Plant extractivism or plantation: what is the best option for the Amazon?

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Introduction

AFTER THE murder of trade union leader Chico Mendes on December 22, 1988, plant extractivism became the great Brazilian environmental idea to curb deforestation and burning in the Amazon and other parts of the tropical world. The big question is whether the plant extractivism advocated by Chico Mendes' followers would be the ideal form of development for the Amazon. What would be the economic viability of extracting non-timber forest products? (Homma, 2010a, 2010b).

The economic importance of extractive products has changed throughout history. So is the case of many extractive products that were very important in the economic, social and political development of the Amazon, such as "backlands drugs" and cocoa (*Theobroma cacao* L.) in the colonial period, rubber (*Hevea brasiliensis* M. Arg.), Brazil nut (*Bertholletia excelsa* HBK), palm heart, and açaí berries (*Euterpe oleracea* Mart.), as well as wood. The sustainability of extractive resources changes as a result of technological progress, the emergence of economic alternatives, population growth, stock reduction, wage levels of the economy and changes in relative prices among other factors. Generally, extractive activities are initiated, go through a phase of expansion and stagnation, and then decline in terms of time and spatial area.

The extractive option as a viable solution for the development of the Amazon should be considered with caution. For extractive products with a large natural stock, as is the case of the fruit and palm of açaí trees, wood, Brazil nuts and even rubber, steps should be taken to allow for a more balanced extraction. Extractivism should not be maintained to the detriment of technological alternatives arising from domestication.

For many products the extractive supply is unable to meet market growth, as with rosewood (*Aniba rosaeodora* Ducke), bacuri (*Platonia insignis* Mart.), wood, uxi [*Endopleura uchi* (Huber) Cuatrecasas] and timber among others. These are economic opportunities for income and employment generation that are being overlooked. Not always biological sustainability ensures economic sus-

tainability and vice versa, and market growth tends to cause the collapse of the extractive economy due to the inability to meet demand. It is a false assumption that every non-timber product is sustainable.

The reduction of deforestation and burning in the Amazon will depend on concrete actions aimed at the partial use of the internal frontier already established rather than on the extractive option, which has great limitations, and on the overall population involved. In this sense, the implementation of agricultural policies is more important than the actual environmental policy to address environmental issues. The emphasis on abstract biodiversity has undermined the definition of concrete public policy guidelines in the Amazon, neglecting the biodiversity of the present and of the past. Extractive products that have high demand elasticity or when producer's entire surplus is captured by producers have higher chances of being immediately domesticated. Not all extractive products will be domesticated; those with large stocks in nature, low economic relevance as well as those for which there are substitutes, whose planting involves technical difficulties, or which require a long time for the economic product to be obtained will have greater economic difficulties to become cultivated plants.

Extractivism as an economic cycle

Extractivism is an economic cycle consisting of three distinct phases (Figure 1). In the first phase there is an increase in extraction, when natural resources are transformed into economic resources as demand grows. In the second phase, the limit of the supply capacity is reached, due to the reduction in the stocks available and the increase in the cost of extraction, since the best areas become increasingly scarcer. The third phase is characterized by the beginning of the decline in extraction, with the depletion of reserves and the increase in demand leading to the beginning of planting, provided that the domestication technology is available and economically feasible. Many plantations were started by indigenous peoples and traditional populations, who identified the plants with the best features of interest, and subsequently carried out by research institutions. The expansion of the agricultural frontier, the creation of economic alternatives, increased population density, the degradation process and the emergence of substitute products are also inducing factors of this decline.

The sustainability of plant extractivism also depends on the rural labor market in which, as a result of the urbanization trend, the rural population is decreasing not only in relative terms but also in absolute terms. This increases the opportunity cost of labor in rural areas, which tends to render extractivism and family agriculture unfeasible, owing to low land and labor productivity. In the long term, the reduction of deforestation in the Amazon would be affected by the process of urbanization and decrease in the rural population in absolute terms, thus promoting the intensification of agriculture and, as a result, reducing the pressure on forest resources.

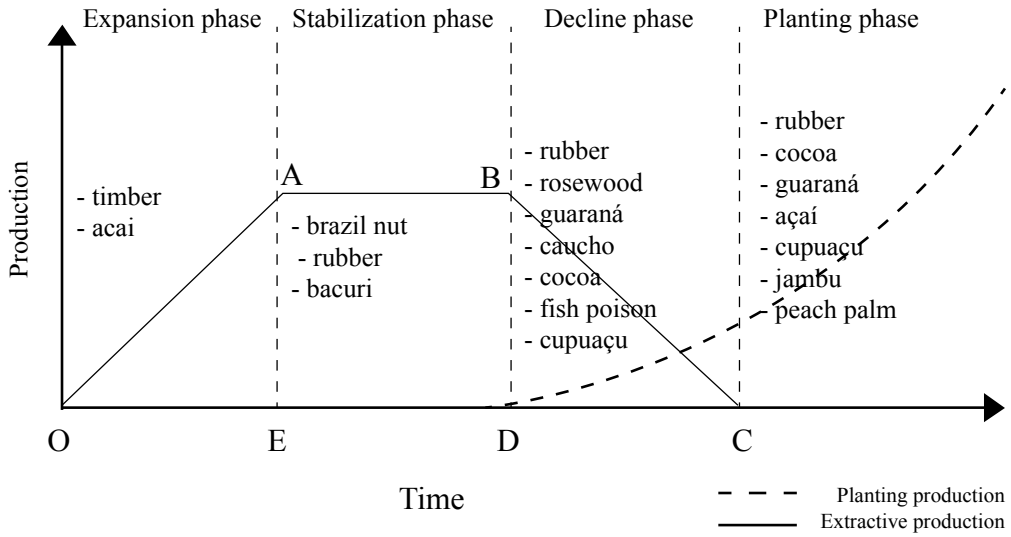

Figure 1 – Plant extractivism cycle in the Amazon (Homma, 1980).

