruit is a uniform mass (it is added 26% of water to a ton of bunches). This mass is poured into an *electromechanical press*, which removes the crude palm oil (from fruit) and a cake, which is composed of almond and almond bark. In order to understand the parts of palm oil, see figure 1 that the source is Agropalma (2006). Thus, separated from the mass, crude palm oil goes to the process of *clarification and drying*. The clarification machine sieves and dehumidifies the oil that, after, goes to the oil dryers by steam and by vacuum.

Palm oil can be separated into two more: the *Olein*, which is very important to the market for vegetable oils and fats, which can be used as cooking oil, as biofuel in vehicle engines; and *Stearin* that can be used as industrial fat to produce cakes, cookies, margarine, mayonnaise, soaps, and as biofuel in generators engines. When the palm oil is extracted, it is stored in tanks with a capacity of 2,000,000 liters in 50 ° C, ready for dispatch in tanker trucks to buyers of oil palm.

The liquid and solid wastes (fibers) from palm oil is decanted and stored in pools. The water from decant is filtered and reused in the production process. The fibers can be used in boilers to generate steam or power. And, after burning, the ashes of the fibers - rich in potassium, extremely necessary in Amazon soils - return to the plantation as fertilizer (EMBRAPA, 2002). These wastes are also used as inputs to produce soaps, candles, among others (PARENTE, 2003, p. 12).

As for the cake, it will undergo a procedure called palmist. Firstly, it is placed in a *grinder* heated by steam from the boiler, to separate the nuts (the almond and almond bark) from fibers. After that, start the process of palmist, where the nuts are crushed in a machine, removing the almonds and sifting the barks. The barks can be burned to generate energy or used to capping roads. The almonds are transformer in pasta, with the addition of water at the same digester used in palm oil. Thus, after this process, it gets oil from palm kernel and palm kernel cake. The palm kernel cake is packed in jute bags and stored in warehouses and transported in trucks chest. But the palm kernel oil is filtered and directed to a silo, ready for commercialization, being transported by tanker trucks (PARENTE, 2003).

Palm oil is heavily used by the cosmetics industry, as in the oleochemical and food industries. The palm kernel cake offers 15% of protein. Although it has less protein when compared with soybean cake, that is approximately 40%, according to Silva et al. (2006), is one of few sources of vegetable protein for animal food that is produced in the Amazon and is not destroy the environment as soya (EMBRAPA, 2002).

The percentage composition of the products and byproducts by weight of bunch is: palm oil: 21%; palm kernel oil: 2%; palm kernel cake: 2.6%; empty bunches: 24.6%; fiber 11.2%; bark: 14.58%; liquid effluent : 23%.

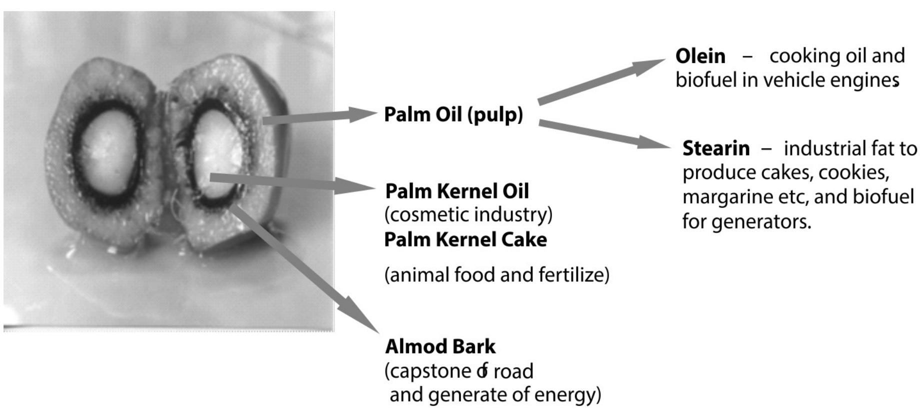


Figure 1 - Palm fruit

The structure to produce biodiesel can be medium or large because the higher fixed asset (machines and large vehicles for transportation). It is also necessary to invest in the deployment of quality analyses laboratory, because the buyers doesn´t accept oil if is out of international standard (with high degree of acidity and presence of impurities). The planting can be realized by small farmers organized in cooperatives or large farmers. However, the investment for planting should be correctly stated, because the production begins only after the fourth year.

