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ASSESSING THE SOCIAL AND ECONOMIC IMPACT OF IMPROVED BANANA VARIETIES IN EAST AFRICA

edited by

Charlotte Lusty and Melinda Smale

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Environment and Production Technology Division
International Food Policy Research Institute
2033 K Street, N.W.
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EPTD Workshop Summary Papers provide an overview of the discussions and findings of workshops and conferences that the division has helped organize and sponsor. It is generally expected that a proceedings volume of papers will be published at a later date

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INTRODUCTION

This report documents the discussions and results of a research design workshop held at the Equatoria Hotel in Kampala, November 7-11, 2002. The meeting was the first formal gathering of the stakeholders of the project "Assessing the social and economic impact of improved banana varieties in East Africa".

The goal of the project is to fortify the impact of improved banana varieties on the livelihoods of smallholder farmers in East Africa. Banana (*Musa*) is a primary food staple as well as an essential cash crop for the region's smallholder farmers. Declining yields brought about by pests and diseases and decreasing soil fertility have compromised food and income security. In selected banana-growing areas, farmers have begun to adopt improved varieties that have only relatively recently become available from the small number of banana breeding programs in existence globally. The National Agricultural Research Organization (NARO) in Uganda, meanwhile, has embarked upon an ambitious breeding program that employs a range of biotechnologies to address the crop's most debilitating pests and disease problems (nematodes, weevils, Fusarium wilt and Black leaf streak disease).

This impact assessment project seeks to support areas of scientific research and policy affecting banana production by employing a unique approach that integrates economics tools and sociological methods within a common conceptual framework. The emphasis is on making a difference during, rather than after, the research or policy decisions have taken place. Furthermore, by evaluating and predicting the effects of improved varieties on farmer livelihoods, participating organizations will be able to target their work more appropriately towards livelihood needs.

This workshop represented the first attempt to bring economists, sociologists and agricultural scientists together to discuss the design of the study and the practicalities of its execution.

WORKSHOP OBJECTIVES

- To promote dialog among social scientists and banana researchers to enhance policy relevance of future impact assessment work

- Initiate the design of social science research that will provide banana researchers and extension workers with information on the impact of their work to use in setting research priorities, selecting "best-bet" traits and genetic backgrounds for traits, timing research efforts, identifying and targeting farmers who are set to benefit most, and designing appropriate dissemination mechanisms

- Identify opportunities for partnerships, building on relevant research that has already been undertaken

- Develop a detailed three-year research workplan

Another discrete aim of the workshop was to introduce the Sustainable Livelihoods Approach to all participants as a framework for the research design. The approach encompasses wide-ranging factors, both static and dynamic, affecting livelihoods, and, in this case, provided a tool to integrate the different disciplines present. Also embedded within the context of the project is the need to ensure that feedback from the research is channeled back directly into scientific research, breeding and networking programs, and that the partners involved learn and develop from the project activities. The workshop, whilst being limited to a practicable size, was carefully designed to bring together parties from agricultural and social science backgrounds. The participants (See Appendix 5) included representatives of the national agricultural research systems in Uganda and Tanzania involved in the breeding and dissemination of banana; NARO, Agriculture Research and Development Institute (ARDI-Maruku), Kagera Community Development Project (KCDP) and Sokoine University, as well as *Musa* taxonomists, social scientists and students, from economic and sociology disciplines, both from within the region and from outside.

This workshop report summarizes the meeting (the agenda is found in Appendix 5), providing abstracts of presentations, an introduction to the Sustainable Livelihoods Framework, and its use in drawing out important livelihood issues and research questions and mapping them into a structured format. All reports of both plenary and working group discussions are presented in Appendices 1 and 2. Finally the results of the discussions on Days 3 and 5 concerning the protocol for stratification of variables for site selection, the workplan, and the organizational structure of the project are described.

ABSTRACTS

SOCIAL SCIENCE RESEARCH TO ENHANCE THE IMPACT OF IMPROVED BANANA VARIETIES

Melinda Smale

GOAL

The goal of the social science research in this project is to use *ex ante* assessment to enhance the impact of improved banana varieties on the livelihoods of smallholders. Rather than calculate the costs and benefits of the investment in banana research after the improved varieties have been developed and adopted by farmers (*ex post*), we seek to assess the potential benefits to investment in certain types of banana improvement before and as improvement occurs. In addition to assessing the magnitude of research payoffs, however, our farm- and community-level analysis will focus on the constraints to future adoption. By identifying constraints, we can inform decision makers about the complementary investments that will need to be made to ensure that potentially successful varieties will indeed be successful.