Due to the dispersion of extractive resources in the forest, labor and land productivity is very low, making this activity feasible only because of the lack of economic options, domesticated crops or synthetic substitutes. As alternatives are created and social achievements raise the minimum wage, its low labor and land productivity nature makes it unfeasible. One of the mistakes of the advocates of extractivism for the Amazon is to consider this sector as being isolated from other segments of the economy.

The extractive economy is embedded in a much broader context than what is traditionally analyzed. In general, the sequence consists of the discovery of natural resource, followed by extractivism, management, domestication and, for many, the discovery of synthetics (Figure 2). Rosewood extractivism, for example, went directly from extraction to the discovery of its synthetic substitute (Homma, 1992).

Soon after the discovery of Brazil, the extractivism of Brazil wood (*Caesalpinia echinata* Lam.) was the country's first economic cycle, which lasted for more than three centuries. The beginning of the depletion of these reserves coincided with the discovery of aniline in 1876 by Bayer chemists in Germany. Other extractive products have been affected by replacement with synthetic products, such as carnauba wax (*Copernicia cerifera*), synthetic linalool (rosewood essence), DDT [fish poison (*Derris urucu* Killip & Smith, *Derris nicou* Benth)], synthetic gums, synthetic rubber (3/4 of the world's rubber consumption), among other examples (Homma, 1996).

With the progress of biotechnology and genetic engineering, it is possible that natural resources can be domesticated or synthesized directly from nature without going through the extractive phase. This aspect means very little to the revitalization of the extractive economy, with the discovery of new potential ex-

tractive resources, especially medicinal and aromatic plants. This situation may occur at the beginning or if the stock of extractive resources available is very large (Homma, 2008). Since the 1990s, many cosmetics have been produced from plants of the Amazonian biodiversity. The big question is whether these new products will be as popular as the *Leite de Rosas* developed by the Amazon rubber gatherer Francisco Olympio de Oliveira in 1929, and the *Leite de Colônia* developed by the physician, pharmacist and lawyer Arthur Studart in Rio de Janeiro in 1948.

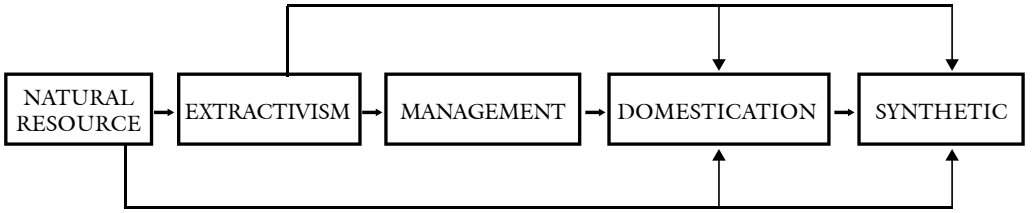

Figure 2 – Possible ways to use the natural resource after its transformation into an economic resource (Homma, 2007)

The manufacturing of herbal medicines and cosmetics is the utopia of many proposals for the use of Amazon biodiversity, since besides requiring high research and testing costs, it collides with Provisional Decree 2186-16 of August 23, 2001. This Provisional Decree provides for the genetic heritage, the protection of and access to traditional knowledge associated with benefit sharing and technology transfer for its conservation and use. Sharing economic benefits with indigenous communities does not encourage large companies to make high-risk investments.

It is arguable whether these mega-opportunities for relying only on the traditional procedure of extractive collection actually exist, as most certainly this procedure will be restricted to the market of distress (Pradal, 1979), with the sale of teas, infusions and potions by peddlers at Ver-o-Peso Market and other similar places of similar folkloric and tourism appeal. The market appeal lies in the treatment of diseases that were totally impossible to be identified in the past (cholesterol, prostate, triglycerides, etc.).

The domestication phenomenon

Humanity began the plant and animal domestication process in the last 10,000 years, having succeeded with more than 3,000 plants and hundreds of animals that are part of world agriculture. Since Adam and Eve ate the first extractive apple (*Malus domestica*) in the Garden of Eden, Humanity has realized that it could not rely exclusively on hunting, fishing and harvesting of wildlife.

Domestication starts with the selection made by the harvesters themselves, who observe the useful features of the resource and, depending on the growth of the market, tend to move on to planting, even in a situation of total lack of research (Leakey & Newton, 1994; Roudart & Mazoyer, 2010). In turn, there

are plants in which domestication tends to be quite difficult, such as uxi, which is characterized by low and slow germination rate, a difficult grafting process and a long time to get to the production process. In other situations, research intervention becomes necessary, as in the domestication of the long pepper (*Piper hispidinervum*), a native plant of Acre, whose leaves led to the discovery of safrole. Without planting, its exploitation would be totally impossible.

It is paradoxical to say that domestication attempts can be successful outside the area of occurrence of the plant extractivism, as with the case of the cocoa, rubber and guaraná. Several Amazonian plants are being grown in the states of Bahia, Espírito Santo, Rio de Janeiro, São Paulo, Paraná, as it has happened and is still happening with cocoa, guaraná (*Paullinia cupana* HBK), rubber, açaí, peach palm (*Bactris gasipaes* HBK) and jambu (*Spilanthes oleracea*). The spilanthol alkaloid found in the leaves, branches and flowers of jambu is described in patents as appropriate for anesthetic, antiseptic, anti-wrinkle, toothpaste, gynecological and anti-inflammatory use, with several products on the market sold as medicine and cosmetic. That is the reason why five patents that use jambu were registered with the United States Patent and Trademark Office (USPTO) in the period 2000-2006 (one American, one French and three Japanese patents); seven with the World Intellectual Property Organization (WIPO) (Japanese, American, British, Danish, Swiss, Brazilian and Australian) in the period from 2006 to 2010; and one with the National Institute of Intellectual Property in 2005. Jambu is used by Natura in the composition of the Chronos wrinkle cream, which used to be bought from plantations in the metropolitan region of Belém. In 2004 jambu began to be provided by the Centroflora Group founded in 1957 by selected producers who grow it organically in the municipalities of Pratânia, Botucatu, Ribeirão Preto and Jaboticabal and dry it in Botucatu.

