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Evolution of cropping patterns and land market activity under liquidity constraint: evidence from Côte d'Ivoire[3]

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Abstract

This paper studies the interrelated dynamics of land market and crop substitution in Lower Côte d'Ivoire. The evolution of the cropping pattern from coffee and cocoa to palm tree first and, more recently and now predominantly, rubber tree, is proved to impact the activity of the land market. In fact, on the one hand, the possibility to lease out the planted plots to tenants who plant annual intercrops during the first years of the immature trees generate revenues for the landlord before the beginning of the production and subsequent returns. In the presence of a tough liquidity constraint, this condition may be binding for the investment decision. On the other hand, crop substitution participate thus to the land market activity, in a region where the agricultural frontier is ended, and where a large group of landless migrants is present. However, intercropping is only a transitory strategy and planting trees may be decided at the expense of staple crop cultivation. Drawing on the agricultural household literatures on land market participation and on investment decision in land-related assets, the paper gives the rationale for these evolutions. The conclusions derived from this analysis are then tested on household primary data collected in 2008 in Lower Côte d'Ivoire. We find strong support for a severe liquidity constraint.

Key-words: household model, tree-planting, land markets, Côte d'Ivoire
JEL: Q12, Q15, D10, O13

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Introduction

Côte d'Ivoire has been experiencing since a few decades a large shift in its agricultural production specialisation: coffee and above all cocoa productions were until then benefiting from frontier agriculture based on deforestation. The exhaustion of the forest and the introduction of new crops represent major evolutions in the cropping patterns. In particular, rubber production is developing rapidly with an increase from 90,000 t to 200,000 t between 1996 and 2008. Primarily grown on large industrial farms heavily supported by public authorities, rubber tree is now the most favoured crop in Southern Côte d'Ivoire, and family farming accounts in 2008 for about half of the national production, even though state intervention in matters of technical and financial support stopped in the 1990's (Ruf, 2009a).

The adoption of rubber by smallholders brings about a significant evolution in land use. The paper investigates the impacts of crop substitution on the land market activity in Lower Côte d'Ivoire. Most of the region under study was settled at the beginning of the 20th century and the opportunity to develop plantations strongly attracted migrants from Central and Northern Côte d'Ivoire as well as from neighbouring countries. Most Ivorians own land or belong to a family owning land; non-Ivorians also do own land, but for the most part are landless agricultural workers who also stimulate the demand for land under tenancy contracts. They engage then in the production of non-perennial crops: food crops and pineapple production for export as fresh fruits (until the collapse of the market in the mid 2000's, Colin, 2010). Under land pressure, the dynamics of crop substitution can be suspected to influence the land market functioning. On the long run, areas planted with perennial crops can be seen as reducing the area brought potentially on the tenancy market. But on the short run, it could be just the opposite. In the case of rubber tree as other tree crops (cocoa, oil palm, coconut, etc.), intercropping is an option the first years following the planting. As the immature period of the plantation is about 6 years, planting intercrops generate revenues or food before the productive stage. Under tough liquidity constraint, renting out plots planted with immature trees so that the tenant can grow non-perennial crops as companion crops to rubber and thereby care of the trees can alleviate the problem of difficult access to liquidity by cutting the costs and generating cash revenues. Tree plantations may be developed at the expense of staple crop production: by freezing a proportion of the land estates, the food security constraint of the household may harden once intercropping food crops and the perennial crop (a common practice) is no longer possible.

To our knowledge, few studies applied to developing countries link participation in land tenancy markets with crop pattern decisions, i.e. studies that take into account crop choice and the decision to rent in/out land (Biarnès and Colin, 1987 for this empirical case; Coxhead et al. 2002 in the case of agricultural expansion). We draw on the agricultural household literatures on land market participation and on investment decision in land-related assets to analyse the rationale of land leasing, rubber tree planting, staple crop cultivation and intercropping. We develop a dynamic household model that takes into account the liquidity constraint and the subsistence constraint the households face. We then turn to empirically study the joint decision of tree planting, staple crop cultivation and land market participation to investigate the influence of crop substitution on the land tenancy market activity. From primary data collected by 328 households[6] in Lower Côte d'Ivoire in 2008, we conclude that

[6] Rather than "household", the right expression should be "the family group depending on the owner of a land estate". This family group might include both agnates (descent group, sharing a common ancestor or descending one from the other) and affines (persons linked through marriage) and be much broader than the usual household as conceptualised in the literature (see Colin, 2008). The term of "household" is used in this paper as a short-cut.

land market participation is heavily related to the planting decision and we find evidence that the liquidity constraint seems to be binding.

1. Land use, perennial crops and the land tenancy market dynamics in Lower Côte d'Ivoire

We first present the general historical and regional context of the empirical analysis of crop substitution and land market participation in Lower Côte d'Ivoire; we then discuss the specific case based on primary survey data to show to which extent the evolution of land use towards rubber tree planting can affect the land tenancy market dynamics.

1.1. Recent trends in the dynamics of land use in Lower Côte d'Ivoire

Since the 1920's and the heavy involvement in coffee and then cocoa production that let Côte d'Ivoire rank first world producer of cocoa, cropping patterns dramatically evolved, in Southern Côte d'Ivoire (the former forested area of the country) in general and in Lower Côte d'Ivoire in particular.

1.1.1. Evolution of cropping patterns in Lower Côte d'Ivoire

The region under consideration in this paper (see appendix 1) remained mostly unoccupied until the beginning of the 20th century. From the 1920s, immigrants (who came primarily from different regions of Côte d'Ivoire) settled there to start perennial plantations. At that time, the village plantation economy was based on coffee and cocoa crops, which were planted after the forest was cleared. The problem of reproducing this plantation economy emerged during the 1960s for the first-settled villages (affecting more recently the villages created in the 1950s-1960s), with the ageing of the plantations and failed attempts to replant coffee or cacao crops due to the local agro-pedological conditions. The establishment of nucleus-outgrower schemes in the region, however, gave a new lease of life to agricultural production, resulting in the smallholder plantation economy converting to new tree crops (oil palm, then rubber trees) and pineapple (Colin, 1990). The Ivorian pineapple almost collapsed in the mid-2000s, and overall dynamics of land use shows a very large and structural development of rubber tree planting – which characterizes more generally Southern Côte d'Ivoire (Ruf, 2009a).

Until the 1970s, latex production in Côte d'Ivoire was extremely limited and operated by large-scale agricultural firms, in particular the Société Africaine de Plantations d'Hévéas (SAPH, African Society of Rubber Plantations) which still has a strong position in Ivorian production. The promotion of smallholder rubber dates back to the 1980s when donors decided to developed financial and technical support for small producers. The Ministry of agriculture delegated smallholdings development programs to SAPH (Colin, 1990; Ruf, 2009a).

