

PLANT EXTRACTIVISM IN THE AMAZON: LIMITATIONS AND POSSIBILITIES

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The political dimension of plant extractivism

The repercussions of the assassination of the trade union leader Chico Mendes on 22 December 1988 led to the consideration of plant extractivism and extractive reserves as a paradigm for agricultural development adapted to the Amazon.

The wide support received from national and international public opinion, international organizations and particularly Non-Governmental Organizations (NGOs), both national and foreign, overshadowed the possibility of any scientific, technical and socio-economic discussion taking place on the subject. Political and anthropological convictions took on more clearly defined shapes, in which plant extractivism and extractive reserves were used as a means for criticizing Brazilian environmental policy and the felling that was then taking place (Maxwell 1991; Margolis 1992).

The impression at the time was that world media and extra-Amazonian public opinion had discovered plant extractivism. Seemingly forgotten was that -

like the fabulous Phoenix, the mythological Egyptian bird which after burning arose from its own ashes - this activity has been carried out from the time the human species appeared on the face of the Earth. In biblical terms, the first apple that Adam and Eve ever tasted in Paradise was an extractive apple, and Paradise was probably not in a tropical region.

In my opinion, the assassination of Chico Mendes had two important repercussions. The first was to call world attention to the Amazon, stereotyped at the time as if a great fire was consuming the whole region. The news figured prominently in the press and other media all around the world, the blaze of press interest in part fanned by the processes that led to the United Nations Conference on Environment and Development held in Rio de Janeiro in June 1992. The most important repercussion, as I see it, was the interest and activity that was sparked off in a whole set of complementary forces concerning the importance of ecological issues.

During the 1970s and 1980s, the Amazon went through a 'tragedy of the commons'. The natural resources of that vast region appeared to be 'free goods', such as air, as if they had no cost, available for the first comer to take. The

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ecological issue transformed the situation of 'tragedy of the commons' into another concept in natural resources theory, known as the 'prisoner's dilemma' - in order either to preserve or to degrade natural resources, society must be in agreement.

It should not be forgotten that the Amazon supports a population which depends, directly and indirectly, on plant extractivism for its survival. These people are not at fault because they live on plant extractivism. As far as possible, the State would have to take responsibility for meeting their needs in terms of education, health, highways and other social benefits. Given this requirement, it would appear somewhat imprudent and unrealistic to consider this option as a paradigm of suitable development for the Amazon.

In my view, plant extractivism constitutes a rather weak basis for development, one that finds its justification in the level of poverty of the inhabitants and the market for marginal manpower. It is an economy that is dying out, doomed to disappear, faced with an increasing market for processed products, salary policies vis-à-vis low soil and manpower productivity, population growth, the appearance of other economic alternatives, among many other factors. The situation today is such that scarcely any households buy bananas, lettuces, mangos, coffee or cotton of extractive origin: along with thousands of other products, these have all been domesticated over the last ten thousand years (Homma 1992a, 1992b).

It is not an assassination that will kill off the extractivist economy, but rather the market economy that will finish it, in silence. The problem of the rubber tappers arises more from problems of an agronomic and economic nature than from ecological ones. Any attempt to

support plant extractivism would only prolong the agony. Each extractive product has its own features, and it is dangerous to make generalizations. However, it cannot be ignored that micro-economic sustainability does not guarantee macro-economic sustainability: one sustainability affects the other, and vice-versa.

Under the cover of this concept of extractivism, the 'Indian strategy' of harmonious cohabitation with nature has also been touted as an 'ideal' option for the Amazon, neglecting the fact that indigenous economies tend to fall apart when entering into contact with the contemporary market economy. One positive effect of the Paiaka episode was the explosion of this china-shop of myths, bringing to light the interplay of economic, political and even ecological interests, together with artificial privileges.

The same goes for extractive reserves, where there exists a fusion of interests. Lack of knowledge on the part of external financing agents as to the limitations of plant extractivism may lead to future frustrations or to 'extractivism' being used as a mechanism for exerting pressure. In this respect, it is obvious that extractive reserves have been transformed into a 'Sword of Damocles' in the Brazilian environmental issue, where plant extractivism in itself is not under discussion, but rather how the Amazon must be managed in order to suit the international ecological community.

Over a period of five years, the proud claims for extractive reserves and plant extractivism have increasingly given way to terrible problems of economic sustainability (Conselho Nacional dos Seringueiros 1992). The paradisiacal vision of the rubber tappers living in a Nirvana-like world starts to disappear when faced with the same people's

hunger and misery. There has been an evident process of 'agriculturization' among the extractors, and decline in the leadership of these movements. As in an Orwellian tragedy, the extractivist movement seems to have crossed the horizons of the world, with claims to be the only model of sustainable development for the Amazon.

This cult to poverty, preaching a return to the past and denying the problems of today, is a demonstration of 'sustainable underdevelopment' for the Amazon. The defence of 'Neo-extractivism' is, to my way of thinking, analogous to considering the way of life of the Inuit or that of the Tuaregs. While the Inuit have shown the world that they are able to live in inhospitable conditions with cold and ice, the Tuaregs manage to live in a very hot environment lacking water. However, these two peoples will find it difficult to achieve any increase in their quality of material life or to evolve with changing circumstances.

The very concept of extractive reserves has undergone changes since it was launched during the second half of the 1980s. From the utopian dream in which the rubber tappers would be able to live exclusively off extractive rubber tapping, its proponents went on to claiming higher and exclusive prices for extractive rubber of extremely poor quality and for a captive market (Instituto de Estudios Amazônicos 1991). Attempts were made to use other extractive species fully, to find technological solutions, to increase the size of native forests, and to seek native species that supposedly had properties able to cure various sicknesses, such as cancer and Aids. Efforts were made to promote the industrialization of extractive products and the implantation of agroforestry systems - two trends that have taken on greater prominence during more recent discussions (Ab'Saber

1992; Allegretti 1989, this digest; Oliveira 1991).

There is a risk of coming out of one utopia and entering another. There is no doubt that industrialization or increase in primary benefits of some extractive products could give them an added value, but it should be borne in mind that these are limited solutions, of limited scope in both geographical and market terms. A similar remark can be made when considering agroforestry systems as the new panacea for the Amazon, leading to an 'extractive reserve without extractivism'. One of the best commercial examples of agroforestry systems in the Amazon is that managed by some two hundred Japanese-Brazilian colonizers in Tomé-Açu, which was a result of various transformations that took place over more than six decades of experience. The major difficulty with agroforestry systems is the market for the products involved, because a fraction of the area would be sufficient to saturate local, regional and even international markets for perennial crops. In addition, agroforestry systems require a more intensive use of human resources, capital and management. It is very likely that the less competent will have to work for the more competent and that only a fraction will manage to evolve into productive agroforestry systems. This supposition is based on the fact that in the Amazon, the tappers, the *caboclos* and the colonizers have always shown a tendency to repeat the practices of their forefathers or of their countries of origin, in the same way as Robinson Crusoe, the character in Daniel Defoe's book. This problem is shared by the whole of agriculture in the Amazon.

