

ECONOMICAL-ENVIRONMENTAL ZONING OF SMALL AMAZON AREA SHOWS FEASIBILITY OF SUSTAINABLE DEVELOPMENT

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An expedition to the heart of Brazil's Amazon region conducted in August has already begun producing results that prove the feasibility of sustainable development in this vast area of tropical rainforest. Economic benefits can be obtained at reasonable cost, without wasting renewable or nonrenewable resources in the area, and with a guarantee of environmental protection and conservation.

The expedition, to the upper Demene River on the border between the states of Amazonas and Roraima, involved researchers, journalists and educationists. It was organized by Agência Estado and the environmental monitoring unit (NMA) of Embrapa, a government agricultural research agency, with support from Universidade Paulista, a private higher-education institution owned by the Objetivo group.

The Demene expedition spent two weeks in the area collecting field data as additional input to a full model for economic and ecological zoning of the region. The data were combined with maps based on satellite images using geographic information systems. The only previous survey of Amazon of comparable scope was conducted in 1975. Project Radam, as it was known, was based on radar images on a scale of 1:1,000,000, whereas the Demene survey uses Landsat images on a scale of 1:250,000 (16 times larger), digitalized and stored in a single vast database together with findings from the field survey and other relevant geographical and scientific information. "The importance of this survey lies on the digital technology we have used, making it dynamic and extremely detailed", says Evaristo Eduardo de Miranda, coordinator of Demene expedition and a researcher at NMA. As a database on the Amazon, it can be used for countless purposes, as environmental and land-use problems arise.

Miranda and his fellow-researchers have so far used the database to produce a preliminary master plan for sustainable development of an area covering 1,83 million hectares at upper Demene River. The team confirmed their initial impression that the biodiversity of the basin is high, in comparison with any other populated or non populated Amazon area. But it also characterized by poor soil and relatively low plant productivity.

Five basic maps were produced, covering soil types, vegetation, hydrology, topography and geomorphology. Each map has an appropriate level of detail and classifies the data covered into a number of units or zones, depending on the logics and dynamics of the subject matter. The average number of ecological zones per map is 20, but the geographic information systems came up with 36 zones altogether in the final synthesis of all five maps. "This digitalized assembly of data from all sources using geographical information systems is an analytical tool of key importance in the case of the Amazon", explains Miranda, "since it enables us to keep up with the fast pace at which new, complex problems are constantly arising in the region".

The zones considered most sensitive or fragile environmentally are on or near the river bank above floodwater levels. Here the majority of the non indian forest population lives, hunting, gathering and growing a few staple crops. The vegetable cover is dryland forest, dense and rich in economically exploitable species. "These zones contain trees that can be felled for the market, as well as the *sorveira* or couma, a type of cow tree that can be milked for its sorva, a latex like that of common rubber tree," says Miranda. "They also provide game for the locals to eat, and they have soil which is not as poor as in the rest of neighbor areas, so that some crops can be grown. Most important of all, they are close to the rivers and channels used for transportation throughout the Amazon, and as such the key elements for any kind of economic activity. The sum of all these features makes these river banks especially vulnerable to ecological deterioration".

At the opposite end of the spectrum are the zones defined as inland deltas or floodlands. These are depressions located between the main rivers; they contain standing water and nutrient-starved soil. Access is extremely difficult. "These zones are protected by the fact that they contain nothing of significant market or subsistence value," says Miranda. "Anyway, it's impossible to get in by boat because the tall reeds and grasses, and the water is too deep for wading".

Miranda's team has also come up with four scenarios for the environmental management of the Demene area. The first would consist of leaving it alone. If no measures were taken either to protect the ecosystem in the area or to permit an intensification of economic development, the drylands near rivers and channels would gradually deteriorate, says Miranda. Logging would increase and river turtles, the most endangered species in these areas, would die out.

"The turtles are more exposed than ornamental fish, the second most endangered species on our list, because they are unable to hide from their pursuers, whom use canoes and power boats", explains José Roberto Miranda, a biologist, member of NMA team. Ornamental fish are at least protected by the fact that they spawn in the rainy season, he adds.

Not much else would be damaged by the first scenario, however. Even destruction of the turtles could be reduced by educational programs, legislation imposing a ban on hunting of this species at specified times of the year, more efficient patrolling by wardens and controls on market and transport. "These measures would be easy to enforce in an area with a small population and river transport only," says Miranda.

Under the second scenario, the research team assumed a degradation in the economic situation of the local population with a corresponding improvement in the environment. In the case of outbreaks of malaria or cholera, for example, or even lower prices of manioc and extracted forest products than at present, the river people would be forced to migrate to the towns and the natural resources in the Demene area would be less intensely used. Social programs would be required, but nature would benefit from a diminished human presence.

If on the contrary, market prices of forest products were to rise, extraction would be stepped up. The impact would vary product by product. Miranda's team has quantified these variables in dollar terms as part of the third scenario, and proposed a feasible policy for dealing with each impact in turn. For example, an increase in the price of *sorva* (the latex of the couma tree that is used to produce chewing gum) would boost extraction of this product, but the environmental impact would be small, since the tree is not felled but tapped, like a rubber tree.