PAST LESSONS

Past lessons in assessing the impacts of technology adoption among African smallholder farmers underscore the need for such an approach. First, social and economic constraints can impede the adoption of even the most promising technologies. Poorly developed markets for planting material, weak institutions for diffusing it, or the extreme poverty and cash flow problems faced by smallholders have often impeded their ability to benefit from technologies that researchers have developed with their interests in mind. The history of maize research and diffusion in Eastern and Southern Africa illustrates this point (Smale and Jayne 2002).

Second, it is clear that not all crop technology, and not every new variety, is popular among farmers. Banana is a unique crop with some challenging characteristics, such as its perishability and bulk, and the difficulties banana breeders need to overcome to improve it. For this reason, it will be helpful to know from a reasonably large sample

of farmers which traits or attributes they consider to be most important, and whether the varieties that are available serve them well or not. If farmers do not perceive diseases and pests in the same way as pathologists, or fail to observe their damage, this may have implications for their expectations of yield savings through the adoption of a disease- or pest-resistant banana and needed investments in educational or other materials.

A third lesson from past experience is that though planting material may be neutral to the scale of the farm operation (meaning that there is nothing inherent in the technology that implies large-scale farmers will have greater ability to use it than smallholder farmers), there is typically an aspect of the technology that favors its adoption by certain social groups. In the case of banana this factor is only access to information. In crops such as rice or wheat, it was access to tubewells and fertilizer.

In general, *ex ante* assessment of this type is critical for two simple reasons: 1) Those who invest in banana research need to think about which investments provide the best payoffs in terms of the priorities as they have defined them; and 2) success must be gauged against a baseline.

RESEARCH PURPOSE AND QUESTIONS

Congruent with these past lessons, we have so far established the following specific objectives for this research:

- Help researchers select the "best bet" varieties (defined as a trait in a banana type)
- Identify social and economic constraints to adoption of new banana varieties
- Profile the farmers who are most likely to benefit from new banana varieties'
- Help in the design of dissemination mechanisms for new banana varieties

To address these objectives, we can ask the following research questions:

- What is the expected total magnitude and distribution of economic benefits from various banana technologies?
- Which technologies are most likely to be adopted, by whom, and which social, economic, and policy factors constrain adoption?

- What is the probable impact of technologies on the livelihoods of smallholder farmers?
- Which are the most appropriate dissemination pathways?

APPROACH

It is rare to have the opportunity to conduct extensive diagnostic research that is farm-based during the crop improvement process. Diagnostic research investigates causal relationships and describes the nature of a situation. Social science research cannot support the work of crop scientists unless there is interaction at key junctures.

Some fields of economic and social inquiry are better suited for addressing the questions mentioned above than others. The appropriate tool to answer questions concerning the expected total magnitude and distribution of economic benefits from various banana technologies at the national and regional level is an economic surplus model, such as that detailed in full by Alston, Norton, and Pardey (1998) and applied in the International Food Policy Research Institute's (IFPRI) "Dynamic Research Evaluation for Management" (DREAM). Using DREAM, scenarios depicting technologies within trade and policy environments can be simulated interactively to highlight "best bets" in terms of returns to research investment or other criteria. Before the results of detailed farm-level analysis are available, a range of scientific and adoption possibilities are assumed. Analysis requires the calculation of and comparison among scenarios of investment criteria, such as the size of social and private benefits relative to health or environmental risks, benefit shares earned by consumers, commercial or smallholder producers, or regions (see Wood, below).

To address the question of which technologies are most likely to be adopted and by whom, the most appropriate tool is a model of farmer decision making applied to survey data using econometric estimation or mathematical programming (see Edmeades et al. and Bagamba, in this proceedings). Analyzing the probable impact of technologies on the livelihoods of smallholder farmers requires the combination of simulation and econometric findings as well as tools of sociological and anthropological analysis that are both quantitative and qualitative in nature. To characterize dissemination mechanisms for a crop such as banana, a similar mix of tools is necessary. Product markets as well as

farmer exchange or marketing of planting material must be characterized and the costs of transacting in these markets documented, while the social position and nature of social relationships that guide these transactions must be understood.

