

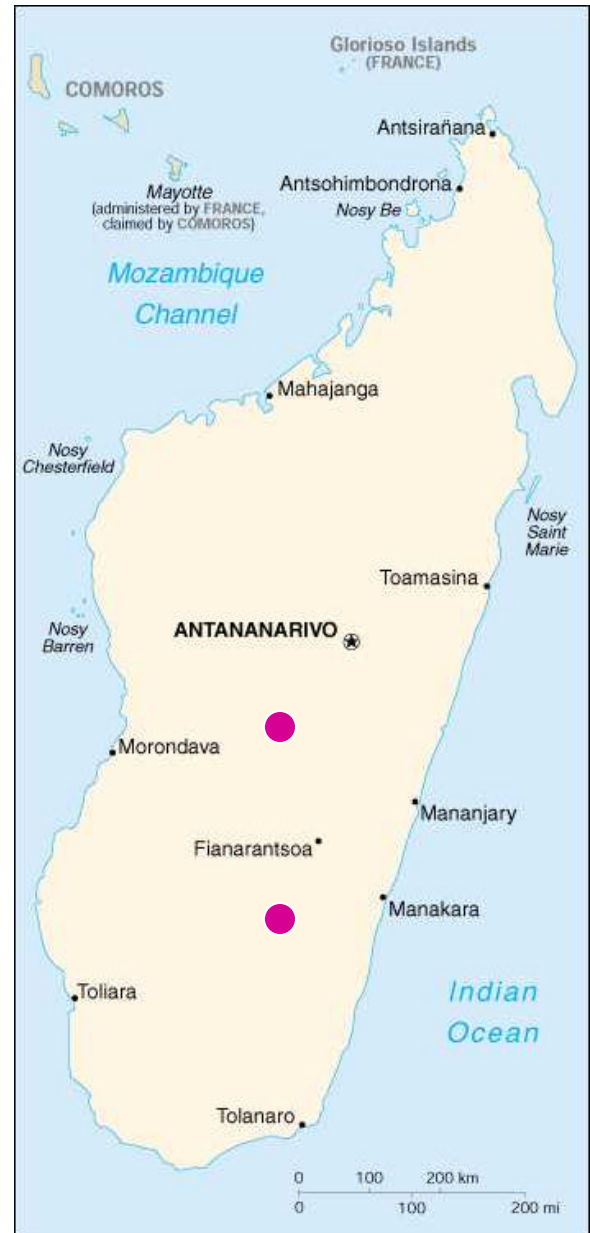
- I. **Research Project:** Rural Markets, Natural Capital and Dynamic Poverty Traps in East Africa
- II. **Collaborating Institutions and Researchers:** **Cornell University** (Ithaca, NY): Dr. Chris Barrett (principal investigator), Dr. Larry Blume, Dr. John McPeak, Dr. Bart Minten, Dr. Ben Okumu, Dr. Alice Pell; **FOFIFA** (Antananarivo, Madagascar): Mr. Jean Claude Randrianarisoa, Dr. Jhon Rasambainarivo (co-principal investigator); **International Centre for Research in Agroforestry** (ICRAF, Nairobi, Kenya): Dr. Frank Place (co-principal investigator), Mr. Justine Wangila; **Kenya Agricultural Research Institute** (KARI, Nairobi, Kenya): Dr. Festus Murithi (co-principal investigator), Mr. Collins Obonyo, Mr. Martins Odoendo, Dr. Willis Olouch-Kosura, Mr. James Ouma.
- III. **Project Dates:** October 2000 – September 2004
- IV. **Support:** Core BASIS CRSP funding with matching funds from Cornell University and the Rockefeller Foundation
- V. **Background (Program Overview):** One fifth of the world's population lives on less than a dollar a day, and most of those ultra-poor live in rural areas and work in agriculture. So the poorest populations in the world rely disproportionately on the natural resource base on which agricultural productivity depends. Recent empirical studies using longitudinal data find that a disturbingly large share of these people suffers chronic rather than transitory poverty. They appear trapped in a state of perpetual food insecurity and vulnerability because their poverty and poor market access preclude their efficient investment in or use of productive assets.