An increase on game hunting would of course affect the species involved, and as a result they would become scarcer in the fringe forests. But the relative inaccessibility of many zones in the area would provide sufficient sanctuary for most, especially if (as is likely) hunting continue to be a primitive activity without the aid of sophisticated weapons or equipment. At present, no one ventures further afield than a day's journey by the boat or on foot when hunting, simply because the game would spoil in the heat and high humidity on the way back if it took much longer.

There are larger river craft equipped with cold storage facilities in the Amazon, but the hydrological regime in the Demene area makes even this an unlikely development. Such craft can enter the basin only during the rainy season, when the wetlands forests are flooded and hunting is far more difficult. The impact of commercial hunting techniques is therefore likely to remain restricted to the mouth of the Aracá River, where these craft can move a certain distance upstream even at low water. The impact of increase gaming, according to José Roberto Miranda, can easily be attenuated by monitoring the levels of wildlife populations so as to ensure that natural stock are replenished. If a species begins to become scarce, a temporary ban can be imposed and special patrols introduced along the rivers. This would require carefully drafted legislation to ensure strict control of predatory hunting, as practiced by cold-storage craft, while allowing ordinary river people to go on catching game for subsistence purposes.

The third scenario also envisages intensification of heart-of-palm and piassaba extraction without any adverse impact on the environment. "This is one of the best options of sustainable development in the Demene area, especially if incentives were offered for entrepreneurs to set up small business to process these raw materials in situ," says Miranda.

Intensive investment in sustainable development forms a fourth scenario. "If the government or environmental groups wanted to develop the upper Demene basin rationally, they could invest in diversification and intensification of agriculture, enhancement of systems to extract some of the more profitable forest products, sanitation, and control of environmental impact if human population in the area suddenly increases," explains Miranda.

This scenario would raise the quality of life for the river population without significantly affecting the environment now or in the future, and at a reasonable investment cost. The first step would be to improve sanitation and hygiene, hence reducing the incidence of malaria and other endemic diseases. It would not be complex since population levels are low and the insects responsible do not reproduce in the "black" (highly acid) waters of the area's rivers. Malaria is widespread in the upper Demene because of negligence, enabling larvae to proliferate in pools or wells, and in open sewers. The area is not congenial to mosquitos, and an adequate anti-malaria program could be implemented at low cost.

The agricultural diversification program would be designed to ensure sufficient food supply during the high-water season, when it is difficult to fish and the local population resorts to game for food. Wildlife could be protected more effectively if there were buffer stocks of vegetable protein for use when the waters rose. The main sources of vegetable proteins would be varieties of kidney bean and corn, adapted to the soil, climate and humidity prevalent in the area. Embrapa has developed such varieties but has not found ways of making their supply available to this remote area of the country. In addition to staple cereals, more fruit would have to be grown. "Not the dessert fruit we consume in the South but highly nutritious species like banana, jakfruit and avocado", says Miranda.

If access were provided to more efficient systems of production it would also be relatively simple to increase agricultural yields without increasing acreages, and hence without necessarily clearing any extra forest for the purpose. Techniques used by the indians are highly appropriate, according to Luiz Eduardo Mantovani, a geologist from researchers team. Throughout the Amazon region, he explains, there are patches of dark, fertile soil rich in organic matter. Geologists have noted that these are located in areas where indians have lived in a settled way for long periods of history, without resorting to the customary Brazilian technique of slash-and-burn widely used when clearing land for planting. Instead, these indians use composting techniques, plowing remains of fish, bonfire ashes, leftovers of meals and crop residues back into the soil. "Over decades, the soil they used became more and more fertile," Mantovani says, "thanks to this organic farming method in plots of between three and ten hectares".

The government could implement education programs including some instruction in this system of production, as well as supplying potash and lime. "A single shipment of good limestone up the Demene River could change the face of agriculture for five to ten years," says Miranda. "And it would cost a negligible amount".

Another element in such a program would be the assistance towards making extraction of forest products and gaming more rational, with control of fish populations and wildlife species. Protective measures would be triggered at the first sign of depletion. Under existing conditions, market laws area effective controls on plant extraction, insofar as forest people would extract products that fetch an attractive price. The local market towns of Barcelos, Novo Airão and Manaus (capital of Amazonas) could be monitored for this purpose.

"It is crucial to remember that none of these proposals makes any sense without the participation of the local population," says Evaristo Miranda. "Everything involved must be discussed with the people in the area, so they can add in their own suggestions and so that their support can be won. Nothing can be done in the Amazon without close cooperation with the river and forest people." And Rodrigo Lara Mesquita, director of Agência Estado, hammers the point home. "If a master zoning plan for the Amazon region is an indispensable instrument for ensuring rational, sustainable development, and indeed as a backbone for a long-term land use policy for the whole of Brazil, every stage of implementation must be exhaustively discussed by all members of society." Mesquita stresses. "Each one of us as citizens, and especially if we have any kind of public responsibility, must strive to find out where we stand and where we intend to go in future."