



# Deforestation and Agricultural Productivity in Ivory Coast: a Dynamic Analysis

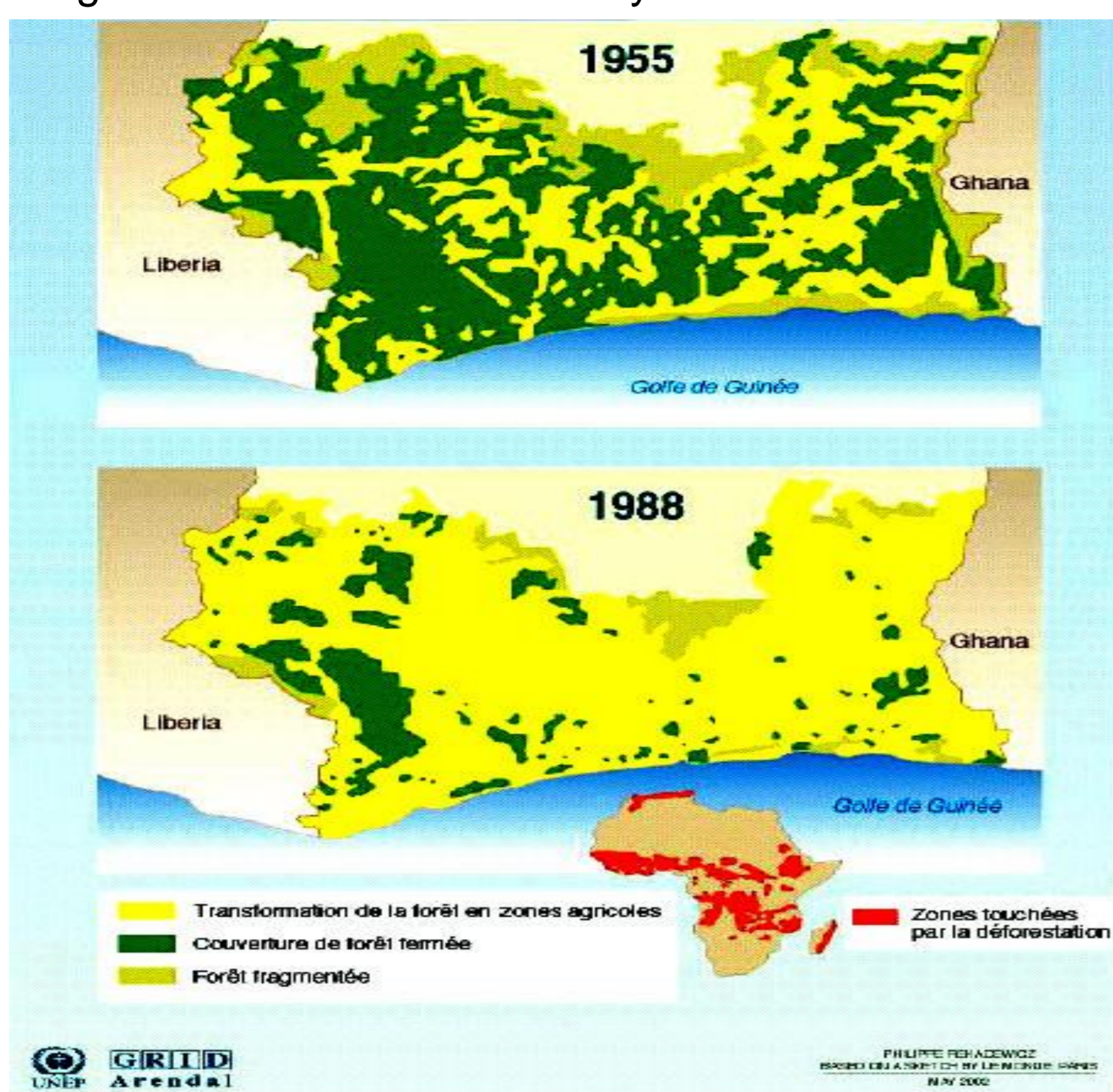
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## Introduction

Ivory Coast is losing rainforest at rate of 300,000 ha a year, of the original 16 million hectares of rainforest only 3.4 million hectares remain. The loss of forest in Ivory-Coast is due mainly to cultivation which is driving by a rising population and poor definition of property rights over forest land.

