VEGETATION REGROWTH ON FALLOWS IN RAIN FOREST AND TREE SAVANNA IN AFRICA (GABON AND CÔTE D'IVOIRE)

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SUMMARY

It is possible to study the recovery of degraded areas by analyzing the vegetation regrowth.

Three studies have been carried out on fallows in Africa. The first one was in an area of tropical rain forest in Gabon which had been cleared manually. The second was on an area of tree savanna in the Côte d'Ivoiret which was also cleared manually. The third study was in the same region but where the land had been cleared mechanically. The possibilities for regrowth were observed to stem from three different potentials. The first comes from new shoots and root suckers, the second from seeds already stored in the soil before the land was cleared and the third is from seeds which are transported into the area after the opening of the vegetation. The presence and evolution of these three potentials is dependent upon physical, biological and historical factors. Our study has shown a strong relation with historical factors. The balance between the relative parts of each of those potentials will determine the pattern of succession.

INTRODUCTION

The regrowth of vegetation after agricultural activity in rain forest and tree savanna is dependent upon various factors such as physical ones, for example, soil and climate; and biological ones which may be, the biology of the species, predators, seed disseminators, soil micro-fauna and the surrounding vegetation. The dynamics of the plant populations, throughout the successive stages of regrowth, depend equally on historical factors which occurred before cultivation was abandoned, such as the type of the original vegetation prior to burning (initial floristic composition, Egler 1954) and the practices of cultivation. These practices are principally the method of clearing but also the length of time given to cultivation, the succession of crops, the types of intercropping, the number of crop rotations and the preservation of existing trees within the cultivated area. It is difficult to obtain reliable, historical data and we were only able to discover part of the background information.

Alexandre (1982), defines three potentials for regrowth of the vegetation in forest areas. This approach can also be utilized for fallows.

The vegetative potential is derived from what remains of the original vegetation i.e. Stumps, roots and tubers of forest and savanna species which are able to produce sprouts and which are also resistant to fire. This potential is displayed in the form of new shoots and root suckers.

The edaphic seed-stock potential is formed by seeds, which resist burning, being present in the soil prior to clearing. This potential is realised through germination.

The external seed potential exists as a result of seeds being brought into the area after clearing and burning. This potential can also be demonstrated through germination.

Each of these three potentials can promote the regrowth of the vegetation. The processes of regrowth may differ according to the historical, physical and biological conditions. Connell and Slatyer (1977) identify three models of plant succession.

The "inhibition" model corresponds to a situation in which the pioneer species colonise the space, thereby impeding the development of species, common to the following stages of succession, for a certain time.

The "tolerance" model, corresponds to a situation in which the modifications to the soil, induced

by the pioneer species, do not influence the species of the further stages of succession.

The "facilitation" model corresponds to a situation in which the pioneer species modify the environment and in doing so permit the germination of other species of later stages of the succession.

In our study areas we look at how the condition and treatment of the land affects the three potentials and what may be the consequences for the regrowth of the vegetation.

LOCATION OF THE AREAS STUDIED

a) Rain forest in Gabon

The area we studied is situated 7 km south of the town of Makokou and 4 km from I.R.E.T. (Institut de Recherche en Ecologie Tropicale) in an area covered by rain forest (Figure 1). The climate is equatorial, with an average temperature of 23.9°C for 1951 to 1975, and an average annual rainfall of 1700 mm for 1953 to 1975. There are 3 dry months distributed over two seasons.

The soils are Oxisols.

The population density is less than 1 person per km^2.

b) Tree savanna in the Ivory Coast

Our chosen area was the land around the village of Booro-Borotou. It is situated 25 km to the north of the town of Touba (Figure 1) in the "subsoudanais" sector (Guillaumet and Adjanohoun 1971), an area of tree savanna.

The climate is humid tropical with an average temperature of 25.7°C and an average rainfall of 1350 mm for 1939 to 1986. The one dry season continues for 4 to 5 months (Chevallier 1990).

This area is burned annually affecting the total savanna area as well as the recent fallows. The soils in this area are Oxisols or Podsols (Fritsch *et al.* 1990).

The population density is from 4 to 10 people per km^2.