Plant extractivism has also been given new names in order to comply with the philosophical context in which it has been placed: traditional extractivism, pure extractivism, modern extractivism,

advanced extractivism, extractivism of non-timber products and even complete changes, such as one of the now most common denominations - 'eco-development reserves' (Acordo Sudam/UNDP 1991). The present backwardness and poverty of extractivist populations and their neglect by governmental institutions (due to lack of political astuteness in catering for the needs of these populations) is criticized, overlooking the fact that this is a result of the very process of change itself. At the international level, the idea of extractive reserves is also being implemented in various countries, sometimes within the context of efforts seeking to reconcile conservation and sustainable development and under exotic names such as the 'biosphere reserves' sponsored by UNESCO.

In February 1992, the Brazilian government, faced with the pressure exerted by NGOs and the critical situation of the rubber tappers, in addition to the proximity of Rio 92, presented an emergency programme for extractive reserves. This document is no more than a testimony of the lack of economic feasibility of plant extractivism, showing that it is unable to stand on its own. In this way, extractive reserves turn into a programme supported by public funds and external financing. The programme deals with these populations as if the only alternative is heavy investment in education, health, and economic alternatives, among others. The consequence is to create inequity for a reduced number of people who are supposedly protecting the forest, while thousands of small farmers will be classed as criminals and will be omitted from receiving such benefits and advantages. Under this concept, extractive reserves will become an instrument for integrated rural development of the populations that earn a living from extractivism. Another consequence will

be the proliferation of dozens of extractive reserves as a way to guarantee such facilities, creating an artificial environment and restricting liberties which have been obtained with much sacrifice. In this respect, the interests of extractivists in extractive reserves arise far more from the lack of governmental attention to basic social services in the rural environment.

This contribution does not intend to draw a fatalistic picture of plant extractivism, but rather to show the other side of the picture, as described by Euclides da Cunha at the beginning of the century. The level of poverty has remained unchanged to the present day, in spite of contributions made in the past (Mendes 1991). From the onset of the Chico Mendes myth, plant extractivism and extractive reserves have become the 'magic cube' or kaleidoscope, where the interplay of interests, pressures and utopias have tended to cause prejudice to the entire Amazon population. Its followers have disseminated the illusion that extractive reserves are indeed a suitable solution for the development of the Amazon and that the future could be 'different' for extractivists (Browder 1992; Torres and Martine 1991).

I wish to stress that I have nothing against plant extractivism and extractive reserves. I understand the extractivist economy as one that forms part of the development process, but consider that it is doomed to gradual disappearance. The extractivist economy carries within itself the very seeds of its own destruction, just as the mythological serpent is self-destructed by devouring its own tail. There is an extractivist population that, as citizens, have every right to aspire to improve their quality of life. They are the only ones who have the right to decide on their destiny and future. The preaching of a return to the past, just as

Rousseau did in his '*beau sauvage*' (noble savage), to comply with a mental model elaborated by some in developed countries, is cynical and may well lead to losing the support of Amazonian society itself.

It should not be forgotten that 16 million people live in the Amazon, with every right to aspire to health, education, sanitation and employment, among others. Half of this population already lives in urban centres, thus increasing the pressures on the rural population to feed both itself and the city dwellers. It will be difficult to achieve this through extractive reserves. In 1991 the GNP of the Legal Amazon was equivalent to US \$22.3 billion, which would be difficult to substitute by inherently extractivist activities. Some argue that the greatest wealth of the Amazon is its biodiversity. But in order to transform biodiversity into wealth, enormous investments and technology will be necessary. It is no use just being a stockroom for genetic resources. Components have to be discovered, analyzed, and domesticated; plantations have to be made rationally; laboratory synthesis has to be carried out; production has to be done on a commercial scale; testing has to take place. It is almost impossible for a developing country to afford these investments.

The present contribution is a condensation of various articles that I have produced since the early 1980s. My intention is to contribute to discussions taking place in world academic fora on this subject. My position has been consistent since the first articles were published. I take a certain satisfaction in the recent increase in the number of research workers who are analyzing plant extractivism and extractive reserves with a more critical eye. I hope that within the next ten or twenty years, these realities

will come to light. I may be wrong, but so far, the arguments that have been presented and the theoretical vision shown have not convinced me to change my position.

In the Amazon, part of the population carries out mining activities or collects garbage in order to survive. Half of the population of Belem lives in swampy areas. It is possible that under these conditions, it would indeed be preferable to maintain the populations that are living off plant extractivism, avoiding urban migration. I fully agree with this, except for the fact that these populations are but a small fraction and it is necessary to consider the Amazon as a whole. The prohibition of tree felling just for the sake of prohibiting, in order to reach 'zero felling' and please the international ecological community, already imposes a heavy social cost on the Amazon. This does not mean that I recommend that we need to 'fell trees for the sake of felling' but it should not be forgotten that there are nearly 500,000 small farmers who need to fell trees for their survival. It is in this perspective that the question of extractive reserves should be considered. They have their importance, on a restricted scale, for certain areas, for small populations, within a short or medium term horizon, as a way of 'buying time', until other economic alternatives arise.

This contribution presents a theoretical discussion of the extractive economy with a neo-classical focus. Over three thousand plants that have been domesticated (in addition to dozens of animals), which constitute the basis of world agriculture, have followed precisely this same path. Even in the Amazon region itself, examples of the tens of species that are being domesticated include *cacao* (*Theobroma cacao* L.), *chinchona* (*Chinchona calisaya* Wedd and *C. ledgeriana*

R. et P.; quinine), *coca* (*Erythroxylum coca* Lam.; cocaine), rubber tree (*Hevea brasiliensis*, M. Arg.), *urucu* tree (*Bixa orellana* L.; dye), *guaraná* (*Paullinia cupana* H.B.K.; Brazilian soft drink), *cupuaçu* (*Theobroma grandiflorum* (Spreng) Schum).

