UTILIZATION OF FOREST PRODUCTS FOR AMAZONIAN DEVELOPMENT: POTENTIAL AND LIMITATIONS

ABSTRACT: The economic importance of extractive products has presented modifications throughout history. Such is the case for several extractive products which have had great importance in the economic, social and political formation of Amazon. Among these products the “drogas do sertão” and cocoa of the colonial period, rubber, Brazil nut, rosewood, palm heart, açai fruit and the timber extraction of today, can be mentioned. The economic improvement of extractive resources suffer therefore from technological progress, economic alternatives, population growth, resource exhaustion, wage levels of the economy, relative prices and many others factors. In general extractive activities, are initiated, pass through a “boom” phase and later disappear, in the spatial and time sense, when economic competition is lost and the product becomes less important.
To consider the extractive option as a viable alternative for Amazonian development the question must be evaluated with caution. First, because the characteristic dynamics of the extractive economy are unacknowledged, and a great contingent of the rural population is dedicated more to agricultural activities than to extraction of forest products. Second, one must consider the real economic importance of these products and also the real alternatives in the future related to technological changes and population growth that could bring about results which are contrary to the aims intended for the extractive options. A certain degree of dependency on extractive activities exists both for those dedicated to agricultural or extractive activities or vice versa, in family income, use of available time and labor and the permanence of the family in one place and activity.
In the case of extractive products which have large natural stocks, such as the fruit and palm heart of açai, timber, Brazil nut and even rubber, measures can be taken to permit more well-balanced extraction. In the case of extractive products, the survival of this system mustn’t be made to the detriment of technological alternatives and the creation of employment through domestication. For almost all extractive products, family labor is required only seasonally, and due to the expenditures of extraction, must be complemented by other activities such as agriculture, fishing, temporary wage labor, etc. In this case extractive activities are a limited solution for restricted areas, with definite risks and products used to buy time while one awaits for new economic alternatives.

Key Words: Extractive economy, Amazon, Non-wood forest products, Rural development.

1 - INTRODUCTION

The economic importance of extractive products has presented modifications throughout history. Such is the case for several extractive products which had great importance in the economic, social and political formation of Amazonia. Among these products the “drogas do sertão” and cocoa (*Theobroma cacao* L.) of the colonial period, rubber (*Hevea brasiliensis* M. Arg.), Brazil nut (*Bertholletia excelsa* HBK), rosewood (*Aniba rosaeodora* Ducke), fruit and palm heart of açai (*Euterpe oleracea* Mart) and the timber extraction of today, can be mentioned. The economic improvement of extractive resources suffer therefore from technological progress, economic alternatives, population growth, resource exhaustion, wage level of the economy, relative prices and many others factors. In general extractive activities, are initiated, pass through a “boom” phase and later disappear, in the

spatial and time sense, when economic competition is lost and the product becomes less important.

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It is a mistake to suppose that the extractive activities are independent and operate in a closed economy. When the British domesticated rubber in Southeast Asia from rubber trees in Amazonia it was like an appliance that has been disconnected from its power source. For most products which come from an extractive economy there are connections with local, regional, national and even international markets and these are also affected by co-evolutionary processes. Extractive products for export which come from the forest and used in many different sectors of the economy also depend on these sectors. For instance, the açai palm fruit collector in the Amazon estuary depends almost entirely upon purchasing staple foods from other areas, in most cases the crops come from areas of shifting cultivation, where majority of rural people earn their livelihood. The positive environmental image that extractivists have achieved, mainly imposed by the media, hides this interrelationship with other sectors of the economy. In addition, the extractors also develop local agriculture to supply some staple foods and animals, according to the price relationship between agricultural and extractive products. This occurs, for example, in the extractive rubber sector. The relationship of the extractive economy to the economic system, where everything depends on everything else, should not be neglected either. During the last century rubber extraction began to boom because it was directly linked to

the demands of the foreign market. In this way, various extractive products have been connected through the market on a local, national and even international level. In this sense, the expansion, stagnation and the decline are related to these economic/market forces in which the extractive system is inserted. Brazil nut extraction in the Maraba region where the economy, social and political changes caused the disintegration of this activity can be mentioned as an example. Other aspects are the transformations of the extractive economy itself, as can seen using the babaçu palm (*Orbygnia phalerata*) as an example. In spite of its great stocks, was characterized by auto-consumption, in the first phase, commercial capital during the second phase in the period between the First World War and the 1950s, followed later by industrial capital and since the 1970s by the transformations in agriculture in the State of Maranhão (Amaral Filho, 1990).

2 - PLANT EXTRACTIVISM AS AN ECONOMIC CYCLE

Four phases characterize the evolution of the extraction of plant resources in the Amazon region (Figure 1). The first phase is that of expansion of extraction, in which clear expansion
of extraction may be observed, favoured by the the existence of better reserves or by the monopolistic position that characterizes the market for a given resource. The extraction of lumber, açai fruit or palm hearts are examples of this situation.

The stabilization phase represents a balance between supply and demand, close to the maximum extraction capacity. In this phase, extractors make every effort to maintain the levels of production they have reached, even though this may imply increasing unitary costs in order to fulfill commitments. Prices start rising from this phase on, given the sector's incapacity to increase extraction in order to comply with the growth of demand. A policy to encourage rational production or protectionist measure for the extractivist sector could be adopted. An effort has been made to promote rational plantation and, paradoxically, attempt to delay the process of extinction of extractivism. The Brazil nut would appear to be reaching the stabilization phase.

