# COMPLEXITIES IN PERIURBAN DYNAMICS

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## ABSTRACT

Suburbs or areas in the periphery of the cities are troublesome to plan when urban growth takes place at fast rate. System Dynamics approach has shown to be suitable to study Periurban Dynamics in spite of all externalities in the system. Immigration, commerce and industry being some of the most important exogenous variables.

Early experiments for a small dormitory periurban region prove the technique to be appropriate, but when commerce and industry dispute themselves, along with housing, for a share of land, the problem becomes complex and interesting.

A simulation was carried out for the periurban Commune of El Poblado, with a population of over 48000 inhabitants, in Medellín, Colombia. Good approximation was observed between historical data and model behavior. Few scenarios were explored in order to examine land-use policies.

## 1. INTRODUCTION

In large cities, urban growth without control generates poor land use distribution, transforming rural areas into areas for industry, commerce and housing, which in general is not optimum from a global viewpoint.

The use of appropriate tools for planning the growth of the metropolis prevents the gradual deterioration of population life standards, since in this manner it is possible to foresee approximate requirements in terms of dwellings, education, health and employment as well as services in general, providing foundations for policy formulation of urban land use.

This paper continues the work on periurban dynamics initially presented in Dyner (1987) and Dyner et al (1989), which takes elements from Forrester (1969) and, Alfred and Graham (1976).

## 2. THE MODEL

The model exhibited in Dyner et al (1989) is appropriate to study the dynamics of residential periurban districts. Nevertheless, its use for larger areas with important industrial and commercial activities turns out to be deficient.

In this paper, the model is adapted in order to support the process of periurban resources planning of housing, roads, education, health, community services, commerce and industry; all of which are treated differently depending on the urban and rural saturation levels.

Perhaps, the most important contribution to the original model is the understanding of the conflict for the use of land between commerce and industry; thus, as the area allotted for commercial use is exhausted, this sector starts to take the area assigned for industrial use and in a less proportion that allotted for housing. This behavior can be model as it is shown in Figure 1, which demonstrates the causal relation among population, area occupied by services and commerce, exhaustion of area allotted for services and commerce, area for industrial use, urban area partially occupied, urban saturation and, demand for rural areas whenever urban saturation is presented.

These phenomena can be observed as a non-trivial problem of multiple predators and multiple prays in terms of different sectors of society having disputes among themselves for land use.