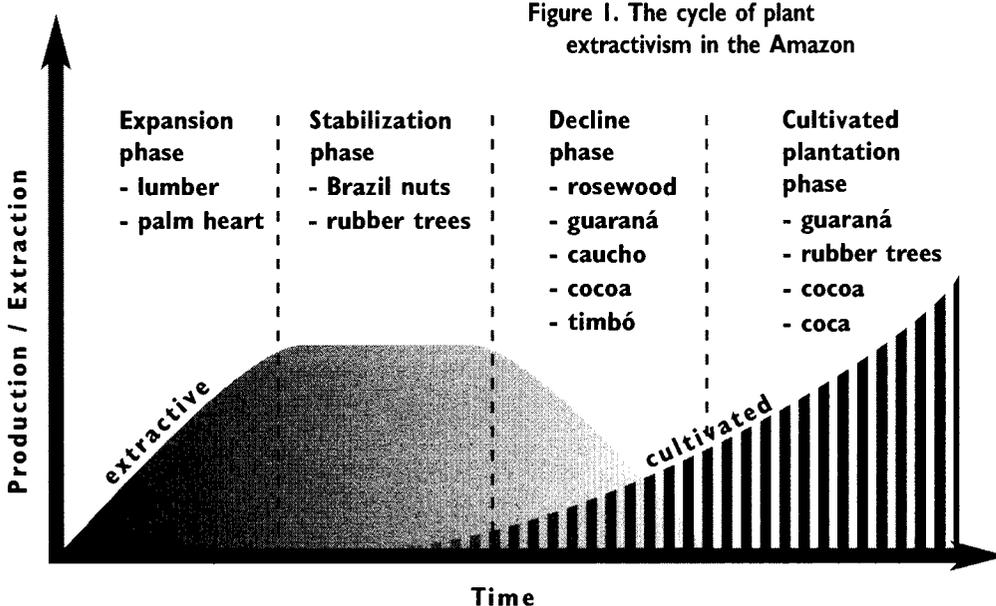
The theoretical dimension of plant extractivism

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, in which clear expansion of extraction may be observed, favoured by the existence of better reserves or by the monopolistic position that characterizes the market for a given resource. The extraction of lumber or palm hearts in the Amazon 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 measures for the extractivist sector could be adopted. In the case of rubber trees, for example, the prices for the internal market are already three times higher than those of the external market. An effort has been made to promote rational plantations and, paradoxically, attempt to delay the process of extinction of extractivism. The Brazil nut (*Bertholletia excelsa* H.B.K.) would appear to be reaching the stabilization phase.

The decline phase, caused by the reduction of resources and increases in the cost of extraction, leads to a grad-



ual 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 (*Aniba rosaeodora* Ducke) is an example of such a 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 synthetic) and the existence of favourable prices.

The length of these 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 (Figure 2). 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 rests on a relatively fragile basis, in which the economic component is the main 'Achilles' heel' or weakest point.

The wide support that the extractivist economy has started to receive, for example in terms of the 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 agri-

Figure 2. Sustainability of plant extraction in the Amazon

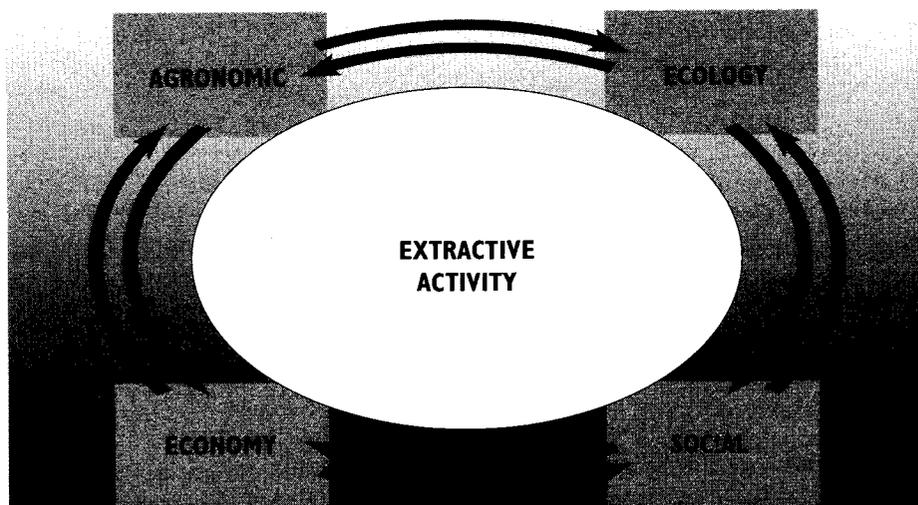
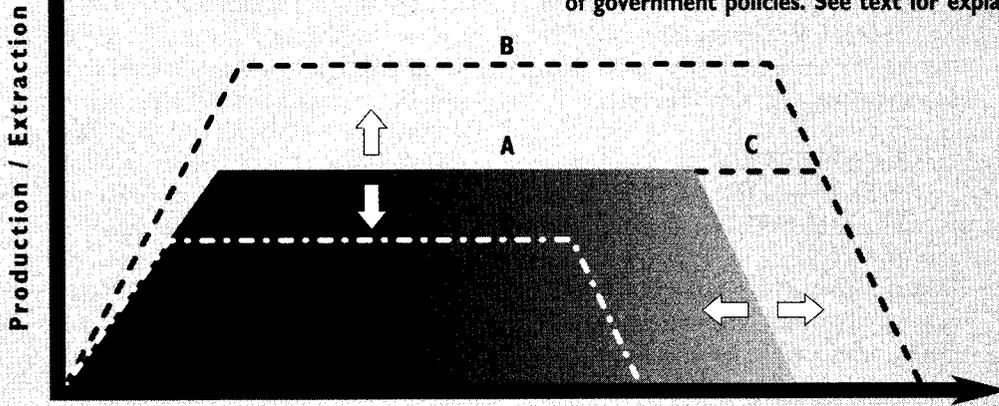


Figure 3. Possibilities of changes in the plant extraction cycle due to the implementation of government policies. See text for explanation



cultural frontiers, but this would not guarantee economic sustainability. Four theoretical possibilities can be envisaged (Figure 3). 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 duration 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 even be shortened. This could happen in areas with high migratory pressure, high demographic density,

Rose wood timber (*Aniba rosaeodora* Ducke, Lauraceae), being brought to the CIEX factory in Manaus for extraction of linalol.



D. Mitja

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.