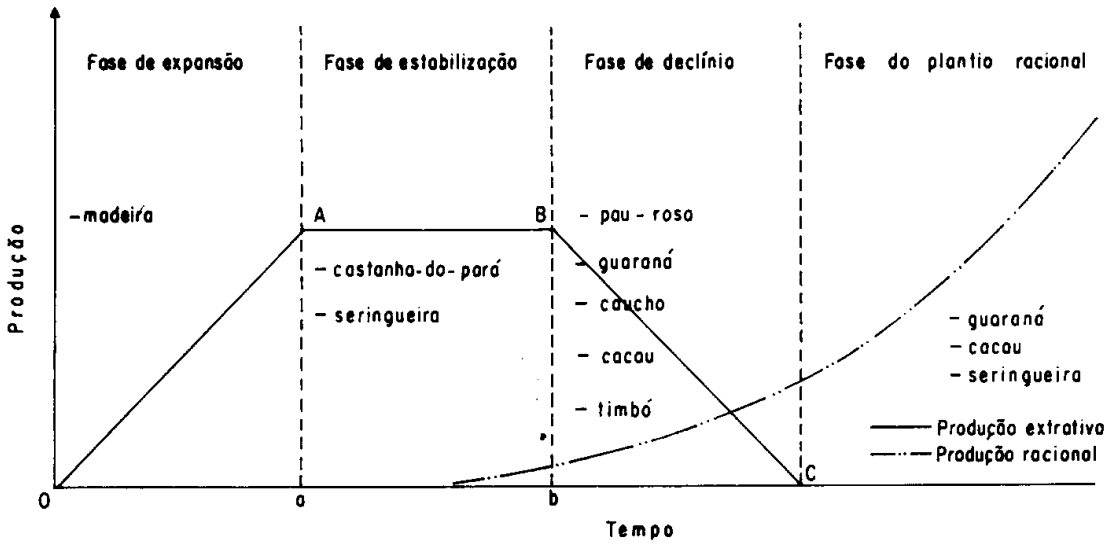

Figure 1- The historical cycle of forest production in Amazonia.

The decline phase, caused by the reduction of resources and increases in the cost of extraction, leads to a gradual fall-off in extraction. Depletion causes a decline in the quantity and quality of the natural resource to be supplied and reduces the volume of extraction, so that with the same effort as before, unitary costs increase. The extraction of rosewood is an example of such situation.

The cultivated plantation phase makes its appearance during the stabilization phase, when the conditions for cultivation are set by the availability of technologies for cultivation, the lack of substitutes (natural or synthetics) and the existence of favourable prices. The permanence of extractive activities will depend on the profitability in relation to other economic alternatives.

The length of this phases does not present deterministic features connected to the availability of stocks of extractive resources. It is closely related to development policies, and affects variables of an economic and social nature, scientific and technological development, migratory currents, manpower markets, and more recently, environmental policies. The feasibility of extractivism through these different phases along a historical process depends on the balance of variables of agronomic, ecological, economic and social characteristics. Thus defined, sustainability requires that activities remain profitable throughout time, providing social improvements for those who participate in them, in addition to the capacity to maintain an adequate balance with regard to agronomic and ecological features.

Therefore, extractive activities have intrinsic characteristics making agronomic and ecological adaptation possible. On interacting with the socio-economic environment, these characteristics determine different effects and in turn affect agronomic and ecological aspects, in a co-evolutive process. However, the balance of these four components rest on a

relatively fragile basis, in which the economic component is the main “Achiles heel” or weakest point.

The wide support that the extractivist economy has started to receive, for example in terms of creation of extractive reserves, may lead to a change in the shape of this cycle. A positive effect would be to freeze the expansion of agricultural frontiers, but this would not guarantee economic sustainability. Four theoretical possibilities can be envisaged (Figure 2). The first, represented by the letter A, is one in which the normal course is followed, as shown previously in Figure 1. A second possibility would be to extend the length of the cycle, increasing the durations of all its phases (B). Alternative C would be to prolong the decline phase. A fourth alternative (D) would be that, with the establishment of extractive reserves, the cycle of plant extraction could be shortened. This could happen in areas with high migratory pressure, high demographic density, the appearance of other economic alternatives and the variables that lead to the natural disappearance of extractive activities. Inevitably, in any of the four alternatives, the final scenario would be the disappearance of these activities.

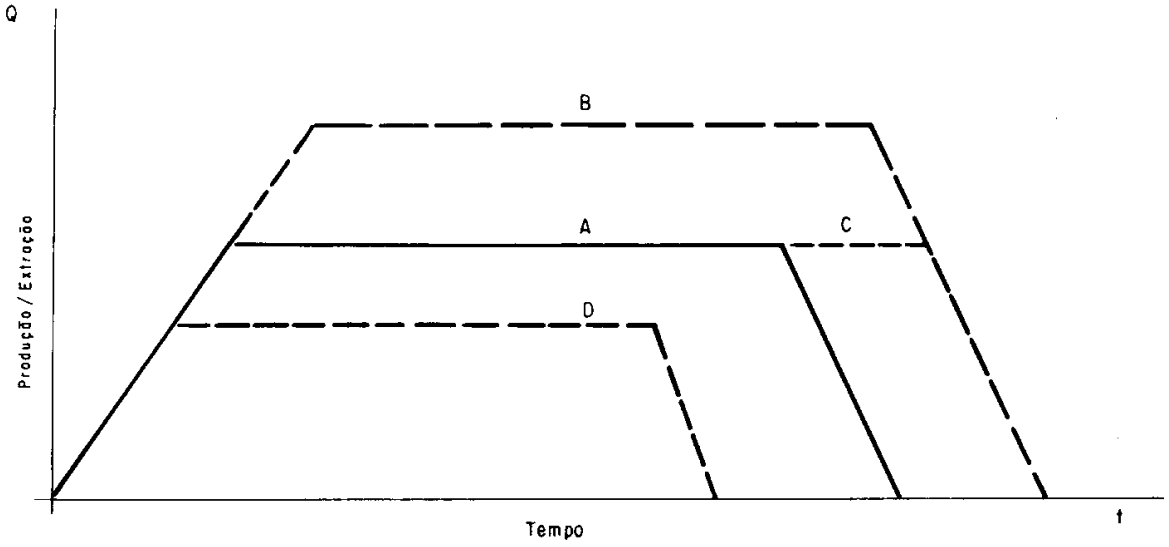

Figure 2- Possibilities of change in the plant extraction cycle due to the implementation of government policies.