VEGETATION REGROWTH ON FALLOWS IN AN AREA OF RAIN FOREST IN GABON AFTER MANUAL CLEARING

a) Historical data for the area

The plots studied in the rain forest of Makokou Gabon underwent manual clearing and burning. The two plots were utilized for 2 and 3 years respectively. The main crop is manioc (*Manihot esculenta*), which is planted along side yams (*Dioscorea* spp.), bananas (*Musa* sp.), corn (*Zea mays*) and cocoyams (*Colocasia* sp.). It is very rare to see the plots cleared

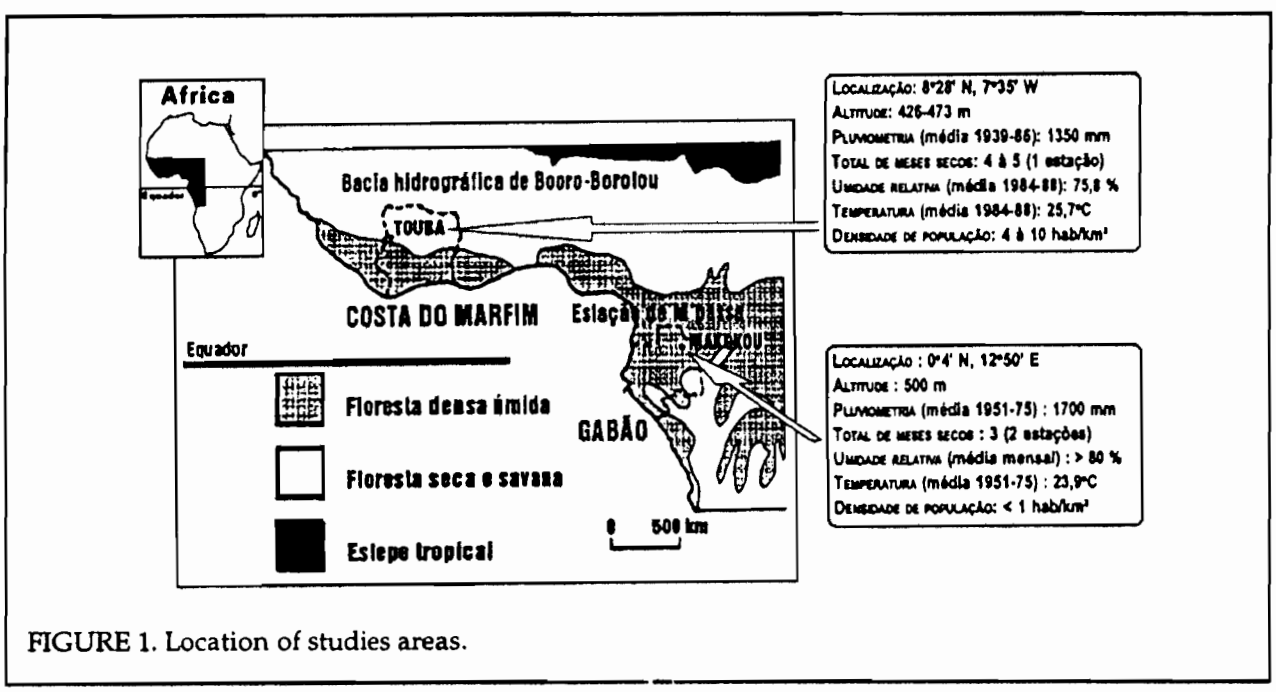

FIGURE 1. Location of studies areas.

of regrowth during the period of cultivation (Mitja and Hladik 1989).

The study was carried out on two five year old fallows.

b) Potential for regrowth

In the rain forest a large number of plant species do not resist the cumulative effect of clearing and burning prior to cultivation. A large part of the vegetative potential is destroyed. Part of the edaphic seed-stock potential is also destroyed for the same reasons. The regrowth of vegetation is principally secured by the remainder of this same potential and by the external seed potential which, thereby, maintains a good level of seed germination (Figure 2).

c) How may the pattern of regrowth evolve?

The regrowth which comes principally from germination follows the "inhibition" model. The rapid development of pioneer species impedes the growth of forest species which have to wait for the death of the first before they can develop. We would concur with Alexandre's results (1989) for rain forest in the Ivory Coast.

d) Some species encountered

The group of pioneer species, which grow rapidly, is represented by *Trema guineensis* (Schum. & Thonn.) Ficalko and *Harungana madagascariensis* Lam. ex Poir. These are substituted in the order of succession by other groups among which are the group of forest species represented by *Distemonanthus bentamianus* Baill., *Pentaclethra eetveldeana* De Wild & Th. Dur. *Petersianthus macrocarpus* (P. Beauv.) Liben. These are already present in the form of seedlings in recent fallows.