There are interrelationships between the different tools and their application. For example, the geo-referenced database used to apply the DREAM model also serves as a sampling frame for baseline survey, while the sample survey findings help calibrate parameters employed in the simulations conducted with DREAM. The bio-economic model adds temporal dimension to analysis of survey data, integrates biophysical data into economic model. The econometric model seeks to identify causal relationships among the complex relationships suggested by the Sustainable Livelihoods framework, while the framework helps to orient and provides a means for enriching the statistical and mathematical models. The framework may serve as a way of linking together the tools from these fields of inquiry in a coherent way.

OUTPUTS

It is hoped that integrating our methods in this way can increase our capacity for policy-relevant social science research. In the meantime, new applications of tools will contribute to further refinement, as in the case of the economics doctoral theses described here at the workshop and theses planned in sociology and entomology. In addition to disciplinary research publications and theses, however, this research must be geared to producing visible outputs that serve as information for research investors and managers.

REFERENCES

Alston, J.M., G.W. Norton, and P.G. Pardey. 1998. *Science under Scarcity: Principles and practice for agricultural research evaluation and priority setting*. Wallingford, U.K. and The Hague: CAB International and ISNAR.

Smale, M. and T. Jayne. 2002. Maize in eastern and southern Africa: "Seeds of success" in retrospect. Environment and Production Technology Division Discussion Paper No. 97. Washington, D.C.: International Food Policy Research Institute.

A BRIEF REVIEW OF IMPACT ASSESSMENT STUDIES OF BANANA IN EAST AFRICA

Hélène Laurence

The project "Impact of banana improvement on livelihoods in East Africa" will assess the impact of improved varieties and some of the implications for food and livelihood security and endemic *Musa* diversity in the East African region. The project is important because it aims to help ensure that banana research and dissemination efforts contribute effectively to improving the livelihoods of banana producing farm households in East Africa. In preparation for the planning workshop held 7-11 November in Kampala, Uganda, efforts were made to review the literature on existing impact assessment (IA) studies on banana and plantain worldwide, to gather preliminary information on the dissemination mechanisms of improved varieties in Uganda and Tanzania and to identify the available georeferenced data in the above designated countries.

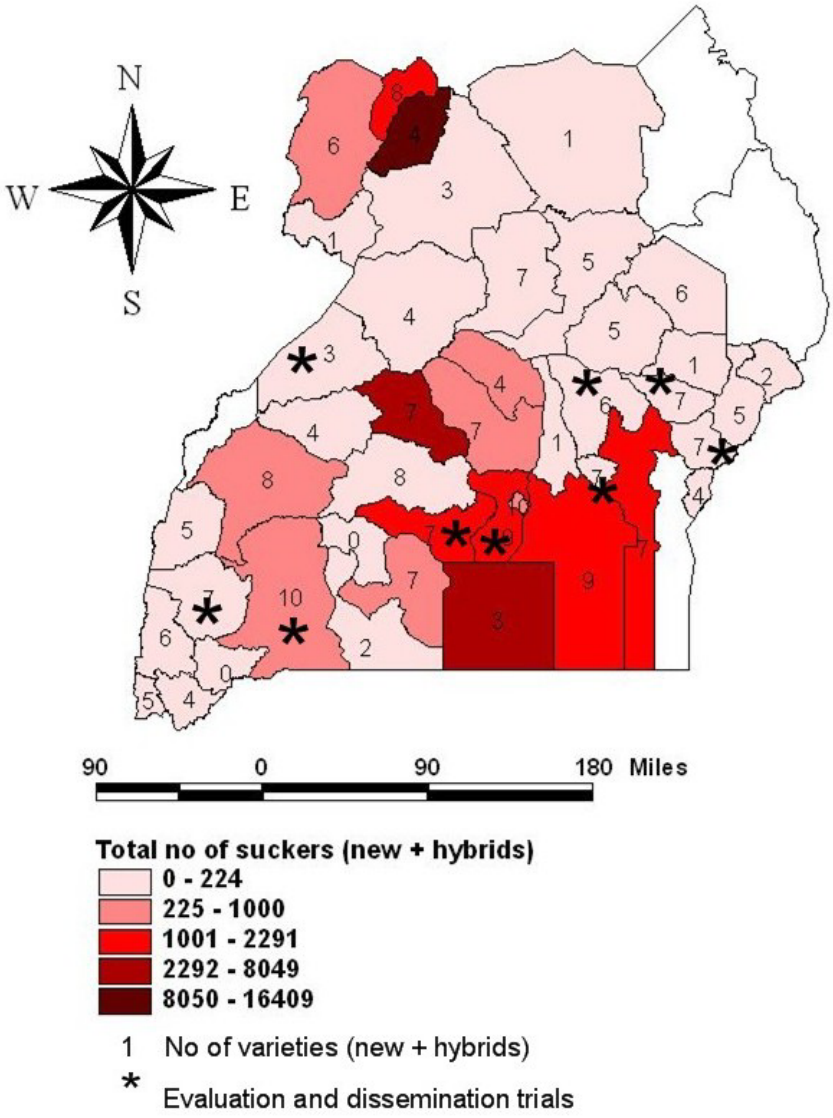
Apart from an *ex ante* IA study in 1999 to evaluate the potential impact of tissue culture technology in Kenyan banana production and some on-going *ex post* IA work on improved banana varieties in Tanzania, little has been done to assess the impact of improved banana varieties, related technologies or dissemination efforts.

