

Land Tenure and Allocative Efficiency in Niger

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Abstract

Using field level data, we investigate whether traditional land tenure systems are an impediment to allocative efficiency in Niger. We find that yields are strongly influenced by the manpower available to farming households, an indication that marginal returns to labor and land are not equalized across households. We uncover no relationship between manuring and whether or not local customs allow land sales. But manuring is influenced by tenure security: farmers who cultivate both borrowed and owned fields divert manure towards the latter. Our findings do not imply that a change in land tenure system is called for.

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While it is no longer acceptable to blame cultural factors for economic stagnation and environmental degradation in Africa, it is in vogue to attribute these problems to local institutional constraints. In particular, many hold the view that the land tenure systems of Africa are in crisis. Because the customary tenure systems usually do not confer title - or even fully 'individualized' use rights - and lack land markets, potential reformers argue that current institutions discourage efficient resource use.

In particular, customary tenure institutions are thought to hinder land transactions and thus factor mobility (the *transactions effect*). Because the establishment of clear ownership lowers the cost and risk of transferring land, land registration or titling is hypothesized to improve factor mobility, resource allocation and thus productivity. Land tenure is also thought to influence agricultural productivity through the *security* (or investment demand) *effect*. According to this hypothesis, the uncertainty of the user's claim to land lessens expected future returns to current investments. Afraid of not recouping the investment made, the user hesitates to spend resources on land-improving inputs. The demand for investment declines and productivity suffers. The literature often fails to distinguish between the security of specific land tenure contracts and the security of the land tenure system itself, however. Finally, it has also been hypothesized that land title can stimulate investment by means of the *collateral* (or credit supply) *effect*. By turning land into a mortgageable, transferable commodity, farmers can use it as collateral to access the credit needed for productivity-enhancing investments. For this reason, land title is thought to raise the supply of investment capital available to farmers (e.g., Feder et al. (1988), Bruce and Migot-Adholla (1994), Atwood (1990), Barrows and Roth (1990), Green (1987), Kille and Lyne (1993)).

In this paper, we use field level data from Niger to investigate whether traditional land tenure systems are an impediment to allocative efficiency in agriculture. We begin with a brief review of the empirical evidence available on Africa and other parts of the world. We then describe the land tenure system prevailing in the study region. The absence of land registration and bank credit in the area makes it ideal for testing allocative efficiency in isolation from collateral effects. Two simple tests of allocative efficiency are introduced. The first focuses on the transaction effect. It is based on the idea that if factor markets are efficient, then returns to land should be equalized across households and thus should not depend on households' resource base. Test results demonstrate that yields are strongly influenced by the manpower available to farming households, an indication that marginal returns to labor and land are not equalized across farms. Factor returns equalization fails to be achieved even though local land tenure and labor institutions provide several ways for the reallocation of factors among farms.

The second test investigates the security effect of particular land contracts. Its starting point is that, if tenure security is not a concern of farmers, resources like manure that have a lasting effect on soil quality should be allocated between fields without regard for their tenure status. Results show a non-significant relationship between manuring and whether or not local customs allow land sales. Results nevertheless show that farmers who cultivate both borrowed and owned fields consistently divert manure towards the latter. The security of specific land tenure contracts thus influences investment in land fertility improvement. This finding does not imply that a change in land tenure system is required.

Review of Empirical Evidence

Studies from Thailand offer evidence for the collateral and security effects of land title (e.g., Feder (1987), Feder et al. (1988), Feder and Onchan (1987)). Similar research in Africa, however, has been far less conclusive. A collection of World Bank studies from Ghana, Rwanda and Kenya found little relation between land rights and credit, in part because both formal and informal capital markets are very thin. Even in Kenya where land owners could show formal documents, title was unrelated to formal credit, the term of loan maturity, or the size of loans (e.g., Migot-Adholla et al. (1991), Migot-Adholla, Hazell and Place (1991), Place and Hazell (1993), Place, Hazell and Lau (1990)).

In terms of long-term land improvements, input use and productivity, the evidence from Africa is again tenuous. In areas of Kenya with land registration, there was no link between either title or land rights and land improvements (e.g., Barrows and Roth (1990)). Weak relationships were also discovered in Ghana and Rwanda (e.g., Migot-Adholla et al. (1991), Migot-Adholla, Hazell and Place (1991), Carter, Wiebe and Blarel (1989)). Only one study from South Africa succeeded at empirically linking tenure security to input use (Kille and Lyne (1993)).¹ On the whole, therefore, existing empirical studies have failed to establish strong links between land rights, investment, and agricultural productivity on African crop lands.