The average yield for each hectare of oil palm, in a year, is 25 to 28 bunches; 3500 to 5000 kg of palm oil and 200 to 350 kg of palm kernel oil. It is possible to compare the productivities between diverse cultures in table, that the source is Furlan Júnior *et al* (2006) and Santos (2008a).

Table 1 – AVERAGE PRODUCTIVITY OF MAIN OILSEEDS.

Cultivation	Commercial name	Productivity (kg/ha/year)	Cultivation	Commercial name	Productivity (kg/ha/year)
Babassu	Babassu oil	100 a 300	Sunflower	Sunflower oil	600 a 1000
Canola	Canola oil	500 a 900	Castor beans	Castor oil	600 a 750
Palm (almond)	Palm kernel oil	200 a 350	Soybeans	Soybean oil	400 a 600
Palm (pulp)	Palm oil	3.500 a 5.000			

The data in Table 1 shows that the palm oil is the most productive oil and is about eight times more productive than soybean. Moreover, palm oil generates byproducts that are not discarded, which can be use as fertilizer, animal food, human food, soaps, among others. With this information it is possible to analyze the high competitiveness of the state of Amazonas on biodiesel production in the domestic and international markets, which means that this state presents the greatest potential for generating biodiesel.

4.3. The Global and Domestic Markets

The commercial production of oilseeds is focused on crops soybeans, cotton, peanuts, sunflower, canola, corn, oliva, palm oil and copra (FURLAN JÚNIOR *et al*, 2006, p. 33). The palm oil, holds the first position in world production of oilseeds, however, in Brazil, this nut is in 3rd place in domestic production. The oil palm, which produces biodiesel, has become a high world oil demand, since "in some U.S. States there was a ban on 'trans' fats in food. The countries with the largest production and consumption may be seen in table 2, that the source is Agrianual (2004).

The world's largest producer of palm oil is Malaysia with approximately 47% of the world market, while larger consumers are: India, China and Indonesia. Malaysia, besides being the largest producer, is also the greatest exporter of palm oil, exporting around 12 million tons in 2004 and producing 13.8 million tons. While Malaysia holds the world market for Palm, Brazil produces only 170,012 tons (2005), corresponding to only 1% of world production. In the following table, one can check the companies producing Palm in Brazil by state, and amount of production. It is worth to note that while Pará produces more than 152 000 tons, Amazonas produces only 400 tons by Embrapa Company, located in Manaus – it may be seen in table 3 that the source is Furlan Junior *et al.*, (2006).

Tabela 2 – PALM OIL – PRODUCTION AND CONSUMPTION (2004/2005).

Countries	**Thousand metric tons**	**Countries**	**Thousand metric tons**
Production		Consumption	
Malaysia	13800	India	3960
Indonesia	11000	China	3855
Nigeria	800	Indonesia	3498
Thailand	780	European Union	3195
Colombia	605	Malaysia	2245
Papua New Guinea	380	Pakistan	1226
Ecuador	340	Nigeria	1071
Côte d'Ivoire	310	Thailand	737
Congo	175	Egypt	700
Honduras	165	Bangladesh	592
Costa Rica	140	Colombia	478
Shrimps	130	Japan	450
Other	837	Other	7345
Total world production	29462	Total world consumption	29352

Despite the favorable climate in the Amazon region, the state is not taking advantage of its potential as a producer of palm oil. The international price of palm oil is the smallest one, which qualifies it for biodiesel production. However, according to Santos (2008a), the ton of palm oil price has increased due to the significant expansion in demand. Besides the palm, the prices are also increasing for other oilseeds, due to expansion of the biodiesel market (SANTOS, 2008). The castor oil plant oil is the highest price among the oilseeds. However, the palm, besides offering high productivity, has the lowest price and the cost of production is relatively low. In 2002[5], when the international price of palm oil per ton, was US$320.00, its cost was US$200.00 (EMBRAPA, 2002).