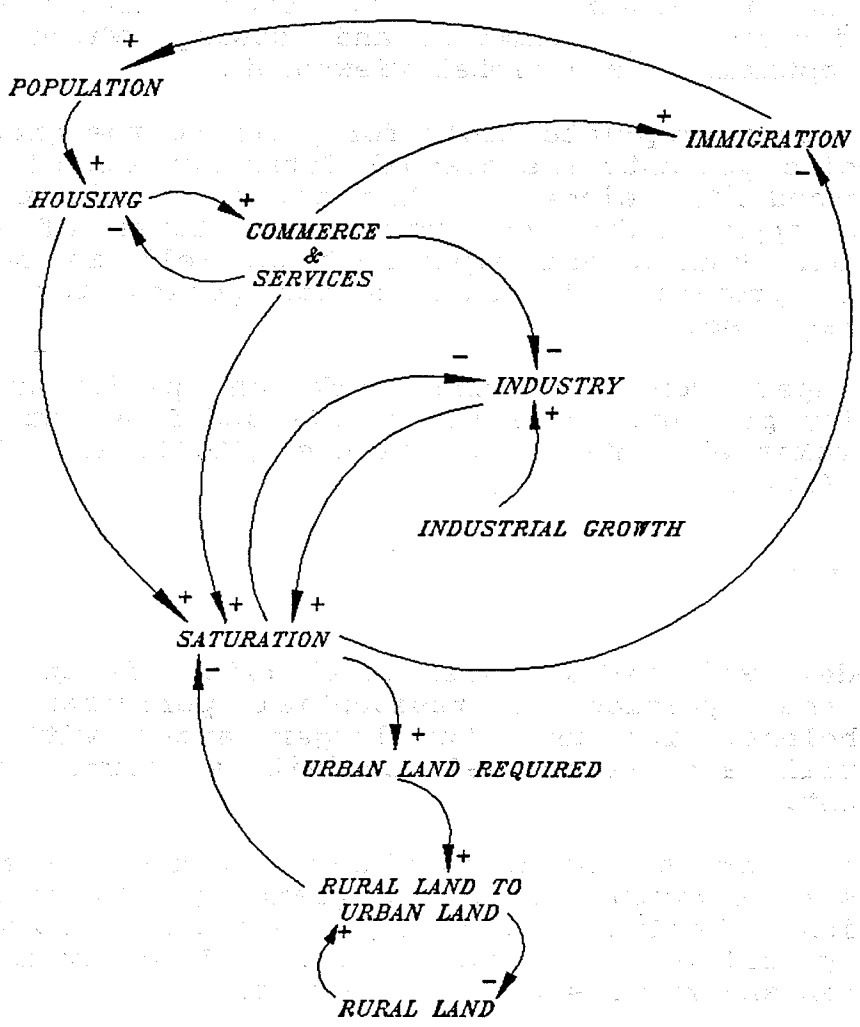


*FIGURE 1. Causal diagram to represent Periurban Dynamics*

The model developed to describe the dynamics of the system is suitable to support the resources planning process. Figure 2 shows a causal diagram of the most important variables which allow to establish population requirements per age groups, as follows:

- The infantile population, both urban as well as rural, demand areas for education and recreation.

- The economically active population, urban and rural, need schools and higher level educational centers.

- The total population require community areas, roads, urban and rural housing, service and commerce premises and, health centers.

The demand for land increases year to year saturating the urban and rural zones; furthermore, the rural saturation grows as the urban area is exhausted and starts to adhere rural space.

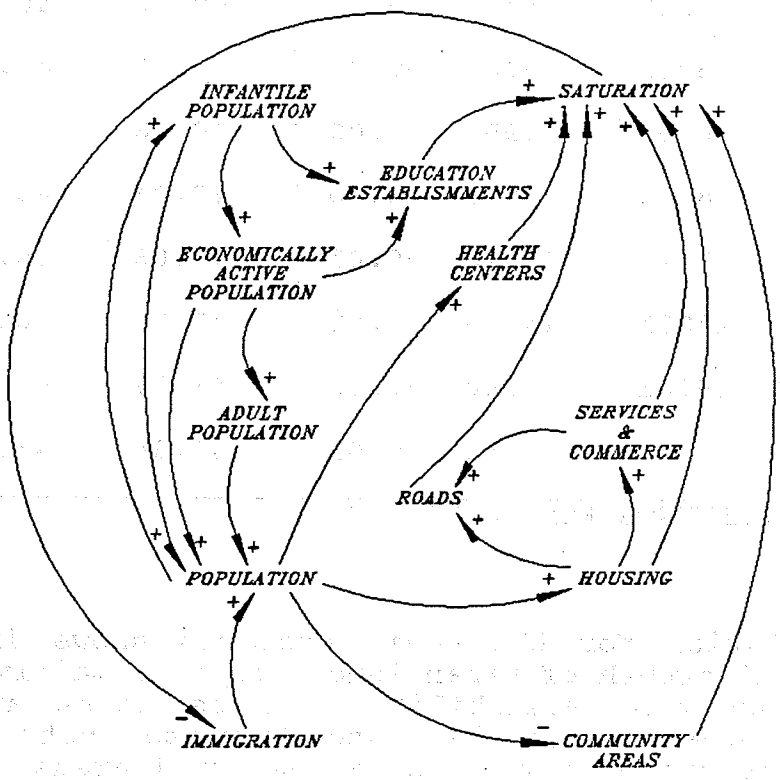


*FIGURE 2. Causal diagram to determine resources required*

## 3. RESULTS

The model was applied to the commune of El Poblado with the purpose of analyzing policies on land use. The validation effected indicates an adequate adjustment marking little percentage differences. Table 1 shows a comparison between model results and historical data.

