REGIONAL PLANNING SUBJECTED TO ENVIRONMENTAL CONSTRAINTS

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INTRODUCTION

The Rio Orinoco basin, the second largest in South America after the Amazon, has an extension of almost 1,100,000 Km^2, with an average annual flow of 1,400,000,000 m^3. Within this basin, south of the Orinoco River and in Venezuelan territory, we find the Río Caroní watershed, with an area of approximately 100,000 Km^2. This region has a population of 400,000 people, of which about 70% inhabit two of the most important cities: Ciudad Bolívar, capital of the State of Bolívar, and Ciudad Guayana, a development pole and industrial center. Up to now there seems to be no important areas of agricultural land of good quality in the region, although it is expected that some soils, although acid and of low fertility, but with good physical composition, could be put under production if used under adequate management.

North of the confluence of the Caroní and Paragua Rivers is the Raúl Leoni Dam, also called Guri Hydroelectric Project, to be completed in two steps. The first step was inaugurated in November 1968, with a total installed capacity of 2,650,000 KW, and it is expected to be concluded by 1977. The second step will take the level of the reservoir to the height of 270 m to complete a total of almost 9,000,000 KW installed in the site. In terms of hydroelectric development the investments anticipated in the construction of the enlargement of the dam to take it to its final step by 1982, are of the order of 1,400 million US$, and in the associated transmission systems of about 500 million US$.

In the 1975-1979 quinquennium the total amount of public and private investments in Guayana will reach over 7,000 million US$. The plan IV of the steel expansion, represents by itself an investment of the order of 3,000 million US$, while the investments in the plans for increasing the aluminum production will reach a figure of above 700 million US$.

More than half of the Río Caroní watershed from where the large hydroelectric potential needed by Guayana's industries is obtained, is covered by highly valuable commercial forests. This has resulted in a high pressure for exploiting the more valuable woods, which fortunately, in this area, is being carried out in a very selective way. The large demographic growth represented by the development pole, has also demanded a regional self-sufficiency in the production of food. This implies turning land into agricultural production to a certain magnitude. However, it is well known that the local soils are relatively poor, and that agricultural production in land that had been covered by stable tropical forests is of short duration. Thus a sustained food production would imply a progressive advance towards the higher parts of the watershed, producing an important and increasing change in the vegetation cover of the area.

These vegetation changes could eventually jeopardize the hydroelectric production complex in two ways: on one hand we can anticipate regime changes, with some increase of the river flows in the rainy season, and reductions in the dry season; on the other hand, with a reduction in the vegetation cover there is a potentially dangerous increase in erosion that, in a region like Guayana, with a relatively abrupt terrain, could reach one, two, and even three orders of magnitude. The first factor might affect the hydroelectric production in case the hydrologic regime would force to introduce important changes in the operation of the dam. The second factor could eventually silt up the reservoir up to the level of the intake of some of the turbines, reducing the life of the dam, or at least reducing its productive capacity if certain turbines have to be taken out of production.

This potential conflict between possible land uses, due to the size of the development programs already on their way, can not be analyzed on the terrain. Mathematical models, particularly computer simulation models, allow a quantitative comparative analysis between different possible strategies of action. With this goal in mind a simulation model was constructed to describe quantitatively the rain-vegetation-soil-river relationship, with the information and type of circumstances that characterize the Río Caroní watershed.

Given precipitation statistics in the region of the Río Caroní watershed, the model simulates in a digital computer the river flows that feed the Guri reservoir. Due to the