Furthermore, those caught in a poverty trap have strong incentives to degrade natural resources in the course of their ongoing struggle to survive. 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. Such degradation exacerbates pre-existing poverty traps, by discouraging capital-strapped smallholders from investing in maintaining, much less improving, the natural resource base on which their and their children's future livelihoods depend. The resulting degradation of the local agroecosystem further lowers agricultural labor productivity, aggravating the structural poverty trap from which smallholders cannot easily escape. These problems feature prominently today in Kenya and Madagascar and in discussions among policy makers, donors, and NGOs as to how best to design poverty reduction strategies.

The project "Rural Markets, Natural Capital and Dynamic Poverty Traps in East Africa," is being undertaken in collaboration with FOFIFA in Madagascar and with KARI, and ICRAF in Kenya with the goal of identifying best-bet strategies to help smallholders escape the interrelated problems of dynamic poverty traps and natural resource depletion. Degradation of soils and market access are the primary foci. Empirical analysis, based on field work in six sites,

four in Kenya and two in Madagascar, and context-driven simulation modeling will be used to identify the most promising approaches to poverty alleviation and repletion of degraded soils.

**Figure 1: Kenya and Madagascar project sites**



## VI. Discussion of 2000-2001 Activities:

- A. Activities undertaken: The project completed all proposed activities this year. This involved four separate field visits by Cornell-based team members, a team meeting in Kenya, release of a draft policy brief, secondary data collection throughout our study sites as well as primary data collection in two of the Kenya sites, design of a simple, prototype bioeconomic model -- the Crop, Livestock and Soils in Smallholder Economic Systems (CLASSES) model – and of the bioeconomic modeling course to be offered in 2002 to FOFIFA and KARI staff in order to train them on modification and use of the CLASSES model and to train them to train the broader community of prospective end-users in Kenya and Madagascar.

*Field visits:* Okumu visited five of the six field sites in Kenya and Madagascar in November and December 2000 (all but the Fianarantsoa, Madagascar, site). In addition to conducting on site discussions with subject community members, this reconnaissance visit afforded an outstanding opportunity to meet with USAID staff to brief them on the project, to review existing data and survey instruments, and to familiarize the team with each site's biological and physical details, essential to the design of the prototype bioeconomic model.

Barrett visited with team members and USAID staff in both Kenya and Madagascar in March 2001 to coordinate the design and implementation of field surveys, to brief FOFIFA and USAID officials on the project, and to participate in a small workshop on this project and related research organized by the USAID mission to solicit the input of and to inform stakeholders from the donor community and government.

Okumu returned to Kenya in May for a brief visit to coordinate with ICRAF and KARI collaborators on the development of the prototype bioeconomic model and on the logistics of the June team meeting.

In June, Barrett, Blume, Okumu and Pell all went to Kenya to visit project field sites in Embu and Baringo and to participate in the first annual project team meeting, held in Kerugoya. The field visits were coordinated with local KARI staff and project post-doc John McPeak, based at the project's Marsabit site. We visited three Kikuyu farming communities in Embu and Kirinyaga: an integrated smallholder coffee/dairy/grain/vegetables operation, a large commercial coffee operation that included post-harvest processing facilities (vertical integration into lucrative non-farm activities), and smallholder mixed tea/vegetables/grains/tubers/dairy farms nearer Mount Kenya.

