Evaluating the relationships between property rights, risk, technology and productivity in sub-Saharan Africa

Socio-economics and Policy Research Working Document No. 18

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Proceedings of the ILCA/IFPRI research planning workshop held at ILCA, Addis Ababa, Ethiopia, August 31–September 1, 1994

Edited by
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Preface

This document reports the results of a small meeting of social scientists from the International Livestock Centre for Africa (ILCA) and the International Food Policy Research Institute (IFPRI) held at ILCA headquarters in Addis Ababa, Ethiopia, on August 31 and September 1, 1994. The meeting was held to plan collaborative research on property rights.[1] Both ILCA and IFPRI have conducted research on property rights in the past and have identified property rights as an important subject for research in their respective medium-term plans. At ILCA property rights research is conducted under the theme of Livestock and Resource Management Policy; at IFPRI it is conducted under the Environment and Production Technology Division (EPTD). A concept note for a collaborative project on property rights and risk was first drafted in September 1993 when economists from ILCA visited IFPRI. A concept note for a study of the effects of policy on the management of fragile lands was developed at the same time.

1. The terms "property rights," "property institutions" and "land tenure" are used by different people to refer to the same phenomena. In these proceedings all three terms refer to the institutional arrangements (i.e. rights, rules, norms, conventions, contracts) that govern the way that people access, use and manage the benefits that derive from natural resources.

In March 1994, ILCA and IFPRI submitted a pre-proposal to a European donor agency for a restricted core project on "Policy research for sustainable intensification of land-use systems in fragile areas of sub-Saharan Africa." The pre-proposal combines elements of the proposed collaborative studies on property rights and fragile lands.

In May 1994, Keijiro Otsuka (IFPRI visiting scientist from the Tokyo Metropolitan University) visited ILCA and Ethiopia as part of a project planning mission. Several ILCA scientists were able to meet with Dr. Otsuka to discuss common interests. Dr. Otsuka introduced his proposed research on the effects of property rights on the use and management of forest lands. Sarah Gavian (Rockefeller Fellow with ILCA in Ethiopia) arranged for Dr. Otsuka to visit a field site in rural Ethiopia.

Brent Swallow (ILCA-Nairobi) and Peter Hazell (Director of IFPRI's EPTD) subsequent met in Nairobi. They agreed that the pre-proposal needed to be developed in greater detail and that the research on property rights should be separated from the research on fragile lands (led by Sarah Scherr of IFPRI and Simeon Ehui of ILCA). They proposed that a planning meeting could be held in conjunction with the meeting of the International Association of Agricultural Economics in Harare, Zimbabwe that several of the relevant scientists from IFPRI and ILCA would be attending.

The workshop was planned during subsequent correspondence and discussions between Hazell, Ehui, Gavian, Swallow and Dr. Fitzhugh (Director General of ILCA). Sarah Gavian managed the logistical arrangements for the workshop. The output from the workshop is summarized in these proceedings and a more detailed proposal is being developed.

Summary

The workshop was conceived for the following purposes:

1. to summarize the results of studies previously conducted by ILCA and others;
2. to identify priorities for future research;
3. to provide guidance for future research— problems, methodology, locations, and resource requirements; and
4. to consider specific proposals for future research and evaluate the areas of complementarily and/or overlap with other past or current projects.

The agenda was developed in accordance with those objectives. Sessions I and II review past research conducted by ILCA, the Land Tenure Centre and the World Bank. Session III links past research conducted in Niger with research now in progress in Ethiopia. Session IV summarizes two ILCA studies that are currently in progress and an IFPRI study that is in the planning stage. Session V introduces a new project proposed as a collaborative venture between ILCA and IFPRI. The remaining sessions were reserved for discussion of research priorities and planned future research.

Results from past studies

The majority of the completed studies have been concerned with two fundamental questions: (1) How do property institutions affect the use and management of resources? (2) How do property institutions act as obstacles or create opportunities for the adoption of new technologies? The basic hypothesis is that property rights that are non-exclusive, insecure or nontransferable will lead to under-investment in land-improving investments and depressed mobility of variable factors of production (e.g. labour). This will in turn lead to inefficient agricultural production and over-exploitation of natural resources. Answers to these questions are important for ILCA because the centre's objective is to generate new technologies and promote policies that will expand the production of livestock products while conserving the base of natural resources.

Two other questions have also been addressed: (3) How do changes in economic and technical conditions affect resource use and property institutions? (4) How do property institutions affect the distribution of resources and income between different groups of people? For example, do spontaneous changes in property rights tend to favour people who have access to external sources of income?

Summary of results

1. Results from two studies conducted in Mali indicate that property rights to one resource (e.g. water) can give people access to other resources and have subsequent effects on productivity. These results support the proposition that analysts should focus on certain "key resources."
2. Mobility is an important strategy for managing the risks associated with high climatic risks. Customary property regimes support mobility and the pooling of climatic risks.
3. Differences in property rights to grazing land (e.g. communal versus private) often indicate differences in production system. Evidence from Botswana indicates that the subsistence-oriented livestock production practiced in the areas held under common property is less productive per animal but more productive per hectare than the

commerce-oriented ranching practiced in areas held Under private property.

4. None of the studies conducted in Africa provide statistical support for the hypothesis that the presence or absence of a title to land affects the use of land-improving investments or productivity. This contrasts with the results of some studies conducted in Asia.
5. Several of the past studies support the hypothesis that factors other than property rights have important effects on people's use of land-improving investments. Examples of such factors include: management, distance to the homestead (manure, trees), soil fertility (manure), distance to a nursery (trees), road (manure) or well (manure), fragmentation of land (trees).
6. Some of the studies support the hypothesis that non-exclusive rights (e.g. undivided inheritance) and short-term rights (e.g. lease or rental) have negative effects on people's investment in land improvements (e.g. manure in Niger, trees in Uganda, Burundi and Zambia).
7. There is clear evidence that property rights are endogenously determined. For example, in southern Nigeria people hold different rights to land that is used in different ways. Because of this endogeneity, it is misleading to interpret correlations between property rights and land-improving investments as evidence of a causal relationship.
8. There is evidence from Zambia, Malawi, Uganda and Rwanda that households headed by women plant fewer trees than households headed by men. It is hypothesized that this difference is partly due to the less secure rights of women.
9. A number of previous studies show a relationship between tenure security and investment, but do not show a similar relationship between tenure and agricultural productivity.

Implications for future research

1. Knowledge of property rights and the way they change can assist in the technology development phase of research. A property rights component should therefore be conducted as part of the diagnostic phase of the research process. Such studies should consider the relationship between property rights and different "envelops" of technologies (e.g. multi-purpose trees), rather than specific technologies.
2. Studies of the adoption of a specific technique or land-improving investment (e.g. fodder bank) should consider property rights to be one of many factors that will effect adoption (e.g. opportunity cost of land, off-farm employment, transaction costs, agro-ecological conditions, credit). A study of 'adoption' requires that the technique has been made available to a large number of people and that a significant number of people have adopted. Multi-variate analysis that compares adoption/non-adoption can separate out the effects of various factors, including property rights. Such studies should therefore be conducted after a time of diffusion and adoption.
3. Any study in which investment is important must be able to measure investments in quantitative terms. Binary measures (e.g. trees/no trees) are too blunt and too often lead to inconclusive results.
4. Productivity studies need to consider long-term versus short-term productivity and sustainability, normal versus drought years, and common versus private lands.
5. A strength of several of the previous studies of private land holdings is that they have been able to measure property rights by a single variable (e.g. tenure security) or a small number of variables (e.g. *hawjou*, owned, rented). Researchers face a difficult challenge to find similar measures for property rights to collectively-used resources. The size of the group of resource users and the right to exclude outsiders are important dimensions of common property regimes that need to be measured.
6. The tenure-productivity empirical work that has been conducted to date is based on relatively simple conceptual models. Those studies could be improved if they were based on household optimization models and testable equations. Working with such models, we can derive and incorporate some necessary restrictions in the econometric

models, and can also introduce concepts such as the-opportunity costs of labour. This should lead to better hypotheses and models. Currently, the null hypothesis of no effect of land rights is more prone to be accepted when it should be rejected than vice versa.

7. Thought must be given to a research approach that will deal with the endogenous nature of property rights. One approach would be to gather data from a large number of sites so that there is cross-sectional variation in the factors that are hypothesized to affect property rights. Extensive surveys and secondary data can be used to collect data at the level of a community, village or small region. The collection of that data will be a formidable task, however, since it may be determined that a minimum data set should include population density and growth, degree of commercialization, the productivity of the landscape (all resources) and its change over time; drought and other risks; ability to cope With drought; externalities such as the poverty reduction benefit from common property; changes in property rights and investment over time; and group action and organization. GIS data layers (Geographic Information Systems) and remotely-sensed data may be important sources of data. GIS may also be an important new tool for analysis.
8. Limitations of the extensive survey approach are: (1) it would not provide insight into the processes of institutional change; and (2) it would mask important variations in property rights within a particular site. In-depth and historical studies of particular locations may be useful for understanding the processes. In addition, it might be useful to consider property rights as the outcome of interactions within a particular community or location. Such models may be based on different game-theoretic foundations.
9. The appropriate combination of data collection techniques will depend upon the relative importance of different research questions and the costs, biases and accuracies of data collected through different techniques. It is important to consider the costs and likely benefits of different methodologies in the preliminary stages of the research. For example, how important it is to collect detailed labour data to investigate the relationship between property rights and productivity.
10. Simple multivariate techniques, such as cluster analysis, might be appropriate at early stages of research to identify important factors and relationships.

Priorities for future research

1. In general, it is the role of the international agricultural research centres (IARCs) to develop new techniques and the role of national centres to adapt techniques to local needs and disseminate. The IARCs also have a role to guide the national centres in methodologies. Then national centres can do the adaptation and dissemination work either independently or in collaboration with IARCs. In the area of property rights research, methodological guidance has been provided for examining the static aspects of property rights. What remains is for IARCs to provide guidance on the dynamics of property rights and land use systems.
2. ILCA/ILRI research should focus on investment in livestock technologies and on productivity of extensive livestock systems and mixed crop-livestock systems.
3. Need to develop a model that better integrates the dynamics of property rights, climatic risk, equity of income and opportunity, and community structure. The Boserup-Pingali-McIntire-Demsetz model of gradual intensification and individualization is inadequate for Understanding the evolution of people's strategies and property rights. Climatic risk is obviously important to both strategies and property rights, especially in areas with high climatic risk but potential for intensification. The model should be validated with a combination of data from secondary sources (including GIS), historical analyses, extensive surveys and intensive surveys.
4. Several research questions should be addressed within the context of an expanded model: (a) Are common property institutions constraints on technology development and intensification? (b) What is the relationship between property rights, production system,

and productivity of livestock and crop-livestock systems? (c) Who bears the transaction costs associated with different property rights regimes? (d) Are common property institutions desirable for risk management, equity, and reduction of transaction costs? (e) Do changes in property rights have disproportionate affects on different social strata (e.g. men/women, rich/poor)? (f) Should the focus of international research be on public or private goods, i.e. should centres produce technological and institutional substitutes or complements for common property? (g) Should technology and institutional development differ based upon the magnitude of risk or risk management options?

Workshop output and proposal development

At the conclusion of the workshop it was agreed that Brent Swallow would assemble and edit the minutes of the workshop. These proceedings are the result. It was also agreed that a detailed proposal for a project on "evolution of land use and property rights under risk" would be developed as a collaborative project by ILCA and IFPRI. Brent Swallow will solicit additional input from ILCA scientists at the ILCA Annual Programme Planning meetings in early October 1994. He will then attend the IFPRI conference at the end of October ("Policies on Local Organizations for Natural Resource Management") and have further discussions with IFPRI colleagues.

Session I: Overview of issues and summary of past research

Chair: Ade Freeman

Rapporteur: Keijiro Otsuka

Welcome and opening remarks

Hank A. Fitzhugh

The Director General (DG) of ILCA welcomed participants to the workshop. He noted that property rights are important because of their effects on the uptake of new technologies, agricultural productivity and resource management. These are especially important issues at the present time. Donor agencies and others are concerned that the outputs of the research process have impact.

The DG asked that the group consider the following questions in the course of its deliberations: (1) What are the key issues? (2) How do the issues rank in order of importance as constraints or incentives to agricultural development or management of natural resources? (3) Which of the priority issues are researchable? (4) How should that research be designed? (5) Who should do what types of research? (6) How much will the research cost in terms of human and financial resources?

Relevant policy questions related to property rights and resource management

Peter Hazell and Simeon Ehui

Hazell started his discussion with the fundamental question: Why are property rights important? The central hypothesis of this collaborative venture is that inappropriate property rights institutions lead to resource degradation.