The dissemination of improved banana varieties in Tanzania and Uganda involves various mechanisms and organizations involved in supplying, multiplying, demonstrating and disseminating at international, national and district levels. Between September 1998 and October 2002 the National Agricultural Research Organization (NARO) in Uganda, which acts as the focal point for dissemination, sent out 82,634 banana suckers. The Kagera Community Development Programme, an interorganizational project, has been responsible for a large amount of dissemination of improved banana varieties in Tanzania, but only in the Kagera region in the northwest. They estimate that they have given out 337,676 banana suckers between 1997 and April 2002.

A number of sources of georeferenced data relevant to banana farmer livelihoods have been identified, with the recent community and household surveys realized by the International Food Policy Research Institute in Uganda proving one of the richest. Using hard copy records from NARO, a first draft map of distribution patterns of improved banana varieties has been created

(Figure 1). Despite the limitations of data availability and quality, GIS mapping can provide an unparalleled tool in analysis and site selection.

Figure 1--Distribution between September 1998 and October 2002 of improved banana plantlets (44,587 suckers) to farming communities by NARO.



IMPACT OF SUPERIOR BANANA VARIETIES (SBVS) IN KAGERA, TANZANIA

Alain Gallez, Olivier Machiels, C. Mbehoma, Respichius Mitti and Gervase Patrick

In 1997, the Kagera Community Development Programme (KCDP), in collaboration with the Belgian Technical Cooperation (formerly Belgian Administration for Development and Cooperation) and Tanzanian Authorities, launched a five year project on the *Propagation and Diffusion of Superior Banana Varieties* (SBVs*)*. The project aims to boost production through the introduction, multiplication and diffusion of one to two million samples of planting material to the Kagera Region of Tanzania. To achieve this aim numerous partners, from universities to community-based organizations, have been involved at each stage of the production, quarantine, growing, testing, multiplication, demonstration and diffusion of plant material. The levels of direct diffusion (from project to farmer) and indirect diffusion (between farmers) are given in table 1.

Table 1--Showing levels of diffusion over the course of the project.

Year	Direct diffusion	Indirect diffusion
1997	1,352	0
1998	2,330	2,684
1999	20,285	12,712
2000	101,420	78,706
2001	151,588	438,878
2002 (on 30 September)	150,333	390,797
Grand total	**427,308**	**923,777**

Recognizing a need to evaluate the progress of the project and following the recommendations of a *Mid Term Review Mission* that took place early in 2001, KCDP took steps to organize a study of the impact of the project. The preliminary observations from the survey are presented here. The impact assessment was conducted at a household level, through a structured questionnaire, informal interviews and observations. The entire exercise, from preparation to interviews, ran from May to October 2002.

For the purpose of the survey, the Kagera Region was “divided” into seven agro-socio-ecological zones, referred to as “systems”. Within each system, two villages were selected based on the characteristics of diffusion (the patterns of the diffusion within the village, its accessibility, the number of suckers diffused within the village), and on several other criteria such as the way the

selected village represents the system. Using the "route method" on a 5 % sampling basis, a total of 358 households were chosen in all 14 villages. However, due to limited time and resources, the survey was implemented in only one village per system, with a total of 192 households interviewed within seven villages. The study also took account of the findings of a "pilot survey" previously conducted in a small area near Lake Victoria.