The Study Area

In contrast to previous work that examined the relatively developed humid zone and

¹ The authors use the value of fertilizer, seed, chemicals and land preparations as proxies for productivity. Here, these have been classified as inputs.

highlands of Africa, this paper focuses on semi-arid Niger. The simple features of Nigerien rainfed agriculture indeed make it particularly suitable for testing allocative efficiency. Field data were gathered in 1990 and 1991 from eight villages along a north-south rainfall gradient in the Tillabéri Department of western Niger.² A sample of sixty households was drawn based on tenure status and manure use. Heads of household described their family's position and settlement in the village, the nature of the family's access to land, as well as land use by individual family members. Questions were posed about manure management and the physical attributes, agricultural practices and land tenure history of major cereal fields. To abstract from intra-household issues, fields managed by individuals other than the household head were ignored.³

The Farming System

The key features of the survey data are summarized in Table 1. Two drought resistant grains, millet and sorghum, dominate cropping patterns.⁴ Crop yields are low, particularly in the dry Simiri region. The use of modern chemical fertilizers is infrequent: only 6% percent of fields receive chemical fertilizer, often in small amounts. Other chemicals and improved seeds are virtually unheard of. Traditional methods for soil fertility restoration, such as shifting cultivation and bush fallow, are in decline due to increased population pressure (e.g., Matlon (1994)). Rotating cereals with nitrogen-fixing leguminous

² E.g., Lolotondi, Bani-Beri and Gabdeye-Bongou in the Simiri canton; Battaré and Kahé in the Bittinkodji canton; and Piliki, Dandiré and Kounari in the Guéladio canton.

³ Using data from neighboring Burkina Faso, Udry (1994) indeed shows that fields managed by women and household dependents have significantly lower yields than those managed by the household head. Unlike in more humid parts of Africa where women are responsible for food production, farming activities on the major cereal fields are directed by the senior male, although other family members have age- and sex-specific tasks and share the harvest.

⁴ As the numbers suggest, millet and sorghum are intercropped on some fields. Cowpea, another common intercrop partly grown as fodder is ignored here because grain yields are very low (e.g., Matlon and Fafchamps (1989)).

crops is uncommon. Windbreaks, bunds, live fences and other techniques for protecting the soil have not been widely adopted.

The principal technique for maintaining soil fertility is the application of livestock manure. 43% of the fields are deliberately manured, either by making animals rest on the field during the dry season, or by carrying livestock manure from the household compound. Although too bulky to be marketed, manure is occasionally exchanged through night paddocking contracts both within the village and with outside herders. According to farmers and agronomists working in the West African Semi-Arid Tropics (WASAT), the effects of manure on soil quality (e.g., crop nutrients, soil texture, and moisture retention) last for more than one agricultural season. The application of manure can thus be regarded as a short-term investment in land.

Land Tenure

Customary tenure arrangements prevail, both *de jure* and *de facto*, over crop lands in Niger.⁵ As the survey and other land tenure studies in Africa have shown (e.g., Gavian (1993), Atwood (1990), Platteau (1995)), customary systems contain private and communal elements. Crop production is carried out by individual households, not the community, and land rights are exclusive for the period of cultivation. Central to the land tenure system is the village chief whose moral power is derived from his position as the senior member of the family that originally cleared the lands for the village. Two different pat-

⁵ The legal codes inherited from the French provided for the registration of private lands while affirming customary rule over lands not otherwise appropriated. These laws, modified by successive Nigerien administrations, have been inconsistently applied (e.g., SEDES (1987), Ngaido (1993), Riddell and Dickerman (1986), Sidikou (1982)). To bring order to a plethora of badly understood laws, the Government of Niger formed the National Rural Code Committee in July 1989. Its goal is to provide security to farmers and herders, promote agricultural investments and protect the environment (see Comité Ad Hoc Chargé de l'Elaboration d'un Code Rural (1989), Comité du Code Rural (1989)).

terns have arisen, mostly along ethnic lines, in the breadth of the land rights granted by Nigerien chiefs to villagers.

The first is closest to the western notion of private property in which land is held permanently by individual families. Land owners are granted the right to use, modify and transfer land, and the legitimate, but highly discouraged, right to sell. The chief settles disputes and allocates open lands to newcomers but he receives no payments from villagers for the fields they farm. The second land tenure system found in western Niger is the Fulfulde *hawjou* system in which land is borrowed from a pool of community lands entrusted to the village chief. *Hawjou* users have the same use rights as owners but cannot sell or lend the land directly to each other. Both tenure systems provide ways of reallocating land within the community. The *hawjou* system explicitly stipulates that unneeded fields must be returned to the chief for reassignment within the community. In the ownership system, land can be reallocated in a decentralized fashion by borrowing fields from one another. Borrowers keep all of the crop output but have no right to make medium-term modifications such as fences, wells and trees. They are of course not allowed to sublet or sell the field.