Thus, the palm oil offers economic potential to be grown in Amazonas for biodiesel production, once your price and cost are relatively low compared with other oilseeds and, furthermore, it is widely accepted in the international market, being the most produced nut in the world.

5 There is no update information about palm oil costs.

Table 3 – DOMESTIC PRODUCTION OF PALM OIL BY COMPANY AND BY STATE (2005)

Company	Quantity (tons)	Company	Quantity (tons)	Company	Quantity (tons)
Pará		Bahia		Amazonas	
Agropalma	125.692	Oldesa	9.000	Caiaué	-
Denpasa	-	Opalma	2.400	Embrapa (pesquisa)	400
Codenpa	3.700	Mutupiran-ga	5.800		
Dentauá	7.500	Roldões	n.d		
Palmasa	6.520				
Marborges	9.000				
Mejer/Yos-san	-				
TOTAL	152.412		17.200		400
Total Brasil	170.012				

4.4. The Biodiesel

Biodiesel is considered a fuel sourced of animal or vegetable oils, which is used as a substitute to diesel oil or as an additive to diesel oil. Its energy balance must be positive "for the rational use of derivatives of biomass as fuel" (FURLAN JUNIOR *et al*, 2006, p. 39). The energy balance is the ratio of the energy consumed in the production and energy available for fuel. Your calculation, between the oilseeds, may suffer considerable changes depending of several procedures for obtaining the energy balance. Despite this variation, the palm has high energy balance in the same proportion than ethanol. Table 4 shows several oil with their energy balances, varying according to the authors presented (because of the different ways to get it) and the source is Furlan Junior *et al* (2006) based in: (1) Basiron e Darus (1996); (2) Urquiaga *et al*.(2005); (3) Almeida Neto et al.(2004); (4) Nogueira and Macedo (2005).

Table 4 – ENERGY BALANCE OF OILSEEDS AND ETHANOL

Oils	Output/Input (1)	Output/Input (2)	Output/Input (3)	Output/Input (4)
Soybean	2,5	-	3,2-3,4	1,43/2-3
Sunflower	-	-	-	-
Palm	9,6	8,66	-	5,6
Castor beans	-	<2,0	2,1-2,9	-
Macaúba	-	-	-	4,2
Ethanol	-	8,06	-	-
Diesel	-	-	0,83-0,85	-
Canola	3	-	1,2-1,9	2,3

In addition to great palm's energy balance, as seen in table 4, among all the palm oil, according to Menezes (1995, p. 122), is the "only option to replace diesel without causing economic and industrial proble-ms" and more, the growing of palm oil is able to reduce and reverse the evil effect caused by the burning of fuels.

Biodiesel from 100% palm oil can be used in any diesel cycle engine (does not require changes in the engines), or can be used mixed with diesel. This fuel can be used both in vehicles and generators. Vehicles were test-ed using palm oil in engines of Elsbett, Malaysia, reaching positive results. With this positive result, the Malaysian Government is now giving priority to projects which asks for palm oil production to electric power generation.

From the point of view of productivity, each hectare of palm oil pro-duces up to 4 tons of biodiesel, according to Energias Alternativas (200-). The production of palm oil does not require technology, high investment in equipment and, also, does not need additional inputs into the process, since you don't need saccharification, fermentation and distillation. Only the separation of glycerol, through alcoolysis and transesterification of fatty resulting elements are needed. "This allows it be done even in small scale rural property level, so as an independent way" (MENEZES, 1995, 116).

In Brazil, palm biodiesel is present in some communities in Amazo-nas, because the rising price of diesel to supply the generators in Isolated

Communities. In a report of the *Dia de Campo na TV*, Roberto Miranda, a researcher at *Embrapa Amazônia Ocidental*, said that to 1 liter of diesel arrived in certain Isolated Communities, it takes 2 liters of diesel (EMBRAPA, 2002). Besides spending, diesel pollutes the environment. An example of this is that most of the 260 power plants in the Amazon region are operated by diesel and, because this, emit double of the pollutants produced by the fleet of São Paulo.