When the British began to domesticate rubber trees in Southeast Asia, marking the second successful experience of biopiracy in the Amazon, it was as if an appliance had been pulled off the electrical current. The same thing happened to tomato (*Lycopersicon esculentum* Mill.) and potato (*Solanum tuberosum*), both from the Andes, tobacco (*Nicotiana tabacum*), maize (*Zea mays*, L), cinchona (*Chinchona calisaya* Wedd, R C. ludgeriana R. et P.), which were transformed into universal crops by the early European settlers. Conversely, many plants of African origin such as coffee (*Coffea arabica* L.), oil palm (*Elaeis guineensis*), okra (*Hibiscus esculentus*), watermelon (*Citrullus vulgaris Schrad*), tamarind (*Tamarindus indica*), were domesticated in the country.

In the case of extractive products of great economic importance, the inevitable path is domestication, management or the discovery of synthetic substitutes. The domestication of jaborandi (*Pilocarpus microphyllus* Statf.) and the beginning of the domestication of fava d'anta (*Dimorphandra gardeniana* and *D. mollis* Benth) by Merck, may be considered examples of this case.

There are plants and animals that will never be domesticated because they

have no economic importance or require a long time to yield the product, exist in large stocks or are difficult to be domesticated. Despite their economic importance, plants like babassu palm (*Orbignya phalerata*, Mart.) and tucum (*Bactris setosa* Mart.), or hardwoods such as jacarandá-da-baía (*Dalbergia nigra*) are likely to be replaced by synthetic substitutes or abandoned. Extractive products still available in large socks such as Brazil nut, babassu and even rubber fall into this category, whose viability may depend on government subsidies.

In the case of animals, the domestication process tends to focus on features that facilitate coexistence with man, promiscuous sexual behavior, young-adult interaction and ease of feeding. Even animals of difficult domestication such as oysters for pearl production (*Pinctada sp.*), ostrich (*Struthio camelus*), quail (*Coturnix coturnix*), saltwater fish and shrimp (*Penaeus sp*), freshwater prawns (*Macrobrachium rosenbergii*) are obtained from breeding farms, thus increasing supply and sales at reduced prices. It is unlikely that the farm breeding of whales or leopards, as well as the planting of slow-growing timber trees will be economically viable (Homma, 2007).

Wild mushroom species will always be picked in Europe using trained pigs and dogs, alongside those obtained from growing that caters to the entire world market. As a result of market growth, many drugs such as marijuana (*Cannabis sativa*) and coca (*Erythroxylum coca* Lam.) are planted and a smart way to destroy them would be by discovering pests and diseases that could hamper their development (Homma, 1990, 1992, 1996, 2004).

In the Amazon, of the hundreds of existing native fruits, many are invisible extractive products whose economic relevance has not been established and only a few will go through the domestication process. As long as there are stocks of these plants in nature and the use of labor to harvest them pays off, the extractive activity may be perpetuated, at least until some external force affects this balance. In other situations, technological dualism may prevail, with plant or animal extractivism coexisting with the domesticated process either temporarily or permanently.

The extractivism of various plants or insects used as dyes, such as Brazil wood, indigo (*Indigofera tinctoria* L.), cochineal (*Dactylopius coccus*) and carajuru (*Arrabidaeae chica* HBK), disappeared with the discovery of aniline and other synthetic dyes (Career, 1988). The extractivism of babassu was the economic mainstay of Maranhão until the 1950s, lost its importance with the expansion of grain crops such as soybean (*Glycine max* L. Merrill), corn, cotton (*Gossypium herbaceum*), the obtainment of cooking oil and the expansion of the agricultural frontier. The current use of babassu is intended for market niches for cosmetics, the discourse of social inclusion and the creation of *free* oligarchic forests of babassu, thus allowing its access to private property.

The extractivism of medicinal plants like salsaparrilha-do-pará (*Smilax papyracea*), which was used to treat syphilis, cinchona, for the treatment of ma-

laria among others was replaced with the progress of the pharmaceutical industry and medicine. The discovery of Viagra to cure male impotence has reduced the killing of animals and the use of plants used in traditional and popular medicine in Asia (Von Hippel & von Hippel, 2002). Some domesticated plants can be found in plantations in the extractive form, such as rubber, vanilla (*Vanilla spp*), cocoa or the introduction of domesticated species in extractive environments (yerba mate), and of animals such as buffalo (*Bubalus bubalis*), which become wild in the absence of management. With the implementation of the Forest Code, which reduces the agricultural land available, the reversal from domesticated planting to extractivism may occur for the use of Legal Reserve Areas and Permanent Preservation Areas.

In the future, new plants and animals from the Amazon will be domesticated. With the domestication process, it is possible to increase supply and get a better quality product at lower prices, thus benefiting consumers and producers.

Extractivism maintenance policies

The Amazonian economy has developed through the use of available natural resources. That is what happened with the extraction of rubber, Brazil nut, rosewood, turtle oil, arapaima, and more recently wood, açaí palm and berries, mining, petroleum, hydropower, among dozens of other products. The use of resources available in nature neglects their exhaustion, is based on the export of raw materials, discourages industrialization, causes displacements in the labor market and perversely affects the local economy. This clearly summarizes the Dutch Disease model developed by Coorden & Neary (1982), regarding the discovery of natural gas reserves in the North Sea in the 1960s, which affected the Dutch economy (Barham & Coomes, 1994).