Given the recent completion of the field work only preliminary results are available. These indicate that factors affecting the adoption of SBVs are:

- access to information
- performance of the traditional banana varieties (the poorer the performance the higher the rate of adoption),
- cultural belief affecting the adoption (traditional growers are slower to adopt),
- household's wealth status (access to land, inputs, mobility and information),
- gender (women-headed households have higher rates of adoption).

In brief, the impact of the introduction of SBVs includes:

- increased banana production (harvest throughout the year),
- increased productivity (bunch weight – Figure 1)
- improved banana husbandry (use of manure, mulch, spacing, detrashing and desuckering),
- recovery of neglected banana fields ("rweya"),
- new opportunities for unexpected banana growing area (14,000 suckers were diffused into nine wards of Biharamulo),
- increased confidence in banana production (bananas growing around the homestead)

Figure 1--Showing increase in distribution of weight class of improved varieties

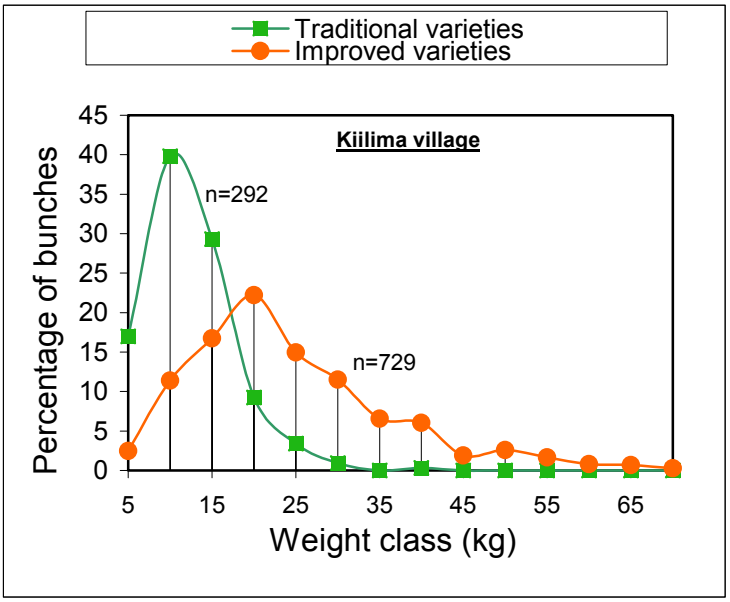


Table 2-- Cumulative diffusion of banana planting material in Kagera Region of Tanzania

	1998	1999	2000	2001	2002 (30 Sept)
Cumulative number of suckers diffused	6,354	39,351	215,052	805,518	1,351,085
Suckers per inhabitant (1.5 million inhabitants)	0.00	0.03	0.14	0.54	0.90

CONCLUSIONS

The rate of adoption of the SBVs in the farming communities has increased continuously over the duration of the project (Table 2). Working with collaborators has enabled the project to reach more households. The population of banana stools in the Kagera Region is estimated to be 150 million and the KCDP project succeeded in distributing a further 1,5 million SBVs. This represents only 1 % of the total estimated banana plant population; even if low this figure is significant, considering the levels of farmer to farmer diffusion.

SOCIO-ECONOMICS OF BANANA PRODUCTION IN UGANDA

Robert Kalyebara

Bananas are a major food crop and source of income for over 70% of farmers in Uganda (IITA 1995). Covering over 30% of utilized agricultural land, the banana is considered the most important food security crop for most of central, western, and eastern Uganda. Uganda is the second largest producer of bananas in the world, with annual output estimated at 10.5 million metric tones, accounting for over 10% of world output (FAO 2001). The perennial nature of the banana crop is important for food security and income generation in the peasant farming communities, which produce more than 90% of the total banana production in Uganda (Karamura 1998). Bananas are estimated to provide 30% of the calories (Figure 1), 10% of protein and 5% of fats for the entire population of Uganda. They (especially exotic types) are also important for beer, juice, gin (Table 1), and increasingly as a source of export earnings.