He distinguished two cases: single-user resources and multiple-use resources. A good example of a single-user resource is land. Absence of secure property rights will result in land degradation, as incentives to improve the resource base do not exist under such conditions. Multiple-user resources are typically common property (i.e., rangeland, ground water, forest). Problems arise when the group that shares use of the common property resource is unable to regulate the use of the resources among themselves and exclude outsiders. Empirical research is needed to quantify the extent of resource degradation due to property rights problems. He listed research questions that are relevant for each of the cases.

The case of single-user resources

1. What is the minimum bundle of rights necessary for sustainable natural resource management under different situations? Do people need full ownership rights in Western sense?
2. Can this bundle of rights be provided by the indigenous community, or must the government intervene?
3. If the government must intervene, what should it do? For example, is land titling necessary?
4. How do property rights systems hold Up under the dynamics of population pressure and agricultural commercialization? Do they evolve towards greater privatization, or do they become a constraint to increasing productivity?
5. Are adequate property rights essential for the emergence of efficient markets, e.g., credit?
6. What is the link between property rights and the distribution of assets in a community?

The case of multiple-user resources

1. How can indigenous institutions that regulate use of common property resources be strengthened, especially under the pressure of increasing population?
2. Under what conditions should common property resources be privatized, and when should they not?
3. How can user groups ensure adequate long-term investment, which requires the security of communal management?

Evolution of crop–livestock systems

Ehui focused on research questions related to the evolution of land use and property rights in mixed crop–livestock systems. The standard model of intensification (e.g McIntire et al 1992), Pingali *et al.*) is that as the population increases and markets develop, crop and livestock sectors will become more integrated, and property rights will become more individualized. But in many cases this does not happen. Why?

1. How does risk affect the intensification process?
2. How is the process of intensification affected by other factors such as the availability of off-farm income, the opportunity cost of land and the degree of urbanization?
3. How do changes in prices, notably changes in product prices by government price policy, affect crop-livestock integration and the management of natural resources?
4. How do property rights affect productivity?
5. How do changes in productivity affect property rights?

Overview of ILCA's research on property rights

Brent Swallow

Swallow presented a paper reviewing the studies of property institutions that have been undertaken by researchers affiliated with the International Livestock Centre for Africa (ILCA) since 1980. Particular attention is given to the systems studies and an ongoing study of the impacts of trypanosomiasis control on property institutions. Past and current studies by other workshop participants are mentioned but not reviewed in any detail.

The majority of the completed studies have been concerned with two fundamental questions: (1) How do property institutions affect the use and management of resources? (2) How do property institutions act as obstacles or create opportunities for the adoption of new

technologies? These questions follow from the centre's objectives of developing technologies and promoting policies to expand the production of livestock products while conserving the base of natural resources. Two other questions have also been considered by ILCA scientists: (3) How does the structure of government affect property institutions? (4) How do changes in economic and technical conditions affect resource use and property institutions? Figure 1 illustrates the relationships between the variables that are hypothesized and tested. Figure 2 illustrates the geographical locations of the various studies.

Property institutions and feed resources in crop–livestock systems

A series of studies have been undertaken by ILCA scientists and their collaborators to evaluate the effects of property institutions on the adoption of feed production techniques in mixed crop-livestock production systems. One study considered the potential effect of property institutions on the adoption of fodder banks (Taylor-Powell and Ingawa, 1986; Waters-Bayer and Taylor-Powell, 1986), two studies evaluated the actual and potential effects of property institutions on the adoption of alley farms(Francis, 1987; Steinbarger, 1990; Lawry and Steinbarger, 1991; Jabbar, these proceedings) and a study now in progress is concerned with the overall processes by which livestock owners obtain feed resources when they begin to adopt dairy production (K. Swallow, these proceedings). The fodder bank studies are discussed in the following paragraphs.

Following ILCA's systems research methodology, ILCA's sub-humid zone team based at Kaduna, Nigeria, identified sedentary agro-pastoralists to be the main target group, the availability of fodder to be the main constraint facing that target group, and fodder banks—confined units of intensive forage production — to be the most attractive intervention to alleviate that fodder constraint (Lipner and Swallow, 1992, pp.5–6; von Kaufmann and Mohammed Saleem, 1989). Studies were undertaken to evaluate the potential importance of property institutions as a constraint on the adoption of the fodder bank (Taylor-Powell and Ingawa, 1986; Waters-Bayer, A. and E. Taylor-Powell, 1986).

The major findings of those studies were:

1. It was important to distinguish between three groups of agro-pastoralists, those who expect to remain settled permanently, those who expected to remain settled for shorter periods of time, and those who are transhumant. The more permanent their settlement, the more secure their rights to land.
2. The only agro-pastoralists who were only willing to initiate fodder banks were those who intended to remain settled for long periods of time and were confident that they could get secure rights to land for extended periods (Taylor-Powell and Ingawa, 1986).

Property institutions and natural pastures

In the late 1970s and 1980s ILCA undertook multi-disciplinary studies of livestock production systems in several locations across Africa. The studies conducted in arid or semi-arid environments focused on the use of natural pastures and the result of those patterns of use on the productivity of livestock and crops. The effects of property institutions were evaluated in studies conducted in Botswana (de Ridder and Wagenaar, 1984, 19&6; Abel *et al*. 1987) and Kenya (Bekure *et al.*, 1991).

The major findings of those studies were:

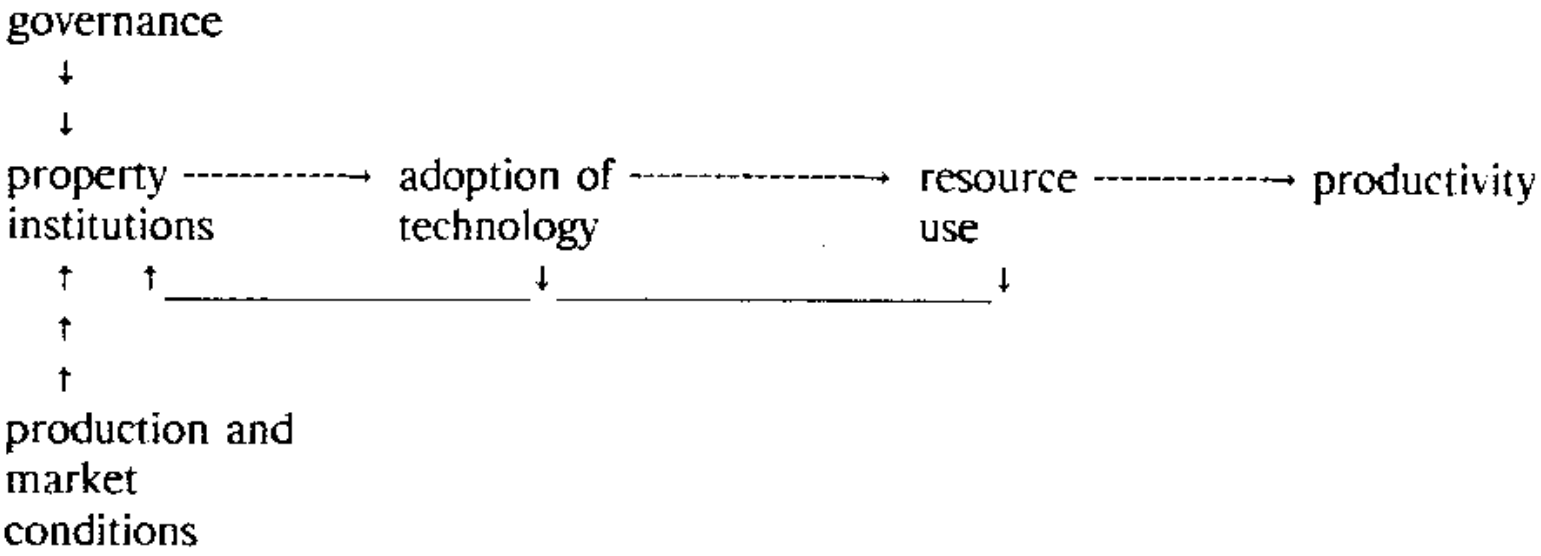
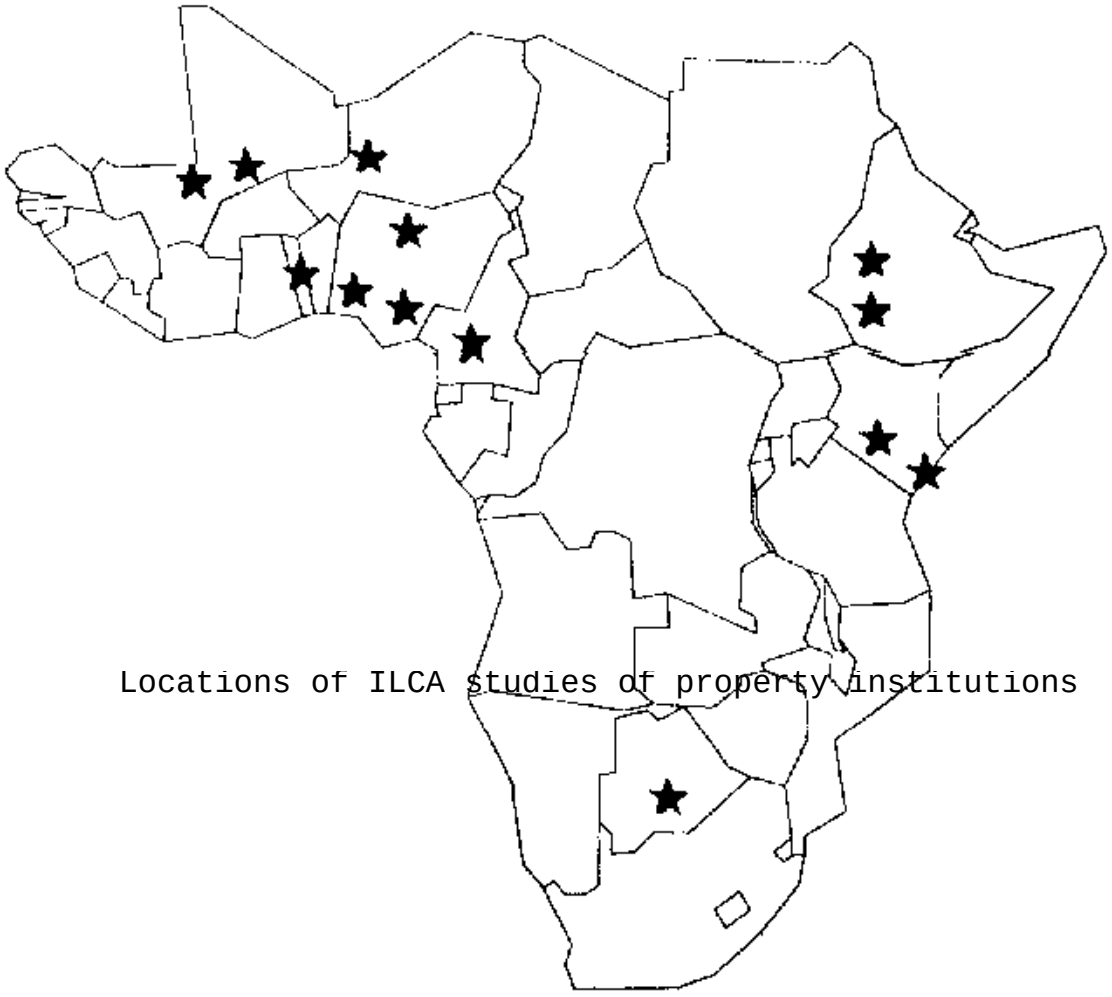


Figure 1 An overview of research on property institutions at ILCA



Locations of ILCA studies of property institutions

1. Autonomous production of livestock on small areas of land is not a viable production strategy in areas where there is large variations in rainfall across time and space. Management units must have access to pastures spread over large areas so that animals have access to a variety of resources (Abel *et al*., 1987).
2. Compared to the pastoral production systems practiced on communal rangeland areas, freehold ranches in Botswana were more productive per animal but less productive per hectare (de Ridder and Wagenaar, 1984, 1986).
3. Changes in land policies and economic conditions at the local and national levels are resulting in the individualization of property rights in Kenya's Maasailand and Botswana As a result, Maasai pastoralists are becoming less mobile and more dependent upon agricultural and non-farm sources of income (Grandin, 1987; Bekure *et al*., 1991; Abel *et al.*, 1987).