Markets are the reason for the existence and disappearance of extractive economies. The transformation of a natural resource into a useful or economic product is the first step of the extractive economy. However, as the market begins to expand, the forces that cause its decline also increase. The limited supply capacity of extractive products leads to the need for domesticated crops or their management and the discovery of synthetic substitutes or other natural substitute.

Extractive reserves are being considered as a solution to prevent deforestation in the Amazon, the best income and employment choice, protection of biodiversity and, more recently, as a mechanism for implementing the Reducing Emissions from Deforestation and Forest Degradation (REDD). The antithesis of this proposal, which is supported by developed countries, is the lack of knowledge of the mechanism of extractive economy and of the importance of changing the technological profile of Amazonian agriculture.

The dynamics of plant extractivism that leads to the trapezoidal shape (Figure 3) may show successive displacements of this cycle over time and for certain geographical areas. This is what happened in the Amazon successively

with the phase of "the backlands drugs" and the extractivism of cocoa, rubber, Brazil nut and rosewood among others. Timber extractivism, which has always been considered in aggregate terms, actually includes dozens of wood species. In general, the beginning of logging is characterized by the extraction of the noblest species, such as mahogany (*Swietenia macrophylla* King) and after its depletion, of second and third class wood.

In the current extraction areas of açaí palm and berries in the Amazon estuary it is observed that the economic viability of this activity and the existence of stocks of açaí trees is a result of changes in the extractive economy over time. The commercial extraction of açaí palm started in 1968 in Barcarena, Pará, due to the exhaustion of juçara (*Euterpe edulis* Mart.) stocks in Atlantic Forest remnants. This palm tree is characterized by the fact that there is no regrowth after cutting. It should be noted that the landscape in the Amazon estuary where açaí trees occur has shown continuous change since the seventeenth century. In the past, the extraction of ucuúba (*Virola surinamensis*, *Myristica sebifera*), andiroba (*Carapa guianensis* Aublet), resins, pitch, patauá (*Jessenia bataua*), cocoa, murumuru (*Astrocaryum murumuru*), pracaxi (*Pentaclethra filamentous*), jutaicica and maçaranduba latex [*Manilkara huberi* (Ducke) Stand.] had great relative importance in comparison with the current extraction of açaí palm and berries (Nogueira, 1997). Logging has had a strong impact over the centuries, encouraging the formation of more homogeneous stocks of açaí trees. Rubber extraction has also caused changes in the landscape since the beginning of the rubber boom and during the Second World War.

In this context, the importance of extractive reserves would be to try to extend the life of extractivism (B and C) (Figure 3), in any of the three phases mentioned above (Figure 1). But the reverse can occur (D), leading to a reduction in the useful life of the extractive economy if new economic options are introduced. Many of the proposals of the recent neo-extractivism are limited to the introduction of agricultural activities among extractivists which, if successful, could lead to the abandonment of traditional extractive activities (Rego, 1999; Homma, 2000).

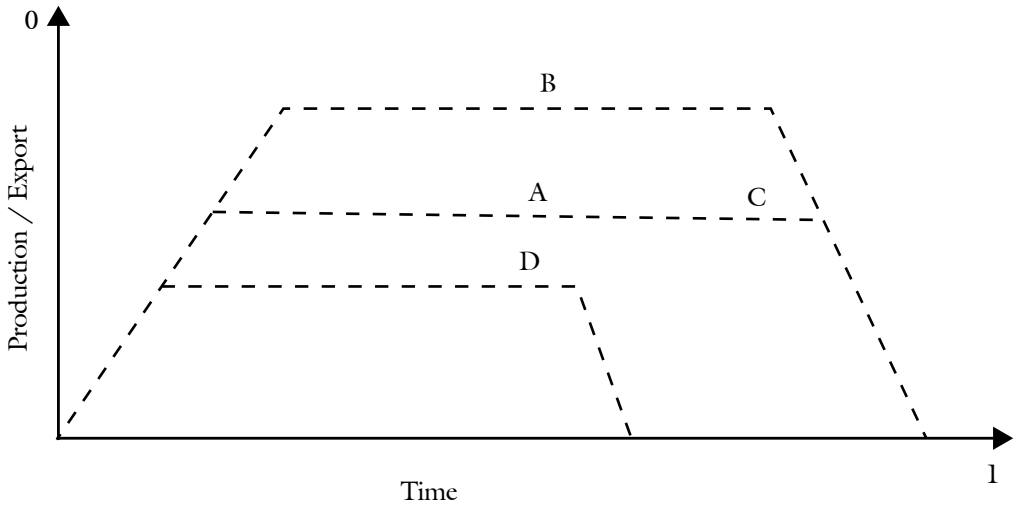

Figure 3 – Possibilities of change in the plant extractive cycle as a result of government policies (Homma, 1996).

The maintenance of extractivism in the Amazon requires preserving the forest, preventing the emergence of competitive activities, improving or building roads, maintaining low population density and, especially, avoiding the funding of domestication research, which induce its disappearance. In the case of the Amazon, the clear support of scientists and environmentalists from developed countries for the maintenance of plant extractivism can create force vectors that prevent domestication, despite obvious social benefits for producers and consumers. Accordingly, policies to support plant extractivism at the expense of domestication may harm the social interests of the population.

Managing extractive resources

The importance of management techniques would enable increasing the carrying capacity, as is occurring in the management of native açaí trees in the Amazon River estuary. Extractivists seek to increase the stock of açaí trees by promoting the thinning of competing plant species, thus transforming the area into an oligarchic forest, as if it were a domesticated plantation and increasing the productivity of berries and palm (Figure 4). This same phenomenon is occurring in the management of the regrowth of bacuri trees in the Northeast of Pará and in the State of Maranhão, induced by the growth of the urban market for this fruit.