The recent evolution shows a real booming of rubber production in general and by smallholders in particular. Between 1996 and 2008, the production increased from 90,000 t to 200,000 t. The share of the volumes grown by smallholders accounted for one third of the total in 1996, whereas it represent half of the production in 2008, at the scale of Southern Côte d'Ivoire (Ruf, 2009b). The production grown on family farms was thus multiplied by four and grew up steadily since 1996, with a notable acceleration since 2003. This evolution is attributed by Ruf (2009a) to an unexpected endogenous adoption of rubber by smallholders – unexpected as the farming systems were still heavily oriented towards coffee and cocoa production, and to a smaller account palm tree, and endogenous as public subsidizes were cut. Ruf underlines the importance of the price incentive in the context of cocoa and coffee

markets crisis, of the exhaustion of the forest land that puts an end to agricultural extension on forest clearing, and of imitating behaviour in crop adoption taking place at the village level (Ruf, 2009b).

1.1.2. Intercropping opportunity and the land markets

Intercropping provides an important means of raising not only productivity and land-use efficiency of smallholder rubber lands, but also income generation during the unproductive immature phase of the rubber tree. Planting densities are, in fact, based on the requirement of mature trees, so that, during the establishment period, land-use efficiency is small. When canopy – thus light capture – is small, a companion crop can be added to young rubber trees. The most common forms of intercrop for rubber in Africa, Asia and Latin America are staple crops (Penot and Ollivier, 2009). Agronomic studies show that the productivity of both crops – actual component crop and future mature rubber trees - is enhanced by the fact they are simultaneously grown. However, the planting density of the component crop matters and should not be too high, in order to ensure high latex yield (Rodrigo et al., 2001). The two crops could in fact compete for resources.

Rubber plantation requires both high up-front investments. As regard investment, the SAPH estimates that the cost of planting and growing rubber trees is in Côte d'Ivoire 1,000,000[7] FCFA for one hectare – from the plot clearing to the first tapping. The time lag between planting and onset of tapping for latex lasts between 6 and 7 years during which no income is generated from rubber production (Ruf, 2009a). However, Ruf found out in a study on central-western Côte d'Ivoire that the costs drop to 400,000 FCFA when taking into account the fact that family labour is engaged in handling and planting seedlings – diminishing labour costs – and that households find ways to cut total costs even if this behaviour should then reduce the yields (grafting the seedlings themselves by using their plantation as bud wood garden, not using fertilizer…). In this context of high upfront investment costs, intercropping is viewed as a mean to efficiently use the land available in the space between rows. For one case, intercropping is practised in the first at least two years after the plantation of the young trees. The plot may be used by the household – head or member – or given out to non-family members: in the latter case, the household perceive a monetary income from renting the plot, or a proportion of the production grown together with the trees if the plot is sharecropped; last, it can lend the plot for free: in this case, like in the others, it saves family labour or hired labour costs as the tenant is maintaining the young trees.

In our sample only landowners grow perennial crops[8]. Land was most of the time acquired by clearing the forest and then inheritance by family members (Colin et al, 2007). The land tenancy market is active. Tenants are most of the time landless producers[9] from neighbouring countries – at the first place Burkina-Faso. This community is unevenly distributed across the villages and forms a group of agricultural workers as well. Tenants grow non-perennial crops on these plots, staple crops – most of the time designed to be marketed, cassava, sweet potatoes or vegetables – or pineapple, until recently (in some villages).

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[7] 1,000 FCFA = 1.525 €.

[8] In other areas, a new type of contract, the "Plant and Share" arrangement, allow non-owners to develop perennial plantations. In such an arrangement, the landowner provides the land to a farmer who develops a tree crop plantation, supplying the seedlings, the fertilizers and the labour until production starts. When production starts, the plantation is shared until it dies, the landowner retaining his/her ownership right to the land bearing the farmer's part of the plantation (see Colin and Ruf, 2009, for an analysis of these contracts).

9 In this text, 'landless' refers specifically to the land ownership status of migrants in the area under study; most of these migrants may have (and certainly have) access to land in their home village.

Leasing out land can occur under different contracts: (i) fixed-rent contracts whereby an amount of money is agreed and paid upfront production; (ii) sharecropping contracts that are of different types in the region but share the common characteristic to be based on ex-post rent payment proportional of actual production level; and lastly (iii) "land for labour" arrangements, which mostly correspond to situations where a tenant is allowed to cultivate "for free" annual crops in a newly planted tree plantation, as by doing so he takes care of the young trees.

1.2. Main characteristics of the sample population

The study draws on primary data collected in 2008. The survey targeted 10 villages located in the regions of Aboisso, Adiaké and Bonoua, in Lower Côte d'Ivoire. Those were chosen on the basis of their ethnic composition (see Appendix 2, and Colin and Bignebat, 2009). A total of 328 households were surveyed.

The land estate's heads were asked about the demographic characteristics of the production and of the consumption units, about the amount of owned and operated land (owner-operated, operated by family members other than the family head, rented in/out), and for each of those plots, about the use of land, the characteristics of the production grown on it, and contracts related to it.

The average total area of land owned is 12.4 ha, with a relatively large variability across villages (from 7.1 in Djimini-Kofikro to 20.7 in Tchitchébé), regardless their ethnic predominance. The family operates 11.6 ha of land on average (1.19 ha being rented out of the family; 0.3 ha are rented in). "Land reserves" are of two types: fallows (on average 2.4 ha) dedicated to restore fertility after a cycle of food crop production, and abandoned plantation (average 1 ha); furthermore, 3.8 ha are old coffee or cocoa plantations, potentially available for new plantings. Thus, whereas the forest completely vanished in the region therefore stopping the possibility agricultural frontier extension, there is (on average) still some land availability.

Planting decision: the case of land exclusively planted with trees

The proportion of owned land planted with perennial crops (included old plantations) is more than the half (57%); only 11% of the landowners report to have no perennial plantation. In 15% of the cases (50 land estates), the land is entirely planted with trees. Most of the time (62%), these are small land estates with an average total area of 4.2 ha, and the proportion of absentee landowners[10] is higher (38% versus 15% if the land owned is not entirely planted

We drop from the sample those cases when they corresponded to mature plantations, as then the total land area is "frozen" regarding the participation to the supply side of the tenancy market. We keep the cases corresponding at least partly to new plantations, as the possibility to lease out land with young trees is still open. We end up with a sample of 307 households/land estates.

Land use strategies and the dynamics of rubber tree planting

As mentioned above, 57% of the total studied land area is planted with perennial crops (rubber, coffe, cocoa or palm trees), namely 7.2 ha on average over a total of 12.4 per production unit. More precisely, on average 12% of the land estate is covered with immature trees and 45% with mature trees; lastly, 8% of the total area is dedicated to annual crop cultivation. However, the picture differs according to the size of the land estate. First, the proportion of the land estate dedicated to annual crop cultivation is 14% for small land estate

(defined as less than the median size, that is 10 ha), whereas it is 6% for the large land estate. Second, the main difference is the recent behaviour in planting trees as 16% of the area is planted with young trees in small land estate and 11% in large; the conversion dynamics seems to have been faster in small land estate relatively to their size, but the stock of mature trees is higher for large land estate (48% versus 39%).

