

Rural Markets, Natural Capital and Dynamic Poverty Traps in East Africa

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Abstract

Recent empirical studies using longitudinal data find that a disturbingly large share of the world's poor suffer chronic rather than transitory poverty (Grootaert et al. 1997, Carter and May 1999, 2000). They appear trapped in a state of perpetual food insecurity and vulnerability due to poor asset endowments and factor market failures, especially for capital, that preclude their efficient investment in or use of productive assets. Moreover, those caught in a poverty trap have strong incentives to deplete natural capital in order to sustain human capital (Perrings 1989). Partly as a consequence, nearly two-fifths of the world's agricultural land is seriously degraded and the figure is highest and growing in the poorest areas of Central America and Sub-Saharan Africa (World Bank 2000, WRI 2000). Such degradation only aggravates pre-existing poverty traps, by discouraging capital poor smallholders from investing in maintaining, much less improving, the natural resource base on which their future livelihoods depend (Reardon and Vosti 1995, Barrett 1996, Carter and May 1999, McPeak and Barrett forthcoming). The resulting degradation of the local ecosystem further lowers agricultural labor productivity, aggravating the structural poverty trap from which smallholders cannot easily escape. This project's focus on poverty traps and their agroecological consequences and etiology thus squarely addresses two of the global constraints emphasized by the broader BASIS CRSP, those that "Trap Poor Households in Cycles of Food Insecurity, Economic Shocks and Unproductive Accumulation" and those that impede "Coordinated and Sustainable Use of Environmentally Sensitive Resources." This project will employ a research design intended to capture household and location variation by examining market access and underlying agroecological conditions in Kenya and Madagascar. We will combine quantitative and qualitative data collection and analysis with simulations based on bioeconomic modeling in order to identify and document effective policies, technologies and programs to combat dynamic poverty traps in rural east Africa.

Narrative

Problem Statement

One fifth of the world's population lives on less than a dollar a day, and most of those ultra-poor individuals and families live in rural areas and work in agriculture. So the poorest populations in the world rely disproportionately on the natural resource base, ecological capital, on which agricultural productivity depends. Recent empirical studies using longitudinal data find that a disturbingly large share of these people suffer chronic rather than transitory poverty (Grootaert et al. 1997, Carter and May 1999, 2000). They appear trapped in a state of perpetual food insecurity and vulnerability due to poor asset endowments and factor market failures, especially for capital, that preclude their efficient investment in or use of productive assets. Moreover, those caught in a poverty trap have strong incentives to deplete natural capital in order to sustain human capital (Perrings 1989). Partly as a consequence, nearly two-fifths of the world's agricultural land is seriously degraded and the figure is highest and growing in poor areas such as Central America and Sub-Saharan Africa (World Bank 2000, WRI 2000). Such degradation only aggravates pre-existing poverty traps, by discouraging capital poor smallholders from investing in maintaining, much less improving, the natural resource base on which their future livelihoods depend (Reardon and Vosti 1995, Barrett 1996, Carter and May 1999, McPeak and Barrett 2001). The resulting degradation of the local ecosystem further lowers agricultural labor productivity, aggravating the structural poverty trap from which smallholders cannot easily escape.

Based on the emerging theoretical and empirical literature (Rosenzweig and Wolpin 1993, Rosenzweig and Binswanger 1993, Dercon 1998, Zimmerman and Carter 1999, Barrett et al. 2000, Holden and Shiferaw 2000, McPeak and Barrett 2001) and our own empirical

observations, we hypothesize that dynamic poverty traps arise and persist in rural East Africa because of four interrelated features of the agroeconomic system.

- (i) Poor market access creates significant fixed costs to market participation. This gives larger producers net price advantages by creating a positive relationship between sales volume and net revenues per unit of output sold and a negative relationship between purchase volume and net cost per unit of input bought. Such effects can induce poorer producers in areas of weak market access to opt out of markets in favor of low-return self-sufficiency, further contributing to factor market thinness.
- (ii) High return production strategies (e.g., raising livestock) entail significant fixed costs that generate increasing returns to scale over some region (i.e., a minimum efficient scale of production beyond the means of the poor lacking adequate financing).
- (iii) Poorer households lacking access to capital to finance productive investments may be unable to undertake lumpy investments, regardless of their expected returns
- (iv) Risk and subsistence constraints discourage long-term investment for asset accumulation and productivity growth among poorer, more risk averse households.

The first objective of this project is to test those hypotheses empirically. In a world without fixed costs, increasing returns to scale, or liquidity constraints, no one is predisposed to remain poor. Indeed, the classic convergence hypothesis arises: the poor should grow faster than the rich, converging on a common income level in time. In such a world, smallholders would borrow against future earnings to invest in natural capital, thereby improving agricultural labor productivity, per capita rural incomes, and food security.

In fact, however, poor communications and transport infrastructure, insecure claims to land and livestock, and weak or nonexistent contract monitoring and enforcement institutions

result in market failures in rural areas of the low-income world. The net unit price paid for purchased inputs (e.g., fertilizer, labor, manure, seed) or received for outputs sold vary by households' physical access to market, the timing of their market participation, and the quantities they transact. These implicit price differences result in incentives that differ across households based on observable characteristics, such as distance to market, marketable surplus, liquidity, etc. In particular, this household-specific or *idiosyncratic pricing* often makes non-land inputs expensive relative to land for poorer households, who then rationally substitute land for non-land factors, either through greater nutrient mining or by extensification onto more marginal land. Consequently, if input prices are relatively lower and/or output prices relatively higher for those with greater *ex ante* wealth, market failures can lead to exclusionary growth, wherein the rich get richer while the poor remain trapped in their poverty.

The fixed costs of livestock¹ and land maintenance create minimum efficient scales of production in some livelihood strategies that generate locally increasing returns to investment in particular assets. For example, the maintenance requirements for low productivity (e.g., 5 kg/day of milk) and high productivity (e.g., 25 kg/day) cattle are essentially identical. Only the amount of energy needed for production varies proportionately with productivity. Feed availability and quality -- themselves determined partly by soil quality -- largely determine livestock efficiency in this environment. Access to pastures capable of producing high quality forages or the ability to purchase supplemental feeds, both wealth-dependent factors, increase the proportion of a cow's total energy intake, which in turn affects milk production output. Similarly, in drier areas, where mobility is key to herd survival and productivity, pastoralists need a minimum size herd to be able to subsist off milk and blood during seasonal migrations (McPeak and Barrett 2001).

Similarly, there are nontrivial fixed costs of land and labor associated with some tree fallows. Use of improved fallows that lead to substantial crop yield increases depends largely on market access (e.g., to germplasm), property rights, and liquidity (Place and Dewees 1999, Kwesiga et al. 1999). Smallholders may be effectively locked in to low-investment strategies by the poor returns that result from their modest initial asset endowments, which leave them below the minimum efficient scale of operation.²

Farmers are surely aware of scale-dependent returns to livestock, trees, or land. The fact that some farmers prove unable to marshal the resources necessary to undertake investment of sufficient scale to generate competitive returns would seem to signal constrained access to investible resources. Binding liquidity constraints due to low savings and credit limits can impede acquisition of assets known to offer highly attractive returns, thereby trapping some initially poorer households – or middle class households that suffer a significant, adverse shock – in poverty (Loury 1981, Dercon 1998). Rural financial markets are notoriously incomplete in east Africa, but they are not wholly absent. Some households keep savings and are able to borrow from financial institutions or informal lenders. However, access to liquid savings and credit may be positively associated with ex ante income or wealth due to collateral requirements, reputation effects, or other mechanisms. In that case, once again, the playing field is far from level, with the rich enjoying better access to high-return livelihoods than the poor.

Liquidity constraints can be aggravated by wealth-dependent risk or time preferences. If the poor are more risk averse than the wealthy, or if they discount the future more than richer persons do, then the poor become less likely to invest in assets (at some present cost) that offer higher expected future returns, especially if higher expected returns are coupled with greater risk. Subsistence constraints that limit the poor's capacity to trade current consumption for

future income gains have a similar effect.

These four hypothesized factors can produce a positive correlation between ex ante wealth and the expected returns to assets (Bardhan et al. 2000), due in part to scale economies, in part to wealthier households' superior capacity to overcome financial entry barriers to remunerative livelihood strategies, in part to the existence of subsistence constraints and wealth-dependent risk and time preferences, and in part to variation in the effective cost of factors of production and the price of marketed output.

The dynamic aggravation of rural poverty through the drawing down of all types of capital, including natural types, thus results from a threshold effect. Farmers caught in a poverty trap are unable to accumulate productive capital and are more likely to exit farming, or to be forced to farm the periphery on ever more marginal land. Farmers above the threshold can maintain, even improve their soil quality, and ultimately their economic outcomes. A similar effect results from factor and product market failures. If the effective cost of investment in soil quality is higher for poorer farmers, the yield of these investments is lower and so they may invest less. Similarly, if the fixed costs of reaching markets make net earnings per unit sold significantly lower for low volume producers, yields on output-augmenting investments are lower. Missing markets and minimum efficient scales of investment or production thus may rationally limit some smallholders' investment in improved natural resource management techniques and in productive natural assets such as livestock or trees that improve soil quality. The second core objective of the project is thus to explore how the existence of poverty traps condition natural resource conservation, particularly soil quality dynamics that centrally affect agricultural and labor productivity and food security.

The first and second project objectives feed into the project's third, more practical, final

objective: to identify and document effective policies, technologies and programs to combat dynamic poverty traps in this setting. The feedback effects between poverty traps and farmer investment in natural capital suggest opportunities for “win-win” innovations, as has perhaps occurred through the recent introduction of smaller size NPK packets in the liberalized inorganic fertilizer market. This project will be able to address explicitly very current questions, such as whether and how to restock farmers’ herds after a major drought, how best to stimulate adoption by the poor – who are typically late or non-adopters -- of improved fallows that seem well suited to smallholder integrated maize-livestock systems or of intensified rice systems that generate demonstrably increased yields. Appropriate public investments by governments and donors depend upon the source of the poverty trap(s) among the target subpopulation(s) of interest. By focusing explicitly on the source of poverty traps, this project can help identify interventions that have proved effective or that are likely to prove effective but have not yet been tried.

The emergence of significant long-run income and wealth inequality is a particularly important feature of poverty traps. Incomes do not converge over time because of threshold and missing market effects. Two smallholders with initial endowments very near to each other on either side of these thresholds will have very different life histories. Speaking analytically, the wealth dynamic has two stable steady states, one poor and one rich, and the possibility of unstable dynamic equilibria in between, at which small shocks can send households into accumulation or immiseration cycles. In related research our team has undertaken in southern Ethiopia, we have found clear evidence of such effects: multiple equilibria including a stable, poor steady state, an unstable intermediate dynamic equilibrium, and a rich, stable equilibrium (Lybbert et al. 2001).

In the textbook world of complete markets, constant returns to scale, and no fixed costs, long-run economic outcomes are invariant to initial conditions. Dynamic economic models built on these assumptions have a globally stable steady state; in the long run, all agents end up in the same place. When these assumptions fail, the models behave very differently, and this difference is a rich source of empirical regularities (Durlauf and Quah, forthcoming). In particular, in the context of human capital investment, missing loan markets have been shown to be important for the creation and perpetuation of income inequality (Loury, 1981). The problem of farmers managing land quality is structurally similar.

We also propose to explore the agroeconomic ramifications of the fact that biological and economic processes work on different time scales. Biological constraints are low frequency, binding only gradually, while liquidity constraints are high frequency, binding quickly because of subsistence requirements. Even if markets were perfect, they might not mitigate the ecological implications of poverty because the effects of ecological degradation are too far in the future to concern current farmers exhibiting high discount rates with respect to future costs and benefits. In essence, the social discount rate might be too low for biology to have an effect on smallholder incentives. And to the extent that poor smallholders discount the future more heavily than wealthier farmers do, in addition to more serious liquidity constraints (Holden and Shiferaw 2000), this effect becomes another source of income and wealth variation.

This project's focus on poverty traps and their agroecological consequences and etiology thus squarely addresses two of the global constraints emphasized by the broader BASIS CRSP, those that "Trap Poor Households in Cycles of Food Insecurity, Economic Shocks and Unproductive Accumulation" and those that impede "Coordinated and Sustainable Use of Environmentally Sensitive Resources."