Market growth has led to the expansion, in recent years, to more than 80,000 hectares of açaí trees managed for fruit production, benefiting more than 15,000 producers in the State of Pará. The growth of the market for açaí has been responsible for this expansion, with an increase in consumption, which used to be restricted to the period before the harvest for the whole year due to processing and freezing, exports to other parts of the country and abroad. The profitability and low investment in the management of açaí plantations discour-

age riparian people from establishing areas of common domain of the forest socialism type.

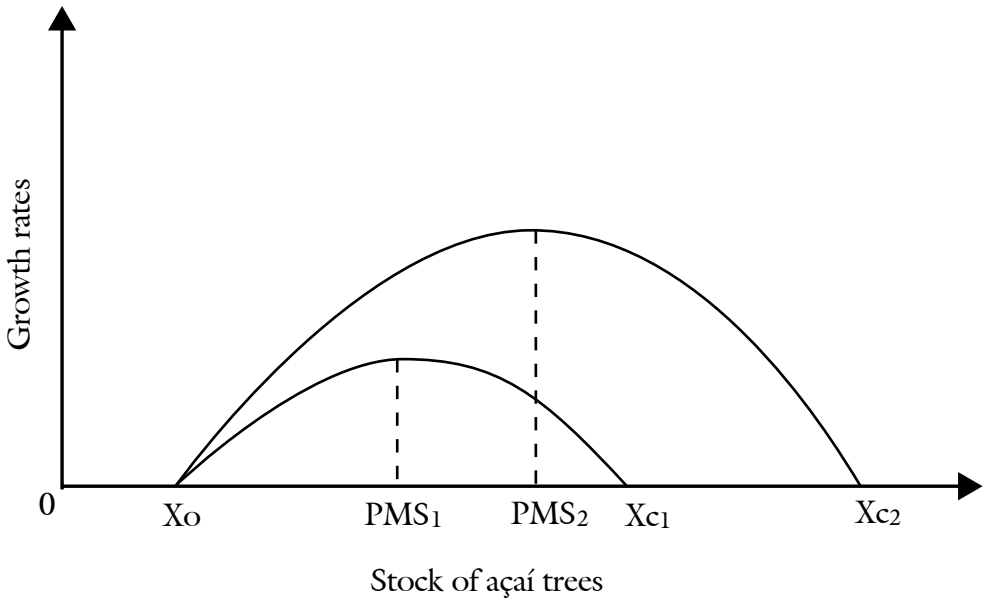

Figure 4 – Change in the carrying capacity resulting from the management of native açaí trees (Homma, 2007).

New opportunities and challenges of domestication in the Amazon

Several Amazonian plants have been domesticated in the last three centuries, notably cocoa (1746), cinchona (1859), rubber (1876) and jambu, guaraná, Brazil nut, cupuaçu [*Theobroma grandiflorum* (Spreng.) Schum], peach palm, açaí, jaborandi, long pepper, especially from the 1970s. Some of the main plants undergoing a domestication process are mahogany, paricá (*Schizolobium amazonicum* Huber ex. Ducke), bacuri, andiroba, uxi, rosewood, among others. Other plants that will be incorporated into the domestication process as a result of market growth include copaíba [*Copaifera langsdorfii* (Desf.) Kuntze], tucuman (*Astrocarium aculeatum* GFW Meyer, fruit very much appreciated in Manaus and *Astrocaryum vulgare* Mart., with potential for biodiesel), fava d'anta, piquiá [*Caryocar villosum* (Aubl.) Perz.] cumaru (*Coumarouna odorata*), puxuri (*Licaria puchury*-major), etc.

The following are some plants in relation to which there is a conflict between the extractive supply of and demand for these products, in which consumers and producers are missing great extractive opportunities.

Cocoa

The harvesting and planting of semi-domesticated cocoa trees was the first economic activity in the Amazon that lasted until the time of the Independence of Brazil, when it was surpassed by plantations in Bahia, where it was taken in

1746 by Louis Frederic Warneaux to the farm of Antônio Dias Ribeiro in the municipality Canavieiras. It is interesting to note that from Bahia cocoa was taken to the African and Asian continents, where it became the main economic activity. With the introduction of the witch's broom [*Crinipellis perniciosa* (Stahel) Singer] in the cocoa plantations of Bahia in 1989, production fell from the peak reached in 1986 of 460,000 tons of dry beans, to the lowest level in 2003, with 170,000 tons, until the beginning of recovery through grafting techniques, reaching 196,000 tons in 2004.

Despite the existence of 108,000 hectares of cocoa trees planted in the states of Pará and Rondônia, cocoa has not received due attention by agricultural planners. In the period 2008/2010, nearly 65,000 tons of cocoa beans were imported, totaling more than 159 million dollars, or the equivalent to one third of the Brazilian cocoa production. This indicates the need to double the planted area in the North over the next five years, so as to generate income and employment and promote the recovery of deforested areas.

Açaí

There are areas with concentration of native açaí trees at the mouth of the Amazon River, which through management could have their density increased. However, sprawling hides environmental risks that have an impact on the flora and fauna.

The transformation of floodplain ecosystems into homogeneous açaí forests, subject to daily flooding due to the construction of run-off channels, traffic of vessels, continuous removal of fruit without the reposition of nutrients, can all lead to risks of production stagnation in the medium and long term, in addition to environmental risks to the flora and fauna.