Amazonas does not produce diesel, so it comes from other states such as São Paulo, Rio de Janeiro, and other countries. Because the distance and difficulty of transport, the diesel becomes five times more expensive than in the rest of the country, according to VEJA AMAZÔNIA (2009). To get an idea of the difficulty, the oil coming from São Paulo takes 15 days to arrive in Manaus and the monthly cost of operation is R$ 10 million to supply 180 million liters of diesel. So, besides being very expensive for the region, diesel is extremely polluting. In a region with the highest biodiversity on the planet, where there is oil that can generate energy, the use of diesel has been a misleading factor.

To check if the price of palm oil biodiesel can be competitive with diesel (which varies between R$ 1.58 to R$ 1.73 in Amazonas), Santos (2008a) examined four scenarios. The first scenario is full vertical production, in which all stages in the production are performed by different companies. In the second, buying the oil from a company (which also carries out planting and crushing), to produce biodiesel, and another company do the transportation to the distributor. In the third scenario, the company buys the bunches, performs the process and produces biodiesel, then the carrier sends to the distributor. The last scenario is the total vertical production, ranging from planting to distribution.

So, for a plant with capacity of 50,000 ton/year, table 5 shows the costs of each scenario, with and without tax – and the source is Santos (2008a). The price of diesel varies between R$ 1.583/l (Manaus) and R$ 1.733/l (countryside), in Amazonas, so, the scenarios 3 and 4 are capable of generate biodiesel cheaper than diesel. This data does not take into consideration the transportation costs to bring the diesel to some isolated communities, like Roberto Miranda pointed out.

Table 5 – COMPARATIVE SCENARIOS BETWEEN THE COSTS OF PALM BIO-DIESEL PRODUCTION

Scenarios	Costs with tax R$/l	Costs without tax R$/l
Scenario 1	2,464	2,375
Scenario 2	2,464	2,375
Scenario 3	1,457	1,152
Scenario 4	1,302	0,934

Since the alternative to isolated communities is to utilize the cleared areas (close to these communities) to grow and then produce biodiesel, these communities would be framed in scenario 4, even on a small scale. As explained previously, the production of biodiesel from palm oil is already being done in the Amazon region, by EMBRAPA. The biodiesel station was installed next to the extraction of palm oil, to facilitate transport, and is called *Centro Experimental da Embrapa do Rio Urubu* (CERU). CERU has about a plantation of 400ha and a field of seed production of palm Tenera.[6] The project has the goal to attend the community of Rio Preto da Eva, to provide biodiesel B100 (100% palm biodiesel) and B20 (20% palm biodiesel blended with diesel) to use in electric generators.

The use of palm biodiesel in the Amazon for power generation will bring environmental benefits, because the palm can be used to recover degraded areas and also to consume the carbon dioxide emitted from fossil fuels. It also promotes social benefits, creating jobs still in the process of cultivation. Besides that, it also has the same characteristics than diesel.

4.5. Impacts of Palm Cultivation and Production of Biodiesel in Amazonas

The state of Amazonas, as it explained earlier, is the state that provides the area climatically most suitable for cultivation of palm. The potential area for cultivation in Amazonas is 54 million hectares (77.25% of the area potentially usable), but the area actually employed to this end is only 400ha by the Experimental Field of Embrapa. It confirms that Amazonas, beyond having the best weather conditions for the production of palm oil, has the highest potential for cultivation too. However, there are restrictions regar-

6 CERU is located 150 km from Manaus, which conducts research with palm seeds for 20 years and is the only provider of certified seeds in South America.

ding the area to be cultivated, because there is a lot of native forest in this region. So, the solution for cultivation palm would be to use the devastated areas in order to reforestation and the generation of electricity, which in the countryside of Amazonas is extremely scarce. According to Homma (2005), if one uses the Amazon deforested areas for palm plantation, the country could produce a quantity of palm oil similar to Malaysia or Indonesia.