Under either system, the absence of registration, land title, and active land markets reduces the possibility for land to serve as collateral. Land pledging, a form of pawning, is the only way in which land can be used to borrow. Unlike in mortgage contracts, use rights are transferred to the lender. Land pledging is not, therefore, a convenient way to finance the purchase of agricultural inputs. It is used mostly as a disguised form of distress sale. Although the direction of causality between land tenure security and access to bank credit is difficult to assess, there currently seems to be no high return commercial inputs suitable for the WASAT (e.g., Matlon (1994), Binswanger and McIntire (1987)).

Given the absence of formal agricultural credit in the area, we cannot test for the existence of a collateral effect.

To summarize, individual farmers in western Niger can hold land in one of three ways: as owned field, as borrowed field, or as *hawjou* field. Interviews with farmers indicate that the security of tenure differs among these three regimes. Owned fields belong permanently to owners and their descendants. Borrowed fields are held in all security until the harvest but can be reclaimed by the owner afterwards. *Hawjou* fields can be used for as long as the farmer requires. If a farmer dies or retires, descendants must nevertheless confirm with the chief their right to cultivate the same fields.

Quantitative survey data largely confirms these findings. Owned, *hawjou*, and borrowed fields have been held by their user for an average of 31, 24, and 7 years, respectively. A third of all borrowed fields were acquired within 3 years of the survey. Borrowing households report having lost or given up at least one field far more often than either owners or *hawjou*-users (57%, 25% and 0% respectively). To summarize the evidence, borrowed fields are less secure than either owned or *hawjou fields*. Although users of *hawjou* fields cannot transfer land to others, their security of tenure is close to that of owners.

Testing for the Transaction and Security Effects

Having described the study area, we now test for the presence of transaction and security effects. Our test of the security effect rests on the fact that manure application is an investment in soil quality that lasts for more than a single crop year. Controlling for application costs, farmers should allocate manure across fields irrespective of tenure status if tenure security is unimportant. Formally, we have:

$$M_i^* = \beta_b B_i + \beta_h H_i + \beta_f F_i + \beta_c C_i + u_i \quad (1)$$

where M_i^* is the amount of manure applied on field i ; B_i and H_i are dummy variables for borrowed and *hawjou* fields, respectively; F_i is a vector of field characteristics; C_i is a vector of household characteristics; and u_i is a disturbance term. The β 's are parameters to be estimated.

Unfortunately, we could not measure the quantity of manure each field received because it is often applied by having livestock spend the night on the field. Manure application was thus recorded as a binary variable M_i , taking the value of one if the field was deliberately manured either by corralling animals on the field or by transporting manure from the homestead during the preceding dry season. Because manuring stops after rains start, it can be treated as independent from rainfall and other shocks that affect yields. Simultaneity between yields and manure can thus be ignored. Equation (1) is estimated in Probit form for the entire sample and for each region separately. If the security effect does not matter, β_b and β_h should be equal to zero.

To be valid, the above test requires the existence of a market for manure. As we have seen, the bulky nature of manure has precluded the development of an active market in the survey region. If manure cannot be exchanged, households with insecure tenure have little choice but to apply whatever manure they have on their fields anyway. The effect of tenure can nevertheless be discerned by observing whether households who hold fields under various tenure regimes choose to allocate their manure to more secure fields. Formally, we further test the effect of tenure on manuring by running equation (1) with household fixed effects to control for the unobservable stock of manure:

$$M_i = \beta_b B_i + \beta_h H_i + \beta_f F_i + \sum_{j \in J} \beta_j D_{ij} + u_i \quad (1')$$

where the D_{ij} are household dummy variables and J is the set of surveyed households.

To facilitate the comparison of results from equations (1) and (1'), we estimate both using the sample of 44 households with multiple fields.⁶ OLS is used for equation (1').⁷ Testing for the security effect boils down to verifying whether β_b and β_h are significantly different from zero.

The test of the presence of a transaction effect is built on the premise that, if land is allocated efficiently within the community, returns to factors must be equalized across households. If they are not, village output could be increased and households be made better off by reallocating factors among them. This is true irrespective of returns to scale. Factor reallocation to equalize returns implies that returns to land and labor must not depend on household preferences and endowments.⁸ Households who wish to work hard are expected either to acquire more land -- through purchase, gift, or rental -- or to work on other people's farm -- through wage labor or labor transfers. Yields may vary according to field characteristics but they should not differ according to household manpower and other characteristics. Consequently, a simple test of the transaction effect can be constructed by noting that, if household characteristics have a significant effect on yield, this is evidence that existing institutions fail to allocate land and labor efficiently within the region or village.