Açaí plantations must be directed to dry land deforested areas and areas that should not have been deforested. Planting in dry land areas would require fertilization and semi-mechanized harvesting, which becomes a limitation due to market growth, labor laws and the need for expert harvesters. Irrigated planting in dry land areas and climatic zoning could extend the harvesting of açaí to different times of the year and reduce prices for local consumers, reaching R$ 24.00/liter, thus leading to the social exclusion of a food product consumed by the lower classes. The rural-urban migration has transferred rural consumers to urban areas, thereby increasing pressure on this product.

Bacuri

With its supply fully extractive, it is the most expensive fruit pulp, reaching R$32.00/kg. Stocks of bacuri trees were felled in the past for obtaining wood. Today areas of bacuri plantation are still being destroyed in Maranhão and Piauí to yield space for soybean plantations, the expansion of pineapple plantations (*Ananas comosus* L. Merril) and clearings on the island of Marajó, in addition to the production of charcoal, firewood and cowpea beans [*Vigna unguiculata* (L.) Walp] in Northeast Pará (Homma et al., 2010b).

A peculiar fact about bacuri is its re-sprouting ability in former areas of occurrence, hence the recommendation for its management on the coastal area stretching from Pará to Maranhão, replacing unproductive burned areas with productive bacuri trees. Another option would be to develop bacuri plantations for the recovery of deforested areas and areas that should not have been deforested.

Brazil nut

Bolivia is the world's largest producer of Brazil nut, and Tahuamanu SA, which is considered the most modern processing industry in the world, is located in Cobija. The extractive supply capacity of Brazil, Bolivia and Peru has limitations, and global production has been steady for six decades. Supply needs to be expanded through plantations. The stocks of Brazil nut trees in Southeast Pará have been replaced by pasture, settlement projects, logging, mining, urban sprawl, etc. There are pioneer Brazil nut plantations: one in full production in a 3,000 ha area, with 300,000 trees planted in the 1980s along the Manaus-Itacoatiara road, and another in the region of Marabá, planted at the same time that belongs to the former Bamerindus Group, which was destroyed by activities of the Landless Rural Workers' Movement (MST) and squatters. Plantations have been established in the region of Tomé-Açu, in agroforestry systems, since the early 1980s; they are similar to native nut trees.

Rubber

In 1951 Brazil began to import rubber, which reaches 70 percent of domestic consumption. In 1990 the production of rubber obtained from plantations exceeded that of extractive rubber. In the period 2007-2009 the share of extractive rubber accounted for only 1.81 percent of the overall production of natural rubber in the country. Rubber production, despite plans such as PROHEVEA (1967), PROBOR I (1972), PROBOR II (1977) and PROBOR III (1981), was a failure and a corruption mechanism (Homma, 2003a). The government currently subsidizes the price of extractive rubber by paying a higher price than that of the rubber obtained from plantations, through the minimum price policy.

In 2010, Brazil broke the natural rubber import record, reaching US$790.4 million (260.8 thousand tons) compared to US$ 283 million (161,3 tons) in the previous year, an increase of 179.3 percent. To eliminate imports, some 300,000 ha of rubber trees should have reached the felling age, which could generate employment and income for 150,000 families of small producers. India, China and Vietnam have succeeded in increasing rubber production within a short period, while Brazil produces just over 200,000 tons, mainly in the states of São Paulo, Bahia and Mato Grosso.

The implementation of a National Rubber Plan is more than urgent for the country, considering the risk of emergence of leaf disease (*Microcyclus ulei*)

in Southeast Asia, for accidental reasons or bioterrorism, the depletion of oil reserves and because if is a strategic product in the world industry (Davis, 1997).

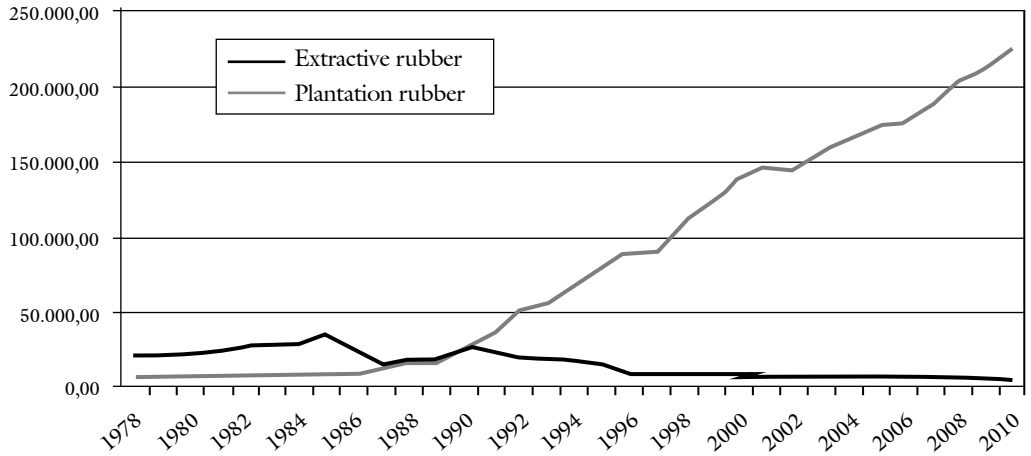

Figure 5 – Rubber production from plantations and extractivism, 1978-2010. In addition to rubber, this change has occurred for cocoa, guaraná and cupuaçu among others.

Cupuaçu

The supply of native cupuaçu is declining in the region of Marabá, as a result of low forest density, felling for clearings and expansion of plantations, with fruit yield starting two years after planting. Japanese-Brazilian farmers in Tomé-Açu were the first to believe in the potential of cupuaçu, with commercial plantations started in 1980 by farmer Katsutoshi Watanabe. The greatest danger of deforestation in the areas of occurrence of native cupuaçu trees is the destruction of genetic material that may be important for breeding programs. The market for cupuaçu pulp, unless new facts emerge, such as use in the chocolate and cosmetics industry, is becoming saturated with around 25,000 ha cultivated in the Amazon, unlike açaí pulp. In turn, cupuaçu seeds, which are sold at the same price as cocoa seeds, present great possibilities for the pharmaceutical and cosmetic industries. The development of cupuaçu trees with greater production of kernels would be important to the production of cupuaçu chocolate.