To make it possible, it is needed to do a detail planning of Ecological Economic Zoning (EEZ). For Rebello and Homma (2005), three conditions must be considered when deploying the EEZ, which are:

1. Use of deforested areas, ecological compensation, recovery of deforested areas and increase the potential market;
2. Indication of appropriate activities (types of planting, for example: corn, soybeans, palm oil etc.), and care for the long-term policies (in order to avoid start a new economic cycle, such as rubber);
3. The question of the sustainability in the Amazon region (grow and development to reach the capillaries of the regions).

According to Ab'Saber (1996), in order to establish the Ecological Economic Zoning in a particular region, it is needed to conduct a detailed study to determine the vocation of all the subspaces, collecting information about economic potentialities. Furthermore, it is necessary to make a list of the main problems emerging through a preliminary survey, establishing a homogeneous methodology. Also according to Ab'Saber (1996), Amazon deforestation is considered disastrous, because the loss of biodiversity. So, according to him, it is necessary to find both an ecologically sustainable and economically profitable model, respecting the areas of forest and reusing degraded areas with edible palms (like açaí and peach palm) and oilseeds.

In 2008, the deforestation of the Amazon reached 12.911km^2, according to data from the National Institute for Space Research. In Amazonas, this rate was 604 km^2, so, all this area can be used for oil palm plantation in order to generate electricity.

The Brazilian electric system is composed by two major areas of supply: the National Interconnected System and the Isolated Systems. The first is characterized by power generation through hydroelectric, transmission via high voltage grids and marketing between the subsystems (SANTOS, 2008, p. 1). The Isolated Systems, however, are characterized by a large number of small units of generator by diesel and the logistic difficulties of fuel supply (ELETROBRÁS, 2009).

According to Figueiredo (2003), the Isolated Systems in the interior of Amazonas is precarious, because the large territory and small population density, which increases the operational cost of the generators and enhancement of the power model, which is composed exclusively by generators by diesel. However, in cities as Presidente Figueiredo and Rio Preto da Eva, there are no power stations.

In Amazonas, 70% of the electrical systems are based on petroleum derivatives, such as diesel oil. Amazonas has a governmental company responsible for power generation, called Amazonas Energia S/A, a subsidiary of Eletronorte, formerly known as Manaus Energia. This company has a thermal park to attend the capital, composed of the following power plants: Aparecida (112MW), Mauá (136 MW) and Electron (102 MW). Besides the plants, the Amazonas Energia has a hydroelectric power plant (the only in State), the Balbina, which operates with a power of 250 MW (ELETRONORTE, 2009).Besides the governmental company, there are three private companies and foreign companies operating in the electricity market in Manaus. The plants of Amazonas Energia do not use diesel. However, among the other companies, 36 units use diesel and the total consumption is 80,578 m^3 of diesel.

In the countryside of state, the electric system is also maintained by Amazonas Energia. In the countryside are 106 Isolated Systems with 407 generating units, totaling a power of 288MW. In all this area, the Isolated Systems uses diesel as a source of energy and the total consumption is 236,332 m^3 of diesel, adding this value to the consumption of capital (80.578 m^3) has a total consumption of 316,910 m^3 of diesel, according to data from 2007. The location of Isolated Systems and the deforested areas it can be view in map 1, that the source is Santos (2008a).