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:

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

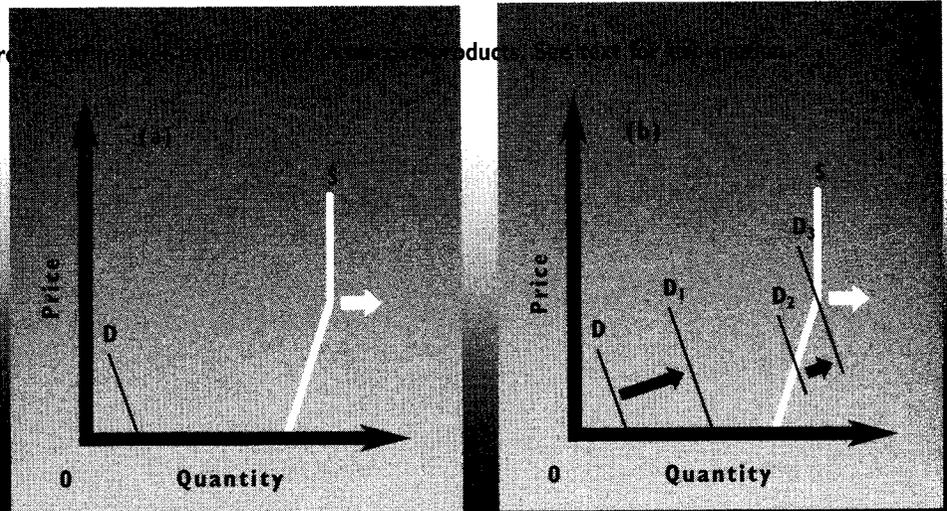
When the rate of this extraction exceeds the speed of regeneration, the natural consequence is gradual scarcity, until it becomes uneconomic to continue with the activity. Generally, when this level is reached, the damage caused to the species threatens its survival and may

lead to its local disappearance and even extinction.

- ◆ **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 channelling 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. The present process of expansion of the agricultural frontier and population movement towards the upland areas of dense forest, also have implications for the

Figure 4. The price and quantity of extractive products



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 palm tree *Euterpe oleracea* Mart, 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.

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 4a). The curves of supply and demand do not cross each other, once the extraction of resources is of direct use to the extractors themselves.

With the growth of the market, the demand curve (D, D1, D2, D3) gradually moves towards the right (Figure 4b), 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.

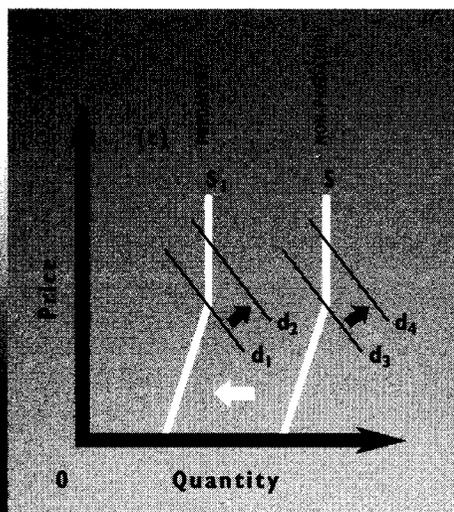
The end of the extractive process

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 4c), the supply (S) curve moves towards 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 to 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 becomes inelastic (Figure 4c), when prices have reached levels which are so high that the growth of demand (D3, D4) leads to domestic forms being encouraged and extractive species are abandoned, substituted by other activities or by the discovery of synthetic substitutes.

The extractive economy is placed within a much wider context than that in which it is traditionally analyzed. It starts initially with the discovery of a



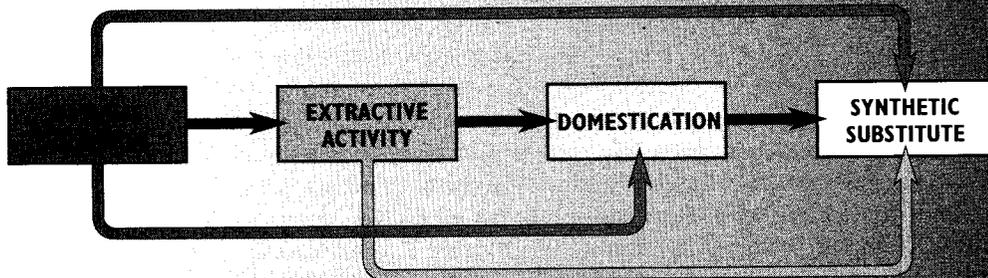


Figure 5. Possible ways of using a natural resource following its transformation into an economic resource

natural resource that presents an economic possibility or that would be useful to humans 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 5). 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 rose-wood, which went directly from extractivism to the synthetic product, or in the case of the 'timbó' (*Derris nicou* (Abul) Macbr and *D. urucu* K. et Sm., fish poison). With progress in biotechnology and genetic engineering there are increasing possibilities for the direct domestication or synthesis of natural resources 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 be possible right at the beginning, or if the stock of available extractive resources were to be very large.

Another aspect that should be considered in extractive economy refers both to scant price-elasticity in demand and to scant profit-elasticity in demand

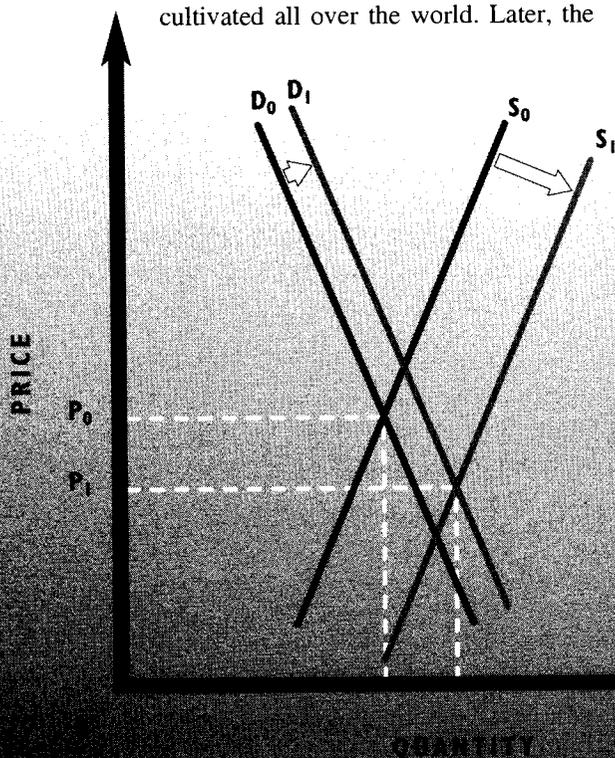


Figure 6. The effect of changes in supply and demand of extractive products in the short-term

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 (Figure 6). A drop in the price level, via a demand price inelasticity, may lead to a drop in profits for extractors.

The relation of the extractive economy to the economic system, where everything depends on everything else, should not be neglected either. During the last century, the beginning of rubber extraction was directly linked to responding to the needs of the foreign market. In this way, various extractive products have been connected through the market on a local, national and even international level.