Property institutions, water and manure

The relationship between property rights and the management of manure has been studied by Hesse *et al.* (1985), Toulmin (1992) and Gavian (1993, these proceedings). All of the studies focused on farming systems in the semi-arid Sahel in which manure is one of the main inputs into crop output and pastoralists are a main source of the manure applied to farmers' fields. The Hesse *et al.* study considered a study area of about 2,000 km² in the Gourma area of Mali; Toulmin focused on a single village in Mali; while Gavian's study spanned eight villages in Niger. Key differences between the study sites concern the methods of water catchment and provision. In the Gourma, the sedentary agriculturalists catch water in cisterns for use in the dry season. The village studied by Toulmin was located over a substantial aquifer into which farmers were able to dig wells.

Hesse *et al.* (1985) found that the cisterns dug and maintained by the RamiBe agriculturalists are important sources of water for Fulani pastoralists and important sources of food security for the RimaiBe. In villages that received relatively reliable supplies of water from rainfall and runoff, the RimaiBe and Fulani regularly exchanged water for manure. In villages that received less reliable supplies of water, the RimaiBe exchanged water for cash.

Toulmin (1992) found that property rights were related to ethnicity, length of settlement and production system. Long-term residents had rights to water from the village well and secure rights to dig their own wells; more-recent settlers had second rights to water from the village well and less secure rights to dig their own wells; transhumant pastoralists had no right to water from the village well and no rights to dig their own wells (Toulmin, 1992). Farm households who owned their own wells were better able to capture the excrement produced by their own animals and able to trade water for the excrement produced by pastoralists' animals than farmers who did not own wells. A production function analysis showed that there was a positive and statistically significant relationship between the production of the staple crop, millet, and the level of manure input (Toulmin, 1992).

Property institutions and the control of trypanosomiasis

In collaboration with ILRAD, we have been studying the economic and ecological impacts of trypanosomiasis control in the Ghibe valley of southwest Ethiopia. The study has a property rights component. In particular, we hypothesize that farmers will react to the exogenous reduction in the risk of trypanosomiasis by keeping more livestock; this will create a greater demand for animal feed and, through animal traction, a greater demand for arable land. These increased demands will be enhanced by the settlement of new immigrants that are attracted to the area. Depending upon the structure of governance, these increased demands can in turn have effects on the institutions that govern the use of feed and land resources.

We have monitored the grazing patterns of a select number of herds for over two years. A preliminary analysis of those data indicates that the use of crop residues varies by season and year. We used preference index — percent of time herds spent grazing crop residues divided by the of area in crop residues — as a measure of the intensity with which crop residues were grazed. A preference index greater than 1.0 indicates that crop residues are used more heavily than the average patch of grassland. During the first year, the preference index ranged from 0 to 3.4 and the mean was 0.54. During the second year, the preference index ranged from 0 to 6.0 and the mean was 1.5.

We are measuring changes in the demand for arable land through a combination of household surveys, actual field measurement and interpretation of satellite images. In early 1993 we interviewed households that kept cattle in the area with effective tsetse control — Gullele — and the area without effective tsetse control — Ghibe. We asked questions about the area of land that they cultivated in 1992, the area they cultivated in 1991 and the area they planned to cultivate in 1993. For households that increased the area they cultivated from 1991 to 1992, we asked how they gained access to that additional land. For households that planned to increase from 1992 to 1993, we asked how they planned to get access to the additional land.

The data indicate that farmers in the two areas had similar patterns of contraction and expansion from 1991 to 1992, but different expectations for 1993. About half of the farmers in the tsetse-control area expected to expand from 1992 to 1993; one-third of those in the non-control area expected to expand. The data also indicate that almost all livestock-owners in the area without effective tsetse control expected to continue to expand by cultivating land that had previously been allocated to them by the peasant's association. In contrast, in the area with effective tsetse control, one third of the households expected the peasants' association to provide them with a new allocation of land.

Interviews with the executive committees of peasant associations in the two areas indicate that there is little prospect for new allocations of land in the area with effective tsetse control. There is already a problem of landlessness and excess demand for land in that area. Neither area has ever had a redistribution of land. Conflict over land rights is likely to increase under the existing system of property rights. There already is anecdotal evidence of land transfers involving cash payments.

Review of World Bank and land tenure centre studies on land tenure and agricultural productivity

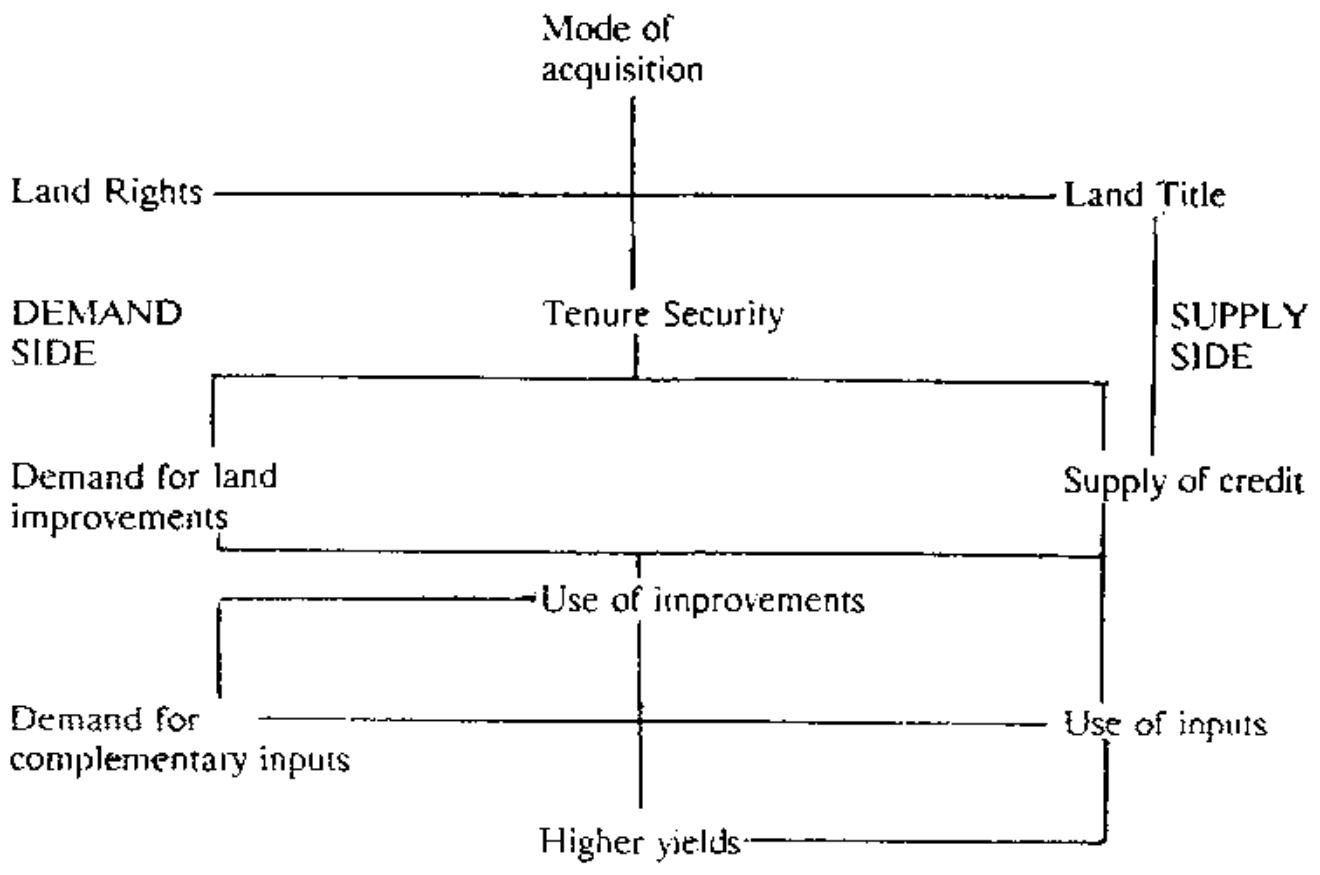
Frank Place and Peter Hazell

Two comparative research programmes on land tenure in Africa were undertaken in the late 1980s. One was based in the Agriculture and Natural Resources Department of the World Bank and the other in the Land Tenure Centre, University of Wisconsin-Madison. A detailed summary of both sets of studies is presented in Bruce and Migot-Adholla (1993). A summary of the World Bank studies is given by Place and Hazell (1993).

The objectives of those studies were to evaluate the tenure security provided by indigenous societies in Sub-Saharan Africa and to examine the its effect on agricultural productivity. The conceptual model that guided the studies is given in graphical form in Figure 3.

Figure 3 Conceptual model linking title and tenure security with agricultural performance

Source: Place and Roth, 1993, p.29


Mode of acquisition
Land Rights
Land Title
DEMAND SIDE
Tenure Security
SUPPLY SIDE
Demand for land improvements
Supply of credit
Use of improvements
Demand for complementary inputs
Use of inputs
Higher yields

World Bank studies

The World Bank study selected Ghana, Kenya, and Rwanda as study sites based upon considerations of land scarcity, agro-climate, and administration tradition. Tenure security is measured by the rights of the household head over land parcels in the following way: most secure is the rights to sell without approval, next is the rights to bequeath, and least secure is case of no transfer right.

Tenure security is closely related with mode and date of acquisition, which suggests that tenure security is largely exogenous. In order to avoid possible estimation bias, a fixed-effects model was used in the estimation of credit, land improvements, input use, and yield functions wherever possible. In actual estimation, the following recursive model was considered:

Credit = f (control variables, tenure security)

Improvements = g (control variables, tenure security, Credit)

Inputs = h (control variables, tenure security, Credit, Improvements)

Yields = F (control variables, tenure security, Credit, Improvement, Inputs)

The results indicate that tenure security does not significantly affect input use and yield, but it does have some links with land improvements and use of credit. These results are important but somewhat confusing.

Study in ICRISAT villages of Burkina Faso

ICRISAT collected detailed data on property rights and agricultural production in 6 villages in Burkina Faso. Twenty-five households were surveyed in each village, including 12 or the population of households using animal traction in each village. A fixed-effects model was applied to evaluate the relationships between land-improving investments and property rights. Manure and fertilizer Use per hectare were treated as dependent variables and various measures of land tenure (e.g., mode of acquisition, gender, collective versus individual) were treated as explanatory variables. In most villages, the results are insignificant implying no relationship between tenure and input use.

Land tenure centre studies

The Land Tenure Center conducted studies in Uganda, Somalia, Senegal, and Kenya. Statistical methodology and major analytical results are as follows:

Uganda: Analysis of variance was Used to determine the relationship between three measures of property rights (i.e. systematic registration, the right to sell land, and purposeful registration) and land-improving investments (i.e. continuous manuring, mulching, fencing and tree crops). The results indicate: (1) no relationship between systematic registration and continuous manuring, mulching and fencing; (2) negative relationship between the right to sell and continuous manuring, mulching, fencing and tree crops; and (3) positive relationship between purposeful registration and continuous manuring, mulching, fencing and tree crops. No account was taken of confounding factors.

Somalia: The dependent variables included log of land value, land levelling, bunding, and canal maintenance investment, whereas tenure variables include registration title, proportion of land under title, and ownership security index. Binary logit regression was employed for investment and OLS without first-stage regression was applied for the land value function. The results indicate that title had a positive effect on land values and that ownership security had no effects on investment.

Senegal: Analysis of variance was used to evaluate differences between villages in variables such as various investments at household level, area planted to crops, village security variables, and security index of plot managers. There were no significant differences.

Kenya: The dependent variables included output, income, and profit per acre, whereas tenure variables include farm size and land title. OLS regressions were employed with few other control variables included. Title was found to have no effect. Farm size displays a u-shaped relationship with output and income, and a logarithmic relation with profits.

In conclusion, it is clear that the statistical methods employed by in most of the Land Tenure Center were problematic. By and large, however, the results are consistent with the results of the World Bank study.

Outstanding research issues

The following are some of the most important issues related to property rights that remain to be addressed:

1. effects of property rights across production enterprises (e.g., grazing systems' effects on tree planting);
2. distribution of impacts by gender;
3. long-term effects of tenure on land productivity,
4. tenure impacts on non-crop related investment,
5. effects of tenure on the supply of credit,
6. the importance of tenure relative to other variables affecting investment, resource use and productivity, and
7. equity aspects of tenure systems.

Session II: Review of research on property rights and agro-forestry

Chair: Sarah Gavian
Rapporteur: Ika Darnhofer

ILCA/LTC research on property rights and alley farming in West Africa

Mohammed Jabbar

In the mid 1970s IITA developed alley cropping (also called hedgerow intercropping by ICRAF) to alleviate the problems of reduced soil fertility, reduced yields and soil erosion that were associated with population growth and reduced fallow periods. In the early 1980s this technology was adapted by ILCA to serve as a source of feed. On-farm research was conducted in two locations of South-West and South-East Nigeria. The locations differ in terms of population density, soil fertility, land tenure and typical farm layout.