The importance of integrated input-output marketing systems emerged repeatedly in conversations with farmers. The smallholder coffee sector is suffering terribly since partial liberalization. The state coffee marketing board previously provided coffee farmers input packages of fertilizer and pesticides as in-kind credit against which future harvest served as effective collateral due

to the state's legal monopsony power in the coffee sector. Now farmers can sell to anyone. However, as a result no one will supply inputs on credit. Given working capital constraints, small farmers therefore are not using chemical inputs and quality is suffering. By contrast, the large commercial coffee operation, which is flush with funds due to its processing operations, can afford inputs and is thereby producing higher yields and higher quality beans and parchment than do the neighboring smallholders. When the harvest peaks, that operation often hires a couple hundred casual workers at a wage rate of KSh100/day.

This arrangement stands in contrast to that prevailing in the tea farming areas just a few kilometers away. Tea labor is hired on a piece rate basis because workers' speed is less potentially injurious to the tea bush – which needs to get pruned back regularly anyway – than it is to the coffee trees. Moreover, because tea must be processed fresh and there are economies of scale to the processing, the many small factories in the tea growing area have effective natural local monopsonies in tea purchasing in the absence of government control. This enables the private tea factories to offer local growers chemical fertilizer as in-kind credit against the tea harvest. Tea's natural pest-resistance means it doesn't require pesticides. Furthermore, the tea bush's strong root system provides effective erosion control when planted densely on the steep hillsides in the Mount Kenya area. The tea farmers are pleased with the returns they're enjoying – for example, more than \$1000/year net cash income (i.e., not including the value of labor or land) for one female household head with only primary school education cultivating just over a hectare of land.

Like tea, the dairy sector in the Embu/Kiringaya region appears an effective platform for smallholder accumulation. The good road network in the area means that those who can afford dairy cattle can sell milk daily within the local market at a profit. Given population density and land pressures, the farmers we saw were all practicing zero-grazing, supplementing the feed from cut-and-carry napier grass, *calliandra* and crop residues with commercially purchased feed concentrates (bonemeal, soy, etc.) and veterinary inputs. Milk yields were as high as 24 liters/day, quite high by developing country standards. Farmers were using the manure, often mixed with household food wastes and nonpalatable crop residues, in composting for nearby vegetable fields, where the resulting rich soils provided fertile ground for high-value, nutritious crops such as tomatoes, kale, cabbage, carrots, and melons for both home consumption and sale. These fields are irrigated as well using piped water, with the farmers having purchased necessary hose lengths with proceeds from horticultural sales. Soil quality is very high, erosion rates are low, children are in school and health indicators are relatively good. This is clearly a high potential area in which steady accumulation appears accessible to those who can get into dairy or tea or who can achieve sufficient scale in coffee in order to add post-harvest processing. The technological differences between coffee and tea – and the resulting different organization of the input and output marketing channels – means that smallholder coffee production is

not, under current institutional arrangements, as lucrative for modest-sized farmers as tea. The vibrancy of this zone underscores the potential for smallholders where financial systems and technologies together make high-return activities accessible. Fixed costs, agroecological conditions (e.g., suitability for tea) and biological production lags that necessitate credit (in coffee or tea, as compared to dairy) nonetheless pose a serious obstacle to some small farmers.

The project's semi-arid site in N'gambo, Baringo District, is but four hours' drive from the Embu/Kirinyaga site, but seems a world away. There is an active nonfarm sector in Marigat town, 8-10 kilometers from N'gambo. Town-based activities provide opportunities for some of the Njemps people, especially those with secondary school training, to complement their agropastoral incomes with a more stable cash income from salaried employment or trading. This observation is very consistent with previous BASIS research finding that nonfarm rural income helps increase and stabilize household income but is accessible almost exclusively to those with sufficient education, working capital, or both (see section X, below). There is a state-sponsored irrigation scheme, fed by the Pekerra River (which went dry during the 2000 drought), in which farmers are allocated one hectare plots in order to grow seed maize for the Kenya Seed Company. They too are provided a package of inputs as in-kind credit against the sale of seed.