VEGETATION REGROWTH IN THE FALLOWS OF TREE SAVANNA IN THE IVORY COAST IN THE WATERSHED OF BOORO-BOROTOU AFTER MANUAL CLEARING

a) Historical data for the area

In the tree savanna of the Ivory Coast (in the Booro-Borotou watershed), after manual clearing and burning a crop of yams (*Dioscorea* spp.) is planted for cultivation. The following years this may be substituted by a crop of rice (*Oryza sativa*), peanuts (*Arachis hypogaea*), beans (*Phaseolus* sp. and *Vigna* sp.), corn (*Zea mays*), sweet potatoes (*Ipomoea*

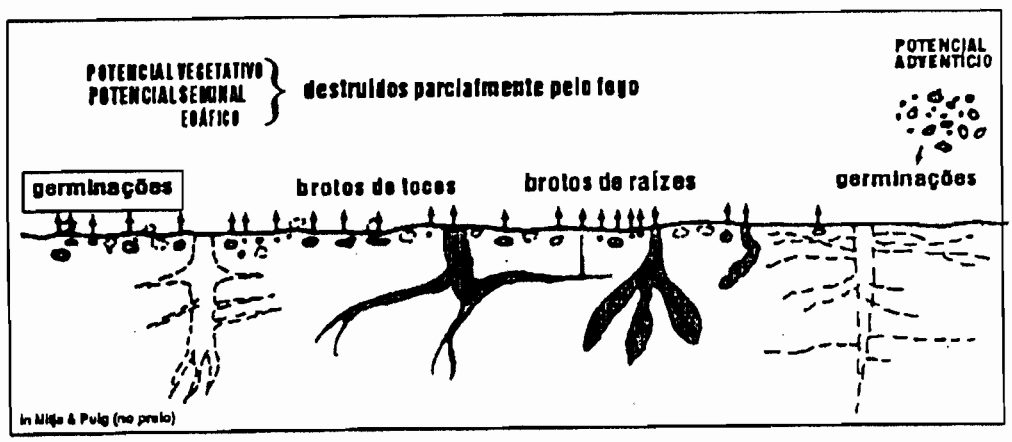

FIGURE 2. The potential for regrowth of Gabon's rain forest after manual land clearing.

batatas) or cotton (*Gossipium* sp.). The last crop is usually Manioc (Camara and Mitja 1990). This corresponds on average to a 7 year cultivation cycle. Re-clearing is frequent for all crops except for manioc and the initial date of regrowth corresponds with the planting of this crop.

The study was carried out on 63 plots, 27 under cultivation and 36 fallows of different ages (Mitja 1992).

b) Potential for regrowth

In tree savanna the species which are present are resistant to burning, which is done annually in this type of area. the regrowth is principally assured by the vegetative potential, that is to say, through new shoots and root suckers but also from the edaphic seed-stock potential as well as from the external seed potential (Figure 3).

c) How may the pattern of regrowth evolve?

The regrowth of vegetation in the tree savanna follows the "tolerance" model. The pioneer species which germinate from seeds and the savanna species which are maintained by new shoots and root suckers begin to develop at the same time. After 30 to 40 years, half of the regrowth is realised and the number of species present is high.

d) Some species encountered

The pioneer species *Trema guineensis* (Schum. & Thonn.) Ficalko grows at the same time as the pre-existent savanna trees which grow from new shoots and root suckers such as *Daniellia oliveri* (Rolfe) Hutch. & Dalz., *Parinari curatellifolia* Planch. ex Benth., *Pericopsis laxiflora* (Benth. ex Bak.) van Meeuwen and *Lophira lanceolata* van Thegh. ex Keay etc.

VEGETATION REGROWTH ON FALLOWS IN TREE SAVANNA IN THE IVORY COAST AFTER MECHANICAL CLEARING

a) The historical data for the area

In the tree savanna around the village of Booro-Borotou some crops have been planted after clearing the land with bull-dozers. This compacts the soil and lifts the superficial horizon into heaps. In these plots, rice and cotton are cultivated alternately with the addition of chemical fertilizers and herbicides. the regrowth of the vegetation commences after abandoning cultivation.