In the South-West population density is 150 persons/km², households are surrounded by bush and trees, there are both near and distant fields. Animals roam freely in the bush and trees around the house. A fallow cycle consists of 3–4 years of cropping, followed by 2–3 years of fallow. A farmer always has access to the same plot of land. In the South-east, population density is 300 persons/km², the compound is intensively cultivated, manured and very productive. The further the field is from the homestead, the lower the fertility tends to be. Animals are usually confined. A plot is cultivated for 1–1.5 years, then left fallow for 4–5 years. A farmer may not cultivate the same plot of land each year.

Francis (1987) conducted some preliminary investigations of the relationship between property rights and the adoption of alley farms in the two areas. His study led to a multi-country study across the humid zone of West Africa. The study was coordinated by ILCA, carried out by the Land Tenure Centre and national partners, and funded by the U.S. Agency for International Development. The study was undertaken in three West African countries: Nigeria, Togo and Cameroon. The objective of the study was to determine the status of land tenure and property rights in the recommendation domain of alley farming, and the way that property rights may influence the adoption of alley farming and other agroforestry techniques. This paper summarizes results from the paper by Lawry and Steinbarger (1991) and presents some new analysis.

Table 2 shows the repartition of the tenure rights on the fields of the sampled households. 'Divided inheritance' refers to a farmer who has inherited the full rights to the land, i.e. he has full control. 'Undivided inheritance' refers to land a farmer has inherited' but where the extended family still has some control. 'Secondary access'' refers to renting, leasing, loaning and pledging.

Table 1. *Tenure status of sampled fields.*

Tenure status	Percent fields		
	Nigeria	Cameroon	Togo
Purchased/gift	6	10	11
Divided inheritance	49	56	25
Undivided inheritance	34	34	33
Secondary access	12	0	31
Total	100	100	100
Sample households	240	146	400

Table 2. *Tenure status of discontinued versus continued alley plots in Nigeria.*

Tenure status	Percent plots		
	Discontinued	Continued	All
Purchased/gift	4	8	5
Divided inheritance	31	68	54
Undivided inheritance	57	14	34
Secondary access	8	10	8
All	100	100	100
N	49	84	133

It is important to note that the tenure status of a field is related to several other variables that might affect a farmers' decision to adopt a land-improving investment. For example, land held under secondary access rights tends to be located far from the household, has poor soil fertility, is rarely fertilized, and has low populations of trees of any kind.

Only in Nigeria was it possible to quantify the relationship between tenure status and alley farming per se. The results given in Table 3 show that alley farms that continued to be used 5 years after their development tended to be located on plots with divided inheritance, while alley farms that were abandoned tended to be located on plots held Under shared inheritance.

However, security of tenure may not have been the predominant reason for discontinuation of the alley farms. The farmers mostly noted biological reasons (Table 3). There may still be an indirect link, however, as poor management might be more prevalent on fields held under less secure tenure. It seems that the farmers are more inclined to take care of the trees if the trees are located on plots where they have a longer term interest, that is, on plots held under more secure tenure.

Table 3. *Reasons for discontinuation of agroforestry in Nigeria.*

Reasons	Percent plots	
	South-West	South-East
1. Poor establishment/growth	22	26
2. Weedy plot/weeded out/poor handling	19	34
3. Farmer moved/died/old/sick	43	2
4. Lost/lack of interest	9	6
5. Land used for building or other purposes	0	8

6. 1+2	7	18
7. 2+4	0	6
All	100	100
N	54	50

Points of clarification

Q.: Were the plots farmer managed?

A: Between 20 and 30 of the plots were managed jointly with ILCA, but the rest where planted and managed by the farmers.

Q: Was there any "backward" linkage from tree planting on improved security of tenure?

A: As part of the literature review it was seen that in West Africa access to land through tree planting is widespread. This also means that short term leases are a disincentive to tree planting. In the present case the time period was too short to be able to see if any farmer who had planted the alley cropping trees on secondary access land has successfully claimed the land at a later stage.

Review of LTC/ICRAF studies on agroforestry in east and southern Africa

Frank Place

Following shortly after its project with ILCA in West Africa, the Land Tenure Centre joined into a relationship with ICRAF (International Centre for Research on Agroforestry) to study the relationships between land and tree tenure and the adoption of various agro-forestry systems. The U.S. Agency for International Development also funded these studies. Field studies were conducted with national partners in Uganda, Rwanda, Zambia and Malawi. Most of the data hate been analyzed. The results are being summarized for presentation and distribution.

The objectives of the study were: (1) To evaluate the role of land and tree tenure on adoption of various agroforestry systems. Other tree planting was also investigated in the course of the study. (2) To assist in designing and targeting agroforestry interventions. (3) To identify tenure policies which would be more supportive of agroforestry development.

The methodology involved the use of the following techniques: (1) informal surveys and discussions to understand the farming systems and identify key factors; (2) formal household surveys, (3) local policy workshops, and (4) seminars. In Uganda and Burundi sampling was done randomly; in Zambia a village was purposively chosen in an area where tree planting had been promoted; and in Malawi ICRAF contact farmers were interviewed. Analysis of the data was accomplished through linear and non-linear regression analyses.

The tenure issues that were examined include the following:

1. The mode of land acquisition and its impact on adoption:

   purchase versus others
   short-term versus others
   matrilineal versus patrilineal

2. Long-term household rights to land
3. The rights of the household to plant trees
4. The rights of the women to plant trees

5. Grazing systems, rights to exclude livestock, rights to fence
6. Size of land holding
7. Fragmentation of land holding
8. Land and tree disputes
9. Access to trees off-farm

Table 4 shows that in all locations inheritance was the most important way of land acquisition. Land markets also played a significant role, especially in Uganda and Burundi.

Table 4. *Methods of land acquisition in the study areas.*

Region	Inheritance & gift (%)	From state (%)	Purchase (%)	Short term (%)	Chief or headman (%)
Uganda					
Mpigi	59	1	41	0	0
Kabale	51	0	45	4	0
Burundi					
Giharo	44	31	25	0	0
Giheta	73	0	16	11	0
Matana	91	4	0	5	0
Muhuta	64	13	21	2	0
Malawi					
Lilongwe	94	0	0	5	22
Zambia					
Southern	65	12	6	0	17
Eastern	89	2	1	2	18

The households were asked questions about the tree products that they used and the sources of those products. The data indicate that self-sufficiency is highest for fuelwood and lowest for poles and fruit. There are large variations between the countries in the percentage of off-farm sources of tree products.

Analysis

1. Define tree variables: purpose and type timing, level of observation
2. Define tenure variables: similar to World Bank studies
3. Single equation models using tobit and logit regressions with controls
4. Calculation of tenure effects and comparison to other variables.

Table 5. *Correlations between tenure status and tree planting in Zambia and Burundi.*

Eastern province Zambia	Probability of planting	Number of trees
HH is owner	.65	8.8
HH isn't owner	.42	2.6
HH has cattle	.65	
HH doesn't have cattle	.36	
Giharo (Burundi)	Number of all trees planted at household level	
Fragmentation index of .4	5.8	
Fragmentation index of .8	1.7	
Distance to nursery 2 km	6.4	

Distance to nursery 10 km	1.7	
Pooled Burundi, parcel level	Probability of planting MPTs	Number of MPTs
Temporary acquisition	.13	4.9
Inherited land	.25	7.3
Purchased land	.16	5.6
Allocated from state	.39	9.7

Major hypotheses and results

1. Tree planting is related to the mode of land acquisition. Tree planting would therefore be more common on purchased parcels than other parcels. This hypothesis was not supported by analysis of the Uganda data, but was supported by analysis of the data from two of the villages in Burundi (Giheta and Matana). In Zambia and Malawi it was found that fewer trees were planted on land acquired under matrilineal inheritance.
2. Women plant fewer trees because they lack the rights (tested in Uganda, Burundi and Zambia). This hypotheses was verified in all areas, except for Mpigi in Uganda. But male-headed households in which women could plant did not have more trees.
3. Tree planting is greater on plots where the households could claim more individual rights (tested in Uganda, Burundi, Zambia). The results for the effect of transfer rights are mainly insignificant, other results are mixed.
4. Tree planting is greater where there is greater rights to prohibit animal grazing (tested in Uganda, Zambia and Malawi). Significant effect found in Zambia, but not in Malawi and Uganda. The hypothesis is further supported by evidence on the locations where trees are planted.
5. Tree planting is less where access to commonly used tree products is greater. Supported by comparisons across sites not supported within sites.
6. Tree planting is greater where households claim ownership to land (Zambia and Uganda). Supported in Zambia but not in Uganda.
7. Tree planting is greater on larger farms/parcels and on more consolidated farms (Uganda, Burundi). Both hypotheses were supported by analyses made in Burundi and Uganda.

Discussion of Jabbar and Place

Q: How do the effects of property rights compare with the effects of location?

Place: Land rights are fairly invariant within a household, but there is significant differences in the distance of the field to the homestead, except for Burundi where there is little variation. There is definitely an effect of distance on tree planting: most of the trees where planted close to the house.

Jabbar: One would have to account for differences in the types of trees planted in an analysis of the effects of distance. For example, coconut and palm trees are not necessarily planted close-to the homestead.

C: Population density alone might not explain certain effects: the way people settle also might have an influence. For example, it could be that in humid West Africa people tend to be more clustered around geographic points, while in Zambia there is little variation in soil fertility and the distribution of people is rather uniform. This results in differences in farming systems, and therefore has implications for the prevalent rights.

Place: In West Africa there also was substantial movement of population to the coast, to plant trees as cash crops (coconut). The population that was already present wanted these

newcomers to plant trees, but did not give them rights to the land. In East and Southern Africa people have been much more sedentary.

Q: You have mentioned that the main problem with the adoption of alley cropping is a management problem. Households are multi-sectorial units, i.e. they have several options for resource allocation. Thus is the opportunity cost of household resources a factor affecting adoption?

Jabbar: We can distinguish two levels: on the first level: why did those who planted trees plant them? They must have considered the opportunity costs of labour at the time, as well as their need for fodder and manure. And on the second level: why did some of those who planted trees decide to continue while others decided to discontinue? I suppose there is such a thing as a 'learning phase', where farmers want to see how it works. They would plant it on poor soils, shortly before the plot goes into fallow. But for the decision to continue versus discontinuing, the additional management needs for establishment was not given any more. It was noted that the probability of discontinuation is higher among those farmers who have less secure rights. But there is a problem of quantifying these different aspects.

C: We usually assume that it is a profitable investment, but many other factors influence the adoption decision, such as biological relationships, know-how, opportunity cost for investment off-farm. I do think it is important to find an approach which sheds light on all others choices available to the farmer.

Place: In this study I have presented, we did not assume trees were 'good', as we do not know if it is the optimal resource allocation for the household to plant trees. But concerning security of tenure, it seems that there also is a perverse effect of tenure security: with household heads migrating to the city to find work, they have to be very secure, and then less labour will be available to plant trees.

C: A number of studies have been able to show a relationship between tenure security and investment, but usually no effect has been shown between tenure and productivity, i.e. although there was investment, the yields were very similar.
C: To summarize: property rights effect the adoption of a specific technology. 'Adoption' requires a large amount of people who do so. If some adopt and others not, there are good chances that other factors play an important role. The timing of a study then plays an important role: often on-station data is used for the economic analysis in the early stages of dissemination. There then would be a greater role for studies that examine an envelope of techniques, e.g. trees in general.

Place: ICRAF also thinks that a broader study is more useful, and not zooming in on the tenure issue. In the study we have tried to incorporate other factors.

C: It would then be important to refocus the workshop on methodological issues, and define variables, data measurements, analytical procedures, the effect of the non-farm sector on farm choices.

C: There is also a problem of endogeneity when we compare results across sites, we cannot assume that the factors (such as population density, degree of commercialization,...) which are exogenous on one sites are so across sites.

Session III: Review of recently-completed and ongoing studies of property rights, resource management and agricultural productivity in Niger and Ethiopia

Chair: Ika Darnhofer
Rapporteur: Bruno Barbier

Property rights and soil fertility management in Niger

Sarah Gavian

This research was undertaken as a Ph.D. dissertation (Stanford University) in conjunction with the ILCA programme in Niamey, Niger. The objective of the research was similar to that of the World Bank studies: to test how land tenure affects land-improving investment, agricultural productivity and resource management. The standard hypothesis is that land tenure that is non-exclusive insecure or non-transferable will lead to under-investment and depressed factor mobility. It is further hypothesized that this will lead to inefficient agricultural production and over-exploitation of natural resources.