The relationship of the price of products and of 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 products/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 7). On the other hand, if the prices of extractive products rise proportionally more than agricultural products (P0), 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

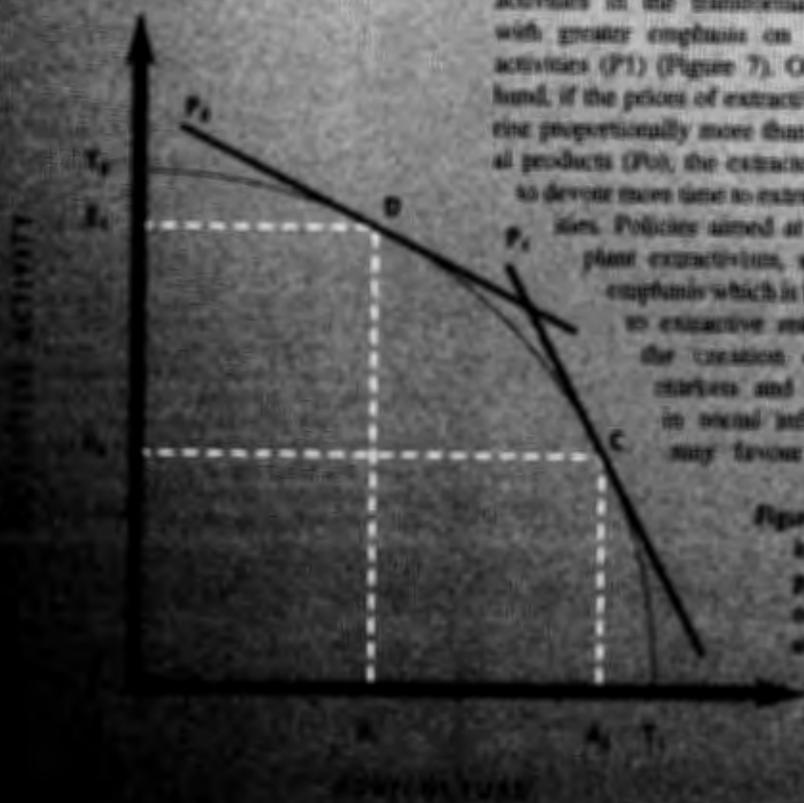
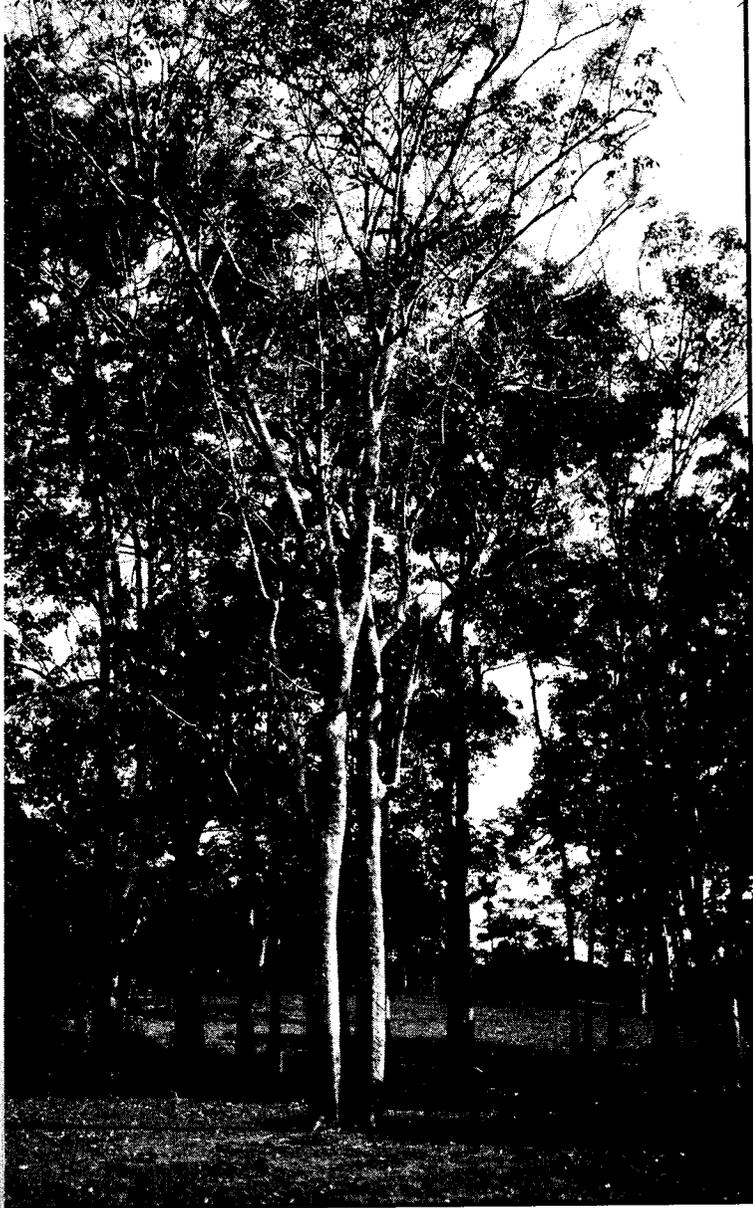


Figure 7. Effects of changes in the agricultural/extractive price relationship on the sectoral activities of an extractor



Small plantation of *Hevea brasiliensis* on the banks of the Rio Negro. The production from areas such as this complements that obtained from local populations.

relation to the benefit of extractive products in the short-term. In the medium- and long-term, the doubt remains whether the conditions provided by these policies can be maintained, added to market limitations.

The influence of domestication of 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, nearly 3000 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 (Heiser 1973). In the Amazon region and other tropical areas, the domestication process is an ongoing phenomenon. It is timely to analyze this process now - for the majority of cultivated plants, this information has been lost in the memory of time.

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 human resources. 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 aspect 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. The reverse could also occur. 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 produc-

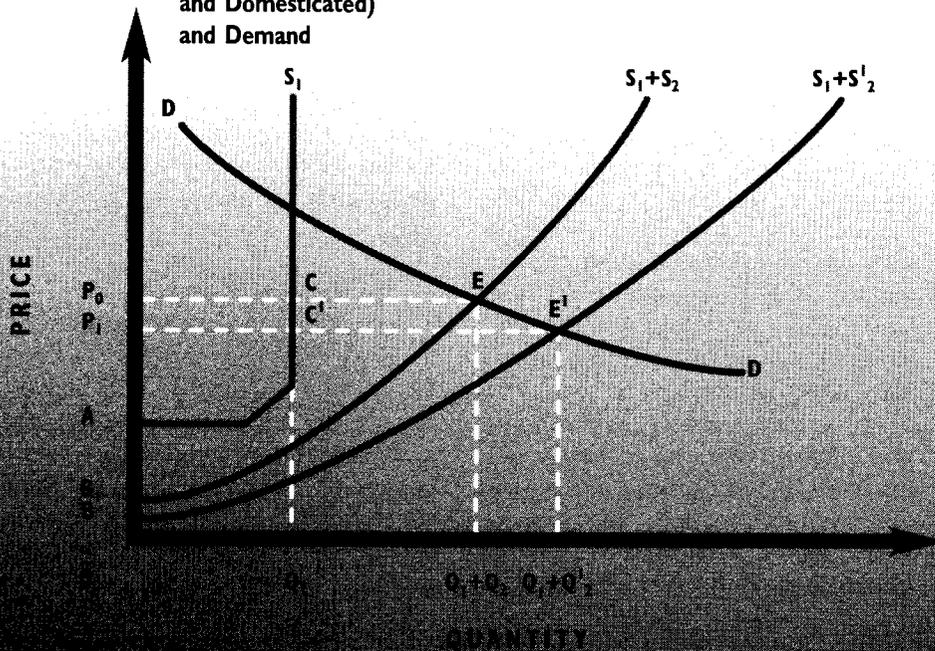
tion factors and contributing to plant extractivism becoming an unprofitable activity.