Research Design

Our project will explore resource degradation poverty traps through policy-oriented empirical analysis and simulation modeling of integrated agroecosystem dynamics and heterogeneous smallholder behavior. Since there are two sources of the poverty trap, incomplete markets and non-convex returns due to the underlying biology, we propose a research design which captures variation in both of these dimensions. We will exploit existing field work by our team to construct interdisciplinary panel data from sites in Kenya and Madagascar covering each cell of a design matrix reflecting better or worse market access on one axis and a drier or wetter agroecology on the other. The planned sites are shown in Figure 1 and described in the next section.

The technology of maintaining land quality differs by agroecology, market conditions and socio-political structures. High potential areas such as our sites in the "better, wetter" cell of Figure 1 have sufficient water to sustain livestock and high-value tree crops year-round. Wealthier farmers enjoy positive soil nutrient balances. They accumulate natural capital by exploiting the complementarities that arise from integrating livestock, agroforestry and crop production. Livestock provide valuable manure, traction and transport, and crop residues provide high quality feed.³ High-resource-endowment farms are liquid and able to hire labor, purchase fertilizer and manure, acquire and maintain livestock, and adopt improved production technologies, building up land quality and wealth, gradually leading to diversification into high-return non-farm activities (Barrett et al. 2000). To the extent that smaller farmers have access to capital markets, they can borrow to overcome liquidity constraints to achieve some of the same gains.

Figure 1: Proposed Field Research Sites

		Agroecological conditions	
		Drier	Wetter
Market Access	Better	north central Kenya (Baringo)	central highlands Kenya (Embu) central highlands Madagascar (Vakinankaratra)
	Worse	northern Kenya (Marsabit)	western Kenya (Siaya/Vihiga) southern highlands Madagascar (Fianarantsoa)

To the extent, however, that poorer farmers are shut out of capital markets (and no site in our research plan, or anywhere in Africa, for that matter, has truly well-functioning capital markets) poorer farmers get caught in poverty traps that lead them to deaccumulate natural capital, reinforcing the productivity differences that distinguish different wealth classes of farmers (Shepherd and Soule 1998). For them, investment in land quality becomes a byproduct of smallholders' choice of livelihoods strategies and production technologies rather than a co-determined choice variable. Choices regarding the use of fallows and of integrating livestock are especially important to the conservation of natural capital on which future agricultural labor productivity depends. When factor market constraints impede adoption of fallows or integration of livestock providing manure and traction, smallholders commonly follow the paths of extensification onto fragile forest or rangeland margins or of mining soils through excessive cultivation through neglect as they invest their time in off-farm employment (Shepherd and Soule 1998, Reardon et al. 1999, Reardon and Barrett 2001). Our research plan is to uncover

how the severity of such resource-related poverty traps changes as we consider sites that are worse in different ways --- either with a poorer agroecology, a poorer market structure, or both.

In areas of weaker market access, the bottom row of Figure 1, a variety of factors including binding liquidity constraints, significant fixed transactions costs to market participation, which also induces widespread absence of trade in manure and fertilizer, considerable price volatility, insecure property rights, and the nontrivial risk of theft make it especially difficult for smaller farmers to acquire and maintain livestock or high-value trees and to sustain soil fertility (Dercon 1998, Holden and Shiferaw 2000). For example, the steady loss of livestock over the past decade has been associated with declining crop productivity and increasing rural food insecurity among poor smallholders in the southern highlands of Madagascar (Dorosh et al. 1998, Freudenberger 1999). But such effects are not ubiquitous in areas of weak market access. Wealthier households also possess a scale advantage in these settings, albeit not because the underlying biology necessarily favors integrated production systems, as in favorable agroecologies, but because significant fixed costs to market participation lower average unit costs of purchased inputs and raise average unit receipts for outputs for farmers with larger transactions volumes.

The experience of drier areas including those in the first column of Figure 1 is somewhat different. Limited water supply makes sedentarization based on integrated crop-livestock production a higher risk proposition. A lack of capital markets and poor marketing infrastructure in northern Kenya lead to volatile livestock prices (Bailey et al. 1999, Barrett et al 2000). Self-selection out of markets then becomes rational, so pastoralists' herds become regulated almost entirely by the biology of reproduction and mortality; marketing and transfers play little role in dampening shocks to pastoral wealth (Fafchamps 1998, McPeak 1999, Lybbert et al. 2001,

McPeak 2000). Missing markets thereby again create a resource degradation poverty trap (Lybbert et al. 2001, Barrett and McPeak 2001). Those who fall below some threshold, commonly estimated at roughly four or five cattle per capita, become unable to support themselves on the range with animal products and have to sedentarize near towns, where they take up cultivation and concentrate their remaining animals' grazing, often leading to localized range degradation and further stress (McPeak 1999). So where crop-livestock integration in higher potential areas typically signals wealth, in lower potential areas with poor market access it more commonly signals stress (Nathan et al. 1996, Smith et al. 2000).

We expect our empirical analysis and subsequent simulations to find that resource degradation poverty traps capture a larger share of smallholders, and evolve more quickly, as we move down the diagonal in Figure 1 from "better, wetter" cell to "worse, drier" cell. The off-diagonal cells help to distinguish the differential effects of biological versus market constraints. For instance, tree products (coffee, tea, macadamia and avocado) may smooth income flows in wetter areas even when factor market access is poor. Similarly, nonfarm diversification opportunities and workably competitive livestock markets may facilitate income maintenance even in drylands enjoying good market access.

We will use our simulation models to explore the effects of various policies on the workings of resource degradation policy traps. One obvious experiment is to examine the consequences of improving market structure. Were agrarian technology not characterized by fixed costs and minimum efficient scales of production, increasing market participation would shrink the poverty trap. Were markets perfect, it would disappear. But the degree to which markets can ameliorate the economic consequences of biological processes is unclear. Other experiments involve measuring the amount of income redistribution that would be necessary to

move an entire population over the threshold. Finally, various taxes and subsidies can be used to change the incentives to use specific agricultural practices that have negative long-term consequences for land quality.

In summary, returns to agrarian capital (land, livestock and trees) and the asset accumulation strategies that underpin poverty dynamics in east Africa depend fundamentally on both the natural and market environments. In particular, incomplete rural markets tend to foster greater dependence on agriculture and thus increased importance of investments in preserving productive agricultural assets. But the appropriate asset(s) in which to invest, land quality, livestock, or high-value trees, depends both on the underlying agroecology and on access to markets.

Research Methodology

The project's research efforts will be structured in three overlapping phases: (1) hypothesis development, model design and field data collection, (2) econometric work to estimate reduced form behavioral/policy functions, and (3) integrated simulation modeling.

The first phase completes the process begun over the past fifteen or so months, culminating in the team meeting held in Kerugoya, Kenya, in June 2001. This has involved extensive discussions between team members as to the hypotheses to be tested, the design of the research and the methods and media for integrating local and national level stakeholders into the process. We expect to complete this hypothesis development and model design process by end-2001. The main activity of the first phase involves interdisciplinary field work to build on existing data collection efforts. Cornell and KARI are presently gathering detailed individual and household-level survey data at quarterly frequency in the Baringo and Marsabit, Kenya, sites

in the context of the USAID Global Livestock CRSP Pastoral Risk Management Project. ICRAF and KARI have been gathering data in Embu, Siaya, and Vihiga Districts for several years in the context of tree fodder and soil fertility replenishment projects. Meanwhile, Cornell and FOFIFA are gathering data in the Madagascar sites under the USAID Ilo project on agricultural productivity and markets, resurveying communities and households surveyed in 1992 and 1997 by FOFIFA and IFPRI (field work Dr. Minten supervised, Minten and Zeller 2000). So we are already actively involved in data collection and analysis in the sites proposed for this project.

Since the focus of the project is on dynamic poverty traps, we need household-level panel data to be able to estimate household behavioral dynamics and to be able to calibrate and validate the simulation models. Because we hypothesize that induced resource degradation is an important contributor to dynamic poverty traps in some of these settings, we also need corresponding agroecological data on the performance and interactions of livestock, crops, soils and trees from each site. We already have a good baseline of household-level socioeconomic data in each site and some data on the underlying biology of these sites. We have begun a detailed inventory and quality evaluation of the existing data so as to establish precisely the holes in the existing data sets and will be filling these gaps in the project's first year. The primary emphasis in year one, however, will be on building up the longitudinal data in each site. Many of the communities under study are among the poorest in all of Kenya, with the Siaya and Vihiga sites clearly the poorest among the medium to high potential areas and the Marsabit sites the poorest in the nation (Kenya Ministry of Planning, 1998). The Fianarantsoa sites in Madagascar are likewise among that nation's poorest (Freudenberger 1999, Minten and Zeller 2000).

Although survey data are necessary for quantitative empirical analysis and for calibrating and validating the bioeconomic simulation modeling that will be a core element of the project, we plan to supplement these with qualitative data collection. In particular, we will do open-ended interviews with subsamples of our respondents in order to recreate oral histories of how people have fallen into or climbed out of poverty, how means of coping with poverty and with shocks have changed over time, and their perceptions of the obstacles that most impede themselves and others in establishing sustainable, sufficient livelihoods. The intent of this supplementary data collection is to flesh out the changing institutional and attitudinal context within which observable behaviors are occurring and changing in order to guard against mistaken inferences about associations among biological and economic variables that might have common institutional or attitudinal causes. For example, if the rise of ethnic clashes has led to less reliable market access and reduced security of land and livestock tenure, one might observe simultaneous resource degradation and impoverishment that is due not to interdependency among those two phenomena but to other, potentially exogenous events.

In the second phase, beginning during the project's first year, but taking precedence in the second year (2002-3), we will use the survey and oral history data and existing theory to estimate intertemporal behavioral functions relating to household production and marketing patterns, market behavior in communities of heterogeneous households, crop and livestock performance and soil nutrient cycling, and the interactions among these processes. Our team and institutions have already been doing related work in these and similar sites, attempting to integrate underlying resource dynamics and smallholder decision-making (Shepherd and Soule 1998, McPeak 1999, Okumu et al. 1999, Lybbert et al. 2000, Okumu et al. 2000). A common thread that emerges in much of this work is the apparent existence of accumulation trajectories

that vary predictably by resource endowment and agroecology. In this project we will attempt to explore such relationships more directly in an attempt to provide robust descriptions of state-conditional asset accumulation trajectories in a fashion amenable to policy analysis.

Finally, beginning in the second year and continuing through the end of the project, we will use those estimated behavioral functions to construct dynamic, integrated household-biophysical models to simulate *ex ante* the impacts of different market, technical or policy changes under incomplete markets and heterogeneous endowments in different agroecologies. While much insightful, prior work looks at different combinations of these (Rosenzweig and Binswanger 1993, Rosenzweig and Wolpin 1993, Lundqvist 1993, Carter and Zimmerman 1998, Dercon 1998, Shepherd and Soule 1998, Holden et al. 1999, Zimmerman and Carter 1999, Okumu et al. 2000, Ruben et al. 2000, Kruseman 2000), it seems no model yet incorporates incomplete markets, heterogeneous agents, and feedback effects between smallholder behavior and the underlying agroecological dynamics of land, livestock and trees. We aim to make that important extension.

Integrated bio-economic models combining both biological processes (plant growth, soil nutrient flows, livestock production, agroforestry) and human behavior are increasingly found to be quite useful both as decision support tools and for *ex ante* assessment of the performance of new technologies and policies (King et al 1993, Swinton and Black, 2000). When founded on parameters robustly estimated from good, local data, properly calibrated and validated by comparing simulation runs to observed cross-sectional or time series variation in the data – as we intend to do – such models can be valuable policy analysis tools, as the explosion in multi-market and computable general equilibrium modeling over the past decade demonstrates. Our team has already built quite sophisticated bioeconomic models at watershed scale in east Africa

(Okumu et al. 1999, 2000) as well as nonseparable household models linked to biological dynamics (Barrett and Arcese 1998) and dynamic models of wealth accumulation in imperfect markets populated by heterogeneous agents (Blume and Easley 1992, forthcoming). We intend to model from the household level up, aggregating across households to identify market- and landscape-level patterns along the lines of Crissman et al. (2000). The length of the time steps involved (e.g., seasonal or annual) will be driven by data availability and dynamic patterns observable in the data. Collectively, we have a solid background for undertaking such work.