Data collection

Data were collected for the 1990–91 crop year in three villages along a rainfall gradient from 350 mm per year to 600 mm per year. Mixed crop-livestock production is the dominant mode of agricultural production in all villages, although there are differing degrees of integration between crops and livestock. Millet and sorghum are the main crops and manure is the main land-improving investment. Farmers cultivate land held under three types of customary property rights: owned, *hawjou* and borrowed. Owned land can be used, modified, lent and inherited. *Hawjou* land can be used indefinitely but cannot be lent or otherwise transferred. Borrowed land can be used for a fixed duration and cannot be substantially modified or transferred.

A total of 60 households were interviewed in a one-visit survey. Data were collected for 134 fields farmed by those 60 households. Fields were measured and their location described, conscious manuring was recorded as a binary variable (yes/no), labour input and yields were measured from farmer recall. Bundles of millet and sorghum were added together to derive a measure of crop output.

Because of the differences between owned, *hawjou* and borrowed land, it was possible to test two different arguments about the effects of tenure. One argument is that "security of tenure" affects the expected returns from investments. The second argument is that the transferability of land affects the mobility of factors. Land that is more transferable can be transferred to activities and uses that earn the highest returns. As measured by the average number of years farmed, rights to borrowed land are less secure than rights to *hawjou* or owned land. Only owned land is transferable.

Data analysis

An analysis of variance showed that manure use was significantly higher on fields held by ownership or *hawjou* than those that were borrowed. However, that analysis did not control for important factors such as soil fertility, distance from the field to the homestead, or household factors such as ability to invest. For example, fields that have high soil fertility may be held under more secure rights and crops on those fields may respond particularly well to manuring.

A simultaneous equations model can control for exogenous variables that are measurable (e.g. distance from the plot to the household) as well as Unobservable field characteristics that influence both yields and manuring (such as soil quality).

$$m = a Z + b t - u$$

$$y = c X + d m + e$$

where

m = manure

Z = exogenous variables affecting the decision to manure

t = tenure status

y = yield

X = exogenous variables affecting yield

u, e = random error terms

Because the quantity of manure was not observed, the variable m represents the binary decision to manure a field. A switching regressions model was therefore estimated Using maximum likelihood techniques.

$$m^* = a Z + b t - u$$

$$m = 1 \text{ if } m^* > 0$$

$$0 \text{ if } m^* <= 0$$

$$y = c_1 X_1 + e_1 \text{ if } m = 1$$

$$= c_0 X_0 + e_0 \text{ if } m = 0$$

An additional complication is added if one admits the possibility of a household portfolio effect. That is, individual farmers have multiple fields and limited access to manure. They must decide to how to allocate the manure to their portfolio of fields. There are several formulations for "fixed effects models." Household dummies can be included as explanatory variables or the data for each household can be expressed in terms of deviation from the mean for the household. The deviation formulation reflects the fact that the farmer melees a decision about an individual field relative to other fields in his portfolio.

Table 6. *The determinants of manuring.*

	All households	Households with more than one Field	

	Level data	Level data	Deviation data
Constant	.61 (.00)	–59 (.00)	.00 (.99)
Gueladio Region	–.11 (.37)		
Bittinkodji Region	–.31 (.04)		
Total Farm Size	–.02 (.03)		
Household Owns Animals	.08 (.52)		
Distance from Compound (km)	–.25 (.00)	–.21 (.00)	–34 (.00)
Distance Squared (km²)	.03 (.01)	.03 (.03)	.04 (.00)
Field on a Plain	.06 (52)	.07 (.45)	–.01 (.91)
Ample Erosion on Field	–.14 (.13)	–.14 (.17)	–.09 (33)
Field Size (ha)	.07 (.00)	.07 (.00)	.06 (.00)
Within 200 m of Water	.20 (.02)	.20 (.04)	.26 (.01)
Fortuitous Manuring	–38 (.02)	.34 (.06)	–.72 (.00)
Presence of Compound 1989	.31 (.01)	.31 (.01)	.17 (.17)
Privately Borrowed Field	–.11 (.24)	–.12 (.15)	–.41 (.00)
Trustee Field	–.05 (.66)	–.09 (.42)	–.22 (.65)
Mean of Manuring	.45	.43	.00
R-Squared	.30	.26	30
n	134	122	122

Results

When data from all of the plots were included in the simultaneous equations model of manuring and yield, no significant difference in the probability of manuring was found between fields held under the different types of tenure. The fixed-effects model also found no significant differences. However, the results from the deviations model indicate that farmers were significantly less likely to manure borrowed fields than owned fields. There were no significant differences in the probability of manuring fields that were owned and fields that were held under *hawjou*.

Land tenure and agricultural productivity in Ethiopia

Sarah Gavian

This research is being undertaken as an ILCA project with support from the Rockefeller Post-Doctoral Fellowship Programme. There are three objectives. One objective is very similar to that of the World Bank and Niger studies: to determine the effects of land tenure on investment, productivity and efficiency in crop-livestock systems in the Ethiopian highlands. The other objectives are: to identify the factors that influence the evolution of land tenure institutions in general and the Ethiopian land tenure systems in particular; and to quantify the prevalence of different types of land related contracts in Ethiopian agriculture and relate the terms of those contracts to household and land attributes. Ethiopia has a very dynamic land tenure situation that makes it very interesting, but also very difficult, to study.

Research methods

The investment-productivity study follows a methodology that is broader and deeper than the previous studies of this type. In particular, a detailed time series of data is being collected on all purchased inputs, labour inputs and manure applied to each field. Soil quality will also be

measured. Also, the mode of access to a particular field will be regarded as a decision variable rather than an exogenous variable. This should improve the strength of the analysis either because the landlord decides which fields will be 'exported' or because the user has a choice of various types of contracts to accept.

The study is based at one site in Tiyo woreda in Arsi region. Agriculture in the area is high input/high output. Wheat, livestock and several other crops are produced in a mixed crop-livestock system. Farmers use fertilizers, pesticides and tractors as inputs into crop production. Data are being collected from about 200 randomly-selected households in four cluster areas along an altitude gradient. Data are being collected at the level of the household and the level of the field. Price data are being collected in local markets in order to convert output quantities into values. A profit function approach is necessary because of the variety of crops that are grown.

Discussion

Q. What do you mean by fortuitous manuring in your Niger study?

A: I mean manuring that does not result from a conscious decision by the farmer. Through the passage of animals along roads and to water points, manure ends Up on the field.

Q: In your Niger study you refer to land that is "borrowed." But isn't it very similar to the share tenancy that we frequently see in Asia?

A: In fact the borrower gives 10% of his yield to the landlord unless the harvest is below 30 bundles.

Q: Is there a market for manure?

A: No. But there is an animal sharing system in which farmers request herders to park animals on their fields.

Q: How did you estimate the quantity of manure in your Niger study?

A: Manure is simply a dichotomous variable: yes or no manure. Of course this is a crude estimate that waters down the effect of manure on productivity.

Q: According to the data (not recorded in these proceedings), land tenure in your Niger villages seems pretty insecure. How did you word the question on "loosing a field" in your survey?

A: The question was "have you ever lost a field in a land conflict?" The data show the high incidence of conflict over land rights in this area.

Q: How did you measure yield across all fields?

A: I measured the fields and asked them the number of bundles they harvested on each field. A bundle is between 18 and 22 kg. These were not valued. In the study I am now doing in Ethiopia I am collecting price information so that I can estimate a profit function.

Q: Did manuring rotate between fields?

A: Farmers manured fields within 500 meters of their houses more often than others Between 500 and 1,000 metres fields were not manured at all. And beyond 1 km from the homestead the fields were again manured, probably in an attempt to obscure the exact size of their cattle herds from their neighbours. But there does not seem to be any regular rotation between fields, as some fields are never manured.

Q: You say that you are collecting price data in the Ethiopia study. What prices: farm gate, retail, wholesale?

A: I am aware that many): prices can be collected. But practical purposes I have chosen to collect market retail prices In the real world the different prices tend to move in tandem anyway. In the study the absolute value of the price is less important than the price ratios, which are preserved by selecting market prices.

Q: Factor endowments of households also play an important role: there are no perfect markets. And factor endowment has a strong effect on productivity.

A: This type of data is being collected in the Ethiopia study.

Session IV: Review of on-going and planned studies of property rights and resource management

Chair: Mamadou Diedhieu
Rapporteur: Sarah Gavian

Changes in resource use and property rights prompted by the adoption of dairy enterprises

Kimberly A. Swallow

This study is being undertaken as a Ph.D. dissertation (University of Wisconsin-Madison) in conjunction with the ILCA programme in Mombasa, Kenya. The general objective of the research is to understand how institutions support techniques. This is important to understand because economic development depends not only on increases in productive capacity but also on the development of institutions that support that production. The research is based on a case study of change in cattle feed production techniques, with a focus on access to inputs used in different feed production techniques. Specific questions addressed in the research include: (1) How do the institutions concerning access to feed change and who would find this worthwhile? (2) Which farmers are able to shift, for example, from grazing to the cut & carry system?

The purposively-selected site is located 44 km from Mombasa and three km from the market centre of Kaloloni. The area is subhumid and receives between 1100—1200 mm average annual rainfall. Soils are sandy and agro-ecological conditions are relatively homogenous throughout the case study village (an area of two km^2), except for riverine areas. The population density is approximately 200 inhabitants per km^2. Three villages were selected, one where farmers utilize a large range of feeding techniques and the others as contrasting sites. All of the land in the area has been registered to individuals or families and there is no area recognized as a village "commons."

Households' major assets include land, cattle and coconut trees. Twenty-five percent of households keep cattle. Subsistence crops are maize, cassava, and rice. Some surplus is marketed.

Research methods

A combination of qualitative and quantitative methods is being used. In the order that they were used the methods are:

1. A rapid appraisal and indigenous knowledge study was undertaken to gain familiarity with the local farming systems and social structure.

2. Village census of socio-economic characteristics. A census of the 310 homesteads in the three villages was conducted using a single-visit questionnaire. Variables included characteristics of homestead head, homestead characteristics, off-farm work, material structure of the homestead, livestock holdings, trees (holdings, source and use of earnings) and hand (holdings, decisions, Use of derived income, access, registration status, etc).
3. Survey of cattle owners. A census was carried out in the same villages on the 80 homesteads that keep cattle using a single-visit questionnaire. Variables included herd inventories (by breed, sex, size, grouping), herd management (who owns/feeds; strategies and problems, contact with extension agents), feeding methods/source in rainy and dry season, feed cultivation/innovation, milk marketing, herd ownership parameters (who, how long, herd composition strategies, etc).
4. Feed monitoring. A weekly survey of the eight households Using cut-and carry feeding techniques was conducted between July 1992 and July 1994.
5. Herd monitoring exercise. In conjunction with the feed monitoring survey, one to two herds were monitored to document where the animals were grazed, the time they spent in different locations, the type of land, the land owners' name, his or her relationship to the herd owner, and whether the herd owner needled to ask or pay for the right to graze his animals.
6. Homestead Case Studies: Multiple interviews with 2–3 households operating representative cattle enterprises and feeding techniques. These interviews will be used to undercover qualitative information about the institutions governing access to feeds.

Preliminary findings & observations

1. Prevalence of cattle ownership and keeping in the case study village. Twenty-five percent of the homesteads kept cattle. Of those, 76% managed only their own animals, eight percent own some cattle that are kept by others, while 24% keep some animals that are owned by others.
2. Goals for keeping cattle. When asked "Why do you keep cattle?" respondents most often answered milk production (97%), social obligation (38%) and emergency cash (35%). Twenty-one percent of the cattle keepers report that they usually sell some milk. These answers suggest that most cattle keepers are more concerned with herd size and subsistence use than maximizing herd productivity.
3. Problems with keeping cattle. The major problems cited by- respondents were health (81%) and access to feed (79%).
4. Classification of cattle enterprises. One key informant was asked to sort cattle-keeping homesteads in his village (Chanagande) using his own judgement. The criteria he used for his groupings were: herd size, breeds and feeding methods.
5. Type of cattle feed techniques: Three basic feed techniques were identified: grazing, tethering, and cut & carry. Each is most often used in combination with others. Of the 37 cattle keepers interviewed from the case study village, 18 relied solely on grazing, 15 combined grazing with tethering, 3 combined cut and carry with tethering and 2 used solely tethering.

Grazing: There was no single "commons" or contiguous area reserved exclusively for common use. Animals are grazed on crop residues and scattered fallow plots, all of which are registered. All grazed animals are herded (never grazed at will). Herds return to the homestead each night and sometimes at noon. Competition between grazing and crops during the growing season causes herders to follow more restricted routes to avoid the fines for crop damage.

Tethering: The largest tethered herd consisted of nine cattle. The two households that relied exclusively on tethering had small cattle herds (3–4 head). The tethering spot is moved 2–3

times a day, but usually remains close to the homestead.