The dynamics of extractive activities that forms the trapezoid described in Figure 1, may show successive dislocations from this cycle over time to a determined geographic area or in macro-economic terms. This is what repeatedly occurred in the Amazon with the “drogas do sertão” phase, extraction of cacao, rubber, Brazil nut, and rosewood, among others. For the case of timber, which has always been considered in aggregated terms, in fact involves dozens of tree species. In general, timber extraction begins with the logging of species considered noble or great commercial value, such as mahogany (*Swietenia macrophylla*, King), and then with the exhaustion of stocks begins to log species of second and third level categories. In the present areas of extraction for palm heart and açaí fruit in the Amazon shows the economic viability of this activity and the existence of stocks of açaí

palms as a result of the transformations of the economic activity over time. The commercial extraction of palm heart started in 1968, when the operation of the first plant in Barcarena, Pará, began due to the exhaustion of *Euterpe edulis* Mart. stocks in the South - Central Brazil. This palm tree doesn't re-grow after cutting. It should be emphasized that the landscape in the Amazon estuary has been undergoing change since the XVII century. This example illustrates the role that the dynamics of extractive economies play in the changing Amazon landscape. In the past, the extraction of ucuuba (*Virola surinamensis, Myristica sebifera*), andiroba (*Carapa guianensis* Aubl.), resins, pitch, patauá (*Jessenia bataua*), cacao, murumuru (*Astrocaryum murumuru*), pracaxi (*Pentaclethra filamentosa*), jutaicica, maçaranduba [*Manilkara huberi* (Ducke) Stand.] lactic products, etc., had greater relative importance in comparison to the present fruit and palm heart extraction from the açai palm. Extraction of timber has also had great impact over the centuries, provoking marked changes in the original landscape. Rubber extraction also caused transformations in the beginning or boom stage of this product and during the period of the Second World War. Timber and palm heart extraction, among others, tend to favor the formation of more homogeneous stands of açai palms, for example.

3- CLASSIFICATION OF EXTRACTIVE ACTIVITY AND THE MARKET EVOLUTION PROCESS

Extractive processes in the Amazon may be classified into two major categories, according to the way that extraction is carried out:

3.1- Predatory or annihilation extractivism: when obtaining an extractive resource entails the destruction of the source, or when the rate of regeneration is slower that the capacity to extract (e.g. in the case of extraction of lumber, palm hearts, rosewood, and indiscriminate hunting and fishing).

When the rate of this extraction exceeds the speed of regeneration, the natural consequence is gradual scarcity, until it becomes uneconomic to continue with the activity. Generally, when this level is reached, the damage caused to the species threatens its survival and may lead to its local disappearance and even extinction.

3.2- Gathering or non-predatory extractivism: when extraction is based on gathering products, maintaining the integrity of the mother-plant that generates the resource. An example is the extraction of rubber or Brazil nuts, where the rate of regeneration covers the rate of extraction. This form of extraction hypothetically guarantees the possibility of extraction *ad infinitum*.

The economic theory of David Ricardo prevails in both these situations, in which initially the best resources are extracted for a given spatial area and with a short term horizon. This approach is not always adopted, given the availability of extractive plant resources in the Amazon forest. Great distances and the difficulties in channeling supply to the markets, the sanitary conditions and a real lack of knowledge of resource potential lead to better quality stocks either not being used or being used in a predatory fashion within the Henry C. Carey perspective. The present process of expansion of the agricultural frontier and population

movement towards the upland areas of dense forest, also have implications for the destruction of these more promising zones.
For some species, extraction may take on a dual form, and involve both destruction for one purpose and gathering for another. A typical case is that of the açai palm tree, from which hearts of palm are obtained by destruction of the individual palm and juice obtained by gathering the fruit.

Even in the gathering form of extraction, resources may often be destroyed - if they are not subject to rational extraction - by depredation aimed at an immediate increase in productivity or by substitution for other more competitive activities, independent of their profitability.

3.3- The beginning of extractive exploitation

The "untouchability" of natural resources may be explained as that of a potential supply, having a cost of extraction which exceeds the potential demand for a given product or which is lacking in economic importance.

With the development of technology, methods of extraction have improved and, together with better levels of infrastructure, the conditions for extractivism have become more feasible, giving rise to the beginning of extraction. This beginning may be understood as a supply (S) which is greater than demand (D), as if it were a free commodity such as air (Figure 3a). The curves of supply and demand do not cross each other, once the extraction of resources is of direct use to the extraction themselves.

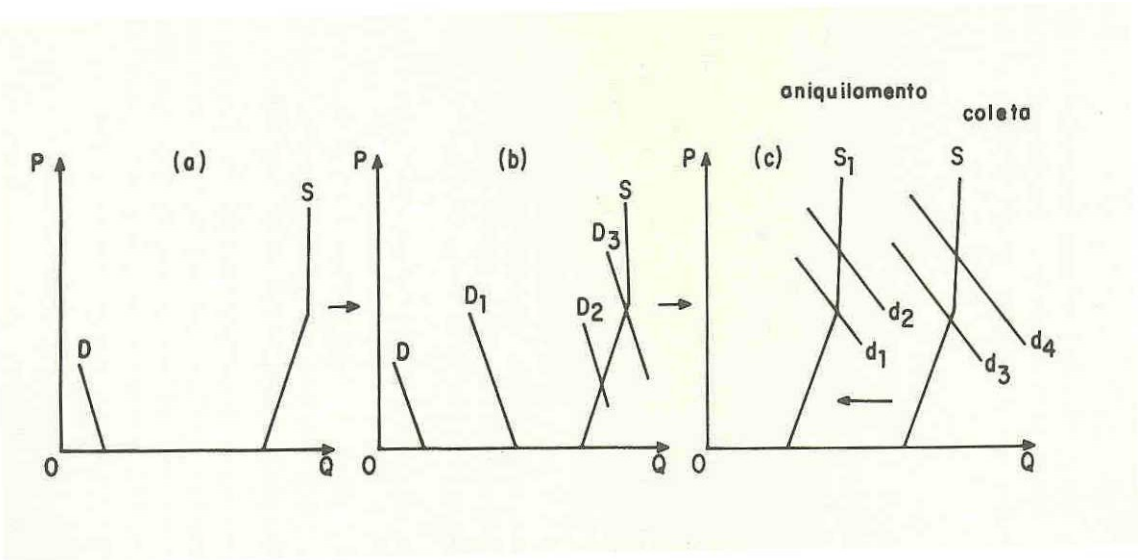

Figure 3- The process of market evolution for extractive products

With the growth of the market, the demand curve (D, D1, D2, D3, D4) gradually moves towards the right (Figure 3b), making the price paid positive in order to guarantee supply of the product. Since a characteristic of extractive resources is that their supply is established

by nature, capacity to supply reaches a certain limit, inelastic in relation to quantity, and remaining vertical. The management of some extractive resources can increase the supply capacity for the product.

3.4- The end of extractive process

The final phase of extractivism may be interpreted as the exhaustion of natural resources, or rigidity of supply.

In the case of extractivism by destruction (Figure 3c), the supply (S) curve moves toward the left, due to reduction in the source of supply. This leads to a consequent rise in prices at each level of balance in the long term, due to lack of attention the exigencies of demand (D1, D2), given the rigidity of prices from the point where greater increases will not be supported.