Policy Relevance

Our team's ongoing and regular interactions with policymakers in Kenya and Madagascar suggest increased appreciation within those circles that poverty, rural markets, and natural resource problems are inextricable in this region. Unsustainable rates of loss of soil nutrients, forests and rangelands have yet to bring noticeable improvement in agricultural productivity, food security, poverty reduction, or economic growth (Smaling et al. 1993, Stoorvogel and Smaling 1998, Sanchez et al. 2000). Inducing sustainable intensification is increasingly recognized as a prerequisite to enabling Africa's rural poor to escape the poverty traps in which they presently find themselves (Reardon et al. 1999).

National and local governments, NGOs, the CGIAR, and international donors are struggling to establish how best to rehabilitate degraded lands and induce sustainable intensification in settings such as the sites in which we propose to work. We perceive significant demand for careful empirical analysis of the dynamic links between resource poverty, agroecological dynamics, and market access, followed up by simulation modeling that enables virtual experimentation with alternative policies. For example, can interventions (e.g., road

building) intended to reduce costs of goods market access induce investment in soil quality through integrating livestock or adopting improved fallows in cropping system? Or might it lead instead to increased mining of soils in the absence of interventions (e.g., soil amendment subsidies) to align financing costs and rates of return on natural capital? If time preferences depend on household wealth, thereby fuelling heterogeneous patterns of investment in natural capital, can redistributive transfers of cash or capital improve rates of aggregate investment in agrarian capital? Might soil erosion taxes or regulations intended to correct land market failures prove regressive – disproportionately burdening the poor – in the presence of incomplete markets that differentially restrict the incentives and options facing different households? And how do the effects of alternative interventions vary by wealth strata and agroecology? For example, might drylands herd restocking programs in the wake of drought be effective in restoring livelihood security among medium-scale pastoralists, but actually hurt poorer communities of settled agropastoralists by aggravating localized range degradation by households too poor (even post-restocking) to survive away from settlements? These and related questions are increasingly being asked by policymakers and analysts in the region. At present, there are few if any analytical tools capable of tackling such complex questions in a convincing manner. Such questions would be quite amenable, however, to exploration through the sort of dynamic empirical analysis and bioeconomic simulation modeling we propose.

While the methodology we propose is perhaps novel, the fundamental questions are longstanding policy concerns in east Africa and, indeed, throughout the low-income world. Land reform questions – of renewed currency in places like Kenya – focus attention on increasing the stock of productive agrarian capital controlled by subpopulations that are *ex ante* poor. Remedying *land quality* problems disproportionately plaguing the poor is a natural analog to

remedying problems of insufficient *land quantity*. But where land reform has proved a political nonstarter in most countries, efforts to attack market imperfections that impede maintenance or improvement of land quality in a distributionally progressive manner may prove more feasible politically. The challenge is largely one of identifying an appropriate mix and sequence of policies. Simulation modeling can assist significantly in such a process.

The poverty traps - natural resource degradation nexus mediated by incomplete markets and biologically-induced minimum efficient scales of production also has significant implications at larger scales beyond the scope of the present project. Micro-level poverty traps in turn beget macro-level relief traps as donor and government resources divert scarce resources from development investments toward relief distribution (Barrett and Carter 1999). Moreover, if a large subpopulation finds itself caught in such traps, this will drive up prices for high quality land, which will further squeeze liquidity-constrained smallholders, and will induce shifts in production technologies and settlement patterns. This may have significant effects on biodiversity conservation, water quality, etc. These prospective general equilibrium effects underscore the importance of improved understanding of dynamic poverty traps in systems characterized by incomplete markets and nonconstant returns to productive assets due to their underlying biology. How to break out of relief traps is indeed a key issue facing East Africa today. This was one of the primary motivation's behind President Clinton's Greater Horn of Africa Initiative.

Host Country Research Capacity Building

In addition to addressing directly questions of pressing policy importance, the proposed project would involve considerable training of host country researchers to build up regional

policy analysis capacity. The total project budget (BASIS funding plus matching funds) provides for four student-years' Cornell Ph.D. training of Kenyan and Malagasy researchers, ten months' annually for a Kenyan post-doctoral researcher based at Cornell, and a two week training workshop at Cornell for two researchers each from FOFIFA and KARI on development of household and village-level bioeconomic models of the sort that underpin the simulation modeling in year three of the project. We intend to seek separate funding for one week end-user workshops in Kenya and Madagascar in year three to train a wider group of policy analysts and local researchers on the policy simulation tools our project will develop and distribute (free of charge) in the region. We also plan annual briefing workshops with policymakers in both Kenya and Madagascar in years two and three, once the project has some preliminary results and recommendations to report, as well as two-day community briefing/discussion sessions in each survey site in years two and three.

It is important to situate this project within the broader African Food Security and Natural Resource Management (AFSecNaReM) program Cornell has just launched with substantial funding (more than \$1.2 million) from the Rockefeller Foundation. That program's objective is to develop African university and government research capacity through (i) Ph.D. and post-doctoral training of multinational teams of scientists organized around a common problem cutting across multiple disciplines, and (ii) collaborative research between established scholars at Cornell and in Africa. The BASIS project fits squarely within AFSecNaReM's initial focus on integrated soil nutrient management in east and southern Africa, enabling us to leverage some training and travel funding from that program, and to provide regular interaction with a broader network of major international donors and of African policymakers and scholars, such as those associated with the multinational Soil Fertility Network and its Economic Policy Working

Group, both based in Harare but covering several nations.

Anticipated Outputs

Our project has a solid balance among academic-oriented research and outputs targeted toward local and global policy-making communities. Our team has a very strong research publications record, including significant publications for both disciplinary and interdisciplinary audiences. We plan to publish several journal articles and perhaps a book from this project.⁴ But we also put high priority on direct dissemination of research results to lay decision makers through policy briefs intended for policymaker and community audiences in the region. We plan a series of such briefs, beginning with one to be released in September 2001, with at least two further briefs in year one, three in year two and five in year three. These will be released in English in Kenya and in French and Malagasy in Madagascar. A guide on how to use the model will be an additional written output.

We plan not only written outputs but also meetings to stimulate interaction with lay decision-makers and insertion of project findings into local practice and policy. We plan annual community meetings in each survey site in years two and three in order to disseminate and discuss emerging project findings with respondents and their communities so as to enable project participants direct, early access to the analysis we conduct on data collected from and with them.

We likewise plan to hold annual meetings with policymakers in Antananarivo and Nairobi in years two and three of the project to disseminate and discuss early findings and hypotheses and to stimulate dialogue on the policy implications of our project's research. Those meetings will be preceded by public announcements in local media, press releases, and targeted dissemination of policy briefs to key decision-makers in central and local government, private industry, the

donor, NGO and local academic communities. Our team has longstanding research programs in the two countries, strong links to policymaker and donor communities in the region, and demonstrable past success with workshops of this sort in both countries. Our established channels of communication and record of engagement with policymakers underscores our capacity to introduce research findings directly into practical, policy deliberations. The policymaker audiences in Madagascar with which we are already in contact and plan to invite to these briefing workshops include FOFIFA (the national agricultural research institute), INSTAT (the national institute of statistics), the Economic Research Policy Group run by PACT, the local USAID mission and its Landscapes Development Initiative and PAGE projects the local World Bank mission, the local economic press (Midi, JURECO, etc.), the Ministry of Agriculture, and the National Secretariat for Autopromotion and Development. In Kenya, our policymaker network includes the Arid Lands Resource Management Program in the Office of the President, the Ministry of Planning and National Development, the Ministry of Agriculture, the Kenya Agricultural Research Institute, the Kenya Institute of Public Policy Research Administration (KIPPRA), the Tegemeo Policy Research Institute, USAID's country and REDSO missions, the World Bank, and NGOs such as FARM Africa, Kenya Rural Enterprise Program. Regional groups such as ASARECA, the consortium of national agricultural research and extension services in eastern and central Africa, its agricultural policy analysis arm, ECAPAPA, and IGAD (the intergovernmental authority on development) will likewise be invited to participate actively in the workshops so as to extend findings broadly in the region. Though referred to in the next paragraph, an output will be the capacity building of several national researchers, at least two who will be trained in a wide variety of methods/tools at Cornell and several others who will be trained on the use of integrative models for ex ante assessment of technological, institutional,

and policy change.

Key indicators of success in this project will therefore include (1) host country personnel trained, both through degree, post-degree and non-degree programs, (2) research publications, (3) policy briefs written and distributed, for which we can also document numbers and sources of requests for copies, (4) documented contact with policymakers, donors, and communities in pre-study and outreach workshops, and coverage by local media, (5) attestation by such stakeholders as to the value of the empirical analysis and decision support tools developed by the project. We plan to document and report these indicators as the project progresses.

This research is aimed at generating practical solutions to pressing problems as well as at improving understanding of how missing markets and the underlying biology of African agroecologies lead to dynamic poverty traps and what policy instruments might most effectively enable vulnerable subpopulations to climb out of those traps. These topics are of more general interest throughout the low-income world, and our regular interactions with the World Bank, USAID, the CGIAR, the Rockefeller Foundation, and other donor organizations will enhance our capacity to introduce the findings from this project into relevant global policy discussions.

Notes to Project Narrative

¹ Unlike monogastrics (hogs, poultry), ruminant livestock (camels, cattle, goats, sheep) need fresh fodder, thereby favoring systems that provide grazing or crop residues. All references to “livestock” should be understood exclusively as references to the ruminant species that predominate in east Africa.

² We do not mean to suggest that all soil amendments exhibit low returns at low rates of investment. Some mineral fertilizers, for example (e.g., P) appear to yield good returns even in

relatively modest doses (Sanchez et al. 2000), and some soil and water conservation structures likewise appear quite accessible to even very small producers (Barrett et al. 2001). An important empirical contribution of this project would be to establish which sorts of investments in natural capital exhibit significant minimum efficient scales of investment.

³ Although biology clearly supports the conjecture of complementarities, there does not appear to be any formal estimation of the gains from crop-livestock integration in African agriculture.

Results from U.S. agriculture suggest that economies of scope - i.e., the gains from crop-livestock integration - are greatest on the smallest farms (Chavas and Aliber 1993).

⁴ A much smaller, one year Phase I BASIS project directed by the PI serves as the foundation for a special issue of *Food Policy* to be published in 2001.

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Project Timeline

The first project year (Oct 2001 - Sep 2002) will focus on pre-study stakeholder workshops at national and community levels, field data collection in our sites, training of one Kenyan Ph.D. candidate, and beginning econometric estimation of model parameters and construction of the bioeconomic model. Each host country team will hold small, pre-study workshops with key policymaker audiences in the capital city, and with key stakeholders in the survey communities in the first or second quarter of the year to brief them on the purpose and design of the project and to elicit feedback on key concerns and appropriate modalities for communicating results back to end-users. Data collection in our Baringo and Marsabit sites is ongoing. Data collection will begin in Embu and Siaya/Vihiga in the second quarter of the year and in the Madagascar sites in May 2002. A team project meeting will be held in June, 2002, in Kakamega, near the project's western Kenya site to coordinate data collection and analysis, to present preliminary results from the econometric estimation and bioeconomic modeling work, and to agree on a detailed outreach plan for the coming year. Immediately preceding or following the Kakamega meeting, we will also hold a short, two-day introductory training session for FOFIFA and KARI participants in the bioeconomic modeling workshop to be held in Ithaca in October 2002.

In the second project year (Oct. 2002 – Sep. 2003), econometric estimation of model parameters will be completed, work will continue on assembling the integrated simulation model, a second team project meeting will be held in Madagascar (exact site to be determined), the two-week modeling workshop for FOFIFA and KARI staff will be held in Ithaca, the first project results and recommendations briefing workshops will be held with policymakers in Nairobi and Antananarivo, and the first annual community workshops would be held in survey

sites. In the third project year (Oct. 2003 – Sep. 2004), the simulation modeling will be completed, final project publications prepared and disseminated, the second annual community workshops will be held in the survey sites, and substantial project workshops will be held in Antananarivo and Nairobi with circa 50 representatives from policymaking and development and donor organizations attending.

Researchers' Qualifications

Ours is a multidisciplinary and multinational team comprised of nine Ph.D. scientists -- six from Cornell, and one each from FOFIFA, ICRAF and KARI -- and one M.S. scientist from FOFIFA. Curricula vitae for the four institutions' principal investigators (Barrett, Murithi, Place, and Rasambainarivo) follow.