Baringo's climate dictates greater dependence on extensive grazing of livestock. Almost all the cattle in N'gambo died in the 2000 drought. Those that were supplemented (usually with crop residues, diverted food aid, bone meal, or palatable forages often cut and carried by household members) fared best. Households are rebuilding herds now, mainly through fast-breeding goats that they then sell in order to buy cattle. This "species sequencing" is the means by which they rebuild to high-return (albeit high-risk) herds in the wake of drought shocks and in the face of credit constraints that keep them from restocking their cattle herds through market.

N'gambo's Njemps households grow dryland maize, millet, sorghum and beans. Yields are low and complete crop failure is common. Farmers use rainwater harvesting and conservation techniques to maximize the chance of getting a crop from these water-starved soils. The 2000 crop failed completely in unirrigated areas – and even the state irrigation scheme dried up in most of its reaches, causing crop failure – and the current crop looks poor. Some of the dryland farmers have been planting the food aid they receive in hopes of getting more maize or beans. By contrast, neighboring farms that irrigate by pumping water from the Pekerra River using diesel pumps or by diverting water from the River by dug weirs – a very labor-intensive activity as we found by observing a team of five young men digging one – are getting terrific yields. The maize stood three meters high in the fields we visited. Not everyone has access to irrigation, however. The pumps are expensive, even on a rental basis (there is a local rental market) and it is expensive and difficult to mobilize labor teams to dig weirs, especially for female-headed households. There has nonetheless been a rush for land accessible to the river

over the past four years, when local farmers first started pump irrigating fields in 1997. Furthermore, these households are not using any fertilizer, except for occasionally on melon fields. They let livestock from throughout the community graze on the harvested fields' crop residues, thereby getting some manure return, but the horticulturalist and animal scientist accompanying us explained to the farmers that the high yields could not be sustained without greater nutrient replenishment of the soils, which were obviously in poor condition. These farmers are growing maize for home consumption and local sale, have no access to credit, and cannot afford fertilizers. The prospects for maintaining yields depend on their capacity to put fields into extended fallow. They already engage in crop rotation (maize, beans, and melons), but the soil needs to rest. But land accessible to the river by weir or pump is scarce, so fallowing is increasingly difficult given land pressure, even with tenurial security under traditional arrangements.

Just outside N'gambo we also visited a Turkana village populated by destitute pastoralists driven from their traditional areas to the northwest by drought and cattle raiders. These households are in dire shape, with almost every child we saw suffering obvious malnutrition (kwashiorkor generally, with a few cases of marasmus). Their herds are depleted, the land they occupy is highly eroded and of low fertility with no irrigation capacity. Things look grim there.

We visited a neighboring child health center, the Family Life Training Centre, which takes in 10-12 seriously malnourished children each month, accompanied by their mother or an older sister. The social worker/nutritionist who runs the Centre monitors height and weight daily for each child so as to provide appropriate ration size and composition to rebuild body mass. Too often, she says, the significant gains the children enjoy while at FLTC for a few weeks are lost within weeks of returning home. FLTC's funding has largely dried up as the Minister of Culture is no longer supporting institutional facilities, only community-based efforts. This seems an odd blanket policy, especially in places where the distribution of power within the community (e.g., where women have little or no voice over resource allocation) is one of the causal factors behind poor child health. The Centre is seeing an increasing number of children orphaned by AIDS or post-partum maternal death. The health situation among the poorer populations of the drylands is clearly deteriorating quickly. Those with access to reliable nonfarm incomes, who accumulate a large enough herd to weather climate shocks like last year's drought, or who have cash enough and land rights near the River to be able to irrigate crops, are doing alright. Most of the rest are suffering badly and lacking in confidence of a recovery. These seem paradigmatic cases of poverty traps.