In the case of extraction by gathering, the end point is reached when supply curve becomes inelastic (Figure 3c), when prices have reached levels which are so high that growth of demand (D3, D4) leads to domestic forms being encouraged and extractive species are abandoned, substituted by the discovery of synthetic substitutes.

The extractive economy is placed within a much wider context than that it is traditionally analysed. It starts initially with the discovery of a natural resource that presents an economic possibility or that would be useful to human beings. The natural sequence is the start of extractivism as an economic activity. In general, the growth of the market and technological progress lead to these extractive resources being domesticated (Figure 4). This would be a natural consequence and has taken place in the case of thousands of extractive products that are presently cultivated all over the world. Later, the growth of the market and technological development lead to the development of synthetic substitutes. Very often one of the phases is omitted, as in the case of the extraction of rosewood, which went directly from extractivism to the synthetic, or in the case of the timbó [*Derris nicou* (Aubl.) Macbr. and *D. urucu* K. et Sm., fish poison]. With progress in the biotechnology and genetic engineering there are increasing possibilities for the direct domestication or synthesis of natural resource that are of use to humans, without having to pass through the extractive phase. This means that there are scant chances that extractive economy can be given a new impulse with the discovery of potential new extractive resources, such as drugs. It might possible right at the beginning, or if the stock of available extractive resources were to be very large.

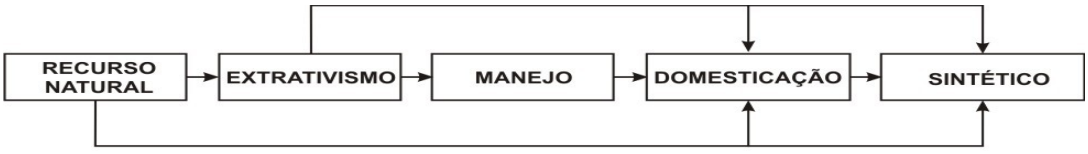

Figure 4- Possible ways of using a natural resource following its transformations into an economic resource.

The incapacity of the extractive sector to cover growing demand and the autonomous progress of science and technology have stimulated the development of synthetic substitutes. There are three basic reasons for substitution of extractive resources by synthetic products: increases in the cost of the natural resource because of depletion of stocks, reduction in the cost of production of the substitute due to technological improvements, and the extractive sector's lack of capacity to cover growing demand for a given product.

In this way, various extractive products have been substituted by industrial products. The discovery of aniline in the nineteenth century was the end of the cycle of extraction of Brazil wood (*Caesalpinia echinata* Lam., dye), which had started following the discovery by Europeans of Brazil in 1500. The discovery of DDT in 1939 reduced the importance of natural insecticides, affecting exportation of extractive timbó from the Amazon. Synthetic rubber is an example of the substitution process. At the present three-quarters of the world consumption of elastic gums is based on synthetics. The discovery of synthetic linalol affected the market for the extraction of rosewood. Others examples of substitutes affecting extractive activities are synthetic waxes, coumarin, non-elastic gums [balata (*Manilkara bidentata* ADC), sorva (*Couma* spp)] and quinine.

Substitution by synthetic product is never perfect. The initial stages of the substitution are very intense, conquering the markets of the natural product. Together with the degree of substitution, the process tends to become stable. Once this limit of substitution is reached, any increase in consumption of the synthetic substitute is accompanied by a complementary quantity of the natural resource. This aspect tends to induce domesticated cultivation and a chain reaction in plant extraction.

The discovery of synthetic substitutes is the end of the extractive resource's "evolutionary process". Synthetic production is independent from restrictions of an ecological nature, providing an increase in the capacity to provide supplies at lower costs than those of the natural resource, producing the effect known as "backstop technology". In the case of extractive resources used as food, domestication would seeem to be the path to be followed.

Another aspect that should be considered in extractive economy refers both to scant price-elasticity in demand and to scant profit-elasticity in demand for the majority of extractive products. The transformation of some products of an extractive origin into "ecological symbols" or setting up artificial barriers (green products, industrialization, souvenirs, etc.) may lead them to have a short-term novelty value. Even so, if the market suggests a significant growth potential, inducement to domesticate the product will be inevitable. In addition, such an outlet for extractive products would appear to be a limited solution affecting only a small portion of the population in specific areas.

From the theoretical standpoint, it is probable that a significant response of extractive supply in the short term will not be accompanied by a proportional change in the demand curve. A drop in the price level, vis-à-vis demand inelasticity, may lead to a drop in profits for extractors.

The relationship of the price of products and factors between the various sectors of the economy also affects extractive economy, independently from the perception of the extractor. The present trend towards agriculture by the rubber tappers, for instance, is very closely dependent on the price relation between agricultural product / extractive product.

If the price of the agricultural product rises proportionally more than the extractive product, the extractor will tend to locate activities in the transformation curve, with greater emphasis on agricultural activities (P1) (Figure 5). On the other hand, if the prices of extractive products rise proportionally more than agricultural products (Po), the extractor will tend to devote more time to extractive activities. Policies aimed at facilitating plant extractivism, such as the emphasis which is being given to extractive reserves with the creation of captive markets and investment in social infrastructure, may favour the price relation to the benefit of extractive produtcs in the short-term. In the medium and long-term, the doubts remains whether the conditions provided by these policies can be maintained, added to market limitations.

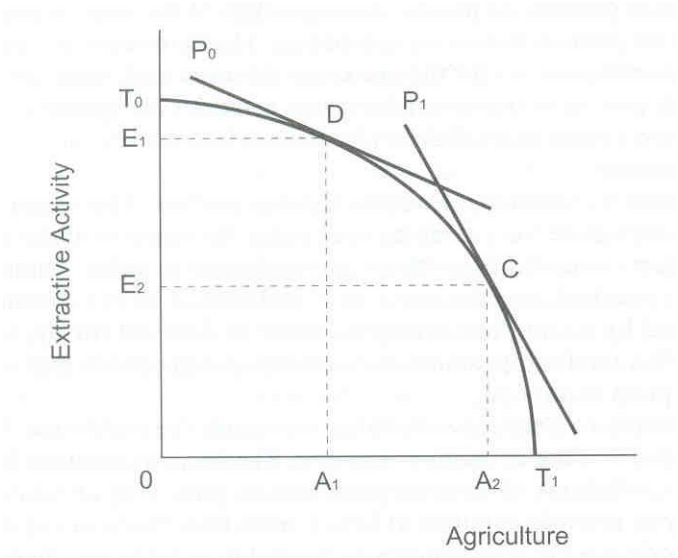

Figure 5- Effects of changes in the agriculture/extractive price relationship on the entire activities of an extractor.