Dr. Chris Barrett, an American citizen, is an associate professor in the Department of Applied Economics and Management at Cornell University, where he is also a member of the graduate fields of conservation and sustainable development, economics, international agriculture and rural development, international development, and international nutrition. He earned a dual Ph.D. in agricultural economics and economics from the University of Wisconsin-Madison, with an emphasis on international development and agricultural production and marketing. He has worked extensively in Africa and has ongoing, current field research in Madagascar and Kenya, where he serves as co-PI on a USAID Global Livestock CRSP project concerning pastoral risk management. In addition to extensive academic publications, he spent several years working on African development issues as a policy economist in Washington. Dr. Barrett is the project's principal investigator, with overall responsibility for all project activities.

Dr. Lawrence Blume, an American citizen, is a professor of economics at Cornell University. Dr. Blume completed his PhD in economics at UC Berkeley in 1977 on dynamic general equilibrium analysis. His research is concerned with non-linear dynamics in games and in general equilibrium models with incomplete markets. He has interacted with biologists at the Santa Fe Institute, where he is an external faculty member and former director of the economics program. Since 1998 he has participated in the John D. and Catherine T. MacArthur Foundation's research network on income inequality. Dr. Blume will take a leading role in building the dynamic simulation models in the project's third phase.

Dr. John McPeak, an American citizen, is a post doctoral research associate for Cornell University, posted to Marsabit, Kenya, where he directs Kenyan field research for the Pastoral Risk Management Project of the USAID Global Livestock CRSP. Dr. McPeak completed his Ph.D. in agricultural and applied economics at the University of Wisconsin-Madison in 1999. He has extensive experience in pastoral systems in both east and west Africa. Dr. McPeak will direct the field research in the Baringo and Marsabit sites in which he is already working in conjunction with the local KARI stations and will participate in the subsequent econometric analysis and simulation modeling.

Dr. Bart Minten, a Belgian citizen, is a Cornell University researcher posted to Antananarivo as Chief of Party on a three-year, USAID-funded policy research project with Madagascar's Center for National Agricultural

Research (FOFIFA), where Dr. Minten is based, and the National Institute of Statistics (INSTAT). He has been working on economic analysis of rural development issues over the last ten years and recently published a book on market liberalization, poverty and environmental sustainability in Madagascar (Minten and Zeller 2000). His experience spans different countries and continents (e.g., Zaire, Madagascar, Uganda, Mexico, and the Philippines). Extensive applied policy work at the International Food Policy Research Institute, the World Bank, central government agencies in Madagascar and Zaire, and his academic background as a doctoral student Cornell University and as assistant professor at the University of Leuven (Belgium) well equip him to employ up-to-date economic analysis and modeling techniques for relevant policy recommendations for local policymakers. Dr. Minten will jointly direct the field research in Madagascar with Dr. Rasambainarivo and will participate in the subsequent economic analysis and policy briefings.

Dr. Festus Murithi, a Kenyan citizen, is an agricultural economist and the assistant director in charge of the Socio-economics and Biometrics Research Programme at the Kenya Agricultural Research Institute (KARI). He previously directed socio-economics research at KARI's Regional Research Center at Embu, one of our planned study sites. He has been actively engaged for several years in the multidisciplinary and multi-institutional KARI/KEFRI/ICRAF collaborative National Agroforestry Research Project, focused on characterizing agricultural production systems, conducting economic analyses of technical interventions, and carrying out adoption, marketing and impact assessment studies of agricultural technologies and policies. He earned a Ph.D. in agricultural economics from the University of Reading (U.K.), where his dissertation presented an economic evaluation of the role of livestock in mixed smallholder farms of the central highlands of Kenya. Dr. Murithi is the principal investigator for the KARI component of the project, with principal responsibilities for the Embu site.

Dr. Ben Okumu, a Kenyan citizen, is a post doctoral research associate at Cornell University. He earned a Ph.D. in Agricultural Economics from University of Manchester (U.K.). His expertise is bioeconomic modeling of the possible impacts of technology and policy interventions in African rural economies, work for which he won the Most Promising Young Scientist Award at the International Livestock Research Institute, one of the CGIAR centers. He hails from the western Kenyan location in which we will be working and previously worked as an economist/planning officer and ministerial adviser in the Kenya Government. Dr. Okumu will be actively involved in all aspects of the project and will direct the year two training of FOFIFA and KARI staff in bioeconomic modeling techniques.

Dr. Alice Pell, an American citizen, is a professor in the Department of Animal Sciences at Cornell University, where she is also a member of the graduate fields of Animal Science, Nutrition, Microbiology and International Agriculture and Rural Development. In addition to graduate degrees in animal science, she holds a master's in education from Harvard and has extensive experience in rural Africa. As a ruminant nutritionist, her research interests include both measurement and prediction of various attributes of rumen function through laboratory and modeling efforts. She is involved in research to predict nutrient excretion of animals and the cycling of these nutrients through other components of the agricultural system. She has been the coordinator of the computer modeling effort for the National Research Council committee charged with revising the nutrient requirements of dairy cattle. Dr. Pell will lead the biological modeling efforts, especially concerning livestock productivity.

Dr. Frank Place, an American citizen, is a policy economist at ICRAF. His main duties are issues related to natural resource policy and impact assessment of agroforestry systems with a focus on East and Central Africa. He has worked extensively on property rights issues in Eastern and Southern Africa. He is also the leader of the Policy Working Group within the African Highlands Initiative and has participated in the formation of a policy maker-researcher-development agent committee in Western Kenya. Prior to joining ICRAF, he worked at the

World Bank on an African land tenure study as well as a study of intensification of agriculture in the highlands of Madagascar. He holds a Ph.D. in economics from the University of Wisconsin-Madison. Dr. Place is the principal investigator for the ICRAF component of the project, with principal responsibilities for the western Kenya (Siaya/Vihiga) sites.

Mr. Jean Claude P. Randrianarisoa, a Malagasy citizen, is a socio-economist with FOFIFA. He holds an M.S. in agricultural economics from Michigan State University, and has been actively involved in the 1997 FOFIFA/IFPRI survey research in the same sites as well as in the current Cornell/FOFIFA field research program under the USAID-ILO project. His M.S. thesis dealt with closely related issues of soils and crop productivity and involved original survey work among some of the households this project will revisit. Mr. Randrianarisoa will have primary responsibility for the field surveys in Fianarantsoa and the Vakinankaratra regions.

Dr. Jhon Rasambainarivo, a Malagasy citizen, is director of livestock research at FOFIFA, Madagascar's Center for National Agricultural Research. He holds the equivalent of both the Ph.D. in animal production and veterinary medicine and the D.V.M., and teaches at the Université d'Antananarivo's Ecole Supérieure des Sciences Agronomiques. He has done considerable research in animal nutrition, and the relationship between soils quality, animal nutrition, and livestock productivity. Dr. Rasambainarivo has been involved in the redesign of the USAID Global Livestock CRSP, in the Association for Strengthening Agricultural Research in Eastern and Central Africa (ASARECA) and its policy arm, ECAPAPA, and in other key regional and international policy and research for a concerning animal agriculture.

Curricula Vitae of Principal Investigators

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I. SELECTED EXPERIENCE

Associate Professor with tenure, Department of Agricultural, Resource, and Managerial Economics, Cornell University.

Member of graduate fields of agricultural economics, conservation and sustainable development, economics, international agriculture and rural development, international development, and international nutrition. 1998-present.

Associate Professor and Assistant Professor, Department of Economics, Utah State University. 1994 - 1998.

Economist, The Institute of International Finance, Washington, DC. Comparative Country Analysis and Africa/Middle East Departments. Analyzed economic developments and macroeconomic outlook for eight African countries, and participated in senior ministerial level missions to these countries. 1987-1990.

II. EDUCATION

Dual Ph.D., Agricultural Economics and Economics, University of Wisconsin-Madison, 1994
M.Sc., Development Economics, University of Oxford, on Fulbright Scholarship, 1985
A.B., History, Princeton University, 1984, *magna cum laude*

III. PUBLICATIONS

Author, co-author or co-editor of 3 books, 50 scholarly journal articles, 18 book or conference proceedings chapters, and many book reviews, published paper abstracts, working papers, and pieces in the popular press.

Selected Publications From The Past Four Years

- David R. Lee and Christopher B. Barrett, editors, *Tradeoffs or Synergies? Agricultural Intensification, Economic Development and the Environment in Developing Countries* (CAB International, 2000).
- Christopher B. Barrett, "Does Food Aid Stabilize Food Availability?" *Economic Development and Cultural Change*, forthcoming.
- Christopher B. Barrett, "Food Security and Food Assistance Programs," in Bruce L. Gardner and Gordon C. Rausser, eds., *Handbook of Agricultural Economics* (Amsterdam: Elsevier Science, forthcoming).
- Thomas Reardon and Christopher B. Barrett, "The Ambiguous Effects of Policy Reforms on Sustainable Agricultural Intensification in Africa: Renewed Threats to Fragile Margins?" in A. Angelsen and D. Kaimowitz, eds., *Agricultural Technologies and Tropical Deforestation* (CAB International, forthcoming)
- Christopher B. Barrett and Travis J. Lybbert, "Is Bioprospecting a Viable Strategy for Conserving Tropical Ecosystems?" *Ecological Economics*, forthcoming.
- Christopher B. Barrett and Yi-Nung Yang, "Rational Incompatibility with International Product Standards," *Journal of International Economics*, forthcoming.
- Christopher B. Barrett and John McPeak, "Differential Risk Exposure and Stochastic Poverty Traps Among East African Pastoralists," *American Journal of Agricultural Economics*, forthcoming.
- Kai-Li Wang, Christopher Fawson, Christopher B. Barrett, and James B. McDonald, "A Flexible Parametric GARCH Model With An Application To Exchange Rates," *Journal of Applied Econometrics*, forthcoming.
- Christopher B. Barrett, "Measuring Integration and Efficiency in International Agricultural Markets," *Review of Agricultural Economics*, vol. 23, no. 1 (Spring/Summer 2001): forthcoming.
- Kevin Smith, Christopher B. Barrett, and Paul W. Box, "Participatory Risk Mapping for Targeting Research and Assistance: An Example Using East African Pastoralists," *World Development*, vol. 28, no. 11 (November 2000): in press.
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- Christopher B. Barrett, Sandeep Mohapatra, and Donald L. Snyder, "The Dynamic Effects of U.S. Food Aid," *Economic Inquiry*, vol. 37, no. 4 (October 1999): pp. 647-656.
- Solomon Desta, D. Layne Coppock, and Christopher B. Barrett, "Opportunities for Asset Diversification in a Livestock System: The Case of the Pastoral Boran of Southern Ethiopia," in David Eldridge and David Freudenberger, eds., *People and Rangelands: Building The Future*, vol. 1, *Proceedings of the VI International Rangeland Congress*, Townsville, Australia (1999): pp. 35-36.
- Christopher B. Barrett and Michael Carter, "Microeconomically Coherent Agricultural Policy Reform in Africa", in JoAnn Paulson, ed., *African Economies in Transition, Volume 2: The Reform Experience s* (London: Macmillan, 1999).
- Christopher B. Barrett, "The Effects Of Real Exchange Rate Depreciation On Stochastic Producer Prices in Low-Income Agriculture," *Agricultural Economics*, vol. 20, no. 3 (May 1999): pp. 215-230.
- Christopher B. Barrett, "Stochastic Food Prices and Slash-and-Burn Agriculture," *Environment and Development Economics*, vol. 4, no.2 (May 1999),pp. 161-176.
- Christopher B. Barrett and Peter Arcese, "Wildlife Harvest in Integrated Conservation and Development Projects: Linking Harvest to Household Demand, Agricultural Production and Environmental Shocks in the Serengeti," *Land Economics*, vol. 74, no.4 (November 1998): pp. 449-465.
- Christopher B. Barrett, "Food Aid: Is It Development Assistance, Trade Promotion, Both or Neither?" *American Journal of Agricultural Economics*, vol.80, no. 3 (August 1998): pp. 566-571.
- Christopher B. Barrett, "Immiserized Growth in Liberalized Agriculture," *World Development*, vol. 26, no. 5 (May 1998): pp. 743-753 (lead article).
- Christopher B. Barrett and Jeffrey W. Cason, *Overseas Research: A Practical Guide* (Baltimore, MD: Johns Hopkins University Press, 1997).
- Christopher B. Barrett, "Heteroskedastic Price Forecasting for Food Security Management in Developing Countries," *Oxford Development Studies*, vol. 25, no. 2 (June 1997): pp. 225-236.
- Christopher B. Barrett, "Food Marketing Liberalization and Trader Entry: Evidence from Madagascar," *World Development*, vol. 25, no. 5 (May 1997): pp. 763-777.
- Christopher B. Barrett, "On Price Risk and The Inverse Farm Size-Productivity Relationship," *Journal of Development Economics*, vol. 51, no. 2 (December 1996): pp. 193-215 (lead article).
- Christopher B. Barrett and Paul A. Dorosh, "Farmers' Welfare and Changing Food Prices: Nonparametric Evidence From Rice In Madagascar," *American Journal of Agricultural Economics*, vol. 78, no. 3 (August 1996), pp. 656-669.
- Christopher B. Barrett, "Market Analysis Methods: Are Our Enriched Toolkits Well-Suited To Enlivened Markets?" *American Journal of Agricultural Economics*, vol. 78, no. 3 (August 1996), pp. 825-829.
- Christopher B. Barrett, "Urban Bias in Price Risk: The Geography of Food Price Distributions in Low-Income Economies" *Journal of Development Studies*, vol. 32, no. 6 (August 1996): pp. 830-849.