Formally, the estimated equation is:

$$Y_i = \alpha_m M_i + \alpha_f F_i + \alpha_c C_i + e_i \quad (2)$$

where Y_i is crop yield on field i , e_i is a disturbance term, and the α 's are parameters to be

⁶ Of the 60 households in the sample, 16 have a single field, 18 have two fields, 20 have three, 5 have four and 1 has six. Results from equation (1) are essentially the same when the whole sample is used.

⁷ We were unable to compute the logit fixed effects estimates proposed in Chamberlain (1980) due to singularity of the Hessian matrix during iterations.

⁸ As the literature on household models has shown, separability between production decisions and consumption preferences should hold in the presence of perfect markets (Singh, Squire and Strauss (1986), de Janvry, Fafchamps, and Sadoulet (1991)).

estimated. As before, variables M_i , F_i and C_i stand for manuring, field characteristics, and household characteristics. Crop output is measured in bundles, which is the unit farmers are most familiar with. A bundle weighs between 18 and 22 kilogram. Since sorghum and millet have similar prices and calories per weight, yields are computed by dividing the number of harvested sorghum and millet bundles by the area of the field in hectares. Because household characteristics and yields vary systematically across regions, we include regional dummies to avoid biasing the test in favor of rejecting efficiency. We also estimate equation (2) separately for each region.

Equation (2) is subject to simultaneity bias because the decision to manure depends on field characteristics that the farmer knows but we were unable to observe. If a field is in good condition and does not require manuring, it will have a high yield even though it is less likely to be manured. Ignoring that e_i is negatively correlated with u_i will result in underestimating the contribution of manure to yields and potentially bias all parameter estimates. To correct for simultaneity bias, equation (2) is therefore estimated in combination with equation (1) using two-stage (2SLS) and three-stage least squares (3SLS) methods. For the 2SLS estimates, predicted manuring decisions from the probit model are used as explanatory variable in the yield equation (Maddala (1983)). For the three-stage least square estimates, we treat the dichotomous manuring variable as continuous.⁹ Although Probit estimates of equation (1) are consistent, estimating equations (1) and (2) jointly uses more information and is more efficient. 3SLS results are those that we present in Table 2.

⁹ Given the large number of explanatory variables and the small size of the sample, we encountered numerical difficulties in deriving Full Information Maximum Likelihood estimates treating manuring as a dichotomous variable. FIML estimates of a system reduced to a few key variables, however, yielded test results similar to those reported below.

Finally, even if we find that manuring is affected by tenure, we need to show that manuring raises yields before we can conclude that efficiency is reduced by tenure security concerns. Conversation with farmers in the area and agronomic evidence from research stations overwhelmingly indicates that manure makes a significant contribution to yields. To demonstrating this formally, we need to show that α_m in equation (2) is significantly positive. Because we do not know how much manure is applied, we must control for manure availability and other unobserved household characteristics. To get a reliable estimate of α_m , therefore, we rerun equation (2) with household fixed effects:

$$Y_i = \alpha_m M_i + \alpha_f F_i + \sum_{j \in J} \alpha_j D_{ij} + e_i \quad (2')$$

and evaluate it jointly with equation (1') using 3SLS.

The Explanatory Variables

All explanatory variables F_i and C_i are presented in Table 1. We briefly discuss their anticipated effect on yields and manuring. Regional dummies capture the effect of climatic and other environmental effects. Other things being equal, we expect yields to be higher in the more humid regions of Guéladio and Bittinkondji. Sandy soils are believed to favor crop growth but reduce moisture retention. Because manure can burn crops on dry soils, Simiri farmers may hesitate to manure sandy fields. Erosion reduces yields but may signal abundance of water on the field. It is expected to discourage manuring because manure can be washed away by wind or rains.

Distance between a plot and the family compound raises travel time and the cost of carrying manure from the homestead. Distance is thus expected to reduce labor inputs, manure application, and yields. Because certain farmers prefer corralling their animals on remote fields where pasture is more readily available, the square of distance is also

included in equation (1). Since it is not uncommon for farmers to manure part of a field only, large fields are more likely to have been manured and plot size is included in the regressions.