Cut and carry: This method is usually reserved for 'grade' cattle, in very small herds (2–3 head). No homestead relies exclusively on this method (i.e. no zero grazing, only semi-zero grazing). The bulk of the daily feed is provided by tethering, but the high quality feed is cut and carry; it is provided during milking. The cut-and-carry method has heavy labour requirements (1–2 people for 1–2 head of cattle), due in part to the lack of good feed during the dry season near the compound. There is a large variety of carried feeds, including natural grasses, crop bi-products (maize chaff and stalks, banana stalks) and purchased feeds (maize chaff and copra cake). While it is possible to plant specialized feeds such as napier grass or *leuceana*, the quantities that are currently planted are inadequate to provide a surplus at any time of year. Pests, drought and storage are all problems. Furthermore napier and *leuceana* are available at the same time of year as natural grasses.

Institutions influencing the use of these feed techniques

Grazing: In general, grazing in not particularly scarce and cattle keepers can graze on other people's lands. By custom, animals have the right of passage and the right to graze all lands that are not cropped. This right extends to stover. Villagers are expected to be 'good neighbours' but there are occasions when a land 'owner' chases grazing cattle away. Non-cattle keepers don't perceive much benefit in such grazing (no value to the manure). Although there is a system of fines for crop damage, officials refuse to get involved in grazing disputes. Such matters are resolved on an ad hoc personal basis. The titling of the land in 1972/73 simply has had no immediate effect on grazing rights. In fact, most people have not yet collected their titles. Similarly, fences are very rare.

Tethering: Tethering activities are kept close to homestead so animals can be protected and moved throughout the day. Animals can be tethered on other's land, with permission, usually not for pay. However, there is a trend toward payment if the cattle are used for commercial milk production.

Cut and carry: Permission of the field owner is often required before one harvests wild grasses or crop residues. Maize stalks and banana stems must be purchased.

Discussion

Discussants were interested in Kimberly's impressions of the types of contracts needed improve resource allocation. How can transaction costs be reduced? What are the roles of markets? (In particular, contracts to provide animal owners access to grazing and farmers access to manure.) It would be useful to Understand what thwarts the development of a market for feeds since the existence of such a market could lessen the conflicts over grazing.

If the rules of access changed so that cattle keepers were limited to their own feed resources (or markets), they would have to either abandon cattle production or intensify their production.

The issue of the role of property rights in the adoption of dairy enterprises is interesting, although such enterprises are not as prevalent in the region of study as they are in the Central Province of Kenya.

Traditional strategies and adaptive resource use by crop–livestock producers in the Sahel

Timothy Williams

This presentation concerns the key properly rights issues arising in the West African Semi-Arid

Tropics (WASAT). The WASAT contains three main agro-climatic zones: Sahel (300–600 mm of annual rainfall falling in 2.5–4 months); Sudanian (600–900 mm, 4 to 6 month rainy season); and Guinean (900–1100 mm, 6–7 month rainy season). The author presented a conceptual framework to explain the responses that farmers in the WASAT region have adopted to deal with changes in their environment. There are several implications for property rights.

A conceptual model of adaptive response

(P1) Risk and uncertainty are pervasive in the WASAT. There are two types of Uncertainty facing crop–livestock producers. First, there is climatic uncertainty. Climatic conditions vary over space and time. This type of uncertainty decreases as area increases, which gives rise to a system of joint access to resources. Second, there also is behavioral uncertainty. People don't know how other players in the system will react. This leads to poorly-managed access to common property resources.

(P2) Farmers take an ecological approach to crop and livestock production. Farmers follow an ecological approach to production as a risk reduction strategy. Examples include intercropping and a careful use of the topo-sequence, devoting certain lands to particular crops.

(P3) Access to different land types modifies the approach that a farmer can take. These ecologically-determined cropping patterns are modified by differential access to land. Late-comers or particular ethnic groups do not have the same access as the original settlers. They are thus directed to upland slopes where they are necessarily restricted to less profitable crops.

(P4) Property rights continuum. There thus arises a continuum in property rights. The low, fertile hands have a wide variety of crops and well articulated property rules. The upland or drier marginal areas tend to have more common property regimes. This is where livestock are kept. The continuum influences the method of production. If farmers only have access to the marginal areas, circumstances may force them to hold livestock. This differentiation (continuum) exists even in small areas, reflecting micro-ecologies.

(P5) Evolution of land use. There are three stages in the evolution of land use. At low population densities, people used the upland slopes for crop cultivation because it was easier than clearing dense areas. They relied on fallow rather than manure (too labour intensive). As population densities increase, there \was a move towards the valleys and lowlands. Due to the great personal efforts needed to clear these fertile areas, farmers demanded exclusive control. In the third stage, drought and increasing population pressure forced people back into the marginal (drier) areas which they had abandoned.

(P6) Land Use is becoming more intensive and permanent, and land rights are becoming more heritable. From the livestock perspective, the increased intensity of cropping implies a lack of fallow and thus decreased grazing area. Fulani pastoralists cannot support their herds in and around villages. The potential for overgrazing is increased and the relationship between Fulani and settled population is upset.

(P7) Farmers have adopted a number of adaptive responses to this situation. (1) They have integrated crops and livestock in their farming systems. (2) They have intensified their use of manure and increased their soil and moisture conservation. (3) They have adopted short-cycle varieties of crops. (4) They have invested in irrigated fruit and vegetable gardens. (5) They harvest crop residues directly. This is in part due to a breakdown in the relationships between herders and settled farmers. (6) They have shifted their livestock species composition toward small ruminants.

Implications for property rights

(P1) Common property resources are jeopardized.

(P2) Behavioral uncertainty is intensified. The increase in pressure on resources increases uncertainty and leads to a breakdown of traditional rules. Transactions costs increase.

(P3) Research questions: Under what conditions is it efficient to privatize resources? How can we decrease transactions costs to improve or maintain common property resources and ensure their efficient use?

Overview of current research

The author and his colleagues will study property regimes in a variety of settings. Because outside regulations are unlikely to alter the use of natural resources, they will focus on the local institutional constraints, asking what incentives are needed to allow people to come together to avoid the assurance problem. They have already carried out a reconnaissance survey in 13 villages, from which they will focus on 7 villages.

Discussion

What is upland and what are marginal lands? In the WASAT context upland is *fadama*, while lowland is *bas-fond*. "Marginal lands" refer to those on the desert edge, with extremely low rainfall. Timothy is not referring to the long-fallow, fertile lands in the humid zones to the south.

What role for agro-forestry? Agroforestry is part of a sustainable solution to managing resources in WASAT, in conjunction with crop/livestock integration. However research on nutrient cycling indicates that soil fertility is such a problem that natural methods are not enough. External inputs, such as fertilizers must be used also.

Clarification of relationship between population pressure and extension of agriculture onto marginal lands. What mechanisms are involved? The literature suggests that this move occurs because of both population growth and low productivity. As output per capita falls, farmers must increase area to maintain production.

Crop livestock interactions: Traditional crop farmers are adopting cattle into their activities. The 1984 drought prompted distress sales of pastoralists' animals. There has thus been a shift of the national herd to the south and into the hands of sedentary farmers.

Distinguishing risk from transactions costs is not straight-forward. First assess how risk influences property rights, then analyze behavioral influences. Animals are mostly kept around the village so these rules can be identified and studied.

The model that the author presented is based on the classic Boserup-Pingali-McIntire view of populations as the driving force in intensification. One of the participants suggested an alternative model. Twenty-five years of droughts have devastated herds and decreased the value of livestock relative to crops, creating disincentives for livestock production. Furthermore, cultivators Usually have stronger claims to land because it costs them less to maintain their access (lower transactions costs). There are thus distortions that favour crop production (drought risk, transactions costs). On the other hand, devaluation, wetter years and improved food security could reverse this trend. After all, rainfall is cyclical. Wetter years would improve rangeland productivity, herd size and the political influence of livestock herders. Possibly they could reverse the policies against them. However the shift in herd ownership means that those using with a grazing interest are also farmers. So the new property rights solution may take a different form from the past. The question is whether property rights have changed so much

that tile long-term comparative advantage of livestock may be thwarted.

The effects of property rights on the use of forest resources

Keijiro Otsuka

Finding the question of the relationship between property rights and forestry management to be under-researched, Keijiro proposes to conduct a multi-country study of community forestry. He is currently selecting sites with collaborators in Vietnam, Indonesia, Ghana, Uganda and Ethiopia. His main hypothesis is that individual property rights will be more efficient when externalities are not important; communal rights will be more efficient when externalities are important.

Characteristics of study sites

Northern Vietnam: Massive deforestation; process of transition from collective to individual system; change from shifting cultivation (SC) to sedentary tree farming (e.g., mulberry and fruits).

Central Sumatra (Indonesia): Certain preservation of primary forests and prevalence of commercial tree planting (e.g., rubber and coffee); coexistence of traditional and new clan tenure; slash and burn with a system of multi-year intercropping of annual crops and tree crops when trees are young. Chief allocates land in a manner similar to that found in much of Africa.

Western Ghana: Gradual deforestation with population pressure; communal ownership of shifting cultivation area and transition to cocoa farming with strengthened individual rights. The sites selected are those where Place and Hazell conducted their early World Bank tenure research.

Central Uganda: Decline in forest covers in savanna woodlands because of excessive charcoal making; diversity of land tenure systems including individual tenure. Frank Place also conducted research in this area as part of the LTC/ICRAF studies.

Ethiopia: Massive deforestation, insecure tenure under collective management, forest projects. At the present time, Otsuka is discussing collaboration with ILCA and national organisations.

Property right systems on "forest" land

Several systems of property rights exist in these sites.

1. Public ownership:

    a. Open access (Uganda)

    b. Spontaneous community management (Uganda)

2. Collective ownership under socialist regime:

    a. Collective management (Ethiopia)

    b. individual use rights (Vietnam, shifting cultivation); land is collectively owned but individually used with permission.

    c. Spontaneous community management to protect irrigation system and thus protect upland forests. (Vietnam), or 3-a

d. Community forest project with free distribution of seedlings etc. (Ethiopia)

3. Customary communal ownership:

a. Communal management (many parts of "modern" Japan and some parts of north Thailand). Community decides rules and regulations about use of forest.

b. Individual use rights with allocation by "clan" chief (Ghana, Sumatra)

4. Individual ownership:

a. Large absentee land-ownership (Uganda)

b. Small to medium resident land-ownership (Uganda, Sumatra)

c. Small owner management (Vietnam, Sumatra)

Methodology

An extensive "community" survey will be carried out in 50–70 locations to assess impacts of changes and regional differences in changes in forest cover, tree volumes, and shifting cultivation. Three types of relationships will be estimated:

shifting cultivation area = F (tenure, population pressure,....)

changes in tenure = G (fallow cycles under shifting cultivation, ...)

tree planting = H (tenure, ...)

An intensive household survey will be carried out in 5–8 locations to assess impacts of household characteristics. Two types of relationships will be estimated:

Area choice functions (trees, annual crops under SC, uncultivated) = f (tenure, ...)

Profit or production functions (trees, annual crops) = g (tenure, fallow periods, ...)

The efficiency of forest use under private and collective rights will be tested using the results of the profit or production function estimations. Separate functions will be estimated for annual crops and trees. From those functions, the marginal product of labour (MPL) will be estimated. If there are no externalities, efficiency would imply equalization of MPLs between annual crops and trees. If there are important externalities, efficiency might imply a lower MPL for private activities than for common activities.

Discussion

Several types of 'forests' have been lumped together here: primary forests, savanna forests, and forest reserves. Certainly these are not equivalent. Furthermore some, such as the savanna forests, may not really be proper forests. This may cause analytical problems.

Types of Externalities: Japan in 16–18th century witnessed a large increase in population, triggering widespread tree cutting on open access mountain forests. The resulting deforestation lead to erosion which harmed the productivity of the privately owned rice paddies in the valleys. A similar process seems to be occurring in places in Vietnam and northern Thailand. A different kind of externality exists in Sumatra where the burning caused by shifting cultivation can cause fire damage soils damage and erosion on adjacent fields; it may also

blur boundaries.

Data Availability: These models assume the existence of time series data of at least 2 different points of time with enough variety in key variables such as population densities. Keijiro expects the extensive survey method to cover wide areas.

Modelling concerns: Forest cover may influence crop yields and vice versa, raising the problem of simultaneity that we have seen through-out our analyses of land tenure.

Session V: Proposed research on evolution of resource use and property rights under risk

Chair: Mohammed Jabbar
Rapporteur: Frank Place

Evolution of resource use and property rights under risk: Issues

Brent Swallow

Since September 1993, ILCA and IFPRI have been engaged in a discussion about the most important, researchable, issues in the area of property rights. A concept note has been developed for collaborative research on the evolution of resource use and property institutions under risk.