The proportion of each perennial crop is the following: 35% of the area dedicated to perennial crops is planted with palm trees, 34% with rubber trees, 32% with coffee or cocoa and 1% with coconut trees. The dynamics of the cropping patterns is striking: half of the plots dedicated to coffee or cocoa were planted before 1976 – and only 11 % since 2000; half of the plots with palm trees were planted before 1998, and the evolution since then is regular (15 to 20 new plots each year); whereas 58% of the plots dedicated to rubber production were planted in 2006 or 2007, with more than 100 plots per year and 140 ha per year. We thus notice an exponential evolution of rubber tree planting since 2000. As the total land reserves constituted by over-aged trees is 1190 ha, we can measure the potential for crop substitution in the region. Furthermore, this dynamics of the cropping patterns interact with the land market activity, as plot newly planted with tree crops can be rented out for intercropping production of food crops or pineapple. Intercropping is practiced for 51% of immature less than three years old trees rubber plantations.

Land market participation and the role of tree planting

The area rented out by the households represents about 10% of the total owned area, among which more than 90% is leased out by the household's head. This represents 325 ha. 45% of the households are leasing land out. A proportion of 48% of the total area rented out by those household's head correspond to plots newly planted with tree crops – 80% being rubber trees. The (temporary) impact of the development of new perennial plantations on the supply of land on the tenancy market is in fact higher than indicated by this figure, as part of leased-out land we surveyed was leased-out in order to prepare the land for a new plantation without incurring any cost (and even getting a land rent); unfortunatelly we did not get systematic information on that point.

The types of contracts that are chosen in the case of intercropping differ from those concerning fallow land: the proportion of plots that are lend for tree care/work is 34% (respectively 15% when no intercropping); the proportions of location and sharecropping contracts is then relatively the same in both cases for the plots that are not lent for free. .

Even if most of the demand on the tenancy market comes from landless tenants, landowners also rent land in: 53.5 ha are leased in, namely by 30 land estates. The plots that are rented in are used for staple crop production (cassava, yam, sweet potato …).

This section was aimed at showing to which extent crop substitution for rubber trees can influence the dynamics of land markets. Intercropping with young rubber trees represents in 2008 nearly half of the area rented out by households. The recent evolution is exponential and moreover, the potential for development of this crop is large.

2. Land market participation and land allocation decisions

To our knowledge, very few analyses, either analytical or empirical, take into account simultaneously the decision to invest in tree planting, or to substitute one crop to the other, with that of renting in or out land. Two streams of literature are dealing, on the one hand, with land market participation, focusing on imperfections in credit, insurance, input and labour markets; on the other hand, with investments in land-related assets. We show that at some

points, they overlap, and propose to draw on these literatures to analyse the empirical dynamics presented in section 1.

2.1. Land use strategies: optimal farm size and acreage decision

A first vein of literature develops models maximising the present value for expected utility of investing in tree planting. In the general framework, uncertain returns have been shown to affect a household's decision to invest in productive assets (Feder, Just, and Zilberman 1985; Rosenzweig and Binswanger 1993). In particular in the case of tree-growing, random prices were focused at expected prices and price volatility are analytically shown to play a role in tree crop adoption (Shively 1998, 1999). Nevertheless, those models, based on the maximisation of the present value for expected utility, do not take into account any capital constraint. However, credit constraints have been used to explain the low levels of investment undertaken by households. Carter and Wiebe (1990) isolate in particular the importance of up-front investments that are made before the returns of the subsequent production are realized (*ex ante* capital) from the money needed to face random shocks when the capital is productive (*ex post* capital). Focusing on *ex ante* capital and taking into account uncertainty, Vargas-Hill (2010) investigates one further characteristic related to the nature of the investment in land-related capital – a model applied to tree-planting –, namely the irreversibility of the investment. She takes into account abandonment costs if the farmer decides to leave the production. She shows that irreversibility, uncertainty (on prices and production), liquidity constraint and fixed cost are factors that altogether influence the investment decision. Land markets are not explicitly included in the analysis.

Lastly, Coxhead and al. (2002) develop an analysis that explicitly takes into account land use – in the shape of two different crops – and the adjustment of the total operated land area. However, the set-up of the studied case is one of agricultural expansion: land variation is mostly seen as land addition, whatever the land use, through deforestation. Increasing the operated size through such deforestation ensures access to good-quality soils.

Renting land out or in is related to the question of the optimal operational farm size. A second vein of literature investigates the existence of economies of scale in production and market imperfections as determining this size (Sadoulet et al, 2001). The canonical hypotheses concern three main points: labour, land and credit.

The latter point is particularly important in the case of tree-planting as it requires up-front investment. However, access to credit is generally considered as constrained: in particular, analyses focusing on credit constrains consider that access to credit is related to farm size, as land is used as a collateral (Binswanger and Rosenzweig, 1986). In some cases, some even argue that, because of asymmetric information, small farmers are totally rationed out of credit markets (see Carter, 1988 for a discussion). Monetary stock and inflows then are supposed to partly alleviate this constraint, especially when land cannot be used as a collateral in the case of imperfectly defined property rights (Vranken and Swinnen, 2006). "Distress renting" when facing urgent cash needs allows to view land renting as an insurance mechanism (de Janvry et al., 2001, p. 15).

However, this literature does not distinguish between the proportion of the production which brings monetary revenues and that which is self-consumed. Therefore, the constraint identified as a liquidity constraint in the canonical household model, as in Sadoulet et al. (2001) implicitly assumes that the total agricultural production is sold and that food needs are covered by sales, or, at least, that the domestic agricultural production is valued at the market price by the household. Nonetheless, if non separable, the agricultural household model generates a shadow price for a commodity which may differ from the market price if a

commodity has an incomplete market or if a constraint is saturated, namely in this case, if the household consumes the entire output (Singh et al, 1986, p. 48). As a result, the question of food security is not explicitly tackled. A related literature investigates however the trade-off between cash and food crop production and underlines the fact that food prices on market are volatile (Fafchamps, 1992) and that households turn to a risk adverse self-sufficiency strategy (Jayne, 1997)

2.2. A general framework

Taking the area of the land estate as given, we investigate the land-use strategies of the landowners, taking into account that some of them internalise food procurement (staple crop production) and others guarantee cash revenues and thus alleviate the liquidity constraint (producing cash crop and/or renting out land). In turn, cash may be allocated to buying food, or to investing in cash crop production in the next period.