The decision to manure depends on whether the fertility of the soil needs to be replenished. Fields that received fortuitous manuring or that are located where the family compound was in the preceding two dry seasons are more likely to have been previously manured and thus require less manuring. Fields located near water are more likely not only to be manured but also to have a higher moisture content and thus higher yields. Crop rotation between cereals and nitrogen-fixing legumes is believed to increase yields and to substitute for manuring. Dummy variables are used to capture these effects.

The manpower available to each household is measured in adult equivalents and divided by total cultivated area.¹⁰ A dummy variable measures whether the head of household has a regular non-farm occupation (other than herding) and is thus available for farm work. Possible wealth effects are captured by adding total farm area and livestock ownership to the manure and yield regressions. As Table 1 shows, nearly all sample household have at least some livestock.¹¹ The age of the household head is included to capture possible returns to experience (e.g., Rosenzweig and Stark (1989)).¹² Because polygamy is feasible only for wealthier households, it serves as another proxy for wealth. With perfect factor markets, none of these variables should have an effect on yields and

¹⁰ Following Dicko and Sayers (1988), family members from 16 to 59 years of age are counted as one irrespective of gender, elders (60 and over) and adolescents (10 to 15) as one half and children below 10 as zero.

¹¹ Because animal owners were reluctant to divulge precise information about the number and types of animals they possess, we were unable to construct a reliable measure of livestock wealth. Animal ownership is measured by a dummy variable.

¹² Measures of education are dropped because very few farmers have any schooling. The smattering of religious or literacy training does not provide adequate variation in the data.

input levels.

Testing for a Security Effect

3SLS estimates of equations (1-2) -- with household variables -- and (1'-2') -- with fixed effects -- are presented in Table 2. To verify the robustness of the results, 3SLS estimates are also calculated by region, and other consistent estimators of equations (1-2) and (1'-2') are computed as well (i.e., Probit for manuring with household variables; OLS for manuring with fixed effects; 2SLS for yields). Results from these regressions are summarized in Tables 3 and 4.¹³

On the basis of equation (1), tenure appears to have no effect on manuring: the coefficients of the borrowed and *hawjou* field dummies are both non-significant. Results from equation (1'), however, indicate that borrowed fields are less manured whenever households have a choice to allocate the manure to other fields. Results are significant both in the OLS and 3SLS regressions, for the combined sample and in one of the three sub-samples. In contrast, the *hawjou* dummy is never significant.

From this combined evidence we conclude that security of tenure is a concern of farmers and that it affects manuring when they can choose among fields with different tenure. Results concerning borrowed fields are consistent and robust. There is no evidence that *hawjou* fields are less likely to be manured than owned fields. The sharp discrepancy in the results from equations (1) and (1') is an indication that there are imperfections in the market for manure. Suppose the contrary, i.e., that a perfect market existed for manure. In this case, subjective returns to manure would be equalized across

¹³ Detailed results are available from the authors upon request.

households. Individuals unsure about capturing future returns to manuring would be better off selling the manure to secure households than applying it on borrowed land. Borrowed fields would thus receive less manure irrespective of whether or not they are held by farmers who also have owned fields, and the results from equations (1) and (1') would be similar.

Other coefficients in equations (1) and (1') generally conform to our expectations, although they are not always significant. Fields on sandy plain or with ample erosion are less likely to be manured only in the dry Simiri region, a result partly in line with expectations. Given the practice of manuring portions of fields only, large plots are significantly more likely to have received some manuring. The cost of applying manure seems to have a strong effect on manuring: coefficients for distance and distance squared are significant in several regressions, both for equation (1) and equation (1'). The relationship between distance and manuring cost is non-linear: it is initially negative then becomes positive for distances beyond 4 Km. Most sample fields, however, are less than 4 Km from the homestead. The role of manuring costs is further confirmed by the fact that manuring is more likely on fields located near water. The presence of the compound on the field in the preceding dry season also has a positive effect on the probability of manuring.

Fields that benefited from fortuitous manuring from other sources are less likely to receive deliberate manuring. Total farm area has a negative effect on manuring in some of the regression, and animal ownership is shown to exert a positively significant influence in the 3SLS regression for the Guéladio region. These results are in agreement with the idea that households have manure resources that are largely determined by the size of their livestock. Household with more land and fewer animals are thus less likely

to manure any particular field.¹⁴

Testing for a Transaction Effect

We now turn to the results from the yield equation. As is evident from Tables 2, 3 and 4, efficiency in the allocation of land and labor resources within the village is strongly rejected: household manpower resources affect yields in all regressions and regions. The coefficient is highly significant in all cases. This implies that differences in land endowments across household are not corrected by land and labor transactions. Presumably, households with less land work harder on each plot and reach higher yields.