Figure 1: Deforestation in Ivory Coast



The competitive equilibrium between forestry and agriculture exists where the rate of return on the last hectare employed in agriculture equals the rate of return on forestry. A problem of interest in seeking this equilibrium is to take account of the interaction effects between deforestation and agricultural productivity. The determination of effects of deforestation on agricultural productivity can be used to establish incentives which will lead to preserve forest resources.

## Objective of the study

The main objective of this study is to analyze the relationship between deforestation and agricultural productivity in Ivory Coast. Specific objectives are: (i) determine a sustainable equilibrium between forest resources and agricultural land using an optimal control model; (ii) estimate long run and short run relationships between deforestation rate and agricultural yield during 1960-2010.

## Research Methodology

**First step:** an optimal control model is used to determine the optimal steady-state forest stock in Ivory-coast.  
**Second step:** an error correction model is used to analyze long run and short run relations between deforestation and agricultural productivity.

## Results

### Theoretical results

At the steady-state forest stock, the present value of the marginal utility derived from holding foresting (conservation motive) is equal to the marginal utility of deforestation.

The optimal rate of growth of deforestation depends upon two motives: the return from deforestation and the conservation motive. The deforestation rate in current period will be high if the conservation motive is relatively weaker than the deforestation motive.

In Ivory Coast, the deforestation motive is essentially the agricultural productivity response from deforestation, since small farmers are the most important agents of deforestation.

### Empirical Results

A Vector Error Correction Model is implemented with the following variables:

$Y_t$ : agricultural yield in constant dollar per hectare;

$X_t$ : rate of deforestation in hectare and

$Z_t$ : average rainfall in millimeter;  $t=1960$  to 2010.

### Long run relationship among agricultural yield, deforestation and rainfall

$$\text{LOG}(Y_t) = -5.34 \text{ LOG}(X_t) + 3.73 \text{ LOG}(Z_t)$$

(-4.21)                      (4.79)

The agricultural yield responds significantly to both deforestation and rainfall. The two elasticities have opposite signs in the long run. They indicate that a 1 per cent rise in deforestation rate will lead to about 5 per cent decline in agricultural yield, while a similar rise in average rainfall will give rise to about 3.7 per cent increase in agricultural yield in the long run.

### The short run dynamic

Variables	Coeff.	P-value
$\Delta \text{Log}(Y_{t-1})$	-0.7198	0.191
$\Delta \text{Log}(X_{t-1})$	-0.0547	0.830
$\Delta \text{Log}(Z_{t-1})$	11.0544*	0.066
Constant	0.0040	0.988
ECM <sub>t-1</sub>	-0.3117***	0.006

The results of the short run dynamic show that in the previous year, the rainfall was the most significant predictor of current agricultural yield.

As expected, the error correction term (ECM<sub>t-1</sub>) is significant and has the correct sign implying a short run adjustment of agricultural yield to the previous period's deviation from the long run relationship. Indeed, the speed of adjustment is 31%, this means that 31 per cent of adjustment to long run equilibrium takes place in the next period after a deviation of agricultural yield from its equilibrium value.

## Interpretation

The estimates indicate that deforestation reduces agricultural yields. The fact that deforestation accelerates soil erosion and thus shifts agriculture to less suitable areas explains partly this result.

Moreover, the estimates show that conservation motive exceeds deforestation motive since deforestation reduces agricultural yields.

## Conclusion

A problem associated with forest management in the rural area in Cote d'Ivoire is that few alternative employment opportunities exist for the labor and capital employed in agriculture.

The rural poor in Côte d'Ivoire have very few options. With few alternatives available to them, the rural poor look to the forests as a short term solution to their economic problems.

Figure 2: Plantation of cocoa and forest trees in Ivory Coast



## Recommendations

Alternatives that could slow down considerably the rate of deforestation and its negative impacts are:

The adoption of joint forest management: local people must be involved in the planning and implementation of programs to manage forests.

Improve productivity of subsistence agriculture: greater productivity from the existing farm will reduce the pressure to convert more forests to these uses.

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