We develop a dynamic model investigating the landowner's decisions at time t, as a proportion of the owned land area, of rubber tree plot planted in 2007 (a flow denoted by u_t^1), staple crop cultivation (u_t^2), land leased out (u_t^3) (without taking into account intercropped new rubber plantations) and land leased in for staple crop cultivation (u_t^4)[11]. The total area of land owned is denoted S. This area is planted (stock of trees) at time t for a proportion θ_t of the total land size. During the first period of growth, the trees can be intercropped with staple crops and, therefore, the land area $u_t^1 S$ participates to the domestic production of annual crop or is rented out[12]. We consider that the proportion of each use is given, and respectively α and (1-α).

Let $f^{Tree}(\theta_t S)$ be the revenue from the mature rubber trees net of the costs; $f^{Food}((u_t^2 + u_t^4 + \alpha u_t^1)S)$ the shadow revenue derived from the cultivation of staple crop on the owned or leased in land, net of the costs; $f^{Rent}((u_t^3 + (1-\alpha)u_t^1)S)$ the cash revenue from the land leased out[13]; $g^{Tree}(u_t^1 S)$, the cost of planting trees; $g^{Food}((u_t^2 + u_t^4)S; \overline{M})$ the cost of buying food to meet the family needs $\overline{M}$ that are above the staple crop cultivated; $g^{Rent}(u_t^4 S)$ the cost of renting land in. We consider the revenue from off-farm activities ($\overline{D}$) as exogenous. We don't allow for sparing money across periods or borrowing money[14]. The decision of the landowner is therefore:

[11] See section 1 for the description of use rights in the specific studied context.
[12] At that time, we do not consider the case of new rubber tree plantations that are not intercropped and maintained through weeding.
[13] Moreover, this behaviour allows to save family labour or avoid hiring wage workers.
[14] There is no credit market in the studied area, we therefore focus on the liquidity constraint.

$$\underset{\{u_t^i\}}{Max} \sum_{t=1}^{\infty} \delta^t \left[f^{Tree}(\theta_t S) + f^{Food}((u_t^2 + u_t^4 + \alpha u_t^1)S) + f^{Rent}((u_t^3 + (1-\alpha)u_t^1)S) + \overline{D} - g^{Tree}(u_t^1 S) - g^{Food}((u_t^2 + u_t^4)S; \overline{M}) - g^{Rent}(u_t^4 S) \right]$$

subject to

$$u_t^i \geq 0 \quad \forall i \tag{1-4}$$

$$\theta_{t+1} = \theta_t + u_t^1 \tag{5}$$

$$\theta_t + u_t^1 + u_t^2 + u_t^3 = 1 \tag{6}$$

$$\theta_t + u_t^1 \leq 1 \tag{7}$$

$$\theta_0 \geq 0 \quad \text{given} \tag{8}$$

$$f^{Food}((u_t^2 + u_t^4)S) + g^{Food}((u_t^2 + u_t^4)S; \overline{M}) = \overline{M} \tag{9}$$

$$f^{Tree}(\theta_t S) + f^{Rent}(u_t^3 S) + \overline{D} = g^{Tree}(u_t^1 S) + g^{Food}((u_t^2 + u_t^4)S; \overline{M}) + g^{Rent}(u_t^4 S) \tag{10}$$

The dynamics of the model is defined by constraint (5) that describes the way trees are accumulated on the land estate; constraint (6) refers to the fact that the area planted with trees cannot exceed the total area owned by the landowner. The food safety constraint is represented by equation (9) and the liquidity constraint by equation (10).

See Working Paper Moisa for the results.

The model is built on purpose on a unitary description of the household. It does not take into account the intra-household decisions, such as that of land distributed by the landowner to family members who enjoy then a use-right on the selected plots.

3. Joint empirical analysis of land-use choices

We turn to the empirical data presented in section 1.2 to assess the joint dynamics of rubber tree planting, staple crop cultivation and participation to the land market. We draw mostly on the empirical literature dealing with land market participation and land-use choice.

3.1. Model specification

In the literature, different model specifications have been used to find the determinants of land market participation (either rental or sale markets), according to the underlying analytical model explaining the household behaviour, and to empirical choices.

First, the probability of participation in the land market has been estimated using Probit/Logit (Yao, 2000) or ordered Probit models (Deininger et al., 2009; Jin and Deininger, 2009). The three categories of the latter are households renting land in, autarkic and renting land out. The year-to-year total change in land area is taken into account irrespective to the fact that a negative outcome may correspond to either a household only renting land out, or one renting more land out than in. And, in this case, the intensity of the transactions is overlooked (in our case, the standardized standard deviation of the area leased out is 160%, household differ a lot in the amount of land they are renting out).

Following the path opened Bliss and Stern (1982) who used OLS regressions to understand the participation of household in the land market, Skoufias (1995) proposes a model for the decision of renting in/out which has often been taken over by the subsequent literature. The

specification relies on Tobit models whereby the independent variable is the amount of land leased in/out, left/right hand censored at 0. Estimating both equations separately allows for asymmetry in opposing side markets, in accordance with the analytical model he proposes, based on the presence of transaction costs. An endogenous switch model allows to infer transaction costs. This is obviously the most common model used and in general both equations are estimated separately (Kung, 2002; Deininger et al., 2003; Teklu and Lemi, 2004; Deininger and Jin, 2005; Vranken and Swinnen, 2006; Holden et al., 2009, among others). Authors, in fact, describe those who are renting out as landlords, whereas those who are renting in are presumed to be landless farmers acting as tenants. Either they suppose that those two groups are distinct, or implicitly that the decisions are made independently one from the other. For various empirical reasons, this hypothesis was ruled out by some studies (Rahman, 2010) that argue that the specific case they analyse does not fit with this assumption – referring there to the fact that plots may be scattered and distant one from the other, so that engaging in both renting land out and in may reduce the waste of time walking from one plot to the other, and lower the supervision costs. We do not observe such a spatial structure of farms in our case[15]. Thus, we take into account only the decision to rent out land. More recently, authors advocated that the use of a Heckman sample selection is more flexible as it allows to separate the decision of participation and the decision of how much they should transact, knowing that they participate (Teklu and Lemi, 2004; Tikabo et al., 2006). However, by doing so the household that do not participate in the land market are dropped out of the sample in the second step equation. In the case of a Tobit estimation all the estimation are used, both those which are at the limit, zero, and those above the limit.

Furthermore, some analyses try to alleviate potential endogeneity bias. Vranken and Swinnen (2006) study a transition country where state farms were privatised in the 1990's, increasing thus the supply of land on the land sale market: therefore, the farm size may be endogenous to the actual behaviour of renting in or out. They instrument this variable by its lagged value before the privatisation program. However, even though they choose a tobit specification for the land area rented in/out (separately), the instrumentation relies on an OLS regression.