A recurring theme across the sites was the importance of integrated input-output marketing channels in the presence of credit rationing. For field crops, where a biological lag between input application and harvest necessitates seasonal credit for those lacking the financial savings to buy inputs on their own, output market monopsony may be a second best solution to the problem

of access to yield-and-quality-improving inputs. Another key theme is the importance of water and soil management. Those farmers who are able to access water through investment in pumps or labor to dig weirs, and who can afford fertilizer and/or use manure/compost get higher yields and quality and can sustain these. In sum, the field visits strongly confirmed the core themes and design of the project's research program.

*First annual team meeting:* The two-day BASIS CRSP team meeting in Kerugoya went very well. 22 persons attended the two day meeting – 5 from Cornell (1 of whom is based in Kenya), 2 from ICRAF, 3 from FOFIFA/Madagascar, and 12 from KARI or KEFRI (Kenyan government research institutions on agriculture and the environment, respectively). We satisfied each of the stated objectives of the meeting, which were as follows: (1) Involve all team members in final definition of general project objectives, research design and methods (both for data collection and analysis), as well as of the project strategy for outreach to ensure practical usefulness of the research at both the broader level of national and regional policymakers and donors and the more local level of subject communities (Baringo, Embu, Marsabit, Siaya/Vihiga in Kenya, Fianarantsoa and Vakinankaratra in Madagascar). (2) Pin down FY2002 (Oct. 1, 2001 - Sep. 30, 2002) workplan details: timing of data collection at each site, timing and site of next team meeting, analysis and modeling. (3) Reach agreement on division of administrative, research and outreach responsibilities between Cornell, FOFIFA, ICRAF and KARI and match the budget to this division of responsibilities. (4) Help with team building by providing more opportunity for team members from different institutions to interact with one another. The team planned its next meeting for June 2002, in Kakamega, Kenya, near the project's western sites in Siaya/Vihiga Districts.

*Draft policy brief:* In August, the team drafted a BASIS Policy Brief entitled "Missing markets, poverty traps, and soils degradation in East Africa" which we expect the BASIS CRSP ME to approve and release in fall 2001. This brief underscores the integration of the pressing problems of persistent rural poverty and loss of natural capital in Kenya and Madagascar specifically, and east and southern Africa more generally.

*Data collection:* The project team has assembled extensive secondary socioeconomic and biophysical data on each of the six project study sites from local theses, reports, and earlier data sets. We have identified and reviewed the previous surveys on which the FY02 survey work will build in establishing panel data (repeated observations of a cross-section of households). Primary data collection took place throughout the year in two of our Kenya sites, in Dirib Gumbo (Marsabit District) and Ng'ambo (Baringo District), where in collaboration with the USAID Global Livestock CRSP pastoral risk management project we are conducting quarterly surveys at household head and individual level in 30 households per site.

*Development of bioeconomic model and related course:* Over the life of the project, we plan to develop, disseminate and apply a bioeconomic modeling tool, the Crop, Livestock and Soils in Smallholder Economic Systems (CLASSES) model in order to create local capacity to conduct ex ante impact assessment of alternative intervention scenarios in these complex, integrated systems. The project team will run a two-part bioeconomic modeling course for selected staff at FOFIFA and KARI in 2002, with the first part taking place in Kenya in June and the second part occurring in Ithaca in October. We completed the design of the course and have distributed draft syllabi to team members in Kenya and Madagascar already.

The team has already made effective use of bioeconomic modeling in such settings. Okumu won the Outstanding Research Silver Medal presented by the World Bank during the Global Development Network Conference held in Tokyo (10-13 December 2000) for his research paper entitled "Technology and Policy Impacts on Economic Performance, Nutrient Flows and Soil Erosion at Watershed Level: The Case of Ginchi in Ethiopia". The medal was awarded Okumu and his collaborators at the International Livestock Research Institute, the International Food Policy Research Institute and the University of Manchester by Japan's Minister of Finance, Kiichi Miyazawa, in recognition of their outstanding work in modeling the complex functioning of the Ginchi watershed in Ethiopia and the likely effects of alternative economic policies and agricultural technologies on both soil conditions and small farmers' welfare.