The starting point or framework was the Boserup, McIntire (and others) model of gradual intensification. This model has been used in documents such as the Winrock *Assessment of Animal Agriculture* to predict paths of future development and recommend research to facilitate that development. Basically, property rights systems follow the Demsetz model which says that population growth alters factor prices, driving up the value of land and giving rise to demand for individualization of property rights The model implies that the main role of research organizations is to develop land-saving technologies.

However, the model ignores three important issues: (1) property rights systems have important risk management implications; (2) property rights systems have implications for the distribution of income and opportunity; and (3) property rights systems also entail different transactions costs. The path of intensification and agricultural development becomes ambiguous once these issues are considered. At least three alternative paths are possible. One, development may proceed along a path of gradual intensification. Two, the risk management and equity aspects of common property may block the process of intensification. Three, intensification may occur in a way that is socially Undesirable. It is important, therefore, to undertake research so that we can better understand the relationships between population growth, commercialization, risk, equity and transaction costs.

Risk management

There exists spatial and temporal variability (climate, topography, etc) within rangelands, and thus there are key resources within rangelands. This leads to the need for mobility and flexibility in grazing. Common property or access to a large land area is desirable in this case. A reduction of risk by accessing larger areas is beneficial for risk averse households and can reduce livestock death in poor years.

A simplified model relating land value to annual rainfall indicates that at low levels (e g. low population), open access systems might prevail due to higher transaction costs associated with other property regimes (assumption is that transaction costs are highest under

individualization). As rainfall increases, systems may move to common property, mixed common and individual property, and then individualized property systems. ILCA would be mostly concerned (in this proposal) with areas where risk and transaction costs imply that property rights are ambiguous.

There are several sources of risk: environmental, behavioral, disease and market. In addition, there may be interactions between some of them. Farmers have various strategies of coping with these risks. Among them are: mobility of livestock, migration of labour, consumption smoothing through asset management, diversification of livestock assets, and adoption of drought resistant plant varieties. While these strategies have an impact on welfare, it is debatable whether or not they might influence property rights systems.

Distribution issues

There are several distribution issues associated with type of property rights system. Examples are: 1) large livestock owners may be the prime beneficiaries from common property rangeland, 2) poor groups' use rights over non-forage products in common lands may be extinguished under private property, 3) wealthy or powerful people usually lead and benefit from the process of individualization, 4) powerful people may be able to block in-migration and stymie intensification, and 5) there are conflicts between pastoralists and cultivators in several areas.

Transaction costs

There may be transactions costs both for groups and individuals under a given property rights system. Transaction costs at the group level may be a function of ethnic diversity of the group (+), governance structure, in-migration (+), size of internal population (+), and diversity of income sources (+), among others. At the individual level, the same variables might enter with the addition of the education, social power, and economic power of the individual.

Research questions

There are a number of researchable questions which arise from this discussion:

1. Are common property institutions constraints on technology development and intensification?
2. Are common property institutions desirable for risk management, equity, and reduction of transaction costs?
3. Should the focus of research be on public or private goods, i.e. should centres produce technological and institutional substitutes or complements for common property? Examples include communal water points versus private boreholes, tse-tse trap control versus drugs, and group rights to land versus individual rights to land.
4. Should technology and institutional development differ based upon the magnitude of risk or risk management options?

Evolution of resource use and property rights under risk: modelling challenges

Peter Hazell

The general motivation for the proposed research is that any intervention must be slotted in at the right time and in the right place, otherwise it does no good. We are therefore interested in areas which have the potential to be developed. Concerning common property, there are two ways of improving the resource. One is to organize the community and have them invest in

the resource— this seems to be rare— or one can individualize property rights so that individuals can invest. But risk throws a wrench into this in that privatization may not be a desirable remedy. Therefore, we need an understanding of the conditions under which institutions and technologies will work and enable communities to jump on the turnpike to development.

A simple model of investment and endogenous property rights

An important relationship is the relationship between property rights and investment (dI/dS). Most of the past studies (including those reviewed earlier in this workshop) have assumed that property rights are exogenous, then estimated single-equation models relating investment to several variables including property rights. But we know that property rights are endogenous. We could specify a structural model and a reduced form model as follows:

Structural model:	Investment = f (property rights, ...)
	Property rights = f (pop density, commercialisation, investment, ...)
Reduced forms:	Investment = f (pop density, commercialisation, ...)
	Property rights = f (pop density, commercialisation, ...)

But to estimate the effect of property rights on investment (dI/dS), must use structural equation for I and this requires estimation of the structural function for property rights. But this would require data from across many regions. The way that most studies are designed we have few observations and problems of measurement that hamper the estimation of cross-site equations. These problems would have to be overcome

Complications to the simple model

In estimating a model of property rights choice, one must be aware of the various factors which may give rise to them. The structural equation specified above implicitly accepted the Boserup-Demsetz model of property rights. However, as discussed by Swallow and Otsuka, property rights choice may also depend upon factors such as the presence of externalities, risk, economies of scale, and distributional objectives The valuation of these are very tricky and when the dynamics of the relationships are considered, additional complexity is introduced.

Property rights = f (pop density, commercialisation, investment, risk, transaction costs, externalities, economies of scale, distributional objectives,...)

Modelling property rights choice

Even if it could be improved to include an expanded set of variables, the above model is still based on a questionable theoretical foundation A more defensible approach would be to begin with a micro-economic model of a household and derive testable hypotheses. This way, we can derive and incorporate some necessary restrictions in the econometric models and can also introduce concepts such as the opportunity costs of labour earlier mentioned by Simeon Ehui. This should lead to better hypotheses and models. Currently, the null hypothesis of no effect of land rights is more prone to be accepted when it should be rejected than vice versa.

To model property rights at the community level, a number of scenarios could prevail. One might be where a benign chief rules over a community and chooses the property rights regime for his citizens. A formulation of the chief's problem would be as follows:

Max U (Income, Risk, Poverty) property rights

where the arguments of the utility function are defined by reaction functions that model the reactions of the people in the community.

Income = f (property rights, ...)

Risk = f (property rights, ...)

Poverty = f (property rights, ...)

A variant of this model might be where some property is privatized and chiefs may choose how much land is in common and private property as well as the property rights systems to operate in each.

Max U (Income, Risk, Poverty)
Ap, Ac, Sp, Sc

Income = Incomep + Incomec

Incomep = f (property rights, ...)

Incomec = f (property rights, ...)

A third model would be where wealthy individuals, not a chief, dictate property rights. Other possibilities may include combinations of groups. This becomes even more complex when dynamics are added to these static maximisation equations.

Conclusion

An alternative to this complicated modelling would be to simply write down sensible estimable equations. For either task, however, formidable measurement difficulties lay ahead. Data would be needed on the following: productivity of the landscape (all resources) and its change over time, drought and other risk, ability to cope with drought, externalities such as poverty reduction benefit from common property, rights over time, investment over time, and group action and organisation.

Discussion of Swallow and Hazell

C: Even in the simplest models of share tenancy, it was difficult to derive reduced form equations so that it was doubtful that theoretical models could be used to construct estimable equations. The endogeneity of property rights would be very difficult to model unless the variable was dichotomous or continuous.

C: Spatial risk may not necessarily lead to stock reduction. Swallow offered the case of the Turkana losing 60 percent of animals to drought.

C: Even household modelling studies have proven to be very costly. Could ambitious community-level studies be affordable? Perhaps secondary sources of information could be used.

C: Two types of methodological approaches could be used to understand the issues raised: an extensive study which covers lots of areas to look at changes in property rights (e.g. McIntire *et al*.) or an intensive study within a few sites. A third possibility would be a study that develops conceptual models and relies on secondary data to test them. After that, one could evaluate whether primary data collection is necessary.

Q: How would secondary access be dealt with in this study? Swallow replied that markets are implied by property rights changes and referred to simulation work on this by Carter and Zimmerman.

Q: Could the models that were presented be adequate for testing whether common property was a constraint on development? This was one of the main issues raised by both Swallow and Hazell when they introduced the problem setting for the proposed research.

C: Security of tenure might have to be measured differently at different sites. This would represent a considerable challenge for modelling.

C: Simpler multivariate techniques, such as cluster analysis, might be appropriate at early stages of research to identify important factors and relationships.

Q: Given the complexity of the problem and the difficulty of the empirical research, is research on property rights systems a high priority at this time? For example, governance may be the most critical constraint to rectify. No policy can be implemented without it.

Hazell: Tenure issues are more likely grass root, local issues, not necessarily for national policy makers. Understanding property rights is important for developing better technologies and timing them properly in the development process.

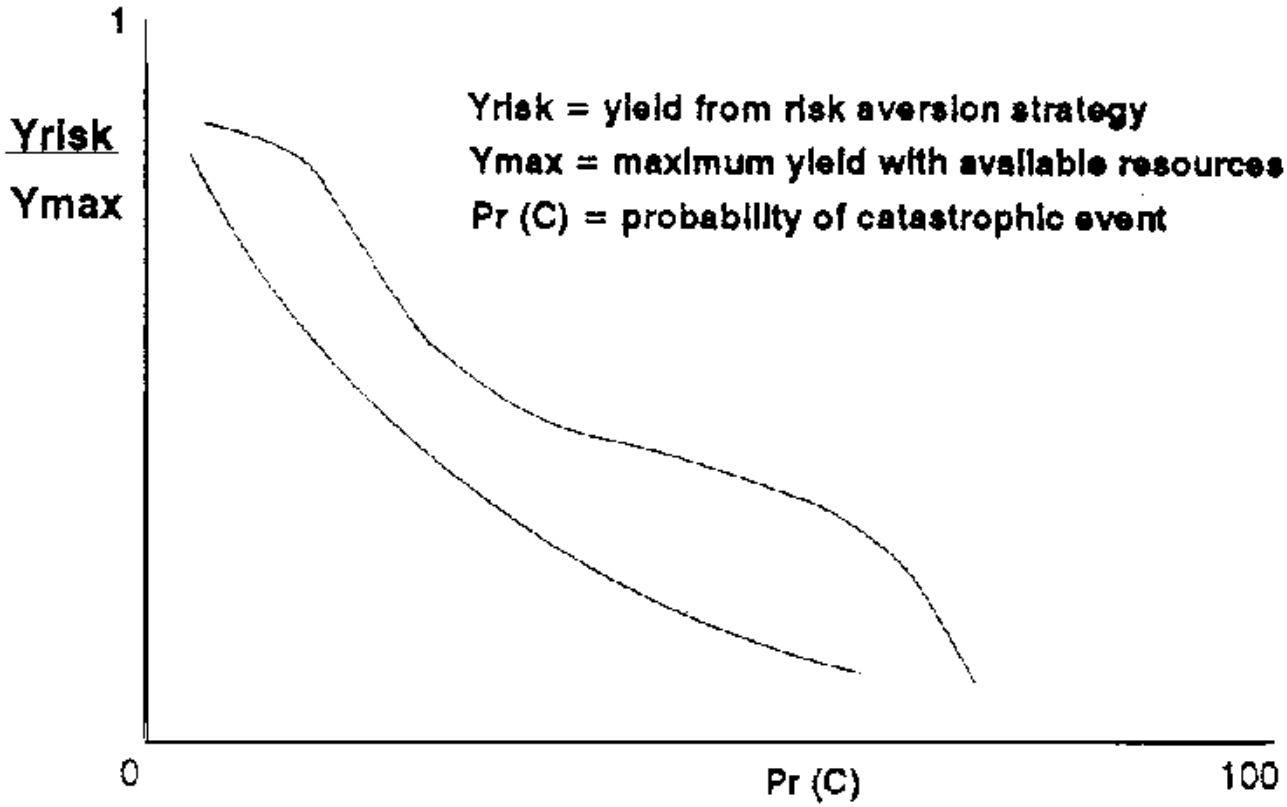
C: It is important to distinguish research to change institutions from research to guide the development of technologies for given institutional situations.