In our case, we draw on the analytical model developed in section 2 to propose the following empirical investigation. The endogenous variables are: the amount of land (in hectares for all equation[16]) rented in (equation 1, *Land rented in*) and out[17] (equation 2, *Land rented out*), dedicated to tree-planting (area of land planted with rubber trees in 2007, equation 3 *Land planted with trees*) and cultivated with annual crops (equation 4, *Land with annual crops*). We denote L_i the area dedicated to the use i. As all of them are censored variables, we turn to a multivariate tobit[18] specification. X_i is the vector of exogenous variables for equation i, so that:

$\forall i \in \{1...4\}$

$L_i^* = \beta_i' X_i + \varepsilon_i$

$L_i = L_i^*$ if $L_i^* > 0$; $L_i = 0$ otherwise (eq. i)

and $\varepsilon_i \approx N(0, \sigma_i^2)$; $\text{cov}(\varepsilon_i; \varepsilon_j) = \rho$, $\forall j \in \{1...4\}, j \neq i$

[15] Except in the village of Kohourou for some cases.

[16] It could have been possible to take the logarithm of the area to ease the reading of the results, but most of the studies use rather absolute levels (see Skoufias, 1995, for a short discussion).

[17] We use the term "rent" for convenience. In fact, the plots are sometimes under share contract.

[18] The computation is run using the maximum likelihood procedure of Stata 10.

We expect to find a correlation between the disturbance terms that would justify the fact to choose a multivariate tobit instead of univariate analysis, as commonly practised in the literature.

3.2. Choice of the variables determining land-use

The choice of the **variables for equations 1 and 2 (leasing in and out)** is based on the existing literature dealing with land market transactions and related to the above presented general analytical framework (Holden and al. 2008, p. 23 for a summary). They include:

i) Socio-demographic characteristics of the household

- *Size, family labour, demographic structure*

The household size and demographic structure: as a consumption unit, the number of adults and children should influence the area dedicated to food crop production and thus possibly rent land in. *Consum_women, Consum_men,* and *Consum_children* are thus proxies for the short term decisions regarding land use. As a production unit, the actual number of dependant family members should influence the decision to rent land out as they are entitlement to ask for land for their own use, *Dependant_women, Dependant_men.* Lastly, the landowner relies on a number of family members who are engaged in the agricultural activities of the land estate, *Family labour.*

- *Off-farm activities*

We took the activities of the household into account: the off-farm employment of the family head (dummy variable, *Head Off-farm),* and the number of family members engaged in non-farm activities (*Dependant Off-farm).* We introduced the fact that the landowner may be absent from the farm (*Absenteism* equals 1 if yes).

- *Gender and ethnic group*

The gender of the landowner (*Gender* equals 1 if male) is added as exogenous variable.

We included dummy variables for the ethnic identity of the household (*Abouré* and *Baoulé,* the reference being *Senoufo*). As these variables are perfectly correlated to villages, we did not control for the villages, but allow for the covariation of unobservable characteristics at the village level.

- *Management skills*

Management and technical skills are approximated by the age (*Household head's Age*) of the household head (as a proxy for the experience)

ii) Characteristics of the owned land and production

- *Size of the land estate*

Regarding the size of the land estate, we consider a distinction between (i) the area non occupied by trees (this area being frozen and considered as exogenous concerning the decision to rent out or in) (*Area except trees*); and (ii) in the equation stating the decision to rent land out, the area planted with mature trees which is a proxy for the stock of capital (see below for an explanation). As the returns to these productions are very different, we separated each crop (*Mature rubber trees, Mature palm trees, Area Coffee/cocoa*).[19] We introduce the area of rubber trees which may be rented out for intercropping, that is the area of rubber trees less than 3 years old (*Rubber less than 3*). Data shows that intercropping practises stop

[19] see section 3.2 for a more complete explanation

between the 3rd and the 4th year; 40% of the households planted at least one plot with rubber trees in the last 3 years. (iii) n the equation specifying the decision to rent land in, the total area planted with trees (*Perennial crops*), as we want to refer to the fact that a part of the land estate is not available to any land-use decision.

- *Wage-labour force*

The total number of annual wage workers is taken into account because they are for the most part of their time employed for perennial crop growing and complement family labour in this activity (*Annual workers*[20]).

iii) Characteristics of the environment

- *Land market tightness*

We introduce the level of land rent at the village level (*Price land rental*) and the number of potential tenants by taking the village size into account (*Inhabitants village)*

- *Labour market tightness*

We proxy the labour market tightness with number of migrants at the village level (*Migrants village).*

- *The degree of land conversion at the village level in 2006*

We capture the heterogeneity in the collective dynamics of changing cropping patterns in measuring the proportion of the total land area occupied with rubber and palm trees (*Conversion degree*). The variable was built for the year 2006, avoiding then endogeneity problems due to the fact that the plantation of rubber trees in 2007 is an endogenous variable.

- We allow for a fixed effect for the village of Djimini which experienced a highly singular dynamics based on pineapple production (Colin, 2010).

It should be noted that some of the variables generally included in models of land market participation were not taken into account for empirical reason:

- (Lack of) access to credit should be determinant for choosing to rent out when the household cannot directly use the total area owned. In our case, there is no opportunity at all to get formal or informal credit[21].
- The importance of agricultural assets – like draft animals – is frequently referred to (Skoufias, 1995, for instance). As the cropping systems we are studying do not require an investment in indivisible goods that can't be rented, we drop the variable.[22] As proxy for the agricultural capital and liquidity constraint, we use therefore the total area allocated to mature perennial crops. In fact, the larger this area, the most probable that the production guarantees monetary cash flows on a regular basis.
- Land tenure security was not taken into account as in the area under study, there is no risk of loosing property rights on land by leasing it out, even if property rights are not formalized (Colin et al., 2007).

[21] Except very small sums borrowed within the family or social network, not sufficient to cover production costs.
[22] Six households in the sample report to have a tractor

As concerns the **land-use equations (3 and 4**, planting trees and cultivating staple crops), some of the variables are the same. However,

- As concerns equation 3: as the decision of planting rubber trees was made according to the land operated at the moment of the decision, we consider the total area not planted with trees at that time, that is in 2006 (*Area except trees in 2006).*
- We also integrate the past plantation of rubber trees as well, as the cost for some of these trees – those immature – should be born each year, without generating any revenue. We distinguish between (i) the trees aged 2 or 3 years (*Area rubber 2 to 3*); (ii) the trees immature but with no intercropping possibility (4 to 6 years) (*Area rubber 4 to 6*), and (iii) the mature trees (*Area mature rubber trees*). As part of the land planted with coffee or cocoa might be considered as a potential land reserve, we could interpret the variable *Area Coffee/cocoa* as a land availability index at the household level (see infra for a discussion). The variable *Area abandoned plantations* corresponds to land occupied by plantations reported as abandoned by the landowner.
- Lastly, we introduced in equation 4 the fact that a proportion of the land estate may be used by family members (*Area given to dependants*) for non-perennial crop cultivation. And we added the area dedicated to the fallows expected in the yam-cassava production pattern (*fallow*s). We distinguish between the areas planted with mature and immature perennial crops as well (*Mature perennial crops* and *Immature perennial crops*) in order to take into account the possibility of intercropping in the case young trees were planted.