Jaborandi

Merck, a company of German origin, was a pioneer in the domestication of jaborandi, with the establishment of a 500 ha plantation in the Chapada Farm it had purchased in 1989 in Barra do Corda, Maranhão, leading to self-sufficiency starting from 2002.

For the processing of jaborandi leaves, Merck created Vegetex in 1972 in Parnaíba, Piauí, which was closed in 2000, with stocks of pilocarpine sufficient to supply the world market for five years. However, one year after the closing of Vegetex, 80 percent of the stock had been sold, leading Merck to outsource its

activities. In July 2002 the Centroflora Group (created in 1957) took control of the assets of Vegetex and established Vegeflora to process jaborandi coming from Barra do Corda.

In 2009, the Division of Natural Products was acquired by Merck Quercegen Agribusiness 1 Ltd., an arm of Quercegen Pharma headquartered in Massachusetts, USA, which began to focus on the planting of fava d'anta and uncária [*Uncaria tomentosa* (Willd. ex Roem. & Schult.) DC.] besides jaborandi. Fava d'anta and uncária are used for the production of quercentin, a powerful antioxidant and anti-inflammatory, with immunological properties.

With the sale of Merck came the rupture with Vegeflora and the supply of jaborandi leaves from Chapada Farm in Maranhão was cancelled. This led Vegeflora to start its own jaborandi plantation in Território dos Cocais, Piauí, distributed worldwide by the pharmaceutical company Boehringer Ingelheim.

Uxi

A plant in early domestication stage, it presents difficulties for the germination of its seeds and the grafting process. Uxi trees available in backyards were obtained from seedlings that sprouted accidentally under those trees in the woods. The Japanese-Brazilian farmers in Tomé-Açu are introducing this plant, the bacuri tree and the piqui tree in agroforestry systems, forming new combinations with açaí, cocoa and cupuaçu trees. Uxi trees have been heavily felled for the establishment of small family farms, and therefore the production of uxi depends on remnants that have survived and have a large local market (Carvalho et al., 2007).

Peach palm

There are 15,000 ha of peach palm trees in the country, of which 7,500 hectares are in São Paulo and 2,500 in Bahia, intended for the production of peach palm. It would be used in the palm production industry, and the fruit in the production of animal feed and vegetable oil. The potential for the cosmetic, pharmaceutical and food industry needs to be expanded. The INPA is the most advanced institution in the domestication of this plant.

Fish poison (timbó)

Fish poison was widely used as a natural insecticide before the emergence of synthetic insecticides, then disappeared and now is returning for use in organic agriculture, but on a rational basis (Homma, 2004). Before the Second World War, the states of Amazonas and Pará were major exporters of fish poison root that was used as an insecticide. The discovery of DDT by the Swiss chemist Paul Hermann Müller (1899-1965) in 1939 to control disease-carrying insects, eliminated the market for natural insecticides. The success in combating diseases gave him the Nobel Prize in Medicine in 1948. The launch of the book *Silent Spring* by Rachel Louise Carson (1907-1964) in 1962 brought to light the ecological risks behind the indiscriminate use of synthetic insecticides

in agriculture. As a result, the importance of using organic insecticides began to increase, especially since the 1990s, awakening the interest in growing insecticides plants such as fish poison, neen, tobacco, etc. Currently, the country imports fish poison from Peru, for use in organic agriculture and for the recovery of degraded areas such as leguminous plantations. Fish poison is an example of a domesticated plant that was widely cultivated in Southeast Asia, Japan, Puerto Rico and Peru and then abandoned. There was a selection of varieties prepared by British, Americans, Japanese, Peruvians and Brazilians that was lost, requiring a fresh start.

Rosewood

Rosewood is another wealth of the states of Amazonas and Pará, which exported as much as 444 t in 1951. The average for the three year period 2007-2009 was less than 25 t and the cost of essential oil was around US$92.00/kg (Homma, 2003a). To export the maximum amount, planting should have started about 20 to 30 years ago, so as to allow the cutting of 30,000 trees/year, and the consequent generation of some 16 million dollars in foreign exchange a year. The experiments in Tomé-Açu, in intercropping with black pepper, show the possibilities for the development of rosewood in deforested areas and in the recovery of areas that should not have been deforested in the states of Pará and Amazonas. Its vertical integration in the region is an alternative to the establishment of floro-xylo-chemical center for the production of essential oils for the perfume, cosmetics and pharmaceutical industries in the Amazon (Benchimol, 2003).

Andiroba

There are already several crabwood plantations combined with cocoa plantations, integrating agroforestry systems in the city of Tomé-Açu and Acará. As the harvest period is the same, use has been focused on cocoa, which is more profitable (Homma, 2003b). More productive techniques need to be developed for processing, as the removal of husks, after cooking, is quite laborious. Measures to inhibit fraud need to be improved. The extractive potential is great but requires organizing communities, processing and marketing. Options for planting crabwood for fruit and wood production as a byproduct in already deforested areas need to be considered, even if to the detriment of extractivism in traditional areas as the market grows.

Copaíba

The supply of palm kernel oil depends entirely on extractivism, which needs to be replaced by plantations, for reasons of market growth, standardization of the oil - currently from half a dozen species with different color, density and composition. There is need to invest in research for the identification of more promising species, the development of domestication techniques and the establishment of plantations. Because it is a perennial (evergreen) tree, current

decisions will only have an impact in the coming decades, hence the need for urgent investments.