III. TRAINING

Have taught courses and directed independent study on microeconomics of international development, econometrics, international economics, business statistics, agricultural markets analysis, rural livelihoods and biological resources, macroeconomics, rural finance, microeconomic analysis of smallholder agriculture, and nutrition and economic development.

Graduate students supervised: Present: 5 Ph.D., 3 MS, 1 MPS, plus minor member on 5 others.

Past: 1 Ph.D., 1 MS, plus minor member on 9 others.

Post-doctoral research associates supervised: Present: 3 Past: 2

IV. EXTRAMURAL RESEARCH SUPPORT

Principal investigator or co-principal investigator on eleven extramural research grants totalling more than \$4.7 million and six internal research grants totalling more than \$0.2 million.

Selected Projects

Pew Charitable Trusts, "The Moral and Social Dimensions of Microeconomic Behavior among the Poor," 2000-2003. Lead an international team of distinguished economists exploring how moral and social considerations condition the behavior of poor persons with respect to solidarity in the face of shocks, adoption of new technologies and natural resource management practices, and information dissemination.

Cornell Institute for International Food, Agriculture and Development, "Integrated Plant-Animal Systems Initiative," 2000-2001. Along with Alice Pell (animal nutritionist) and Erick Fernandes (soil scientist), and in collaboration with networks in eastern and southern Africa, co-direct an interdisciplinary modeling and training effort emphasizing the intersection of soil nutrient cycling, livestock productivity, crop growth, and small farmer decision-making in an environment of incomplete and

imperfect markets.

U.S. Agency for International Development, Linkage grant with International Livestock Research Institute, (co-PI; N. McCarthy, PI), 1999. Team of three economists exploring land tenure and risk management among pastoralists in east Africa.

AAEA Foundation, Cornell Institute for International Food, Agriculture and Development, Farm Foundation, Food and Agriculture Organization, International Food Policy Research Institute, and International Livestock Research Institute, “Agroindustrialization, Globalization, and International Development,” 1999. Co-organized a major international conference on this theme, resulting in special issues of three different journals.

Cornell University Agricultural Experiment Station, “Rethinking Food Aid For the 21st Century,” 1998-2001. Work on improving understanding of food aid’s effects on relieving food insecurity in recipient economies and on international commercial trade in foodstuffs.

U.S. Agency for International Development, Broadening Access through Strengthening Input Systems Collaborative Research Support Program (BASIS CRSP), “Agriculturalists= Asset and Income Diversification Patterns to Ensure Sustainable Livelihoods,” 1998-2000. Directed a team doing comparative analysis of diversification patterns among different subpopulations of African farmers across distinct agro-ecologies. Special issue of *Food Policy* forthcoming in 2001 as a result of this project.

U.S. Agency for International Development, Small Ruminant/Global Livestock Collaborative Research Support Program (SR/GL CRSP), “Improving Pastoral Risk Management on East African Rangelands: Identifying Opportunities for Reducing Household, Community, and Environmental Stress and Promoting Rural Development,” (co-PI; D. Layne Coppock, PI), 1997-2003. Interdisciplinary effort to understand and assist pastoralist populations’ means of mitigating and coping with natural and manmade risk in southern Ethiopia and northern Kenya.

V. SELECTED PROFESSIONAL SERVICE

Associate Editor, *American Journal of Agricultural Economics*, 2000-2004.

Guest Editor, *Agricultural Economics*, forthcoming.

Guest Editor, *Environment and Development Economics*, forthcoming.

Editorial Council (Associate Editor), *Journal of Agricultural and Resource Economics*, 1998-2000.

Member, Editorial Advisory Board, *Agricultural Economics*, 1999-2000.

Chair, American Agricultural Economics Association International Committee, 1998-2000.

VI. FOREIGN LANGUAGES

English (native), French (moderate to fluent), Swahili (basic),

FESTUS MEME MURITHI

SEX: MALE
DATE OF BIRTH: 24 November 1959
PLACE OF BIRTH: MERU CENTRAL DISTRICT - KENYA
NATIONALITY: KENYAN
RELIGION: CHRISTIAN
MARITAL STATUS: MARRIED
LANGUAGES: ENGLISH, KISWAHILI, KIMERU, KIKUYU AND KIEMBU

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FORMAL EDUCATION

Month/year	Name and address of educational institution	Degrees and certificates obtained, and area of specialization
May 1995 to July 1998	University of Reading - UK Dept. of Agriculture, P.O. Box 236, Reading RG6 6AT, Berkshire, United Kingdom.	PhD. (Agric. Economics)
October 1987 to December 1990	University of Nairobi Dept. of Agricultural Economics P.O. Box 30197, Nairobi.	MSc. (Agric. Economics)
October 1981 to July 1985	University of Nairobi Faculty of Agriculture P.O. Box 30197, Nairobi.	BSc. (Agriculture)
March 1979 to December 1980	Nkubu High School - Meru P.O. Box 126 Nkubu - Meru.	Kenya Advanced Certificate of Education (KACE)

Month/year	Name and address of educational institution	Degrees and certificates obtained, and area of specialization
January 1975 to December 1978	Nkubu High School - Meru P.O. Box 126 Nkubu - Meru.	East African Certificate of Education (EACE)
January 1968 to December 1974	Ntharene Pry. School P.O. Box 116, Nkubu - Meru.	Certificate of Primary Education (CPE)

ON THE JOB SHORT DURATION TRAINING COURSES/WORKSHOPS ATTENDED

Name of training course/workshop	Dates when held	Organizer(s)	Venue
Gender in Agricultural Research and Extension	29 March - 1 April 1999	KARI	RRC- Embu
Methods for Analyzing Agricultural Markets	9-15 November 1998	ICRAF/CIP/ILRI/CIAT/ICRISAT/IITA	ICRAF-Nairobi.
Systems Simulation in Animal Health and Production	2 May to 2 June 1995	Veterinary Epidemiology and Economics Research Unit (VEERU) - University of Reading - UK	VEERU - University of Reading, UK.
Impact Assessment Methodologies in Agricultural Research Projects	11-22 July 1994	CMRT Project /USAID/REDSO/FSA	Egerton University - Njoro, Kenya.
INFORM: Management Information System for Agricultural Research	5-16 September 1994	KARI/ISNAR	Kenya Institute of Telecommunications: Mbagathi - Nairobi, Kenya.
Agroforestry Research for Development	9-27 May 1994	ICRAF/DSO	ICRAF-Nairobi.
Monitoring and Evaluation	25-29 October 1993	KARI/ISNAR	KARI-NARC- Muguga, Kenya.
Program Formulation and Priority Setting at Program Level	28 October - 1 November 1991	KARI/ISNAR	KARI-NARC- Muguga, Kenya.
Socio-Economic Research for Agroforestry Systems Development	2-6 September 1991	ICRAF	ICRAF-Nairobi.
Survey Experimental and other Data Analysis Training	28 October - 17 November 1990	Egerton University and CIMMYT	Egerton University- Njoro, Kenya.
Workshop for Social Scientists	October 1990	Price Waterhouse	KARI-NARC- Muguga, Kenya.
Word Processing with Wordperfect			
Farming Systems Research Program: On-Farm Research Workshop, Experimental Phase	27 August - 11 September, 1987	Dept. of Agric. Economics, University of Zimbabwe and CIMMYT East Africa	University of Zimbabwe- Harare.

EMPLOYMENT POSITIONS HELD

Month/year	Name employer	Positions held and responsibility
May 2000 to present	KARI, P.O. Box 57811, Nairobi.	Assistant Director in charge of Socio-economics and Biometrics Research Program in KARI
February 2000 to April 2000	“	Senior Research officer (Agric. Economics) and National co-ordinator of Socio-economics Research Program in KARI
August 1998 to January 2000	“	Senior Research officer (Agric. Economics) and head of Socio-economics section at RRC-Embu.
May 1995 to July 1998	“	Research Officer (Agric. Economics) at RRC-Embu and PhD student at Reading University.
May 1991 to April 1995	“	Research officer (Agric. Economics), Project Manager of the KARI/KEFRI/ ICRAF National Agroforestry Research Project and head of Socio-economics section at RRC-Embu.
January 1991 to April 1991	“	Research officer (Agric. Economics), Research-extension liaison officer and head of Socio-economics section at RRC-Embu.
October 1987 to December 1990	“	Research officer (Agric. economics.) at RRC-Embu and Msc. student at Nairobi University.
August 1985 to September 1987	Ministry of Agriculture and Livestock Development - Nairobi	Research officer (Agric. Economics) at NAHRC-Naivasha and RRC-Embu
March 1981 to October 1981	Teachers' service commission-Kenya	Secondary school teacher

PUBLICATIONS/REPORTS

FRANZEL, S.; **MURITHI, F.M.** and ARIMI, H.K. (1998). An assessment of the early stages of adoption and economic impact of *Calliandra calothyrsus* for fodder among dairy farmers in the highlands of central Kenya. Paper presented to the National Agroforestry Research Project Symposium: Regional Research Centre - Embu. Embu, Kenya. 9-11 December 1998.

FRANZEL, S.; O'NEILL, M.K.; ROTHHAERT, R.L.; ARIMI, H.; and **MURITHI, F.** (1998). Leguminous fodder trees: boosting milk production and income for farm families. *Agroforestry Today* **10 (2): 12-17.**

FRANZEL, S.; ARIMI, H.; KARANJA, J.N. and **MURITHI, F.M.** (1996). Boosting milk production and income for farm families: The adoption of *Calliandra calothyrsus*: as a fodder tree in Embu District,

- Kenya. *East African Agricultural and Forestry Journal*, vol. 62: 1& 2.
- FRANZEL, S.; ARIMI, H.; **MURITHI, F.M.** and KARANJA, J.N. (1996). *Calliandra calothyrsus*: Assessing the early stages of adoption of a fodder tree in the highlands of central Kenya. Paper presented to the First Kenya National Agroforestry Conference, Nairobi, Kenya. 25-29 March 1996.
- GACHANJA, S.P.; MUGWE, J.N., and **MURITHI, F.M.** (1998). Fruit and nut trees in agroforestry systems within smallholder farms of Central Kenya. Paper presented to the National Agroforestry Research Project Symposium: Regional Research Centre - Embu. Embu, Kenya. 9-11 December 1998.
- GETHI, M.; **MURITHI, F.M.**; MACHARIA, N. and NJOROGE, K. (1997). Maize/bean intercropping system in medium altitude areas of Kenya: farmers' practices and research challenges. In E. Adipala, J.S. Tenywa, M.W. Ogenga-latigo (eds.), *Proceedings of the African Crop Science Conference*, pp.765-770, Pretoria, 13-17 January 1997.
- GETHI, M.; **MURITHI, F.M.**; HASSAN, R.M. and NJOROGE, K. (1995). Crop protection constraints in maize production in Eastern Kenya: A survey report on farmers' perception. Paper presented to the 11th *Scientific conference of the Association of African Insect Scientist (AAIS)*, Yamoussoukro, Cote d'Ivoire, 11-18 September, 1995.
- GITARI, J.N.; KANAMPIU, F.K. and **MURITHI, F.M.** (1996). Maize yield gap analysis for mid-altitude areas of Eastern and Central Kenya. In P.O. Fungoh and G.C.O. Mbadi (eds.), *Proceedings of the 5th KARI Scientific Conference*, 14-16 October, Nairobi, Kenya.
- HASSAN, R.M.; **MURITHI, F.M.** and KAMAU, G. (1998). Determinants of fertilizer use and the gap between farmers' yields and potential yields in Kenya, pp. 137-161. In Hassan, R.M. (ed.) *Maize Technology Development and Transfer: A GIS Application for Research Planning in Kenya*, CAB International in association with CIMMYT and KARI, Wallingford, UK.
- KARIUKI, I.W.; **MURITHI, F.M.**; IRUNGU, J.W. and MBIJIWE, P.N. (1992). Methodology of farming systems approach to research, extension and training. Paper Presented to a Training Workshop for extension and Research staff; Embu, Kenya. 30 July 1992.
- KIRUIRO, E.M.; KARIUKI, I.W.; PATERSON, R.T. and **MURITHI, F.M.** (1996). Input and output data monitoring at the zero-grazing model farm unit at RRC-Embu; the case for dairy Cattle Performance on Agroforestry based Feeding System. *Livestock Feeding Systems Workshop*. 30 July 1996. Embu, Kenya.
- MURITHI, F.M.** (2000). Adaptive research needs and the role of farmer participatory research. Paper presented to the Second Scientific Conference of the Soil Management Project (SMP) and Legume Research Network Project (LRNP) at Mombasa, 26-30 June 2000.
- MURITHI, F.M.** (1999). Economics of smallholder peri-urban dairy farms using forages and fodder trees. Paper presented to the FAO/KARI/MALDM Workshop on Integrated Smallholder Dairy Farming Systems in Peri-urban Areas held at Embu, 13-18 June 1999.
- MURITHI, F.M.** (1998). Economic evaluation of the role of livestock in mixed smallholder farms of the central highlands of Kenya. PhD Thesis, University of Reading.