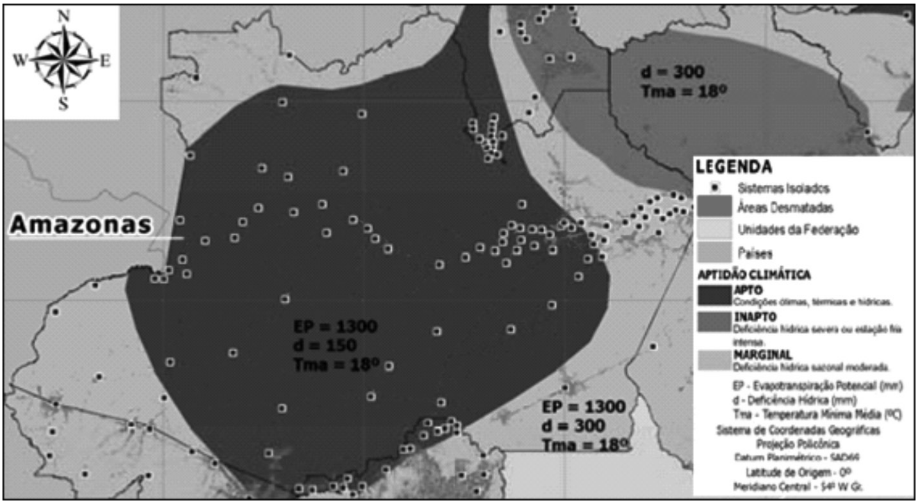
The map shows the climatic suitability of Amazonas that is the darker region, as well as isolated systems, the squares in black, and deforestation, the region in red. It possible to note that the trend of deforestation is coupled with the creation of an Isolated System. So, as they are nearby regions (the cleared area and isolated systems), it is possible to use the cleared areas for palm plantation to recovery these areas, and produce biodiesel from palm oil to supply the generators of Isolated Systems, to prevent these inland communities remain without electricity due to high cost of diesel.

Analyzing how much can be produced of palm biodiesel only in the deforest area in 2008 in the Amazonas, we have: if the deforest area, in 2008, was 604 km^2 (that is equivalent 60.400ha); if each hectare produce 4 tons of biodiesel, so it can be produced 241.600 tons of biodiesel (without taking into account the deforest areas that did not take part in the statistical of INPE on previous years, of regions that were deforest and not replanted)

In all the state, in 2008, was consumed 316.910 m^3 of diesel. If $1m^3$ is equivalent to 0,3531466 tons, so, it has *111.915,7 tons of diesel in 2008,* which represents only the half that can be product in the deforest areas in Amazonas, in 2008.

So, it is confirmed that cultivating all the deforest area of 2008 to produce palm biodiesel, the diesel can be totally replaced and it will generate surplus. Taking into consideration that most communities consumes diesel and it does not supply all the demand (so the lack of electricity in the countryside regions), it can be concluded that palm plantation in deforested areas could supply the necessity of diesel and would avoid the lack of power in Isolated Systems.

According to Santos (2008a), EMBRAPA reports the creation of 4 to 5 jobs in 7 to 8 hectares. So, taking a conservative base to generate 4 jobs (a family of 4 people working) in 7 ha, we have: 60,400ha of palm plantation will generate employment for 8.628 families, or 34.514 people.



MAP 1: Regions ables, unables and marginal's, deforest and Isolated Systems

Bearing in mind that most communities consumes diesel and it does not meet the needs (hence the lack of electricity in the countryside), the conclusion is that the oil palm plantation in deforested areas fills the need for use of diesel and could avoid lack of electricity in isolated systems.

According Amarildo Camaleão, Chairman of the *Desenvolvimento Rural do Assentamento Tarumã-Mirim*, the value of income obtained from oil palm plantation is approximately R$ 700.00 to R$ 1,000.00 per month for the cultivation of three hectares. So, considering the potential area described above (60,400 ha), the income generated would be approximately R$ 14 million, a very significant income for these regions.

It is important to say that, in addition to generation of electricity to communities, jobs and income, the palm oil has important environmental impacts and allows the generation of new activities. In environmental terms, it can recover the degraded areas, recover the soil and prevent erosion, absorb carbon dioxide emitted into the atmosphere and reduce the harmful effect of diesel. As regards its ability to stimulate new activities:

i) it generates income in isolated communities stimulating local markets;

ii) the production process of palm oil generates the cake - a source of vegetable protein - which would increase the breeding of chicken, pigs and cattle milk.

iii) the fine oils, derived from the extraction of palm oil, associated with biodiversity would allow the generation of a multitude of small local industries to provide national and international markets.