The Ginchi model is reported on in one of the 22 chapters of a new book on *Natural Resources Management in African Agriculture: Understanding and Improving Current Practices* edited by project co-PIs Barrett and Place (along with Abdillahi Aboud of Egerton University, Kenya), due to be published by CAB International in April 2002. The book originated in a major international conference held at ICRAF headquarters in Nairobi, Kenya, in June 2000, and underscores the themes of this project.

## **VII. Key Findings and Results**

Since this was a pre-proposal planning year, most efforts were directed toward working out the detailed modalities of the collaboration among the four institutions, including remaining research design and methods questions (e.g., how to make the most of and maintain control over the modeling, scaling issues, etc.). We can report, however, on new, key findings from related research by project principals that heavily influence the present project.

- 1) Nonfarm earnings account for a considerable share of farm household income in rural Africa, typically more so than in other world regions. The September 2001 special issue of the journal *Food Policy* on the topic "Income Diversification and Livelihoods in Rural Africa: Cause and Consequence of Change," edited by Chris Barrett, Tom Reardon (Michigan State University) and Patrick Webb (Tufts University), brought



together a set of eight papers presenting and synthesizing evidence from across the continent. These papers originated in the previous BASIS CRSP project “Asset and Income Diversification Patterns to Ensure Sustainable Livelihoods” and ties closely to the themes of this new project. Of particular note, the special journal issue identifies three empirical regularities. First, there exists a positive relationship between nonfarm income and household welfare indicators across most of rural Africa. Second, substantial entry or mobility barriers to high return niches within the rural nonfarm economy limit access to a subpopulation of relatively well-endowed households. Third, panel data evidence from across the continent suggest that greater nonfarm income diversification causes more rapid growth in earnings and consumption. These latter two regularities, combined, foster a positive feedback loop, wherein those participating in the rural nonfarm economy enjoy faster income growth, thereby providing the resources to plow back into expanded nonfarm activity.

- 2) The following text comes from the Preface to *Natural Resources Management in African Agriculture: Understanding and Improving Current Practices*, Christopher B. Barrett, Frank Place and Abdillahi A. Aboud, Editors Wallingford, UK: CAB International, April 2002. “It is no secret that both the land and the people of rural Africa are suffering. In recent years, researchers, practitioners and policy makers concerned with persistently high rates of rural poverty and food insecurity and declining per capita agricultural productivity in Sub-Saharan Africa have begun to attend seriously to the formidable natural resource management problems that are both cause and consequence of these ills. Much has been written about both the vicious cycle in which poverty leads to natural resource degradation, which in turn leads to low resource productivity and renewed poverty, as well as about the need for agricultural intensification on existing cultivated and grazed lands. Researchers have dedicated considerable time and resources over the past decade to develop, often in collaboration with farmers, farming technologies and natural resource management practices to break the vicious cycle, to facilitate intensification, and thereby to increase agricultural productivity, food security and rural incomes across the continent.

Unfortunately, rates of adoption and diffusion of improved natural resource management practices have generally fallen short of expectations. There are no simple answers to the questions of why many African farmers unsustainably exploit soils and water and why many do not adopt or adapt other, seemingly superior technologies already available. A clear understanding of these processes is nonetheless urgently needed. Any such an understanding must also adequately explain important examples of farm- and community-level innovation and careful natural resource stewardship across the continent, else it will provide a poor platform on which to base future policy and research.

The chapters that follow cultivate such an understanding developed from detailed reports on both failures and success stories from across the full range of agroecosystems and economic and institutional conditions found on the continent. This volume thereby breaks new ground in identifying important regularities regarding core determinants of and constraints on natural resource management adoption patterns. Perhaps more importantly, the volume's breadth and depth make clear the key policy and research priorities on which new initiatives need to focus in order to foster substantive improvements. Understanding and improving current practices remains a core challenge in the important task of eliminating poverty and malnutrition in rural Africa over the course of the 21<sup>st</sup> century."