- MURITHI, F.M.** (1998). Marketing of fruits and nuts in the coffee-based land use system of Kirinyaga District, Kenya. Paper presented to a training course on “Methods for Analysing Agricultural Marketing” held at ILRI and ICRAF, Nairobi, Kenya. 9-15 November 1998.
- MURITHI, F.M.** and FRANZEL, S. (1998). An evaluation of the economic role of cattle in the mixed smallholder farms of Embu district, Kenya. Paper presented to the National Agroforestry Research Project Symposium: Regional Research Centre - Embu. Embu, Kenya. 9-11 December 1998.
- MURITHI, F.M.;** MACHARIA, N. and GETHI, M. (1994). Maize Farming in the Mid-altitude Areas of Kenya: Farmers Practices, Research and Extension Challenges. KARI/CIMMYT Maize Database Project: A Survey Report, RRC-Embu.
- MURITHI, F.M.;** TUWEI, P.K.; O'NEILL, M.K.; TYNDALL, B.; THIJSSSEN, H.C.J; GACHANJA, S.P. and O.Z. NYAATA, O.Z. (1994). Production and marketing of fruits and nuts in the coffee-based land use system of Kirinyaga District, Kenya. *AFRENA Report No. 77. International Centre for Research in Agroforestry (ICRAF), Nairobi, Kenya.*
- MURITHI, F.M.;** MACHARIA, N. and GETHI, M. (1993). Maize Farming in the Mid-altitude areas of Kenya: Farmers Practices, Research and Extension Challenges and the Potential for increased productivity. In Proceedings of a workshop on “The Role of Research, Extension, Women and Farmers’ Assessment of Maize Production Technologies in Kenya. Maize Database Project Seminar,” 23-24 September 1993. Nairobi, Kenya.
- MURITHI, F.M.;** O’NEILL, M.K.; THIJSSSEN, H.C.J.; MUGENDI, D.N.; MWANGI, J.N. and NYAATA, O.Z. (1993). Agroforestry technologies for fodder production and soil fertility improvement in Meru District, Kenya. *AFRENA Report No. 76. International Centre for Research in Agroforestry (ICRAF), Nairobi, Kenya.*
- MURITHI, F.M.** and SHILULI, M. (1993). Effects of the liberalization of fertilizer markets on the distribution and use of fertilizer on food crop production: A study on Embu and Meru Districts, Kenya. In Mwangi, W.; Rohrbach, D. and Heisey, P. (eds.) *Cereal Grain Policy Analysis in the National Agricultural Research Systems of Eastern and Southern Africa; CIMMYT/SADC/ICRISAT; Addis Ababa, Ethiopia.*
- MURITHI, F.M.;** THIJSSSEN, H.C.J.; MUGENDI, D.N.; MWANGI, J.N.; O’NEILL, M.K and NYAATA, O.Z. (1993). Survey on agroforestry technologies used for soil fertility improvement in Meru District, Kenya. In *Atta-Krah, K. (ed.), East and Central African AFRENA Workshop, 6-10 September 1993, Kabale, Uganda: Summary proceedings.*
- MURITHI, F.M.;** THIJSSSEN, H.C.J.; MUGENDI, D.N.; MWANGI, J.N.; O’NEILL, M.K and NYAATA, O.Z. (1993). Survey on agroforestry technologies used for fodder production in Meru District, Kenya. In *Atta-Krah, K. (ed.), East and Central African AFRENA Workshop, 6-10 September 1993, Kabale, Uganda: Summary proceedings.*
- MURITHI, F.M.** (1990). Efficiency of Resource Use in Smallholder Milk Production: The Case of Meru Central Dairy Farmers, Kenya. MSc Thesis, University of Nairobi.
- MURITHI, F.M.** (1990). Transfer of technology. In Murithi, C.N. and Murithi, F.M. (eds.), *Proceedings of Research/Extension Linkages workshop, Embu, Kenya, 11-13 September 1990.*

- MURITHI, F.M.**; KANAMPIU, F.K. and KANGA, L.M. (1990). Effects of spatial arrangement on grain yields and production labour requirements. In *Kenya Agricultural research Institute, Regional Research Centre-Embu, Annual Report*.
- MURITHI, F.M.**; KANAMPIU, F.K.; MURITHI, C.N. and KANGA, L.M. (1990). Economic evaluation of some cropping systems of maize and beans. In *Kenya Agricultural research Institute, Regional Research Centre-Embu, Annual Report*
- MURITHI, F.M.** (1987). Factors influencing the use of purchased inputs on food crop production in Gaturi South Location, Embu District: A Survey Report, RRC-Embu.
- NYAMAI, D.; MBOTE, F.; **MURITHI, F.**; MUKOLWE, M.; KIMANI, J.; MUGWE, J.; MBOGO, J.; KANGARA, J. and OWUOR, B. (1999). Report of the agroforestry technical study tour by a team from Kenya on the Ahmara National Regional state/Sida cooperation in Rural Development Programme, Ethiopia: 31 October - 10 November 1999.
- NYAATA, O.Z.; **MURITHI, F.M.**; MUGENDI, D.N.; MWANGI, J.N.; O'NEILL, M.K. and THIJSSSEN, R. (1992). Potential for planting MPT in existing Pennisetum plots. In Hoekstra, D. and J. Beniast (eds.), *East and Central Africa AFRENA Workshop, 22-26 June 1992, Kigali, Rwanda: Summary proceedings. AFRENA Report No. 58*. International Centre for Research in Agroforestry (ICRAF). Nairobi, Kenya.
- NYAATA, O.Z.; **MURITHI, F.M.**; O'NEILL, M.K.; MWANGI, J.N.; MUGENDI, D.N. and THIJSSSEN, R. (1992). Potential for planting understorey MPT under existing *Grevillea robusta* boundary plantings. In Hoekstra, D. and J. Beniast (eds.), *East and Central Africa AFRENA Workshop, 22-26 June 1992, Kigali, Rwanda: Summary proceedings. AFRENA Report No. 58*. International Centre for Research in Agroforestry (ICRAF). Nairobi, Kenya.
- OKOBA, B.; **MURITHI, F.M.**; GACHANJA, S.P.; SIJALI, U.I.; GICHERU, P. and MAINA, J.M. (1997). Report on a feasibility study of irrigation suitability of Njukiri/Nthambo irrigation project, Embu District. Kenya Agricultural Research Institute, Regional Research Centre, Embu, Kenya.
- OKURO, J.O.; **MURITHI, F.M.**; VERKUIJI, H.; MWANGI, W.; DE GROOTE, H. AND GETHI (2000). An assessment of the adoption of seed and fertilizer packages and the role of credit in smallholder maize production in Embu district, Kenya. A survey report, Regional Research Centre - Embu.
- O'NEILL, M.K.; KANAMPIU, F.K. and **MURITHI, F.M.** (1992). Low input alternatives for improved soil management. In C.S. Wortmann and J.K. Ransom (eds.), *Soil fertility research for maize and bean production systems of the Eastern Africa highlands: Proceedings of a working group meeting*, Thika, Kenya. 1-4 September, 1992. CIAT African Workshop Series No. 21. Dar es Salaam, Tanzania.
- O'NEILL, M.K. and **MURITHI, F.M.** (1994). Local adoption of agroforestry technologies in the Mt. Kenya highlands. In *Agronomy Abstracts, 1994 Annual meetings, American Society of Agronomy, Crop Science of America and Soil Science Society of America, Seattle, Washington*, 13-18 November 1994.
- THIJSSSEN, H.C.J.; **MURITHI, F.M.**; NYAATA, O.Z.; MWANGI, J.N.; AIYELAAGBE, I.O.O. and MUGENDI, D.N. (1993). Report of an ethnobotanical survey of woody perennials in the coffee zone of Embu District, Kenya. *AFRENA Report No. 62. International Centre for Research in Agroforestry (ICRAF), Nairobi*.

THIJSSSEN, H.J.C.; **MURITHI, F.M.** and NYAATA, O.Z.(1993). Existing hedges on farms in the coffee based land use system of Embu District, Kenya. *AFRENA Report No. 65. International Centre for Research in Agroforestry (ICRAF), Nairobi.*

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Home - (254-2) 521116
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EDUCATION

Phd. in Economics, University of Wisconsin-Madison, 1988.
MA in Economics, University of Wisconsin-Madison, 1984.
BSc. in Business, University of Illinois-Urbana, 1981.

WORK EXPERIENCE

Policy Economist, International Centre for Research in Agroforestry,
July 1997 to present

Numerous research activities focussing on East Africa. Areas of research include economic analyses of agroforestry systems, studies of adoption and impact of agroforestry systems, and policy studies especially linked to soil fertility replenishment. Activities range from development of proposals for regional projects to development of dissemination publications of economic and policy studies for major research and policy clients. A member of the Technical Support Group of the African Highlands Initiative and leader of its policy working group.

Contact: Brent Swallow (b.swallow@cgiar.org)

Economic Consultant, International Centre for Research in Agroforestry,
July 1994 to July 1997

Numerous research and training activities included a financial analysis of agroforestry technologies in sub-Saharan Africa sites, a study of land use and tree resource management at the parish and household levels in Uganda and Malawi (with IFPRI), a review of tree tenure in grazing lands (with ILRI), organization of workshops for policy makers on integration of policies for sustainable land management, and significant proposal writing and training materials development.

Contact: Anne-Marie Izac (a.izac@cgiar.org)

Economist, Land Tenure Center and International Centre for Research in Agroforestry, January 1992 to July 1994

Project coordinator of a study which examined the factors behind household tree planting and adoption of agroforestry, with particular emphasis on land and tree tenure issues. The position was based at ICRAF in Nairobi. Led the analysis and write-up of data from over 600 households in Uganda, Burundi, Malawi, and Zambia in collaboration with national university faculty in each country.

Contact: *Dr. John Bruce, Land Tenure Center (jwbruce@facstaff.wisc.edu)*

Economic Consultant, AF3 Dept., World Bank, June 1991 to December 1991.

Analysis of farming systems and constraints in the highlands of Madagascar with a survey of over 300 rural households. The analysis took place in Antsirabe, where I also trained Malgache colleagues in econometric techniques and software applications.

Contact: *Dr. Benoît Blarel, World Bank (bblarel@worldbank.org)*
Mr. Yves Bigot, CIRAD, Montpellier, France

Economic Consultant, AGR Dept., World Bank, October 1988 to May 1991.

Principal activity was a study of indigenous land tenure and agricultural productivity in Sub-Saharan Africa, including a statistical analysis of household and parcel level data collected from nearly 1,000 households in Ghana, Kenya, and Rwanda.