Markets are the reason for the existence and disappearance of extractive economies. The transformation of a natural resource into an useful or economic products is the first step in an extractive economy. However, as the market becomes larger, the forces which cause its decline also increase. The limited supply capacity of an extractive product brings about the need to cultivate domestic plantations or to discover synthetic or other natural substitutes.

4- THE IMPORTANCE OF DOMESTICATING EXTRACTIVE RESOURCES

The domestication of extractive resources started right from Neolithic times, ten thousand years ago. It has been estimated that from that time on, 3.000 species, found primitively in Nature, were progressively selected, adapted and cultivated. Of these, barely 100 species of

plants are cultivated on a wide scale and they support rural production and the innumerable activities that complement each other. In the Amazon region and other tropical areas, the domestication process is an ongoing phenomenon. It is timely to analyse this process now - for the majority of cultivated plants, this information has been lost in the memory of time.

Depending on the product the domestication process has some distinct characteristics:

Extractive products with great economic importance
In this case the inevitable path is domestication or the discovery of synthetic substitutes when product scarcity is verified, inelasticity of supply and growth in demand. Those extractive products that have elastic demand or control of the markets have more chance to be domesticated, due to the possibility of appropriating the producer surplus. The domestication of jaborandi (*Pilocarpus microphyllus* Statf.) and the beginning of the domestication process for fava danta (*Dimorphandra gardeniana* and *D. mollis*) by Merck can be stated as examples of this case. Thousands of plants and animals domesticated by humans in the last ten thousand years also fall into this category.

Extractive products without the possibility (need) for immediate domestication
Many extractive products, due to the long time periods and elevated costs required for their reproduction will hardly every attract some interest for their domestication in spite of their economic importance, as is the case for babaçu palm and tucum (*Bactris setosa*, Mart.) or the planting of jacarandá-da-baia (*Dalbergia nigra*), that will either be substituted by other alternatives or be abandoned. Those extractive products with large stocks, such as timber resources, açaí, Brazil nut, babaçu and even the rubber tree also fall into this category.

Extractive products without a defined economic importance
In the Amazon region, for example, of the hundreds of wild fruits which exist, only some will suffer the process of domestication due to their possible economic potential. While available stocks exist or compensate for the workforce required of harvesting the fruit, the extractive activity may perpetuate at least until some external force affects this balance.

Conspicuous extractive products
The importance of the extractive product in this case results from some indirect use for pleasure, well-being, environmental awareness, among others. Green products fall into this category, but it is quite probable that with continued growth in markets, forces for their domestication, when feasible will come into effect. In the same way as Giffen goods exist, that is much less inferior than a fall in prices, induces a reduction in the quantities demanded, the Veblen goods exist where the value occurs from scarcity and from the very high prices.

The domestication process does not happen in a uniform manner for extractive products. The most important reason for domestication resides in the advantages of reductions in the cost of production and increased productivity of land and labour. In addition to practical advantages, these factors make it possible to break the rigidity imposed by the extractive sector's lack of elasticity in supply which, in addition to the limitation fixed by stocks, depends almost exclusively on the movement of manpower to increase extraction. This

aspects makes it unfeasible to respond to the growth of demand in a long-term perspective. On the other hand, domestication leads to the production of an identical commodity of better quality than the extractive product. The quantity yielded by a given domesticated plant species can be produced in a much smaller area. Thus domestication of an extractive resource in the Amazon region has a positive effect on the preservation and conservation of its forest resources. With domestication, extractive resources are not valued, and this makes it possible for other more lucrative economic alternatives to be established, intensifying the destruction of natural resources.

The visible consequence of domestication is its capacity to widen supply, contrasting with the static or declining nature of extractivism. This makes the price level of the product fall, also provoking a reorganization of the production factors and contributing to plant extractivism becoming an unprofitable activity.

The analysis of the effect of domestication of plant extractive resources should also cover the effects of distribution. As the change are slow, two distinct groups have formed: one devoted to the extractive sector and the other to cultivating the extractive product in a rational way, using available technology for domestication. Figure 6 shows two groups offering the same product. This graphic illustration consists of an adaptation of the Evenson (1983) model to analyse the benefits of disseminating agricultural technology among two regions.

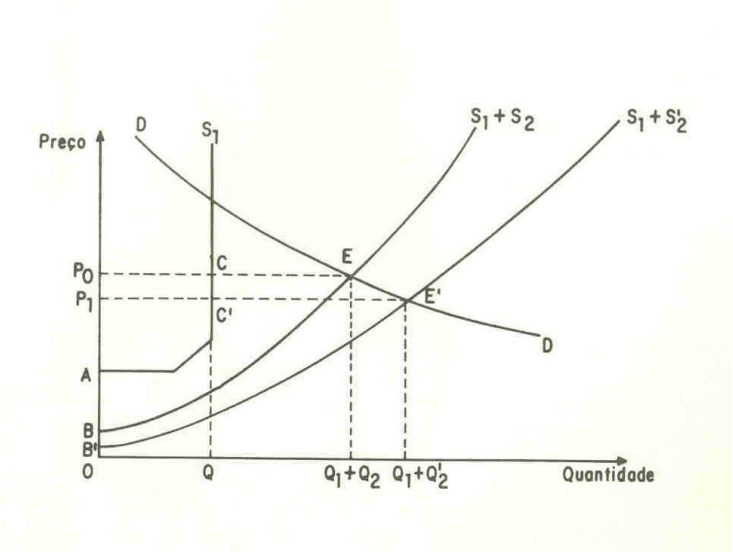

Figure 6- Model of the disequilibrium that is established between combined supply of a forest product (from extraction plus cultivation) and demand (adapted from Evenson, 1983).

Curve S1 is the curve of the supply of extractive product, and is perfectly inelastic: S1 + S2 is the joint supply curve of the extractive product, together with the domesticated one, with a predominance of the latter and curve DD is the demand for the product. Balance of the initial prices Po, to which the extractors supply Q1 and domesticated production the quantity Q2.

While the technology used in cultivation remains unchanged, or in a short and medium-term situation, the supply curve of extractivism tends to remain inelastic and move towards the left. Exhaustion and depredation of reserves lead to a decreasing participation of extractivism in the market.