Variables other than household manpower appear to have little or no discernible effect on yields. This is not entirely surprising given the high variance of yields in the WASAT and the ensuing difficulty in identifying yield effects in a small sample. Fields located where the household compound was in the previous two dry seasons are shown to have higher yields in some of the regressions, a likely reflection of the disproportionate amount of household and livestock manure these fields received. Contrary to expectations, regional dummies have no effect on yields: differences between regions observed in Table 1 seem to be entirely attributable to differences in the intensity of cultivation captured in the household manpower variable. In some regressions, large plots are shown to have lower yields even after controlling for distance, field location, and household fixed effects. It may be that farmers choose to cultivate certain fields extensively and others intensively as a form of insurance against rainfall variations. This issue deserves more

¹⁴ We also estimated an expanded version of equations (1-2) and (1'-2') that includes chemical fertilizer. Results from these regressions, which are to be interpreted with care given that the very small number of sample fields that received fertilizer (see Table 1), do not alter our conclusions regarding manuring and tenure.

work.

Regarding the effect of manuring, results show that manure application has a significantly positive effect on yields, but the evidence is less strong than anticipated: for equation (2), the 3SLS coefficient of manuring is significant at the 10% level in Guéladio only; for equation (2') it is significant only for Guéladio and the combined sample.¹⁵ These results are in apparent contradiction with agronomic evidence and statements by surveyed farmers that strongly emphasize the role of soil fertility in yields. The answer to this puzzle lies in the endogeneity of the manuring decision: manure and chemical fertilizer are primarily applied to fields with declining fertility. Confirmation of our suspicion can be found in the fact that in a simple OLS regression of yields on manuring plus field and household characteristics, manuring has a negative, though non-significant, coefficient. This coefficient turns large and positive when the simultaneity of manuring is recognized. Moreover, 3SLS estimates of the covariance between u_i , the disturbance in the manuring equation, and e_i , the disturbance in the yield equation, are all negative (Table 2). Because intrinsic soil fertility remains unobservable to us, however, we cannot control for it precisely and are unable to accurately measure the effect of manure on yields.

Conclusion

Using survey data from Niger, we tested whether traditional land tenure systems allocate land efficiently and whether tenure insecurity affects households' manure allocation. We found robust evidence that tenure insecurity incites farmers to divert scarce

¹⁵ The manuring coefficient is also significant in the 2SLS regression for the Bittinkondji region.

¹⁵ Similar results obtain in the case of chemical fertilizer.

manure resources to more secure fields whenever they can. On the other hand, we found no evidence that laws and customs regarding the transferability of land, e.g., owned land versus *hawjou* land, have an effect on short-term investment decisions. We conclude from these findings that security matters but traditional tenure systems are not in question. What is important is the regime under which a particular field is farmed, i.e., whether it is held permanently (e.g., owned or *hawjou*) or temporarily (e.g., borrowed). The security of particular land contracts must not be confused with the security of the land tenure system as a whole. Replacing traditional systems with western-style tenure through land titling and other measures would not do away with land rentals and thus with security concerns. Our findings on the effect of security concerns on productivity do not imply that a change of land tenure system is called for.

Household manpower resources were shown to have a significant effect on yields in all regressions, a finding that is in contradiction with allocative efficiency. Traditional institutions facilitating the reallocation of land across farms, like gifts, loans, land pledges, sales, and redistribution by the chief in the *hawjou* system, seem insufficient to achieve efficiency. Labor transactions fail to make up for differences in land endowments. Regression results regarding manure also suggest that households differ in access to manure. Returns to the three most important agricultural inputs, land, labor and manure, thus appear not to be equalized across farms.

Although alarming, these findings should not be construed as an indictment of traditional land tenure systems. It is doubtful that formal markets for land and other factors of production would totally eliminate allocative inefficiency. There is indeed evidence that farm size and other household characteristics influence returns to farming in a variety of institutional setups (e.g., Carter (1984), Feder (1985), Deolalikar (1988)) and thus that

factors are not allocated efficiently across farms.¹⁶

Even if one were to conclude that the establishment of land markets would improve efficiency, it remains unclear how this can be achieved. Land titling requires expensive surveying of all crop land and is likely to be unpractical beyond the immediate neighborhood of major urban centers. In an environment of multiple market imperfections where customary forms of land tenure do not pose tenure security constraints, land titling and other measures to encourage land markets are not likely to induce increased investment, productivity, or efficiency. Furthermore, the costs of establishing and managing land titles may not be justified if the welfare loss from current inefficiency is low. Using data from neighboring Burkina Faso, Fafchamps (1993) estimates the elasticity of substitution between land and labor at weeding time to be between .55 and .95, a value sufficiently large to enable households with ample labor to increase output through careful weeding. Results reported here provide some support for this idea: based on estimated parameters, every additional adult worker on the farm generates around 350 Kg. of grain -- well above what is required for adult consumption. It is therefore possible that current levels of allocative inefficiency are permitted to exist because they do not generate large welfare losses. This issue deserves more research.