The analysis of the effect of domestication of plant extractive resources should also cover the effects of distribution. As the changes 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 8 shows the two groups offering the same product. This graphic illustration consists of an adaptation of the Evenson (1983) model to analyze the benefits of disseminating agricultural technology among two regions.

Curve S1 is the curve of the supply of the 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 price is P₀, to which the extractors supply Q1 and domesticated production the quantity Q2.

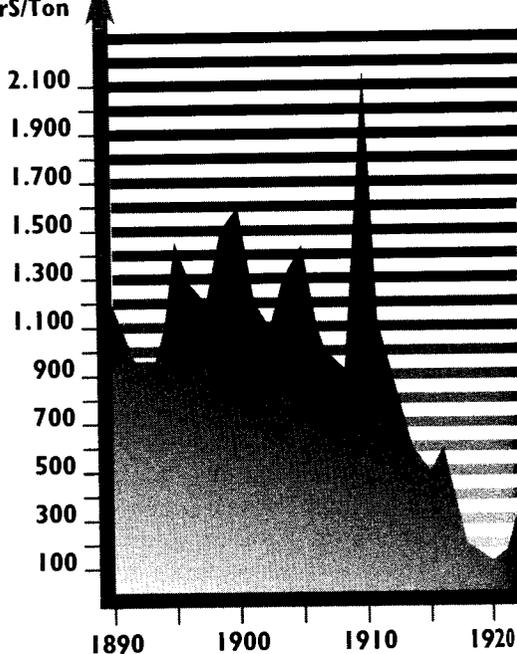
Figure 8. Model showing the balance between Joint Supply (Extractive and Domesticated) and Demand



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 to 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 for P1, the quantities supplied by the extractors remains static as Q1. Figure 9 illustrates the real prices received by the rubber tappers of the Amazon between 1890-1985. This confirms the predictive nature of the domestication theory. High prices that prevailed until 1910 and the limited supply of extractive rubber, stimulated domesticated plantations in South East Asia, which in turn, caused the prices to drop.

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, *chincona*, etc.), others are cultivated in their own region (*guarana*, *urucu*, coca, etc.) and still others are in an advanced stage of domestication. Some examples are native fruits such as *cupaçu*, peach palm (*Bactris gasipaes* H. B. K., an edible fruit), *açaí*, *bacuri* (*Platonia insignis* Mart., an edible fruit), *tucumã* (*Astrocaryum tucuma* Mart., fruit), etc. toxic plants such as the *timbó*, aromatic plants, such as rosewood, *cumarú* (*Dipteryx odorata* Aubl.), medicinal plants, *copaiba* (*Copaifera duckei* Dwyer), *andiroba* (*Carapa guianensis* Aubl.), *ipecacuanha* (*Cephaelis ipecacuanha* (Brot.) A. Rich), *jaboran-*



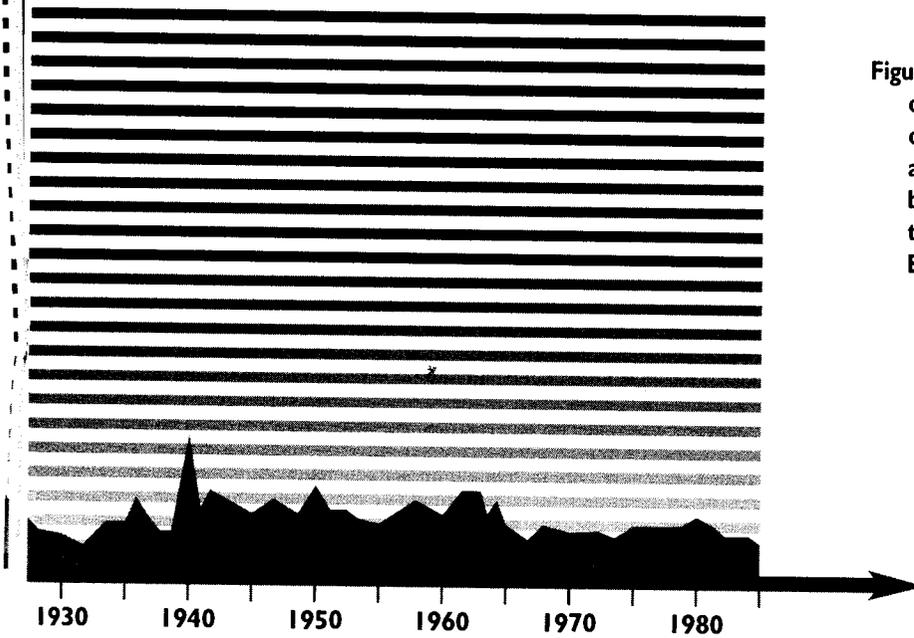
di (*Pilocarpus microphyllus* Stapf.) and other native forest species used for lumber.

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 areas of extractive reserves, and of large stocks of extractive products, very often leads to domestication taking place in regions outside the dominion of extractivism or being carried out by farmers who are not overly fond of extractivism.

The discovery of synthetic substitutes and plant extractivism

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

Figure 9. Evolution of the real price of natural rubber as received by rubber tappers. Brazil, 1890-1985



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 *timbó* from the Amazon. Synthetic rubber is an example of the substitution process. At 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. Other examples of substitutes affecting extractive activities are synthetic waxes, non-elastic gums and quinine.

Substitution by synthetic products is never perfect. The initial stages of the substitution process 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 seem to be the path to be followed.

The expansion of the agricultural frontier and plant extractivism

In view of the expansion of the agricultural frontier and population growth, the demand for farming land has become the most important reason for the decrease in forested areas. While the demand for farming land increases, the supply of land for extractive activities falls. With this, the price of land for extractive activities becomes higher and a reduction of this activity takes place. In the case of extractivism by annihilation, such as that of lumber, this extraction advances with the supply of farming land itself, in contrast to gathering extractivism that depends on the remaining stock of primitive forest. This substitution of forest cover by the expansion of the agricultural frontier is independent of the profitability of extractive activities.