- VIII. **2001-2002 Work Plans:** BASIS ME will extract necessary material from work plan filed with ME in August.
- IX. **Collaboration with other projects:** This BASIS CRSP project is collaborating closely with the USAID Global Livestock CRSP project on pastoral risk management (PARIMA), including joint survey work in two of our Kenya sites: Dirib Gumbo in Marsabit District, and Ng'ambo in Baringo District. The project is also collaborating in the design and validation of bioeconomic modeling frameworks with related efforts supported by the Cornell International Institute for Food, Agriculture and Development (CIIFAD) and the Rockefeller Foundation.
- X. **Outputs:**
1. **BASIS CRSP Publications:**
- 1) Christopher B. Barrett, Lawrence E. Blume, John G. McPeak, Bart Minten, Festus Murithi, Bernard N. Okumu, Alice Pell, Frank Place, Jean Claude Randrianarisoa, and Jhon Rasambainarivo, "Missing markets, poverty traps, and soils degradation in East Africa" BASIS Policy brief submitted, 10 pages, August 2001.
2. **Other Print Outputs:**
- 1) Trip report by Ben Okumu (December 2000).
  - 2) Trip report by Chris Barrett (June 2001).
  - 3) Christopher B. Barrett, Thomas Reardon and Patrick Webb, editors, "Income Diversification and Livelihoods in Rural Africa: Cause and Consequence of Change," special issue of *Food Policy*, vol. 26. no. 4 (August 2001): pp. 367-384.
  - 4) Christopher B. Barrett, Mesfin Bezuneh, and Abdillahi Aboud, "Income Diversification, Poverty Traps and Policy Shocks in Côte d'Ivoire and Kenya," *Food Policy*, vol. 26. no. 4 (August 2001): pp. 367-384.
  - 5) Christopher B. Barrett, Thomas Reardon and Patrick Webb, "Nonfarm Income Diversification and Household Livelihood Strategies in Rural Africa: Concepts, Dynamics and Policy Implications," *Food Policy*, vol. 26. no. 4 (August 2001): pp. 315-331.

- 6) Garth J. Holloway, Christopher B. Barrett and Simeon Ehui, "Innovation and Market Creation," *Journal of the American Statistical Association*, Proceedings of the Section on Bayesian Statistical Science (December 2000): 148-153.
- 7) John McPeak and Christopher B. Barrett, "Differential Risk Exposure and Stochastic Poverty Traps Among East African Pastoralists," *American Journal of Agricultural Economics*, vol. 83, no. 3 (August 2001): pp. 674-679.
- 8) Shane M. Sherlund, Christopher B. Barrett, and Akinwumi A. Adesina, "Smallholder Technical Efficiency: Controlling for Environmental Production Conditions," *Journal of Development Economics*, forthcoming.

3. Non-Print Outputs:

- 1) Project web site: [http://www.aem.cornell.edu/special\\_programs/AFSNRM/Basis/](http://www.aem.cornell.edu/special_programs/AFSNRM/Basis/)

XI. **Photos, etc.:** Separately, I sent a number of electronic photographs to Marsha a month or so ago.

Attached please also find a copy of a team photo from our June 2001 team meeting at the Roswam Hotel, Kerugoya, Kenya. The team members in the picture are (from left to right): (Front row): John McPeak, Ben Okumu, Sallyannie Muhoro, Larry Blume, George Karanja, Samuel Gachanja, James Ouma, Festus Murithi, Chris Barrett, Bart Minten (Back row): Martins Odeno, Jessica Ndubi, Collins Obonyo, David Mbugua, Alice Pell, Justine Wangila, Jabez C. Buigutt, Wellington Mulinge, Frank Place, Jhon Rasambainarivo, Jean Claude Randrianarisoa, and Francis Kihanda.