¹⁶ This issue is quite distinct from that of the efficiency of farmers in allocating the resources at their disposal.

Bibliography

- Atwood, D. A., "Land Registration in Africa: The Impact on Agricultural Production," *World Development*, 18, no.5: 659-671, 1990.
- Barrows, R. and Roth, M., "Land Tenure and Investment in African Agriculture: Theory and Evidence," *J. Modern African Studies*, 28: 265-297, June 1990.
- Binswanger, H. P. and McIntire, J., "Behavioral and Material Determinants of Production Relations in Land-Abundant Tropical Agriculture," *Econ. Dev. Cult. Change*, 36(1): 73-99, Oct. 1987.
- Bruce, J. W. and Migot-Adholla, S. E., *Searching for Land Tenure Security in Africa: Review*, Kendall-Hunt Publishing Company, Dubuque, Iowa, 1994.
- Carter, M., "Identification of the Inverse Relationship Between Farm Size and Productivity," *Oxford Econ. Papers*, 1984.
- Carter, M., Wiebe, K., and Blarel, B., *Land Titles, Tenure Security, and Agricultural Productivity: Theoretical Issues and an Econometric Analysis of Mediating Factors in Njoro Division, Kenya*, University of Wisconsin-Madison, Madison, 1989. (mimeograph).
- Chamberlain, G., "Analysis of Covariance with Qualitative Data," *Review of Economic Studies*, 47: 225-238, 1980.
- Comité Ad Hoc Chargé de l'Elaboration d'un Code Rural, *Plaquette Code Rural*, Ministère de l'Agriculture et de l'Environnement, Niamey, Niger, July 1989. (version provisoire).
- Comité du Code Rural, *Synopsis - Version Provisoire*, Ministère de l'Agriculture et de l'Environnement, Niamey, Niger, September 19, 1989.
- de Janvry, A., Fafchamps, M., and Sadoulet, E., "Peasant Household Behavior with Missing Markets: Some Paradoxes Explained," *Economic Journal*, 101(409): 1400-1417, November 1991.
- Deolalikar, A. B., "Nutrition and Labor Productivity in Agriculture: Estimates for Rural South India," *Rev. Econ. and Statistics*, 70(3): 406-413, August 1988.
- Dicko, M. S. and Sayers, R., *Recherches sur le Système Agropastoral de Production de la Zone Semi-Aride du Niger: Etude de la Composante Animale (Résultats Préliminaires)*, Center International Pour l'Elevage en Afrique (CIPEA), Niamey, Niger, 1988.
- Fafchamps, M., "Sequential Labor Decisions Under Uncertainty: An Estimable Household Model of West-African Farmers," *Econometrica*, 61(5): 1173-1197, September 1993.
- Feder, G., "The Relation Between Farm Size and Farm Productivity," *Journal of Development Economics*, 18 (2-3): 297-314, August 1985.