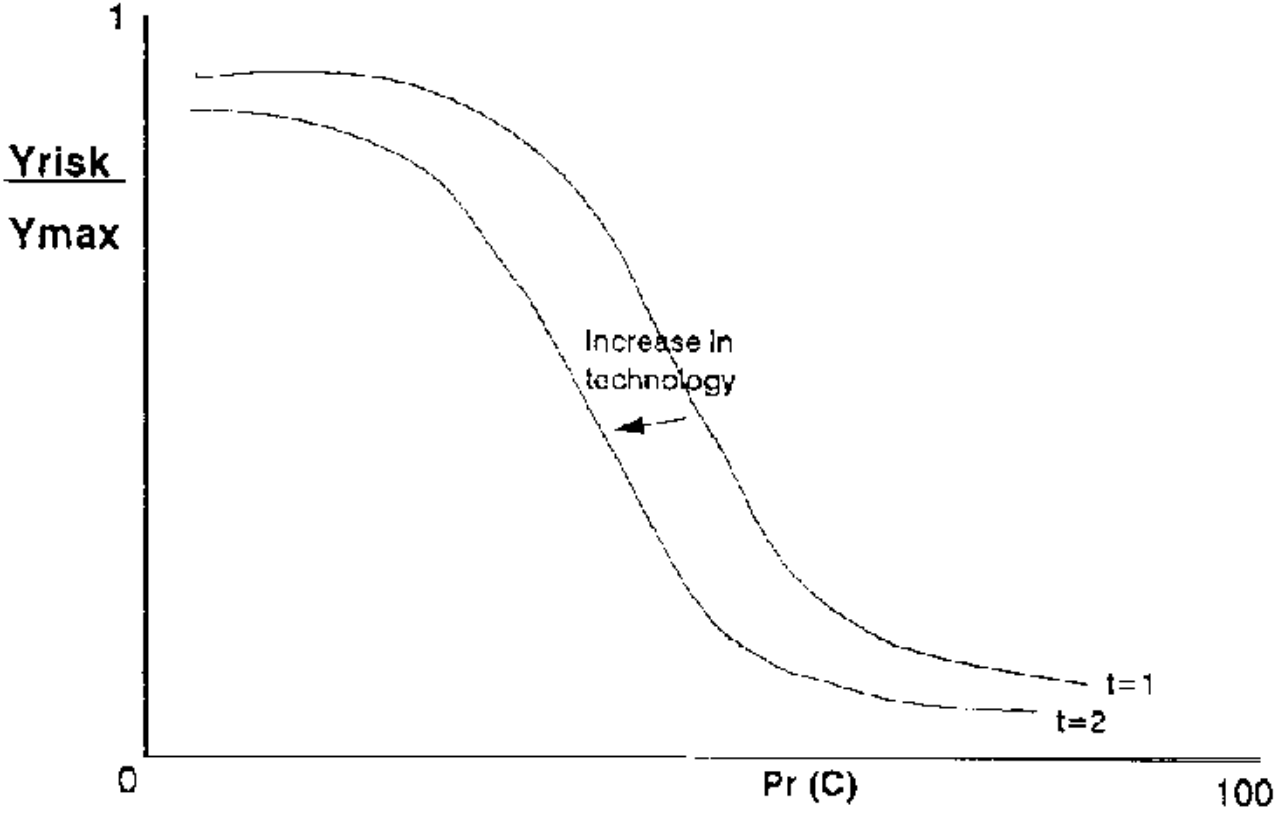
Fitzhugh: Emphasized Hazell's motivation for the research, to facilitate the development process. He stated that it was necessary to shift agriculture from subsistence, yet many projects have failed to do so. He strongly favoured doing a research project correctly, if expensively, rather than doing a cheaper inferior alternative. He supported a modelling approach that builds on firm theoretical foundations. He mentioned two possible sites for work, Zimbabwe, and the West African transect through 3 agro-ecological zones. He also suggested that researchers in the CG system look to collaborate with development projects as a means of collecting data more cheaply.

Lastly, the DG showed a graph depicting the probability of a catastrophe on one axis and the ratio of risk aversion yield to maximum achievable yield on the other. He mentioned that it is downward sloping but that the precise location would be important. The location might depend on farmer endowment (Figure 3, top panel). Hazell added to this by demonstrating how the curve may be used in a dynamic framework. He postulated that over time, the maximum yield value would increase due to innovations. This would shift the curve inward indicating that the risk aversion strategy became relatively worse over time. The research project would then be ultimately aimed at pushing the curve outward by improving the risk aversion strategies (Figure 3, bottom panel).

Figure 3 A model of the relationship between risk and productivity

Source: H.A. Fitzhugh, workshop proceedings


1
Yrisk
Ymax
Yrisk = yield from risk aversion strategy
Ymax = maximum yield with available resources
Pr (C) = probability of catastrophic event
0
Pr (C)
100


1
Yrisk
Ymax
Increase in technology
t=1
t=2
0
Pr (C)
100

Session VI: Conclusions and priorities for future research

Facilitator: Brent Swallow

Rapporteur: *Kimberly A. Swallow*

The remainder of the workshop consisted of open discussion among the whole group. There were four purposes of that discussion. One purpose was to take stock of the research that has been done on property rights and identify issues that need to be added, redirected, or concluded. For example, what issues/relationships do we really know enough about? The second purpose was to identify priorities for future research. The third was to further develop the research proposed by Swallow and Hazell. And the final purpose was to reach agreement about the form of the outputs from the workshop.

By the end of the deliberations, the group should be able to respond to the questions posed by the Director General. That is, (1) What are the issues? (2) How do they rank in importance as constraints or incentives to agricultural development and/or sustainable management of natural resources? (3) Which of these priority issues are researchable? (4) How should research be designed? (5) Who should do it? (6) How should it be organized? (7) How much will it cost in terms of human and financial resources?

What are the research issues?

1. How do property rights affect the adoption of land-improving investments? The standard hypothesis is that property rights that are non-exclusive, insecure or nontransferable will lead to under-investment in land-improving investments.
2. How do property rights affect agricultural productivity? It is hypothesized that nonexclusive, insecure or non-transferable property rights will result in an under-investment in fixed investments and reduced mobility of variable factors. The result will be inefficiency and low productivity.
3. How do property rights affect the stewardship of natural resources? It is hypothesized that collectively-used resources will be exploited beyond their social optimum. It is also hypothesized that people will divest in soil on lands for which they hold non-exclusive, insecure or non-transferable property rights.
4. How does the presence of risk affect the desirability and evolution of property rights?
5. How do property rights affect the equitable access to income and opportunity? It is hypothesized that poor and vulnerable people are particularly dependent upon collectively-used resources.
6. How do property rights affect people's access to credit?
7. How does the development of a land market affect factor mobility and human welfare?
8. How are property rights determined? How do they change?

What is known from previous research?

Many of the previous and current studies (e.g. World Bank, LTC/ILCA studies, Gavian's studies in Niger and Ethiopia, some of the ILCA systems studies) have investigated the relationship between property rights, adoption of land-improving investments, and productivity of crop-based production systems. The following propositions are based on the results of those studies.

(P1) Security of land tenure is the only aspect of property rights that is likely to affect people's use of techniques that generate relatively short-term benefits (e.g. mulching, manure, fertilizer). People who use land under short-term lease or rental contracts may under-invest in these types of techniques (see Place and Hazell, Place, Gavian in these proceedings). Nonetheless, short-term contracts may be socially-desirable in many instances.

(P2) Property rights is only one of many factors that affect people's incentives to undertake investments in land-improving investments such as improved fallows or multipurpose trees. Analysis of property rights should be conducted as part of the diagnostic phase of the technique development and dissemination process.

(P3) Studies of the affects of property rights on the adoption of particular techniques should be done after a significant amount of adoption has occurred so that the affects of other variables can be identified and controlled.

(P4) The relationship between property rights and crop productivity has been investigated in several of the previous studies without clear results. Relatively little research has been conducted to investigate the productivity of livestock and crop-livestock systems.

Who should do what?

(P5) In general, it is the role of IARCs to develop new techniques and the role of national centres to adapt techniques to local needs and disseminate. The IARCs have a role to guide the national centres in methodologies. Then national centres can do the adaptation and dissemination work either independently or in collaboration with IARCs.

(P6) In the area of property rights research, methodological guidance has been provided for examining the static aspects of property rights. What remains is for IARCs to provide methodological guidance on the integration of property rights dynamics into technique development and the determination of recommendation domains.

(P7) ILCA/ILRI research should focus on livestock systems (e.g. de Ridder and Wagenaar) and crop-livestock systems (e.g. Toulmin). Productivity studies need to consider long-term versus short-term productivity and sustainability, normal versus drought years, and common versus private lands.

How should research be designed?

(P8) Studies involving an analysis of investment need to move beyond binary measures of investment to quantitative measures (e.g. number of trees per hectare).

(P9) Studies of the effects of property rights on technique adoption need to take better account of other variables affecting adoption.

(P10) We need to improve on the way that we conceptualize property rights. They should be regarded as endogenous rather than exogenous. This approach would help to explain changes in property rights, investment and natural resource management over time. Critical constraints on the development process could be identified.

Peter Hazell proposed a conceptual framework that includes the major research variables and relationships (Figure 4). The participants then discussed the relative importance of different variables and relationships for future research.

Figure 4 An expanded model of property rights

The key variables are: policy, population density, property rights, climate risk, credit access,

land market, production behaviour (investment, technique adoption, community action), and outcomes (human welfare, equity, production, natural resource management). Exogenous drivers are: climate risk, population growth, history of property rights and policy.

Priorities for future research

a) Climate risk: High priority

- The consensus was that climate risk is an important variable that deserves more attention than it has been given.
- It was also pointed out that climate risk is more important for certain areas (semi-arid and arid).

b) Land markets: Low priority

- Research has been done on this by the Land Tenure Center, Carter (simulations), Roth (Ghana)
- For land markets to be important, property rights need to be individualized and tradable. This situation will be a long time in coming in many areas of Sub-Saharan Africa. We are more interested in how property rights get to the stage of being individualized.

c) Credit access: Low priority

- Credit access is being studied by others.

d) Equity: High priority

- This has received inadequate attention in the past.

e) Evolution of property rights: High priority

Planning collaborative research on the evolution of property rights under risk

(a) Problem Settings

What are the key problem settings that should be focused on? Where are these problems most important to study?

- intensification: sub-humid zone of West Africa
- human welfare: Semi-arid, resource poor and vulnerable populations. (If focus on the drier areas of West Africa, will also need to look at linkages to the sub-humid areas via migration.)

(b) Research methods and work plan

The research will involve a considerable modelling component at the outset. This modelling will be based on a review of secondary literature. The model will generate specific research questions and hypotheses to be tested (e.g. Otsuka above). Some simulations could also be conducted.

An extensive survey/rural appraisal of 30 to 40 sites can be conducted in order to investigate some of the relationships included in the model (e.g. climate risk and population density, climate risk and property rights) and some of the alternative paths of intensification that are actually occurring. Sites for the extensive surveys will be selected to represent contrasting

situations of population density and growth, commercialization, property rights history and other important factors. Sites could be purposively selected to take advantage of other research or randomly selected to avoid selection bias. All of the sites should have the potential for intensification and crop–livestock production.

Data on the following variables will be collected during the extensive survey: policy, population density, climate risk, property rights, investment and mobility. Of these variables, the most difficult variable to measure may be property rights since different groups in a community have different rights and rights change over time. Climate risk and population density data may be available from GIS data bases. These could be ground-truthed during rapid appraisals. Mobility could be measured by the proportion of time spent on own versus others' fields.

A detailed analysis of 2 or 3 study sites could also be conducted to investigate issues such as distribution and productivity. These sites will need to be selected purposively to take advantage of other research.

(c) Could we return to the sites of the systems studies? Could such an approach provide opportunities to investigate questions that would be of interest to ILCA for other reasons?

i. Botswana (at least two sites)– How does individualization affect productivity and mobility?
ii. Kenya (Maasailand) – How does individualization affect productivity and mobility?
iii. Ethiopia (Boran)
iv. Nigeria (transect from humid to sub-humid) – What factors affect adoption of fodder banks and alley farms?
v. Mali (at least two sites) – Equity

(d) What sites can be offered by current ILCA and IFPRI research in Africa?

Questions: Do we get enough variation in the existing sites? For work in progress can we add variables now? We want distinctions of common property versus private property and spatial versus temporal issues. We can only stratify on exogenous variables otherwise we will get biases.

i. Sites included in the study of ecological and economic impacts of trypanosomiasis control: Zambezi Valley of Zimbabwe; southern Burkina Faso and northern Cote d'Ivoire; Ghibe valley of south-west Ethiopia
ii. Niger: Williams/Turner sites
iii. Ethiopia: Gavian's sires
iv. Several sites: Otsuka's forestry sites where there are livestock

(e) What sites could be available elsewhere in the world?

i. Honduras: sites of the IFPRI *et al.* fragile lands study
ii. India: ICRISAT's sites
iii. Syria: ICARDA's sites; grazing on the step, overgrazing
iv. World wide: add-on to the evaluation component of World Bank projects

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Note: [ILCA] indicates a study that was primarily financed by ILCA and executed by ILCA researchers. [ILCA-COLLABORATOR] indicates a study in which ILCA played a major role, but also involved collaboration with other organizations.

Appendix II: List of participants

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