The indicators of the expansion of the agricultural frontier in the Amazon are evident and may be seen through the opening up of highways, increases in the areas cultivated of the main crops, the growth of herds, the expansion of the area of farms, and the number of properties, among other changes. The immediate consequence of the expansion has been the promotion of contingents devoted to extractivism and of migratory currents for agricultural activities, and in the long-term, contraction of the extractive sector.

The supply of cheaper land in the Amazon is another attraction for those who come here. This aspect provides Ricardian profits for those who incorporate the agricultural frontier in the Amazon. This aspect contradicts the idea presently in vogue that it is the speculative profits from Amazonian land that are the main reason for its occupation. In the case of the Amazon, productive gains are more important

than speculative ones, in contrast to what happens in the South and South-east of the country.

Population growth and plant extractivism

The growth of the population is a corollary of the expansion of the agricultural frontier. A larger population means increased requirements for food, health, education, employment, housing, highways and other social infrastructure in a co-evolutionary process. The end result will be a reduction in the potential area for plant extractivism.

At the onset of rubber extraction, a large proportion of the population was involved in order to be able to implement the growth of extraction, as long as it depended exclusively on manpower. At present, as the growth of the population has caused an increase in demographic density, this factor has started to disrupt extractive activities. At the beginning, the expansion of the agricultural frontier and population growth may cause an increase in extraction by opening up new areas of extraction and access to new resources, but the trend in the medium- and long-term is towards constriction and reduction. This is what is happening with the area of Brazil nut trees in Marabá, Pará. In the long-term, population growth will limit the conditions for the establishment of new families of extractors, given the fixed stock of extractive resources.

The disruption to plant extraction created by population growth is due to the fact that a large proportion of this population practices shifting cultivation. This system is stable as long as the population density is low, making it possible to let the land lie fallow during an appropriate period of time and thus enable regeneration to take place. The very dynamics of the expansion of the agricultural frontier have caused shift-

ing cultivation to be replaced by other more capitalist forms. This process of occupation indicates that in 1985 in the Northern region, there was a total area of over 10 million ha of already altered forest and some 1.35 million ha occupied by shifting agriculture. The expansion of this area shows the reduced potential area for plant extractivism that had been damaged by population growth.

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.

Depletion of extractive resources and of plant extractivism

In the exploitation of extractive resources, the normal pattern is to gather those resources that are within easiest reach. When these resources become scarce, less accessible and poorer quality ones are incorporated into the extraction process. Sometimes, due to unhealthy conditions, difficulty of access and lack of knowledge of the resources, this incorporation does not happen, following an anti-Ricardian pattern of behaviour.

Thus, extraction is subject to four different sources of pressure, related to the depletion of the resource: congestion is related to an increase in the number of extractors in a given spatial area, implying an increase in the cost of extraction; stock concerns the availability of the natural resource; marketing imposes a limit on the commercial extraction of the natural resource, as being economically viable to produce; finally, strategy is related to the sense of timeliness in proceeding with extraction (or depredation) before other competitors do so.

The depletion of extractive resources

imposes a behaviour that is different from that followed with other resources, such as gold or diamonds for example. For these two products, scarcity leads to their increased value. In the case of extractive resources, scarcity (in addition to causing increased costs of extraction) may lead to a fall in demand. Once extraction has taken place in the more accessible areas, the trend is then towards an increase in the cost of extraction. On the demand side, faced with a reduction in the amounts supplied, these products start to lose value once the amounts extracted do not compensate for their marketing, profitability or industrialization. Here there is a double effect, a rise in the cost of extraction and a fall in demand, leading to disappearance of the activity. Very often when this stage has been reached, the process of domestication or the discovery of industrial substitutes is already quite far advanced.

The paradox is that in the final phase, very often the presence of domesticated crops in extractive areas may help to maintain plant extractivism, in the short term.

Present developments and prospects

The creation of unrealistic expectations about the importance of plant extractivism in the Amazon has led to a situation of environmental interventionism. The response to the assassination of the union leader, Chico Mendes, meant that plant extractivism and extractive reserves took on a global reach and became part of the contextual agenda in any discussion related to tropical forests. This idea of the Amazon has divided up into four significant branches:

The solution for the Amazon via plant extractivism. A very strong constituency within the 'ecological movements' still believes that it is possible to accomplish the development of the Amazon through plant extractivism, with or without extractive reserves. Advocates of this view consider that the unhappy situation of the extractors is due to an unfavourable government policy in relation to the sector, to lack of support for the marketing of extractive products and to inadequate efforts for realizing the supposedly great resource potential existing in the forest. They assume that technological modifications will be made in the sense of increasing soil and manpower productivity, such as proceeding to obtain more dense distribution of rubber trees and Brazil-nut trees, etc. On the other hand, there is also speculation about the supposed value of as yet unknown forest products, which might be useful in curing various forms of cancer, Aids, etc., and thus become an important source of income for the extractors. These ideas have found sympathy with individuals who have absolutely nothing to do with the extractive cause, notoriously in the sector forming and shaping public opinion at national and international levels, influenced by the repercussions of the assassination of Chico Mendes.

Agroforestry systems or 'extractive reserves without extractivism'. In spite of the emphasis placed on plant extractivism as a suitable way of promoting the development of the Amazon, the defenders of the idea started seeing the ideological weakness of their position. Plant extractivism 'preserved nature but also preserved the poverty of the extractors', and 'plant extractivism was not a guarantee against felling the forest, as this depended on the level of poverty',

and the media itself started to perceive that the rubber tappers were not living in a paradise as the intense propaganda would lead one to believe. It was also seen that rubber trees are not an ecological problem but an agrarian-economic problem. The problem of the rubber tappers was fundamentally much more one of an agrarian nature, that turned itself into an ecological problem with important economic features related to the survival of those involved. It is the fruit of a crisis that had its origins in the process of domestication of the rubber tree, the penetration of capitalism in this area and the labour laws concerning the Statute of the Rural Worker that were established in 1967.

The counter-response of the ecological movements was that the solution would be the implementation of agroforestry systems. They considered that in this new conception, extractivist reserves would not be stagnant spaces, and that on the contrary, in the future, agroforestry systems would substitute extractive activities and would be able to evolve with them. The experience of the Japanese-Brazilian colonizers in Tomé-Açu became the new paradigm of development for the humid tropics.

As already mentioned at the beginning of this contribution, limitations are found at the level of marketing of products, distances in relation to consumers, and the complete change in the working process that has become more capital and manpower intensive, among many other considerations (Fearnside 1992). The Brazilian experience of rural extension has shown that these changes tend to occur in the most dynamic sectors of agriculture and that only a small fraction manage to evolve, making the less competent become employees of the more competent. This is a possible line of action, but one of fairly limited

dimensions, that unfortunately is being transformed into the new Amazon utopia.