With increasing technological skills of cultivators, greater quantities will be offered. The joint supply curve for S1 + S2 moves, the price falls por P1, the quantities supplied by the extractors remains statics as Q1.

Although, in the case of the majority of extractive products, the domestication process has already taken place, in the Amazon the phenomenon is still in process. Many extractive products of the Amazon region have already been domesticated and become important agricultural products in their new areas [(rubber, cacao), chinchona (*Chinchona calisaya* Wedd. and *C. ledgeriana* R. et P., quinine), etc.], others are cultivated in their own region [guarana (*Paullinia cupana* HBK, Brazilian soft drink], urucu (*Bixa orellana* L., dye), coca (*Erythroxylum coca* Lam., cocaine), jambu (*Wulffia stenoglossa*), malva (*Urena lobata* L.) and still others are in advanced stage of domestication. Some examples are native fruits such as cupuaçu [*Theobroma grandiflorum* (Spreng.) Schum], peach palm (*Bactris gasipaes* HBK, an edible fruit), açai, bacuri (*Platonia insignis* Mart., an edible fruit), tucumã (*Astrocaryum tucuma* Mart.,fruit), camu camu (*Myrciaria dubia*), etc. toxic plants such as the timbó, aromatic plants, such as rosewood, cumaru (*Dypterix odorata* Aubl.), medicinal plants, copaíba (*Copaifera duckei* Dwyer), andiroba, ipecacuanha [*Cephaelis ipecacuanha* (Brot.) A. Rich], jaborandi (*Pilocarpus microphyllus* Statf.) and other native forest species used for lumber.

The expansion of domesticated cultivations demands certain conditions, such as the availability of technology, a favourable demand for the product, the non-existence of substitutes (synthetic or natural), and the non-interference of extractive stocks. The presence of large stocks of extractive products, very often leads to domestication taking place in region outside the dominion of extractivism or being barried out by farmers who are not overly fond of extractivism. The paradox is that in the final phase, very often the presence of domesticated crops in the extractive areas may help to maintain plant extractivism, in the short term. The convivence of erva-mate (*Ilex paraguariensis*), with its cultivation, which occurs in the State of Parana, with the predominant supply from extraction, or the predominance of supply from plantations, which occurs with rubber, is related to available stocks, profitability, competition from other alternatives, among others points. For the case of erva-mate, the extraction of this herb is in a phase of disintegration. While in the past its extraction was destined for export, since the crisis of 1931, it has been exploited for national markets and in the contemporary period, its sustainability depends on the production of food crops and domestic animals and because of the absence of another activity which could occupy this economic space (Yu, 1988)

With funding from the British Goverment, the Goeldi Museum of Para State has been developing the domestication of pepper (*Piper hispidinervium).* This plant is native to the State of Acre and its characterized by the presence of safrol in its leaves, an oil with uses in

the perfume industry and for organic insecticides. With the decline in the extraction of sassafrás [*Ocotea pretiosa (*Nees) Mez.], in Santa Catarina and Parana, and cutting prohibited since 1991, interest has been re-kindled in a substitute plant which contains safrol. In its natural state, the density of *Piper hispidinervium* is very low, which makes its extraction unprofitable in commercial terms. In the case of *Piper hispidinervium*, the domestication process is passing through an extractive phase. This also proves that not all natural resources are appropriate for an extractive economy.

Domestication is also occuring with jaborandi, which produces an active ingredient called pilocarpine, which has no synthetic substitute. The jaborandi market has been a monopoly of Merck, which has been developing a plantation of 300 ha (7 millions plants) in Barra do Corda, Maranhão State. Merck has found difficulties with extractive harvesting of this product due to the recent competition with the use of jaborandi for shampoo. Recent publications are beginning to discuss the domestication of ipecacuanha, found in Rondonia State, from which is extracted ementine from its roots. This plant is being tested in Darjeeling, India (Franz, 1993). This indicates that there is no reason for the Amazon to be just a storage house for genetic resources, but on the contrary, it is more probable that many plants will follow the same route as chinchone, tomato, potato, rubber, cacao, guarana and many other native plants of the region.

For this to take place, greater efforts must be made which aim to domesticate present and potential extractive resources. Only in this way will it be possible to meet the demands of market growth, offering products with improved quality at lower costs, and increase the productivity of land and labour. It is through domestication that will be possible to create real market opportunities for the groups of people which live from extractive activities. For some products, of course, one observes complete disregard for domestication considering the abundant stocks of some products or the long time periods required to begin production. This is the case of the oil palm babaçu that has been substituted by other vegetable oils, other synthetic detergents and labor competition for other activities. The protection of these resources demands the creation of economic alternatives for this contingent of the population.

5- MANAGEMENT OF EXTRACTIVE RESOURCES

For many extractive resources, both those which annihilate and are collected, extraction should be undertaken in the most rational manner possible, being careful not to exceed the carrying capacity. It must be remembered that rational management doesn't guarantee existence "*ad infinitum* ", since this is determined by the economic relationships between the many sectors of the economy. In general, for extractive resources which are found in large quantities, such as wood, Brazil nut, babaçu and açai palms, efforts to guarantee rational/sustainable extraction must be made. This will insure that the extraction may continue for a long period, as well as guarantee the conservation of natural resources. For some extractive resources, such as the açai palm in the State of Pará, managed extraction for the gathering of fruit has resulted in a more homogeneous forest, and consequently increased the productivity of land and labour. As this is far from being the general rule, extraction of other products may lead to their disappearance and a loss of genetic resource.

Extraction from the native rubber trees, despite the efforts of environmental movements, has shown decreases in the amounts of latex extracted from native stands. In 1990 for the first time, production from rubber plantation was greater than extractive production. The low productivity of land and labour, in relation to the present minimum wage is more responsible for the stagnation of rubber extraction, than the expansion of domestic plantations, and induces the planting of annual crops. Even though only 1/7 of the rubber stocks available in the extractive areas is effectively under exploitation, as shown by surveys carried out by FUNTAC (1990), it is unlikely that the extraction of rubber can suffer a sevenfold increase. Limitations of family labour, or increased population density, end up making extraction unprofitable. In the case of cultivated rubber trees, relatively low productivity, due to the prevalent level of technology is still a great limitation in terms of economic viability.