Lacking variables relatively to the literature are:

- Soil quality (Coxhead et al., 2002). In our case, the impossibility of empirically measuring soil quality is less important than in other cases, as most of trees that are planted are rubber trees. As argued by Ruf (2009b), coffee and cocoa exhausted mainly the superficial layer of the soil, whereas planting rubber trees is efficient because their roots are getting nourishment below it.
- Contrarily to the main part of the literature (Deininger and Jin, 2006, Holden et al., 2009, among others), the question at stake in this region is not that of the impact of tenure security on investment decisions (Colin et al., 2007), so that we do not include any proxy for it.

Summary statistics for these variables are reported in appendix 3.

3.3 Results of the empirical analysis

Preliminary results are reported in table 1.

The Wald χ^2 test results indicate that the chosen exogenous variables contribute significantly as a group to the explanation of the joint decision of renting in and out, planting trees and cultivating annual crops.

Table 1: Land market participation and land-use decisions

VARIABLES	(1) Land rented in		(2) Land rented out		(3) Land planted with trees		(4) Land with annual crops	
Family characteristics								
Consum_women	-0.0124	(0.0360)	-0.0646	(0.105)			0.0575	(0.0356)
Consum_children	0.134***	(0.0282)	-0.151*	(0.0862)			0.116***	(0.0265)
Consum_men	-0.0524	(0.0344)	0.284	(0.169)			0.00984	(0.0685)
Dependant_women			0.133	(0.108)				
Dependant_men			-0.147**	(0.0649)				
Dependant_total					-0.00676	(0.101)		
Household head's age			-0.0202	(0.0142)	-0.00473	(0.0151)	0.00240	(0.00890)
Absenteism			0.959	(0.706)	-0.422	(0.373)	-0.324	(0.526)
Gender	0.106	(0.110)	-1.134**	(0.609)	-0.258	(0.559)	-0.323	(0.477)
Head Off-farm	0.292	(0.222)	0.566	(0.371)	-0.190	(0.431)	0.0662	(0.275)
Dependant Off-farm	-0.0207	(0.0833)	-0.143	(0.162)			-0.253*	(0.150)
Family labour			-0.162	(0.161)	-0.0517	(0.115)		
Baoule	0.430**	(0.189)	2.517***	(0.756)	-0.0375	(0.518)	0.0303	(0.294)
Aboure	-0.198	(0.233)	-0.193	(1.330)	1.357	(1.930)	-1.335***	(0.646)
Sénoufo	ref		ref		ref		ref	
Land Estate characteristics								
Rubber less than 3 years (ha)			0.599***	(0.107)				
Rubber 2 to 3 years (ha)					-0.748***	(0.182)		
Rubber 4 to 6 years (ha)					0.695***	(0.0814)		
Mature rubber trees (ha)			-0.127**	(0.0563)	-0.642***	(0.106)		
Mature palm trees (ha)			0.0576	(0.0974)	-0.0469	(0.0659)		
Area Coffee/cocoa (ha)			0.0369	(0.0417)	-0.0443	(0.0308)		
Area except trees (ha)	-0.0523**	(0.0205)	0.204***	(0.0455)			0.176**	(0.0789)
Area except trees 2006 (ha)					0.148***	(0.0573)		
Perennial crop (ha)	-0.0206**	(0.00780)						
Mature perennial crops (ha)							-0.0574**	(0.0237)
Immature perennial crops (ha)							0.00464	(0.0185)
Area given to dependants							-0.0582	(0.138)
Abandoned plantations					-0.221**	(0.102)		
Sékou Touré fallows							-0.0174	(0.0855)
Annual workers			-1.142**	(0.542)	0.226	(0.366)		
Village characteristics								
Inhabitants village			-0.213	(0.635)	-0.614	(0.946)		
Migrants village			-0.128**	(0.529)	1.57	(0.998)		
Price land rental	0.00493*	(0.00284)	0.0408	(0.112)	-0.141	(0.165)	0.175***	(0.0450)
Village: Djimini			2.146*	(1.241)	-2.322	(1.585)		
Conversion degree	0.00355	(0.00364)	0.0945**	(0.0375)	-3.349	(3.623)		
Constant	-1.697***	(0.567)	-3.454	(2.667)	-0.631	(3.933)	-1.473	(0.910)
Observations	307		307		307		307	

Robust standard errors in parentheses (correcting for intragroup correlation at the village level)
*** p<0.01, ** p<0.05, * p<0.1

i) Renting land in and out

Regarding first the **decision to lease land in**, the results show some expected relationships. Landowners who have a larger land area – the area allocated to mature perennial crops that freeze the plots being excluded – rent less land in. This observation seems to be driven by the size constraint represented by the owned land, and not by the fact to have frozen a proportion of the land estate with trees. In fact, the negative influence of the area planted with perennial crops on the area leased in shows that the reason why staple crop is grown on plots that are not owned by the households is not obviously due to the choice to plant. The result holds when we distinguish between young perennial crops that may be intercropped, and thus avoid to have to rent land in to cultivate annual crops, and mature perennial crops: then, only the area planted with mature perennial crops turns out to be significantly negative.

There is no sign of a potential binding liquidity constraint concerning the land market participation: the landowner revenues generated by off-farm activities have no influence on the area leased in, and the area from perennial crop production have a negative influence. However, it should be noted again that only part of the contracts involve a cash-rent to be paid before the production cycle – but, 58% of the area is effectively under fixed-lease contracts. Last observation regarding liquidity constraint, the average rent at the village level, which might have been a negative incidence on the area rented in, has in fact a positive influence[23]: the landowner is not sensitive to price mechanism, the elasticity of the demand being negative. Therefore, buying food on the market or leasing land in for staple crop production seems not to be a severe constraint.

Nevertheless, the size of the family, namely the number of children, has a positive impact on the area leased in. In the case of large families, the internalisation of the staple crop production seems to be privileged.

Regarding the **decision to lease land out**, the results show unsurprisingly that the land estates with a large available land area (*Area except trees*) have a larger area leased out. Moreover, we see that the influence of perennial crops is significant, but that it should be understood according to their types: in fact the area planted with mature palm trees or coffee and cocoa doesn't modify that rented out. However, the choices previously made in rubber tree planting are strongly related to the participation in the land market. The stock of mature rubber trees is negatively linked to it, so that we can propose that the revenues from latex production may alleviate the liquidity constraint of the landlord and decrease the probability of renting land out, especially for fallows. Conversely, the plots planted with young trees can be leased out for intercropping, and the results show a strong relationship between both variables. Therefore, we conclude that cropping pattern conversion takes directly part to a transitory (as intercropping is possible during the maturation period of trees) dynamics of the land market.

This statement is confirmed by the fact that the conversion degree of the village where the land estate is located has a positive impact on area of the land leased out by the landowner. As the dynamics of conversion is relatively recent with 1/3 of the plots grown with perennial crops planted in the last 3 years, the villages which have the highest conversion degree of their cropping pattern were still in the process of converting their agricultural production at the survey time.