Contact: *Dr. Peter Hazell, IFPRI (p.hazell@cgiar.org)*
Dr. S.E. Migot-Adholla, World Bank and Government of Kenya
(smigotadholla@worldbank.org)

REFEREED PUBLICATIONS

Otsuka, K. and F. Place. 2000. **Land Tenure and Natural Resource Management: A Comparative Study of Agrarian Communities in Asia and Africa**, Johns Hopkins Press (in press).

Place, F. and K. Otsuka. 2000. "Population Density, Resource Tenure, and Tree Resource Management in Uganda," with Keijiro Otsuka, **Land Economics** 76 233-251.

Place, F. and K. Otsuka. 2000. "Population, Land Tenure and Natural Resource Management: The Case of Customary Land Area in Malawi," submitted to **Journal of Environmental Economics and Management** (in press).

Otsuka, K. and F. Place. 2000. **Land Tenure and the Management of Forest, Agroforest, and Cropland: A Comparative Study of Asia and Africa**, in Lee, DR and CB Barrett Agricultural Intensification, Economic Development, and the Environment in Developing Countries London: CABI.

Jama, B., Buresh, R.J., and F. Place. 1999. Sesbania Tree Fallows on Phosphorus-Deficient Sites: Maize Yield and Financial Benefit. **Agronomy Journal** 90 (6), pp. 717-726.

Kwesiga, F.R., S. Franzel, F. Place, D. Phiri, and C. P. Simwanza. 1999. Sesbania sesban improved fallows in eastern Zambia: Their inception, development and farmer enthusiasm. **Agroforestry Systems**, 47, 1/3, pp. 49-66.

Place, F. and P. Dewees. 1999. Policies and incentives for the adoption of improved fallows. **Agroforestry Systems**, 47, 1/3, pp. 323-343.

- Place, F. and S. Migot-Adholla. 1998. Land Registration and Smallholder Farms in Kenya. **Land Economics** 74 (3) 360-373.
- Place, F., Roth, M. and P. Hazell. 1994. "Land Tenure Security and Agricultural Performance in Africa: Overview of Research Methodologies," in Bruce and Migot-Adholla eds., **Searching for Land Tenure Security in Africa**, Dubuque, Iowa: Kendall Hunt Publishing.
- Migot-Adholla, S.E., Benneh, G., Place, F., and S. Atsu. 1994. "Land, Security of Tenure, and Productivity in Ghana," in Bruce and Migot-Adholla eds., **Searching for Land Tenure Security in Africa**, Dubuque, Iowa: Kendall Hunt Publishing.
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- Hazell, P., Migot-Adholla, S.E., Blarel, B., and Place, F. 1994. "Land Tenure Reform and Agricultural Development in Sub-Saharan Africa," in K. Hoff, A. Braverman, and J. Stiglitz eds. **The Economics of Rural Organization: Theory, Practice, and Policy**, London: Oxford University Press.
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- Migot-Adholla, S.E., Hazell, P., Blarel, B., and F. Place. 1991. "Indigenous Land Rights Systems in Sub-Saharan Africa: A Constraint on Productivity?," **World Bank Economic Review**, vol. 3 (1), pp. 155-175.
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OTHER PAPERS SUBMITTED FOR REVIEW

- Place, F. and K. Otsuka. 2000. Land Tenure Systems and Agricultural Productivity in Uganda. Submitted to **Journal of Development Studies**.
- Place, F. and K. Otsuka. 2000. Tenure, Agricultural Investment, and Productivity in the Customary Tenure Sector of Malawi, submitted to **Economic Development and Cultural Change**.
- Franzel, S., Coe, R., Cooper, P., Place, F., and S. J. Scherr. 2000. Assessing the adoption potential of agroforestry practices: ICRAF's experiences in subsaharan Africa, paper submitted to a special issue of **Agricultural Systems** and presented at the International Symposium of the Association for Farming Systems Research-Extension, 29/11 – 4/12, Pretoria, South Africa.
- Place, F. and B. Swallow. 2000. Assessing the Relationships between Property Rights and Technology Adoption in Smallholder Agriculture: A Review of Issues and Empirical Methods submitted to

Meinzen-Dick, R. Knox, A., Place, F. and B. Swallow (eds) **Property Rights, Collective Action, and Technology Adoption.**

Hansen, J., Luckert, M., Minae, S., and F. Place. Tree Planting Under Customary Tenure Systems in Malawi: An Investigation into the Importance of Marriage and Inheritance Patterns. Submitted to **Journal of Development Studies.**

Kristjanson, P. Place, F., Franzel, S., and PK Thornton. 2000. Assessing Research Impact on Poverty: Starting with farmers. Paper for the International Workshop entitled "Assessing the Impact of Agricultural Research on Poverty Alleviation" (CIAT), Sept. 14-16, 1999 and submitted to **Agricultural Systems.**

Baland, J-M., Gaspart, F. Place, F., and J-P. Platteau. 1999. Poverty, Tenure Security and Access to Land in Central Uganda: The Role of Market and Non-Market Processes. Submitted to **Journal of Development Economics.**

OTHER REPORTS AND PRESENTED PAPERS

Place, F, Franzel, S, DeWolf, J, Rommelse, R, Kwesiga, F, Niang, A, and B Jama. 2000. Agroforestry for Soil Fertility Replenishment: Evidence on Adoption Processes in Kenya and Zambia. Paper prepared for Workshop on Understanding Adoption Processes of Natural Resource Management Practices for Sustainable Agricultural Production in Sub-Saharan Africa, 3-5 July 2000, ICRAF, Nairobi.

Barrett, C, Place, F, Aboud, A, and D Brown. 2000. The challenge of improved natural resource management practices adoption in African agriculture: A social science perspective. Paper prepared for Workshop on Understanding Adoption Processes of Natural Resource Management Practices for Sustainable Agricultural Production in Sub-Saharan Africa, 3-5 July 2000, ICRAF, Nairobi.

Place, F and A Waruhiu. 2000. Options for biodiversity in eastern and southern Africa: A report on a regional workshop on Mainstreaming Agriculture into Forestry: Towards Systemic Biodiversity Policies, 21-22 November 1999, ICRAF, Nairobi. Nairobi: ICRAF.

Pender, J, Place, F, and S Ehui. 1998. Strategies for Sustainable Agricultural Development in the East African Highlands, paper presented at the International Conference on Strategies for Poverty Alleviation and Sustainable Resource Management in the Fragile Lands of sub-Saharan Africa, 25-29 May, Entebbe, Uganda.

Place, F. 1996. Towards Improved Policy making for Natural Resource and Ecosystem Management in Sub-Saharan Africa, Proceedings from a Workshop held 2-6 October 1995 at ICRAF, Nairobi: ICRAF.

Place, F. 1996. "The Role of Land Tenure on the Adoption of Agroforestry," Paper Prepared for the 1st Kenya National Agroforestry Conference, Muguga, Kenya, 25-29 April, 1996.

Place, F. 1996. "The Use, Management, and Tenure of Trees on Common Lands: A Review of the Literature with Emphasis on Sub-Saharan Africa," Report Prepared for ILRI, 1996.

Place, F, Mwanza, S, and F Kwesiga. 1995. "A Cost-Benefit Analysis of Improved Fallows in Eastern Province, Zambia," ICRAF (mimeo).

Place, F. 1995. The Role of Land and Tree Tenure on the Adoption of Agroforestry Technologies in Uganda, Burundi, Zambia, and Malawi: A Summary and Synthesis, Land Tenure Center, University of Wisconsin.

Place, F. 1995. "An *ex ante* Impact Analysis of Selected Agroforestry Technologies in the SALWA AFRENA," ICRAF (mimeo).

Place, F. 1994. "Cost-Benefit Analyses of Selected Agroforestry Technologies in the Southern African AFRENA," ICRAF (mimeo).

Place, F. 1994. "Land Tenure and Agricultural Development in Customary Areas: Preliminary Results from Eastern and Southern Province," in Roth, M. (ed.) Land Tenure, Land Markets, and Institutional Transformation in Zambia, Land Tenure Center.

OTHER

Foreign Languages:

English -- native

French -- comprehension - very good
speaking - fair/good

Computers:

Extensive work with the following software:

STATA, SAS, SPSS, Gauss, LIMDEP, TSP, Lotus, Quattro Pro, Excel, Harvard Graphics, Powerpoint, Word Perfect, MS-Word

Developing Country Experience:

Lengthy Experience:

BURKINA FASO, HAITI, KENYA, MADAGASCAR, UGANDA, MALAWI, ZAMBIA, BURUNDI

RASAMBAINARIVO Jhon Henri

Date of Birth : October 16 1946, Antananarivo
Director of Research, FOFIFA

Adresse : FOFIFA-DRZV B.P. 4 Antananarivo 101
Tel (261 20)22 405 78
Mobile 032 07 142 78
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1 :- Domaines de compétence

Les compétences et les travaux réalisés par le candidat sont principalement dans le domaine de la production animale et de la gestion des espaces pastorales en régions tropicales.

Il a réalisé des travaux d'investigation et d'analyse de la valeur alimentaire des matières premières pouvant entrer dans les rations des animaux domestiques

Il a entrepris des expériences qui ont abouti à la détermination des techniques d'installation et de gestion des plantes fourragères les plus adaptées aux différentes conditions écologiques de l'Ile. Il a conduit des essais qui ont permis d'évaluer les performances des animaux élevés sur certains pâturages malgaches.

Le pâturage naturel a été étudié au cours de plusieurs missions qu'il a effectuées dans les différentes régions de Madagascar où l'élevage extensif est prédominant.

Dans le cadre des travaux contractuels entre FOFIFA et le Programme Sectoriel Elevage (PSE), il a animé les travaux de recherche – développement multidisciplinaire visant à mieux connaître les contraintes et les performances des systèmes de production laitière sur les Hautes Terres.

Il a aussi dirigé des équipes qui ont pu mener à bien des travaux d'investigation et des expériences au niveau de diverses exploitations d'élevage de porcs et de volailles.

Les résultats de ces travaux ont été publiés dans des rapports et publications au niveau national et international.

Il est, par ailleurs, enseignant dans les Universités d'Antananarivo et de Mahajanga.

Il est membre titulaire de l'Académie malgache.

Au niveau international, il est membre du Comité Directeur d'un Programme de recherche sur l'analyse des politiques agricoles en Afrique orientale et centrale.

2 :- Expériences professionnelles

Au cours des 25 années de fonction, le candidat a participé à plusieurs projets de recherche, relatifs à ses domaines de compétence. Par ailleurs il a occupé différentes responsabilités tant au niveau national qu'international.

2.1.Responsabilités professionnelles dans le cadre de la recherche appliquée au développement rural

1993 à ce jour Chef de Programme de Recherche sur les systèmes de production laitière

1993 à 1999 Coordonnateur des travaux de Recherche-Développement menés par FOFIFA-DRZV au sein du Programme Sectoriel Elevage (PSE)

- 1998 Responsable des travaux de recherche entrepris par FOFIFA-DRZV pour le compte de la Maison du Petit Elevage (MPE)
- 1988 Membre du groupe de travail mis en place pour élaborer le Programme National de la Recherche Agronomique (PNRA)
- 1988 Membre du groupe de travail mis en place pour la préparation du Plan d'Action Environnemental à Madagascar (PAE)
- 1987-1988 Membre du groupe de chercheurs ayant dressé le bilan des recherches zootechniques et vétérinaires à Madagascar
- 1986-1988 Chef du Projet « Investigation sur la composition chimique des aliments du bétails à Madagascar » FOFIFA –CEE
- 1986-1987 Membre de la Commission consultative pour " le renforcement de la législation et des activités de contrôle de la qualité des denrées alimentaires à Madagascar " (Projet FAO /TCP/ MAG 4510)
- 1981-1983 Boursier FIS (Fondation International pour la Science) sur l'utilisation des sous –produits agricole pour l'alimentation des ruminants en saison sèche
- 1980 Membre du groupe Interministériel sur l'étude des feux de brousse.
- 1979-1980 Chef du Projet « Recherche sur l'alimentation fourragère des bovins dans le Faritany de Mahajanga ». (Projet FAFIFAMA, financé par la Banque Mondiale).