In the case of açai palm that suffer twofold extractivism (fruit and palm heart extraction), the fruit market growing is bringing homogeneous process of açai palm stocks in Amazon estuary, in areas near Belem and reducing the palm heart extraction. The consequence of this homogeneity stocks with the growing fruit market should be better evaluated. With the valorization of açai fruit in this last ten years, had tendency in the sense of thickening of this specie and as indirect consequence, for instance, in the destruction of male trees of buriti (*Mauritia flexuosa* Lin.), judging unnecessary. The fact that in this extractive areas, that suffer daily flooding the pressure for agricultural purpose was less, allowing the açai palm stocks regeneration.

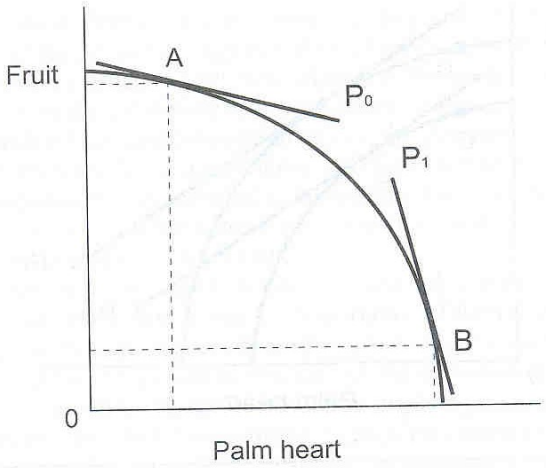

Figure 7-. Effects of changes in the price relationship extractive products on the entire activities of an extractor.

As can see in the Figure 7, the extractor face actually with the opportunity to gather fruit or palm heart, depending on relative price of this two products and the labour cost. In the nearest areas from market and easy transport conditions the fruit extraction reveal more profitable and advantageous. The relative price devaluation of palm heart become in the principal factor that is carrying the conservation of açai palm stocks in comparison the restrictive environment policies that hadn't sucess.

The management of some extractive resource associate with improvement of infrastrucuture eliminating some constraints can increase technical and alocative efficiency. In Figure 8, the point D displays both technically and allocative inefficiency, C displays allocation efficiency both technical inefficiency, B displays technical efficiency but allocative inefficiency, and A defines the points of economic efficiency.

In areas far from the markets and have transport difficulties, the palm heart extraction become more advantageous. In the face of great disponibility of açai palm stocks and that could be enlarged by means of management, it is probably that the growing fruit market cannot bring to domestication process at moment. One possible scenery in future for the domestication of açai palm is related the growing market for palm heart, in the plantation developed in Central-South of Brazil. Even in the case of products which have large stocks, the appearance of domesticated plantations may occur to meet the needs of certain specific markets that have comparative advantages.

Stocks of extractive resources which have not yet been incorporated to the extractive process, or show economic potential (patuá, buriti, timber, etc) which may be exploited by an extractive form of "colonization" must be made with care. The environmental damage, although less than of agricultural activities, may end up being similar in the long term.

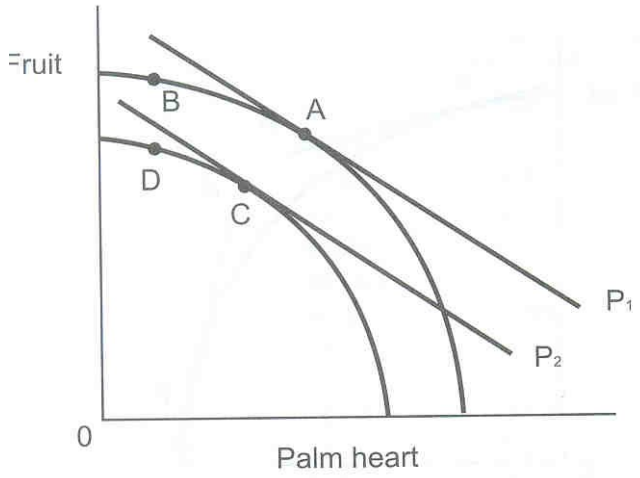

Figure 8- Possibilities for managing extractive resources to increase their frontiers of productivity and efficiency.

To begin the management of açai palm requires labor, maintenance and rational gathering of the fruit. Its become usual to extract palm heart at the start to clear the area and give some initial capital for management. The amount of labor necessary requires the engagement of temporary workers, with the appropriation of economic surplus by açai palm owners. The communal property for administration of açai palm stocks through extractive reserves or another associative form, without definite land tenure title, will be attractive only if there is a menace for land appropriation, and the development of transport and processing, to solve the labor shortage and leadership problems becomes possible. At the moment, the theft of açai fruit by neighboring and unemployed people dwelling in the villages has become routine in the main extractive areas. With the gradually growth in the açaí market for fruit it is probable that large areas of the Amazon estuary is going to transform into homogeneous stocks of açai palm along the rivers. Besides the other anthropogenic transformations carried out in the last two and half centuries (wood extraction, channel opening, extraction of other extractive products etc.) the process of promoting the growth of homogenous stands of açai palm, and the effects of this in relation to biodiversity should be studied more closely. Even though this activity causes less environmental damage in areas where agricultural pressure is low and where natural resource constraints occur in upland areas. It has been a mistake to analyse the extractive economy from only a static point of view and in an isolated perspective, forgetting the dynamics, transformations and interrelations over time.

6- CONCLUSIONS

An analyse of the different extractive products that were domesticated in Brazil and in particular in the Amazon, suggests that when the markets are small, extractive activities have the conditions to survive. But as the markets grow and the supply from the extractive sector becomes unsatisfactory, and in view of available technology and favorable prices, the domestication process begins, which then results in the collapse of the extractive economy. This process of domestication, has always tended to be verified among those

who are not dedicated to extraction in general, and outside the area of influence of the stocks of these resources.

The emphasis on plant extraction has been one-sided in giving attention only to the sector itself, forgetting the importance of domesticating these resources as a means of protecting biodiversity, and secure new economic alternatives, employment and growth in demand. As the domestication of extractive resources is antagonic to the permanence of plant extraction, policies contrary to this tendency must be avoided, even if this causes losses to the extractive economy, but provides benefits for the consumers. As a majority of the resources for agricultural research in tropical countries comes from international organizations and the developed countries, policies that attempt to favor extractive activities on their own, without giving attention to technological modifications, may cause considerable harm to the society.

For those extractive resources which have large stocks, such as timber, açai palm, Brazil nut and in part even the areas for rubber extraction, management is important to allow their extraction for greater time periods and increase the supply potential, with the least possible wastage. Certain proposals of an environmental nature, in creating captive markets for extractive products, impeding the domestication process, besides causing losses to the consumers, may have opposite effects on the efforts for the conservation and preservation of natural resources in the medium and long term.