[23] This positive relation might be due to the fact that these landowners are settled in villages where the tenancy market is most active (due to the presence of large group of landless tenants) and thus the land rent higher.

ii) Tree-planting and annual crops cultivation

As regards the investment decision in **planting rubber trees**[24], the results show that the behaviour is mostly explained by the size of the land estate and the dynamics of previous investments.

Unsurprisingly that the land area allocated to new trees planting is positively related to the available land area. A cycle of tree-planting seems to emerge:

- The area planted with trees that are 2 or 3 years old, namely that allow for intercropping (by the family or by tenants), has a negative impact on the actual decision of planting (endogenous variables, trees planted in 2007). We may think that, in this case, the liquidity constraint is binding: in fact, after an investment made two or three years ago, the liquidity constraint is probably tougher as the investment generates no revenues. Moreover, the amount of the rent generated by leasing out one hectare of land is less than 10% of the monetary investment needed to plant one hectare of rubber trees.
- The result showing that the area planted 4 to 6 years ago is positively related to the new plantations confirms this conclusion: the capital stock may be higher after such a period of time. The result may thus be due to a necessary time period of monetary accumulation before planting again, due to a temporary liquidity constraint following the purchase of the inputs required for the plantation.
- Lastly, the presence of mature rubber trees has a negative impact on the area planted in rubber trees in 2007. Yet, only 17% of the total stock of rubber trees (mature) were planted before 2000, and most of them just before 2000. We suspect therefore a generation effect in rubber tree planting, whereby some of the land estates begun planting rubber trees before the others: in fact, 21% of the landlords report the presence of mature rubber trees; all of them report to have immature trees aged between 4 and 6 years; however, almost 70% of them don't report any rubber trees younger than 3. When looking at their characteristics relatively to those of the land estates with no mature rubber trees, we may have an insight in the reason why they stopped planting rubber trees. First, they are far larger than land estate with no mature trees (17.5 ha versus 11 ha), and they heavily invested in rubber tree planting: when counting mature and immature trees, the total area is 6 ha versus 0.8 ha for the others, or 2.4 ha on average for those reporting the presence of immature rubber trees). Last, their land availability is still large as they don't lease land out more than the others, and the difference in annual crop cultivation is slight. We may therefore think that the liquidity constraint is at least partly explaining their behaviour.

The impact of the land areas that may be planted with new crops has a surprising impact on rubber tree planting. We distinguish between the declared abandoned plantations or the ageing coffee/cocoa plantations, the latter being reported by the household as still productive. We do not find any evidence that having a large area planted with ageing coffee or cocoa trees (85% of the trees were planted more than 20 years ago) has an impact on rubber tree planting; even if not any longer very productive, these plantations are clearly seen by the planters as still worth to keep. However, the acreage of land occupied by old plantations explicitly reported as such by landowners has a negative impact on the area planted with rubber trees in 2007. Only 15% of the land estates are composed of such abandoned plantations, and almost all of them are in the village of Kohourou (91%, that is 2/3 of the landowners interviewed in this village

[24] We do not deal in this paper with the choice between rubber tree and other tree crops.

who account for 97% of the total area of abandoned plantations in the sample). In this case, the total area is that large that, relatively to it, the area planted with trees is small.

Last, the **cultivation of annual crops** on the owned land estate increases with its size and that of the family, namely the number of children. Moreover this area is decreasing with the number of family members that are engaged in off-farm activities (home-made processing, small businesses…) and thus work less on the land estate and privately earn money.

The area planted with mature perennial crops is negatively related to the area cultivated with annual crops everything else equals, in particular the available area not grown with perennial crops. This may be due to the fact that revenues from tree production can be used to buy food on the market. Conversely, the area planted with young trees that can be intercropped has no statistical impact on the area cultivated with annual crops (including intercropping): intercropping or not does not seem influence the production of food crop. Under the assumption of subsistence constraint, no further areas will be allocated to food crop production other than those necessary.

The covariance between the residuals of the two equations is found to be different from zero. In other words, running separated estimations of univariate tobit equations for each behaviour would have led to biased results.

Conclusion

This analysis draws on the literature on land tenancy markets and proposes to take into account the evolution of cropping patterns as a determinant of the land market activity. Even though planting perennial crops lowers land market participation in the long run (with an impact varying with the length of cycle plantation renewal), the possibility to practice intercropping when the trees are immature allows for leasing planted plots out (or preparing the land for a new plantation). Furthermore, this opportunity can partly alleviate the liquidity constraint when up-front investment and thus working capital is needed, by cutting costs. Lastly, using the planted plots to intercrop staple crop alleviate transitorily the need to find, and even lease in, land in order to cultivate food crops.

The results show that planting trees increases, at the household level, the area of land leased out. Furthermore, we found evidence for a tough liquidity constraint, as those endowed with agricultural capital (stock of trees) and subsequent revenues from agricultural production tend to lease less out, everything else equal. Lastly, the decision to lease land in seems to be more driven by the total land estate size than by the acreage decision for perennial crop plantation: small land estates rent more land in, whereas the area of land dedicated to perennial crops has a negative impact on the area leased in. Land pressure, leading to leasing in behaviour, does not therefore seem to be induced by the amount of the total land area planted with trees and that will be unavailable for annual crop cultivation until the trees are uprooted.
The question remains open to know if, from the tenant point of view, the evolution from a land market dynamics based on frontier agriculture, to the above presented dynamics based on crop substitution under land pressure is neutral: it may in fact affect the price of land, as well as the production yields and subsequent revenues of the tenants, in particular in the case of intercropping. Moreover, the perennial crop choice is of importance: where palm trees are less productive after 25 years on average, the yields of rubber trees remain not decreasing during 40 years after planting. Intercropping opportunities may therefore be different according to cropping patterns.