This way, the palm biodiesel, in the Amazon region, can be used to replace diesel, reducing environmental pollution and, at the same time, avoiding the lack of electricity in Isolated Systems. In addition, another factor that contributes to use of biodiesel blends of palm oil is the question of deforestation next to Isolated Systems that enable planting on degraded areas regions and biodiesel production in their own communities. Finally, the cost for biodiesel production is lower when occurs total vertical production, which demonstrates the feasibility for biodiesel production of palm oil in deforested regions, generating development, with improved quality of life of the population, due to the reduction of pollution, creation of employment and income, and, of course, generation of energy that can improve the population health (hospitals) and education (schools).

5. Conclusion

This paper had the goal to analyze the possibility of the use of biodiesel of palm oil for electric power generation, focusing on the development of the Amazon region. This goal was reached and there among the countless problems that Amazon region faces that hamper the economic development of the region, the electric power is one of the main obstacles. Thus, the biodiesel of palm oil is an important factor for the generation of development, not only providing electrical power to the communities, but generating employment and income, already from cultivation.

Given the need to seek an alternative of economic development for the Amazonas, federal public policies, regional and state agencies have demonstrated special attention to this region, articulated for the promotion of social and economic development of the state, through the production of biodiesel from palm oil. This eventually led to the State Program of Biodiesel, created from PNPB, a specific project to study the feasibility of biodiesel of palm oil in Amazonas. Despite the attention reflected by public policies, SUDAM, as the body which aims at the development of the Amazon region, did not provide resources in 2004 for the Western Amazon region that performs studies with Palm oil for biodiesel production.

The oil palm is a culture that promotes development, since it is able to restore deforested areas, absorb carbon dioxide (decreasing the greenhouse effect), generate employment and income, replace diesel, doesn't require adaptability of engines and also originates by-products may be used in the food industry (human and animal) and chemistry, as well as providing the population of the Amazon region improvements in quality of life.

Due to the broad range of by-products, palm oil has reclaimed in the international market, primarily in the United States, China and Europe. In Brazil, the low production is not allowed to meet domestic demand, importing from the largest producer of palm oil in the world, Malaysia.

The state of Amazonas has historically evolved by economic cycles, usually characterized by a peak of production and ending without impacting permanently the region's economic development. Thus, the culture of oil palm seems to be an endogenous development process that would not result in a cycle, since this is focused on the internal market, meets the demand of the population by a viable option and ecologically correct for the electric power generation, generating employment and income in a decentralized manner, enabling the expansion of economic activities in Isolated Communities.

Growing crops of oil palm in Amazonas may generate a virtuous circle of growth, since in the entire production process, the palm oil originates by-products that can be leveraged, either as fertilizer, feed or food. In addition, palm oil is able to attract resources to the country, given that the reduction of one ton of carbon dioxide is worth £ 10.00 in the Kyoto Protocol.[7]

Biodiesel production of palm oil in Amazonas meets the needs of Amazonas communities which depend exclusively on diesel, which is considered highly polluting and, furthermore, very expensive due to the cost of transport. An example that can be said is that for each gallon used in generating, it spends around two liters of diesel fuel, the result of the high cost of transport. It is important to note that, in the international market, diesel is considered to be cheaper than biodiesel of palm oil, but in the interior of the Amazon region, the price of diesel is higher because of the expense of transport and therefore becomes unviable using this at inland communities.

It is therefore concluded that biodiesel production of palm oil in Amazonas impacts positively on State due to economic, social and environmental benefits, particularly in relation to energy generation that will allow the proper functioning of schools, hospitals, laboratories, technical courses, amongst other positive aspects.

This paper analyzes the possibility of using biodiesel of palm oil only in Amazonas, checking the weather conditions for cultivation, as well as the impacts on environment and economy that it may lead to inland communities. Extending the theme of this paper, a suggestion for future work would analyze the economic viability of palm oil plantation, in a given deforested area next to an isolated system, and deployment of a biodiesel plant that meets this system.

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