Domestication, for many extractive products, may mean improved conservation of the natural resources, avoiding pressure on their stocks. This is occurring at present with jaborandi. In other situations, the domesticated genetic resources show greater ranges of variation, which is the case for beans.

The extractive economy is subject to transformations which stem from the extractive economy itself and from other economic activities in which it is found, in a co-evolutionary process, considering that this sector is not stagnant. The technological transformations and the global economy also tend to affect the extractive economy, terminating in some situations, in that during the final phase, this sector remains to pull along other sectors such as agriculture.

A large part of the Amazon population involved in extraction of plant resources, also dedicate time to agricultural activities. The allocation of time to extractive activities depends on the products to be collected, the accessibility of the resources, their compatibility with the agricultural calendar and the price relationship between agricultural and extractive products. In the Amazon case, the consequence of prohibiting forest clearing and burning has resulted in a relative increase in prices for annual crops, mainly food crops. This has made many people involved in extractive activities to see better possibilities in the production of food. Extractive activities in this case are no guarantee to avoid deforestation, as this depends on the economic situation of the producer. *Even the end of extractive activities doesn't necessarily mean an end to the forest*. Therefore it becomes important to provide incentives for agricultural systems which involve, annual and perennial crops and livestock in areas where extractive activities dominate. This is a way to guarantee their

spatial and temporal permanence, reduce levels of deforestation in primary forest, increase income and guarantee the supply of basic foods.

The extractive economy, because of its characteristics of low productivity of land and labour, and given the dispersion of extractive resources means that the process of domestication is inevitable if the market shows perspectives for growth over the long term. In the same way, considering extractive activities as an option for uncleared areas is also unconvincing due to the fact that a great majority of the rural population do not have personal aspirations to dedicate their life exclusively to extractive economies.

Many extractive products diminish in quality due to the processing used, the degree of perishability (mainly food products), the need to include some form of industrialization, besides the wastage during collection and processing. In addition the need to use sub-products generated during extraction, processing and industrialization. The distances in relation to the markets inhibit greater use of the açai fruit, in spite of the large stocks available, due to the absence of an adequate technology. Extractive resources can be characterized by the great variety of products and low quantities per product or few products and great quantity per product, that usually have specific characteristics in relation to the economic viability of extraction and commercialization. Each extractive products has specific characteristics, which makes it unwise to make generalizations.

It is mistakenly believed that extractive reserves are an important means to avoid deforestation in the Amazon. The act of forest clearing is closely related to the economic situation of the extractor. The fall in rubber prices, for example, in relation to agricultural products lead to a process of “agriculturalization” in the areas of rubber extraction in this period. If the economic situation improves it is quite probable that the rubber tappers and other extractors will have a tendency toward raising cattle, which is a tendency among small-holders farmers.

Deforestation occurs as a process of occupying the land and from the beginning is linked to the family life cycle. Even though deforestation can continue throughout this cycle, it is more intense in the first few years. This procedure ensures title to the land and allows a considerable stock of secondary vegetation to develop, which permits the maintenance of a migrant farmer and minimizes the long term costs of slash and burn activities to prepare the planting area. Cultivation in areas cleared from primary forest has greater agricultural productivity, almost no land costs, reduces the expenses of weeding, provides opportunities for the sale of timber, but as these areas are located in frontier regions, the disadvantages in relation to product prices, transport, costs and availability of labour etc. are present. On the other hand, cost of slashing and burning can be cut in half if the cultivation takes places in secondary forest areas which have greater access to transport as they are normally located in older frontier areas, demanded higher prices for products, and have greater availability of labour, among other factors. Among these disadvantages are decrease in agricultural productivity, higher costs for weeding, higher costs for land and the difficulty to have adequate periods of fallow as demographic density increases. Shorter fallows periods can lead to a situation were the use of the land for agricultural activities may be unprofitable if no technological advances are introduced.

As a large part of the extractors also carry out clearing of the primary forest, to use for agricultural activities, a component of the research is related to the use of secondary vegetation. Processes which accelerate its regeneration, enrichment with tropical wood species, among others, are important to reduce the incorporation of primary forests into the productive process. In this manner, for the global view, if the objective is to try to reduce the deforestation and burning of the Amazon's primary forest, there is need to analyse broader public policies that favour the use of secondary forest areas of Amazonia.

Labour laws and the social benefits achieved have had an effect on rural labour in Brazil, principally in the Amazon, where there are two costs. For those hiring labour it has become more and more costly as employees are obliged to pay the minimum salary, and those who receive this salary it is very little. For those that voluntarily dedicate their time to extractive activities, end up having to accept incomes below the minimum salary, which justifies the maintenance of these activities, for the simple fact that other economic alternatives don't exist. The gradual disapperance of rosewood extraction, besides the exhaustion of more promising stocks close to waterways, took place mainly due to a lack of interest (on the part of those extracting the product and their bosses). Labour laws gave many legal advantages to the workers which has made extractive activities quite risky for the employer when it comes to paying salaries (including overtime hours, occupational hazards etc.). This has meant that rosewood, despite the abundance of reserves in headwater regions of the rivers the number of extraction plants has declined from about 50 in the decade of the seventies, to only 5 today.

With the exception of the logging sector, the extraction of forest products can be characterized as being labour intensive, the reason why their survival depends on the existence of marginal or low cost labour. Labour intensive activities that don't manage to evolve technologically, either increasing the productivity of land and labour or processing of the product, have difficulty surviving when labour costs have real increases. This phenomenon is not exclusive to extractive activities, but to agriculture itself, as is occuring with the disappearance of jute (*Corchorus capsularis* L.) and malva cultivation in the Amazon.

Competition with other sectors of the economy is another variable that affects the extractive economy. Public policies for the extractive sector, must involve goverment investments in social infrastructure such as education, transport, roads, etc. to improve the quality of life in these areas. In this manner, one can't discard the hypotheses that improvements in educational opportunities, the creation of new economic alternatives, population growth, increase in land values due to the restrictions in supply resulting from the support to extractive activities, improvements in social infrastructure, may terminate provoking the disintegation of the extractive economy over the medium and long term. Thus, while in the past plant extractivism drained manpower from agriculture, today it is the reverse, and it is agriculture that is draining manpower from extractivism.

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