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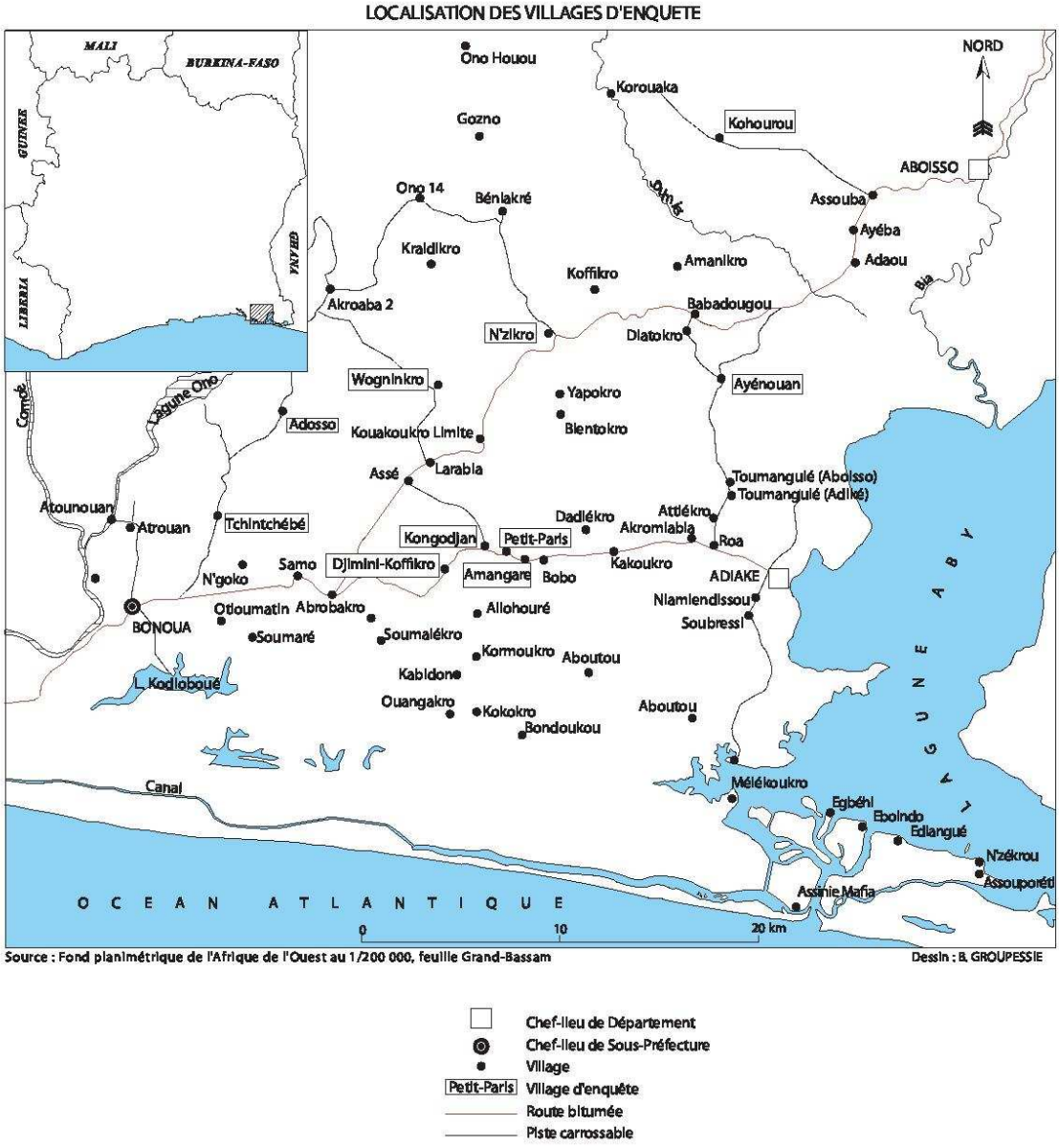
Appendix 1: Map of the study area



Appendix 2: villages and selection

Villages were chosen in Lower Côte d'Ivoire on the basis of their ethnic composition. Three different ethnic groups settled in the region (Abouré, Baoulé and Sénoufo) and this difference may induce different behaviours in matters of acreage decisions. Moreover, the village differ according to their own dynamics (land market activity, specialisation in specific crops, presence of migrants), we chose to control for this in the econometrics part (see Colin and Bignebat, 2010 for details).

		Number of households owning lang					
	Ethnic composition	Abouré		Baoulé		Sénoufo	
S/préf.	Village	CU	PU	CU	PU	CU	PU
Bonoua	Tchintchébé	6	12	-	-	-	-
	Wogninkro	12	29	-	-	-	-
	Adosso	13	30	-	-	-	-
Adiaké	Djimini	-	-	23	41	-	-
	Kongodjan	-	-	-	-	13	15
	Petit-Paris	9	17	-	-	-	-
	Amangare	11	17	-	-	-	-
Aboisso	Nzikro	-	-	36	45	-	-
	Ayénouan	-	-	16	22	38	40
	Kohourou	-	-	-	-	61	61
Total		51	105	75	108	112	116

CU: consumption unit ; PU : production unit

Appendix 3: descriptive statistics

Variable	unit	Mean	Std err.	Min	Max
Endogenous variables					
Land rented in	ha	0,0429	0,2673	0	4,125
Land rented out	ha	1,0586	1,6078	0	9
Land planted with trees	ha	0,4837	1,3719	0	16
Land with annual crops	ha	1,0920	1,5203	0	9
Family characteristics					
Consum_women	nb	3,5798	3,0512	0	20
Consum_children	nb	2,7394	3,6743	0	28
Consum_men	nb	2,7557	2,1577	0	19
Dependant_women	nb	2,5081	2,7951	0	20
Dependant_men	nb	1,3974	2,0401	0	18
Dependant_total	nb	3,9055	4,4657	0	37
Household head's age	years	53,2508	13,5964	18	100
Absenteism	dummy	0,1498	0,3575	0	1
Gender	dummy	0,9088	0,2884	0	1
Head Off-farm	dummy	0,4821	0,5005	0	1
Dependant Off-farm	nb	1,6743	1,3351	0	7
Family labour	nb	1,6515	1,5251	0	11
Baoule	dummy	0,3322	0,4718	0	1
Aboure	dummy	0,2964	0,4574	0	1
Sénoufo	dummy	0,3713	0,4840	0	1
Land estate characteristics					
Rubber less than 3 years	ha	1,0603	1,9278	0	16
Rubber 2 to 3 years	ha	0,5798	1,2955	0	9
Rubber 4 to 6 years (ha)	ha	2,4625	3,9997	0	36
Mature rubber trees (ha)	ha	0,9186	2,4276	0	20
Mature palm trees (ha)	ha	2,3216	3,1344	0	17,5
Area Coffee/cocoa (ha)	ha	2,2581	4,6806	0	33,5
Area except trees (ha)	ha	5,2008	5,2558	0	34
Area except trees 2006 (ha)	ha	5,6845	5,5602	0	34
Perennial crop (ha)	ha	7,2606	7,4933	0	42,5
Immature perennial crops (ha)	ha	1,5440	2,7126	0	27,5
Mature perennial crops (ha)	ha	5,7304	6,6119	0	34
Area given to dependants	ha	0,7769	1,3057	0	10
Abandoned plantations	ha	1,0542	3,2554	0	24
Sékou Touré fallows	ha	2,4353	3,3503	0	23
Annual workers	nb	0,1303	0,5566	0	5
Village characteristics					
Inhabitants village	nb*1000	2,7302	1,4478	0,524	4,366
Migrants village	nb*1000	1,4466	0,7865	0,354748	2,81607
Price land rental	10^6 FCFA	0,6897	0,2507	0,425	1,44545
Village: Djimini	dummy	0,1336	0,3407	0	1
Conversion degree	%	39,5	14,1	19,6	59,0