2.2 Expériences professionnelles dans le domaine de l'enseignement universitaire et post universitaire

Université d'Antananarivo, Ecole Supérieure des Sciences Agronomiques

depuis 1976 à ce jour est Enseignant en 3^{ème} Année et
a encadré 1 thèse de Docteur Ingénieur (1994)
et 22 Mémoires de fin d'Etude,

Université d'Antananarivo, Faculté des Sciences

a été Membre du jury à la soutenance d'une Thèse de Doctorat d'Etat es –Sciences (1993)

Université d'Antananarivo, Faculté de Médecine

a encadré une Thèse de Doctorat en Médecine.(1997)

Université d'Antananarivo, Faculté de Droit, d'Economie, de Gestion et de Sociologie

a encadré un DEA d'Economie (1999)

Université de Mahajanga, Faculté des Sciences: Unité de Formation Professionnalisante.

a encadré 5 travaux de Mémoire en vue de l'obtention du Licence – es- Sciences et Techniques Agricoles

(1999)

Ecole Professionnelles Supérieure Agricole de Bevalala, Antananarivo

Depuis 1996 à ce jour enseigne en 2^{ème} Année

a encadré et a été membre du jury de 5 Mémoires de fin d'Etude

Centre de Promotion Vétérinaire (CEPROVET, Programme Sectoriel Elevage)

De 1994 à 1999 a assuré des enseignements post universitaires pour les Docteurs Vétérinaires en place à Madagascar.

2.3. Responsabilités internationales

De 1997 à ce jour : Member of Steering Committee of ECAPAPA .

(East and Central Africa Programme for Agricultural Policy Analysis,) Entebbe, Ouganda.

1987 à 1991 : Member of Steering Committee of PANESA.

(Pasture Network for Eastern and Southern Africa,) Nairobi, Kenya.

3:-Participations à des Conférences et des Ateliers de travail internationaux

Années	Villes et Pays	Thèmes
1999	Lyon, <u>France</u>	26 ^{ème} World Veterinary Congress
1999	Antananarivo, <u>Madagascar</u>	Coordinator's Workshop on AFRA II -17 (1) Projects (IAEA) (2)
1998	Gympie, <u>Australia</u>	Dairy production in New South Wales and Queensland (Australia)
1997	Entebbe, <u>Uganda</u>	ECAPAPA(3) Stakeholders' Meeting
1997	Dar -es- Salaam, <u>Tanzania</u>	Coordinators Workshop in AFRA II -17 Projects (IAEA)
1996	Entebbe, <u>Uganda</u>	East Africa Livestock Assessment Workshop ,Entebbe (SR-CRSP) (4)
1996	Accra, <u>Ghana</u>	Atelier scientifique des Coordonateurs des Projets d'élevage AFRA
1995	Berlin, <u>Germany</u>	7 th International Conference of Institutions of Tropical Veterinary Medicine.
1993	Palmerstown (<i>New- Zeland</i>)Townsville (<i>Australia</i>)	17 th International Grassland Congress
1991	Gaborone <u>Bostwana</u>	Joint PANESA(5)-ARNAB(6) Scientific Workshop
1989	Montpellier, <u>France</u>	16th International Grassland Congress

1989	Grand baie <u>Mauritius</u>	International seminar on Integration of Livestock with crops in response to increasing population pressure on available resources
1988	Hameln <u>Germany</u>	International Symposium on poultry Production in Hot Climate Countries
1988	Lilogwe <u>Malawi</u>	4 th PANESA Annual workshop and Steering Committee meeting
1987	Arusha <u>Tanzania</u>	3rd PANESA Annual workshop and Steering Committee meeting
1985	Antananarivo <u>Madagascar</u>	Colloque international sur l'amélioration de l'élevage en zones tropicales
1984	Harare <u>Zimbabwe</u>	1 st PANESA Workshop
1981	Lexington, <u>Kentucky, USA</u>	14 th International Grassland Congress

(1)AFRA: African Regional Cooperation Agreement ; (2)AIEA : Internatioanl Atomic Energy Agency;
(3) ECAPAPA : East and Central Africa Programme for Agriculture Policy Analysis;(4)SR-CRSP : Small Ruminant Collaborative Research Support Program (5) PANESA :Pasture Network for Eastern and Southern Africa.
(6) : ARNAB African Research Network for Agricultural By-products

4:- Les travaux

L'ensemble des travaux du candidat a pour objectif général de générer des connaissances précises et objectives qui permettront aux opérateurs du secteur des produits d'origine animale d'avoir des revenus adéquats et de contribuer plus efficacement à la sécurité alimentaire de la population .

En effet, à la différence de ce qui se passe dans les pays industrialisés, il est bon de signaler qu'à Madagascar et dans la majorité des pays africains, la place de l'élevage dans les systèmes de production agricole ,ainsi que les orientations de l'utilisation des animaux domestiques dépendent principalement de facteurs socio-culturels, écologiques et économiques. Ainsi, les efforts menés pour assurer le bien être de la population humaine par l'utilisation des animaux et des produits d'origine animale se doivent de tenir compte de ces différents facteurs.

Le candidat a surtout travaillé dans le domaine de l'alimentation animale et principalement celle des ruminants. Il a entrepris des études et a encadré des équipes scientifiques qui ont travaillé sur le pâturages, tant en ce qui concerne la production bovine que l'amélioration de l'environnement pastoral. Il s'est intéressé aux matières premières tant du point de vue de leur disponibilité, que sur leurs valeurs alimentaires. Il continue d'animer des équipes dont les expériences ont déjà données des résultats directement utilisables chez les éleveurs laitiers, tels que les cultures fourragères en contre saison, les compléments alimentaires à base de mélasse, urée et minéraux.

Il a initié et a dirigé des travaux d'investigation et de diagnostic technico-économiques des exploitations laitières, avicoles et porcines. .

Le candidat est issu d'une formation biologique, mais au fur et à mesure d'une part, des travaux qu'il a réalisés avec et chez les éleveurs et d'autre part, des visites entreprises auprès de différentes équipes de chercheurs dans plusieurs pays de l'hémisphère sud (Afrique du Sud, Australie et Nouvelle-Zélande) où l'agriculture occupe une place économique prépondérante. Il est de plus en plus convaincu qu'une approche bio-économique mérite d'être adoptée surtout si les ressources sont faibles et que les nouvelles techniques à transférer se doivent d'être socio-économiquement acceptables par les différents opérateurs.

Les travaux actuels et futurs du candidat sont ainsi principalement orientés sur ces aspects d'intégration de la biologie à l'économie dans le domaine de la santé et de la production animales.

Liste des publications récentes (1994 et ultérieures)

- 2000 **Le développement laitier sur les Hautes Terres: forces et faiblesses.**
ANDRIAMBOLONONA H., RAKOTONDRAMANANA, RASAMBAINARIVO J.H,
RAKOTOMALALA B.
Communication présentée lors de la séance plénière de l'Académie des Arts, des Lettres et des Sciences du 20 Janvier 2000, Antananarivo, (sous presse)
- 1999 **Effets de la distribution d'un complément à base de mélasse-urée-minéraux sur la production laitière des vaches des petites exploitations des Hautes-Terres malgaches.**
RASAMBAINARIVO J.H. RAMBININTSOA Hanitra, RABEHANITRINIONY M., et
RALAMBOMANANA N.
Poster présenté lors des journées scientifiques de célébration du 25^{ème} anniversaire de FOFIFA, Septembre 1999, Antananarivo
- 1999 **Rapport sur les Recherches d'accompagnement pour contribuer au renforcement de la qualité des aliments du bétail et à l'élaboration d'un référentiel technique en alimentation des porcs et des volailles à Madagascar.**
RASAMBAINARIVO J.H., RABEARIMISA R. BASTIANELLI D. RALAMBOMANANA
D. Bakoly, RAVAO Marie E.V., RAMANITOHANINA S., RAVAOJANAHARY F.T.
FOFIFA-DRZV, Programme Sectoriel Elevage et Maison du Petit Elevage,
Antananarivo, Madagascar. 96p
- 1998 **La biodiversité des animaux domestiques à Madagascar**
RASAMBAINARIVO J.H.
in Monographie Nationale sur la Biodiversité, ONE, ANGAP, PNUE, Antananarivo, Madagascar p.81-84
- 1997 **Etude de la faisabilité d'une unité industrielle de farine de poissons. Propositions techniques.**
RASAMBAINARIVO J.H.
CAP-USAID Mahajanga, Madagascar. 37p
- 1997 **Mission agro-pastoralisme et production fourragère dans le Sud-Ouest de Madagascar.**
TOUTAIN B. et RASAMBAINARIVO J.H.
CIRAD-EMVT, Mamokatra, Montpellier, France. 113p.
- 1997 **Les pratiques agropastorales et la conservation des sols à Madagascar;**

RASAMBAINARIVO J.H.

In Bilan, évaluation, synthèse des travaux réalisés à Madagascar en matière de conservation des sols"Antananarivo, Madagascar. 19p.

1997 La productivité des pâturages malgaches.

RASAMBAINARIVO J.H.

IN Dossier de l'Atelier de travail sur l'"Elevage et l'Environnement à Madagascar 29 Mai 1997 .Aquaterre,Antananarivo.Madagascar.p97-100.

1996 Livestock production constraints and research priorities in Madagascar.

RASAMBAINARIVO J.H.and RASOLO F.

IN Proceedings of East Africa Livestock Assessment Workshop Entebbe, Uganda January 29th-1st February 1996,,Small Ruminant CRSP and ASARECA ,p77-84

1996 Données récentes sur les systèmes de productions laitières péri -urbaines des Hautes –Terres malgaches.

RASAMBAINARIVO J.H, RAKOTONDRAVAO, RAFALIMANANTSOA Ely, RABEHANITRINIONY M. et RATOVOANAHARY M.

Proceedings of the VII International Conference of Institutions of Tropical Veterinary Medecine. Berlin, Germany 25-29 september,Ed Zessin K-H German Foundation for International Development and Food and Agriculture Development Centre.,Germany. p185-189.

1995 Bilan des recherches et des actions sur la production de fourrages.

RASAMBAINARIVO J.H.

Communications présentées au cours de l'Atelier national intitulé "Réunir nos compétences pour une gestion durable des ressources naturelles sur les Hautes -Terres de Madagascar" organisé par l'African Highland Initiative décembre 1995 à Antananarivo, Madagascar. D1-D14.

1995 Les graminées fourragères à Madagascar.

RASAMBAINARIVO J.H. et RAZAFINDRATSITA R

IN Pastoralisme ,Coordinateurs Ph. DAGET et M.GODRON Ed. Hatier et AUPELF-UREF,p156-162.

1994 La situation actuelle de l'élevage laitier sur le Hautes-Terres et le Moyen Ouest

RASAMBAINARIVO J.H., RABEHANITRINIONY M., RAJOTONDRAVAO, RALINIAINA M. RATOVOANAHARY M.

FOFIFA-DRZV/Projet Sectoriel Elevage, Antananarivo 102p.

5:-Titres et Diplômes Universitaires

Années d'obtention	Diplômes	Lieux d'Etude
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1992	Agrégation (1) de l'Enseignement Supérieur du CAMES Option: Médecine Vétérinaire et Production Animale	Libreville, <i>Gabon (lieu du Concours)</i>
1974	Doctorat vétérinaire	<i>Lyon, France</i>
1973	Diplôme d'Etudes Approfondies (DEA) Botanique Tropicale/ Biologie Végétale	<i>Paris VII, France</i>
1973	Diplôme de Spécialisation Post-Universitaire d'Elevage et de Médecine vétérinaire en zone tropicale	<i>Maisons- Alfort, France</i>
1967	Certificat d'Etudes Supérieures de Licence es-Sciences (SPCN)	<i>Antananarivo, Madagascar</i>
1966	Baccalauréat de l'enseignement du Second Degré	<i>Antananarivo, Madagascar</i>

(1) « Agregation » is the highest Diploma in the French university system. It is equivalent to the PhD in the US system

6:-Décoration nationale

Chevalier de l'Ordre National (1999)

7:-Société Savante

Membre titulaire de l'Académie Nationale des Arts, des Lettres et des Sciences, Antananarivo.

8:-Associations professionnelles et sociales

- Collège des Chercheurs (Ministère de la Recherche Scientifique), **(Membre)**
- Commission Scientifique d'Evaluation et d'Appréciation (MRS) **(Président de la Section Agronomie)**
- Ordre Nationale des Docteurs Vétérinaires Malgaches **(Vice Président 1999-2002)**
- Lions Club Antananarivo Doyen **(Président 1996-1997)**