Guaraná

During the administration of President Emilio Garrastazu Medici (1905-1985), when the Minister of Agriculture was Luis Fernando Cirne Lima (1933), Law 5,823 of 11.14.1972, the so-called Law of Juices, was enacted and subsequently regulated by Presidential Decree 73,267 of 12.06.1973. This law established, in the case of guaraná, the amount of 0.2 to 2 grams of guaraná per liter of soda and 1 gram to 10 grams of guaraná per liter of syrup. Although the difference between the legally permitted minimum and maximum amounts was 10 times, there was a great demand for the product, leading to semi-extractive production in the State of Amazonas, which ranged between 200 and 250 tons a year, to heights of up to 5,500 tons (1999), and then falling to 3,100 tons between 2005 and 2008, of which Bahia is the largest domestic producer (Homma, 2007).

Other plant products

The list would be long, and if it weren't for space limitations, other plants would have been described such as: jambu, camú-camú [*Myrciaria dubia* (HBK) McVough], patauá [*Jessenia bataua* (Mart.) Burret], vanilla, priprioca (*Cyperus articulatus* L), breu branco (*Protium pallidum*), patchouli (*Pogostemon* spp), cubiu (*Solanum sessiliflorum*), buriti (*Mauritia flexuosa*), taperebá (*Spondias mombin* L.), tucuman (Pará and Roraima are exporting to Manaus), bromeliads and orchids.

Fauna resources

For four decades poultry consumption was restricted to sick people or postpartum women. In the 1960s the country began a major expansion of poultry production, with poultry meat production exceeding that of beef and with less environmental impact. Brazil has become the largest exporter of chicken and beef, allocating 30 percent and 20 percent respectively of the national production to exports. The same does not apply to fishing, in which 56,1 percent of the domestic production is of extractive origin and 43,9 percent from farms. Globally, this ratio is between 58,7 percent of extraction and 43,9 percent of aquaculture. It should be noted that in the country, fish production is less than 10 percent of beef or chicken production. Surely Amazon deforestation would have been higher if the production of chicken had not reached the current technological levels. In this sense, there are great opportunities for promoting a revolution in Brazilian aquaculture, by enabling the establishment of fish farms for Amazon fish like tambaqui (*Colosoma macropomum*), arapaima (*Arapaima gigas*), peacock bass (*Cichla ocellaris*) and the breeding of the Amazon turtle (*Podocnemis expansa*), tracajá (*Podocnemis unifilis*), etc. Successful fish farms are located in Mato Grosso do Sul, Amazonas, Rondônia and currently in the state

of Acre, with a view to ensuring a route to the Pacific and the purchase of fish-meal from Peru as raw material for feed.

Conclusions

Plant extractivism in the Amazon was very important in the past, is important in the present, but it is necessary to think about the future of the region. It was rubber extractivism that enabled the settlement process in the region and the construction of productive infrastructure, supported the domestic economy for three decades as the third export after coffee and cotton, and promoted the annexation of Acre to the national sovereignty. As other examples, in the case of rubber, the country cannot depend on the economics of rubber extractivism. The maintenance of extractivism is justified as a way to "buy time" while awaiting alternatives to prevent the rural exodus or when there are large stocks of the resource. The establishment of a strong industrial park with the domestication of extractive plants currently known and potential ones is the best guarantee to avoid biopiracy in the Amazon and neighboring countries and to generate income and employment.

There is no denying that the extractive economy has been the reason and cause of regional underdevelopment by relying on the availability of natural resources, in the belief of their inexhaustibility. To maintain the extractive economy, it is important to prevent research on the domestication of plants and animals that can be incorporated into the production process. Thus, the cult of underdevelopment, of many environmental proposals, both domestic and foreign, in favor of extractivism in the Amazon conceals results that may go against the interests of consumers, industries and the extractivists themselves. Similarly, to maintain extractivism it is important not to create alternative sources of income and employment, improved infrastructure, given the low land and labor productivity of the extractive economy, hence the obscurity of many environmental proposals advocated by developed countries for the Amazon.

Unlike boasted, the creation of extractive reserves has not always been a guarantee of the conservation and preservation of natural resources. Despite the emphasis on management, the exploitation of many extractive resources tends to lead to their depletion, the destruction of the forest and change to new locations. Logging, cattle breeding and farm activities may lead to an *extractive reserve without extractivism* over time. Avoiding deforestation and burning in the Amazon will depend on the partial use of the 75 million hectares already deforested (2012) with appropriate productive activities and on the promotion of the recovery of areas that should not have been deforested. This list includes a set of biodiversity products from the past and the present and those yet to be discovered.

For extractive food products that involve conflicts between food supply and demand, it is urgent to promote their domestication. The insistence on extractivism leads to social losses for producers and consumers. For extractive

products used as medicinal plants, cosmetics, toxics, etc. by traditional communities, the amendment to Provisional Decree 2186-16 is necessary, at the risk of preventing the development of new products, and as a mechanism of income and employment generation for regional populations.

The implementation of the Forest Code providing for the recovery of destroyed ecosystems can lead to the development of hybrid systems involving domesticated plantations converted into extractive or managed resources to restore Legal Reserve Areas and Permanent Preservation Areas.

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Abstract – The growing market for forest products has led to the domestication of plants and the discovery of synthetic substitutes. Other variables such as population growth, the change in relative prices, low productivity of land and labor of the extractive activity conflict with the increase in wage levels affecting sustainability in the medium and long term. The creation of green markets and certification can extend the life of the extractive economy, but eventually it will have difficulties in maintaining itself in the long term, with market growth. The insistence on maintaining the extractivism leads to losses for producers and consumers.

Keywords: Plant extractivism, Amazon, Extractive theory, Rural development.

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