- Feder, G., "Land Ownership Security and Farm Productivity: Evidence from Thailand," *J. Development Studies*, 24(1): 16-30, 1987.
- Feder, G. and Onchan, T., "Land Ownership, Security and Farm Investment in Thailand," *Amer. J. Agr. Econ.*, 69: 311-320, Feb. 1987.
- Feder, G., Onchan, T., Chlamwong, Y., and Hongladorom, C., *Land Policies and Farm Productivity in Thailand*, John Hopkins University Press, Baltimore, 1988.
- Gavian, S., *Land Tenure and Soil Fertility Management in Niger*, Food Research Institute, Stanford University, Stanford, 1993. (unpublished Ph.D. dissertation).
- Green, J. K., *Evaluating the Impact of Consolidating Holdings, Individualization of Tenure, and Registration of Title: Lessons from Kenya*, Land Tenure Center, University of Wisconsin, Madison, 1987. Land Tenure Center Paper #129.
- Kille, G. S. and Lyne, M. C., *Property Rights to Land, On-Farm Investment and Farm Productivity: A Study of KwaZulu, South Africa*, University of Natal, Pietermaritzberg, South Africa, 1993. (mimeograph).
- Maddala, G., *Limited-Dependent and Qualitative Variables in Econometrics*, Cambridge University Press, Cambridge, 1983.
- Matlon, P. J. and Fafchamps, M., *Crop Budgets in Three Agro-Climatic Zones of Burkina Faso*, ICRISAT Progress Report, Hyderabad, 1989.
- Matlon, P. J., "Indigenous Land Use Systems and Investments in Soil Fertility in Burkina Faso," *Searching for Land Tenure Security in Africa*, John W. Bruce and Shem E. Migot-Adholla (eds.), Kendall-Hunt Publishing Company, Dubuque, Iowa, 1994.
- Migot-Adholla, S., Hazell, P., and Place, F., *Land Rights and Agricultural Productivity in Ghana, Kenya and Rwanda: A Synthesis of Findings*, Agricultural and Rural Development Department, the World Bank, Washington, D.C., 1991. (unpublished manuscript).
- Migot-Adholla, S., Hazell, P., Blarel, B., and Place, F., "Indigenous Land Rights Systems in Sub-Saharan Africa: A Constraint of productivity?," *World Bank Econ. Rev.*, 5: 155-175, January 1991.
- Ngaido, T., *Land Use Conflicts in Western Rural Niger: Kollo and Tillabery Arrondissements*, Land Tenure Center, University of Wisconsin, Madison, 1993. (discussion paper #1).
- Place, F., Hazell, P. B., and Lau, L. J., *An Economic Analysis of the Relationship Between Land Rights and Agricultural Productivity in Sub-Saharan Africa*, Agricultural and Rural Development Department, the World Bank, Washington, D.C., 1990.
- Place, F. and Hazell, P., "Productivity Effects of Indigenous Land Tenure Systems in Sub-Saharan Africa," *Amer. J. Agr. Econ.*, 75: 10-19, February 1993.
- Platteau, J., *Issues of Efficiency and Equity*, United Nations Research Institute for Social Development, Geneva, Switzerland, March 1995. (Discussion Paper #60).

- Riddell, J. and Dickerman, C., *Country Profiles of Land Tenure: Africa 1986*, Land Tenure Center, University of Wisconsin, Madison, 1986. Land Tenure Center Paper #127.
- Rosenzweig, M. R. and Stark, O., “Consumption Smoothing, Migration, and Marriage: Evidence from Rural India,” *J. Polit. Econ.*, 97 (4): 905-926, August 1989.
- SEDES, *Etude du Secteur Agricole du Niger: Bilan-Diagnostic-Phase I*, Société d’Etudes pour le Développement Economique et Social (SEDES), Paris, 1987.
- Sidikou, H. A., “Niger,” *Les Politiques Foncières Etatiques en Afrique Noire Francophone: Enjeux et Perspectives*, p. 171-196, E. Grêgoire, E. Le Bris, and E. LeRoy et al. (eds.), Laboratoire d’Anthropologie Juridique de Paris, Université de Paris I, Paris, 1982.
- Singh, I., Squire, L., and Strauss, J., *Agricultural Household Models: Extensions, Applications and Policy*, World Bank, Washington, D.C., 1986.
- Udry, C., *Gender, Agricultural Production and the Theory of the Household*, Department of Economics, University of Northwestern, Evanston, Illinois, June 1994. (mimeograph).

Table 1. Characteristics of the Sample

	All Regions	Simiri	Guéladio	Bittinkodji
Household characteristics:				
Total farm size (in ha)	7.2	13.6	4.1	3.1
Age of household head	46	55	44	37
Family manpower (per ha)	1.4	0.7	1.8	1.8
Percent with livestock	92%	84%	94%	100%
Percent with non-farm occupation	43%	23%	52%	56%
Percent of polygamous households	24%	30%	31%	0%
Field characteristics:				
Field size (in ha)	2.2	3.8	1.5	1.0
Distance from compound (in Km)	1.1	1.7	0.6	1.2
Percent borrowed	19%	19%	8%	41%
Percent <i>hawjou</i>	15%	0%	35%	0%
Percent on sandy plain	74%	70%	75%	78%
Percent with ample erosion	22%	30%	21%	11%
Percent within 200 m of water	32%	23%	17%	74%
Percent with fortuitous manuring	5%	9%	4%	0%
Percent with compound in 1989-90	14%	2%	17%	26%
Percent with history of crop rotation	8%	7%	13%	0%
Crop yield (in bundles)(*)	52	18	72	70
Percent with manuring	43%	35%	52%	41%
Percent with fertilizer	6%	7%	2%	11%
Number of fields	122	43	52	27

Based on field level data. Households with a single field were dropped from the sample (see text). (*) Each bundle weighs approximately 18 to 22 Kg. Given their similar prices and caloric content, millet and sorghum are aggregated together.