| YEAR | HOUSING | | | INDUSTRY | | |
|---|---|---|---|---|---|---|
| | HISTORICAL | MODEL | DIFF(%) | HISTORICAL | MODEL | DIFF(%) |
| 1981 | 5069 | 5069 | | 40.3 | 40.3 | |
| 1982 | 5363 | 5430 | 0.01 | 40.46 | 40.42 | 0.00 |
| 1983 | 5958 | 5904 | -0.01 | 40.62 | 40.61 | 0.00 |
| 1984 | 6953 | 6954 | 0.00 | 40.78 | 40.67 | 0.00 |
| 1985 | 8978 | 9013 | 0.00 | 40.94 | 40.67 | -0.01 |
| 1986 | 11127 | 10970 | -0.01 | 41.08 | 40.67 | -0.01 |
| 1987 | 13851 | 14160 | 0.02 | 41.19 | 40.85 | -0.01 |
| 1988 | 15761 | 15360 | -0.03 | 41.27 | 41.48 | 0.00 |
| 1989 | 16411 | 16150 | -0.02 | 41.34 | 41.48 | 0.00 |

TABLE 1. ELEMENTS FOR VALIDATION

The simulation for the basic scenario shows initially an exponential growth of urban land occupied, mainly due to the fact of terrain availability, but as these areas become exhausted the construction rate decreases putting pressure for out migration flows towards the rural areas, provoking a gradual drop of land for farming, as can be observed in Figure 3.

Figure 4 shows the behavior of variables commerce and industry. The former increases year after year surpassing the area assign for its purpose; thus, it starts putting pressure on other uses of land, particularly on industry which decreases gradually until almost exhaustion.

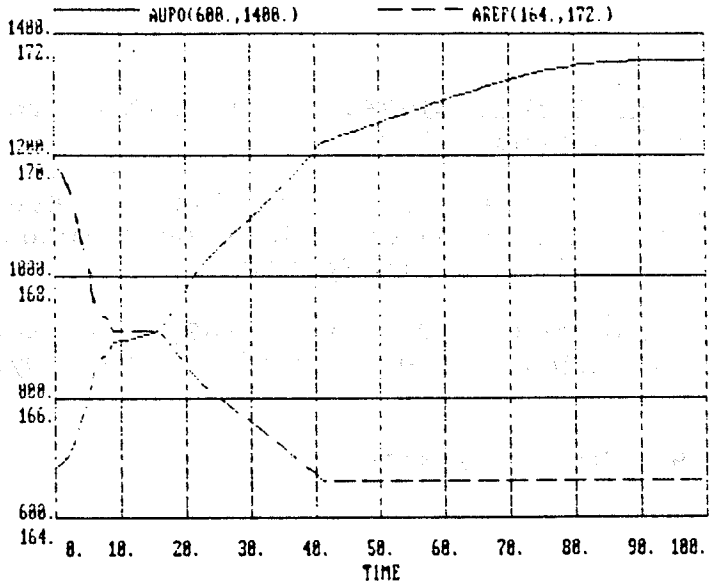


FIGURE 3. SIMULATION OF URBAN AND RURAL LAND USE.

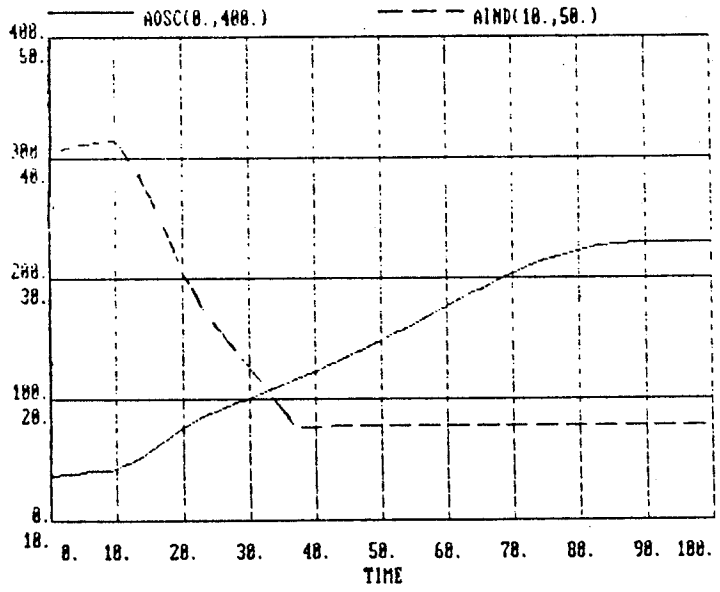


FIGURE 4. SIMULATION OF INDUSTRIAL AND COMMERCIAL LAND USE.

## 4. REFERENCES

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