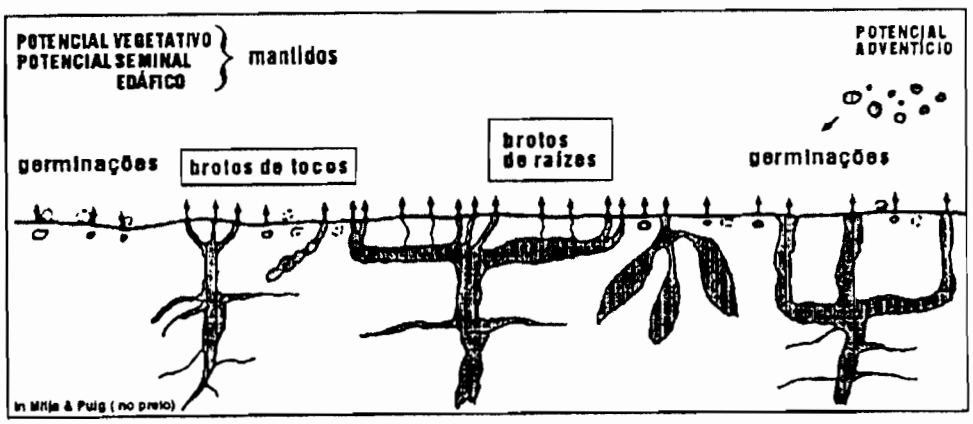

FIGURE 3. The potential for regrowth of Ivory Coast's tree savanna after manual land clearing.

The study was carried out in three plots, one cultivated and two fallows of 6 and 9 years old respectively.

b) Potential for regrowth

In the tree savanna after mechanical clearing, the vegetative potential and edaphic seed-stock potential is eliminated. The root suckers and stumps were torn out and part of the superficial soil removed taking with it the seed-stocks.

In this case the regrowth of the vegetation is secured only from the external seed potential (Figure 4).

c) How may the pattern of regrowth evolve?

The regrowth after mechanical clearing follows the "facilitation" mode, with the effect that the pioneer species which come and germinate on a degraded soil encourage a later germination of other species of plants. It should be noted that, even without the advent of choking plants which may take over, the regrowth of the vegetation, in whatever form, will be very long.

d) Some species encountered

The fallows are principally formed by Gramineae *Imperata cylindrica* (Linn.) P. Beauv. in the initial stages of regrowth and there are only a few individuals present of *Trema guineensis* (Schum. & Thonn.) Ficalko and *Piliostigma thonningii* (Schum.) Milne-Redhead.

CONCLUSION

Throughout various stages of succession the vegetation regrows from the three potentials cited. The vegetative potential and the edaphic seed-stock potential provide the initial vegetation. They have to be resistant to clearing and burning in order to develop primarily on the cultivated plots and later on the fallows. The external seed potential brings in seeds after the burning. These three potentials depend equally on historical, physical and biological factors for their development.

Analysis of the vegetation in the light of the three potentials allows us to see which of the models of succession may occur on our plots in forest and tree savanna.

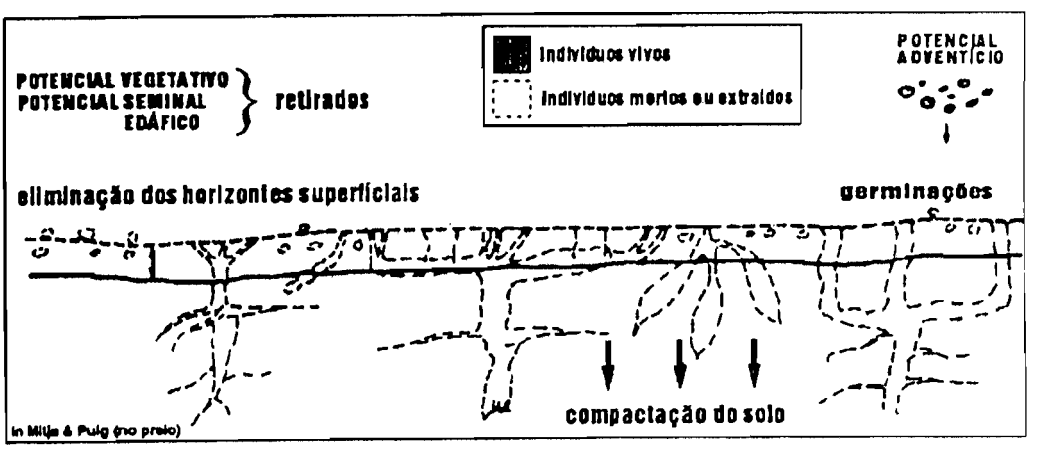

FIGURE 4. The potential for regrowth of Ivory Coast's tree savanna after mechanical land clearing.

This study demonstrates the mechanisms of the regrowth of the vegetation which if known may be utilised in order to avoid degrading the land when it is cultivated.

ACKNOWLEDGEMENTS

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