Industrialization of extractive products.

Another branch of ecological movements attempts to defend the industrialization of extractive products as a way of giving new life to the idea of extractivist reserves, based on experience with the Brazil nut. It should be remembered that this is also a limited prospect, where the same considerations are valid, when structuring a market in remote places (Léna and Oliveira 1991). Extractive products are characterized by the dispersion of resources, making for low manpower and land productivity. Extractive resources may be characterized by presenting many products and a small quantity per product or few products and large quantity per product, each tending to present specific features as to the economic viability of extraction and marketing. It should not be forgotten that the environmental question demands cooperation and that economy demands competition. It is probable that some isolated events may succeed at the cost of much effort and at the expense of funds invested at a loss by ecological movements or by the government.

Extractive reserves as a proposal for integrated rural development.

In a pragmatic perspective, some extractors are beginning to see extractive reserves as a way of attracting foreign resources that will bring benefits in terms of social infrastructure. The lack of government support to the rural environment in terms of schools, health centres, highways, transport, communications, etc. makes certain leaders view support to extractive reserves as a way to obtain these advantages. On the part of the government, this approach also seems to be

perceived as a way of attracting foreign resources, as the idea of extractive reserves is a very prepossessing one abroad. In this way, extractive reserves become the money of exchange to facilitate negotiations related to the foreign debt, resources from the group of developed countries (G7), policies for the development of extra-Amazon areas, whereby this region becomes the 'bartering merchandise' to ensure the flow of essential resources.

The consequence of this process would be to create inequity and a totally artificial environment, that in the medium-term would imply a loss of interest on the part of the populations themselves, while the options would become more and more limited. If in fact resources were invested in this way, most probably the region would attract a migratory flow to these new areas or if they were implemented in densely populated areas, the collapse of extractive economy would take place sooner.

It should be noted that these four branches are not a stagnant division. It may be observed that the defenders of extractivism or of extractive reserves simultaneously support, for example, all four possibilities.

The truth is that extractivists are going to be around, for better or for worse, for a long time yet. With or without concrete solutions, independently of our will or opinion, they will find their solutions to survival, with or without extractive reserves.

Conclusions

The dead Chico Mendes became much more important to the ecological movements defending plant extractivism and extractive reserves than if he had remained alive. There is no doubt that the assassination of Chico Mendes brought with it an important contribution in the form of re-thinking the development process that had been adopted in the Amazon. However, this dialectic can be criticized when it attempts to place extractive reserves or plant extractivism as the new paradigm for agricultural development in the Amazon. Any speculation in this respect would be to reverse the economic and social development process of the Amazon peoples, where the level of urbanization and the expectations of the rural population may lead to complete disinterest

in the medium- and long-term, unless the government or ecological institutions start investing resources at a loss, in order to make long-term maintenance possible.

The great paradox is that plant extraction is going to subsist for many years in the Amazon, with or without extractivist reserves, simply due to lack of economic options or alternatives. The remaining large stocks of extractive resources, limited markets, stagnation of real salary levels and the process of national and regional development will all contribute to dictating the real prospects for the maintenance of plant extractivism as an economic activity. A situation of economic stagnation, unemployment, slow market growth of extractive products, low real salary levels, among others, may contribute to make this activity last longer.



The problem of the economic feasibility of extractive reserves is considerable. When the importance of extractive products lessens *vis-à-vis* market growth, and there is a growth of the cost of extraction and exhaustion of the capacity to cover increasing demand, there should be a fall in the number of families involved in extractivist practices. Therefore, a great majority of the work force involved in this activity will devote itself to agriculture or will move towards the cities. Lumber extractivism would probably be the last extractive activity in the Amazon. Another doubt is related to the disposition of the extractors in relation to the total group who remain in this traditional economic system (Kohlhepp 1992).

Extractive reserves in the Amazon are only feasible in a few favoured places, in short- and medium-term

dimensions. Limitations include the difficulty of guaranteeing financial feasibility and developing markets for new products. The first step is to discover a product that is capable of involving a sufficiently large contingent of manpower. Once this product is discovered, it will inevitably attract the attention of agro-industry because, if it has any real commercial value, it will quickly be domesticated.

Communities that are devoted to extractive activities need to evolve towards more intensive forms of production, through cultivation of native and exotic plants. Plant extractivism cannot become a barrier to the implementation of domestic cultivation of extractive essences with a potential market value.



Rio Negro

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A substantial effort must be made towards the domestication of present and potential extractive resources to be incorporated into the productive sector. An increase in production from activities carried out in small plots (plantations of rice, maize, beans and manioc) and breeding of animals by the extractivists should be encouraged. These limitations are also common for the major contingent of small-scale farmers in the Amazon.

The promotion of extractive reserves cannot be done to the detriment of other productive activities of the regional primary sector. The production of food and animal protein is also essential in order to ensure food supplies to the Amazon population, generation of employment and improvement in the pattern of living. However, preservation and conservation of the Amazon require permanent economic activities for the whole regional population.

Maintenance of rubber tapping activities to comply with the 'will' of idealists of extractive reserves, implies a social cost for Brazilian society in its entirety. Considering that the country imports 80% of its requirements for consumption of natural rubber, Brazil cannot overlook the need to develop a wide programme for the cultivation of rubber trees, even though it means the collapse of extractivist economy. The social problem of the rubber tappers (between 55 and 70 thousand tappers), should be solved through other options, as it affects the interests of over 145 million Brazilians. On the other hand, those extractive resources that show a great potential or with oligarchic features, should be exploited by the interested sectors. When dealing with products having a low regenerative capacity, or when a considerable investment has to be made to extract them or to obtain any

profit, or when dealing with extraction by annihilation, the implementation of extractive reserves should be viewed with caution. In this process, more rational techniques should be encouraged that add to value, causing the least waste possible and promoting cultivation.

In the particular case of the extractive sector, there should not be too many expectations of the possibility of improving the technological process of plant extractivism in itself, but rather there should be a search for production systems involving cultivation of perennial plants and staple foods. The market and the capability of the extractors themselves in adapting to these new systems will determine the degree of success of these initiatives. For those resources for which there are large stocks, extractivism will probably prevail for a long time. The keynote in this case should be to attempt to find a better way to carry out extraction, add value, improve marketing processes and avoid waste.

Summing up, in my opinion there is no doubt that plant extractivism in the Amazon was important in the past, and still has its importance in the present, but I am trying to alert about the future. If the Amazon region, and why not, Brazil itself, really want to achieve 'environmental autonomy' and find the way to autochthonous development, these goals cannot simply be based on plant extractivism and extractive reserves. The Brazilian government will have to try to increase the technical underpinning of agriculture, providing good conditions for farmers, because it is there that its greatest comparative advantages reside. ○

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