Figure 1--Contribution to calories consumed by the entire Ugandan population by major food group

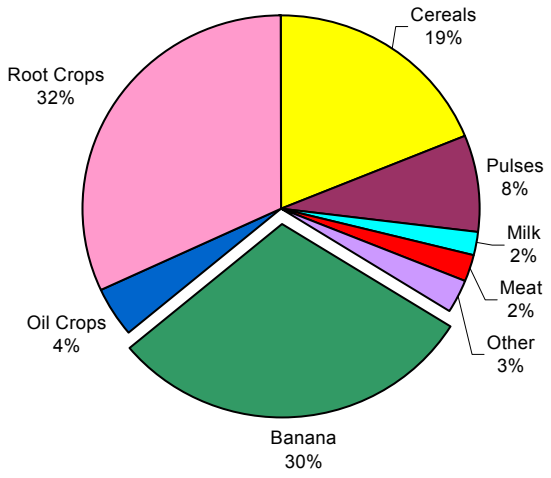


Table 1--Types of bananas grown in Uganda and their uses

Type	% of Area	*Matooke* (Food)	Flour	Dessert	Juice	Beer, Wine, Whiskey	Chips	Confec-tionery	Roasted (Snack)
Matooke	60	*	*				*	*	
Gross Mitchel (*Bogoya*)	7			*			*		
Apple banana (*Ndiizi*)	7			*			*	*	
Exotics (PHIA, etc)	Negl.	*	*	*	*	*	*	*	
Beer types (*Kayinja*, etc)	25		*		*	*	*	*	
Roasting types (*Gonja*)	1		*					*	*

The main banana cultivars grown are the East African highland bananas, *Musa* AAA-EA (Chandler 1995). These cultivars are unique to the East African region, and 90% of their cultivation occurs there. They are grown between 1000-2000 meters above sea level as the primary food staple and source of income in local markets. Coastal hybrids of AB, AAB, and ABB genotypes, referred to as exotic bananas, are also grown mainly in the lowlands of central and eastern Uganda. There is high export and industrial potential among these groups despite a recent decrease in production.

Production is mainly by small-scale farmers who have two main objectives: (1) subsistence and (2) income generation (55% pure subsistence, 39% semi-commercial), with a very small but growing proportion of pure commercial farming (6%). Bananas are traditionally grown in pure stands or intercropped with coffee and fruit trees, however commercial production tends to be monoculture.

In the past few decades, banana was a highly sustainable crop in Uganda, with long plantation life and stable yields. Recently, the crop has been losing ground in parts of western region, and most of central and eastern regions because of high severity of production constraints including soil fertility decline, banana weevils, nematodes, Fusarium and bacterial wilts. Drastic yield declines in these areas have led to the replacement of bananas with annual crops. Production of the crop has shifted to the country's Southwest where productivity is relatively higher. Productivity in Central Uganda is estimated at 6.0 ton/ha, while in the Southwest it is 17 tons/ha, still low compared to the potential 60 tones/ha attainable at research stations (Tushemereirwe *et al*. 2001). Despite the decline in production, banana is still the most preferred staple in many regions, and commands a relatively high price in urban markets.

In addition to soil and biotic constraints, the economic importance of the crop is affected by the following socio-economic constraints:

- High cost of production – high intensity labor demands
- Limited market – especially at peak of harvest
- High cost of marketing fresh bananas
- Poor sustainability of production systems because of soil depletion
- Poor access to information.

The responsibility of conducting research on priority constraints and developing appropriate interventions is mainly borne by the National Banana Research Programme (NBRP) based at Kawanda Research Institute (KARI) of the National Agricultural Research Organization (NARO). The goal of the NBRP is to enhance banana productivity and utilization through development and promotion of technologies for integrated management of the banana crop. Enhanced banana productivity will, in turn, contribute to the national goal of improving food security and poverty eradication. In order to achieve its goal the NBRP works in close collaboration with various international, national and district level agencies involved in banana R&D.

The NBRP has embarked on an ambitious research program mainly driven by the principle of participatory planning, implementation, and transfer of technologies. The activities currently undertaken are categorized into the following themes:

- Developing banana genotypes with resistance to weevils, black Sigatoka and nematodes.
- Evaluating foreign germplasm under different ecological conditions and bulking farmer acceptable cultivars for dissemination.
- Developing biological and cultural control options for management of weevils and nematodes.
- Social and economic evaluation of alternative solutions, market orientation, and continuous monitoring and evaluation of client satisfaction.
- Accelerating transfer of improved banana technologies to farmers and other stakeholders through on-farm research.

The NBRP's socioeconomics research agenda is focused mainly on developing recommendations on input use, soil fertility management, commercial enterprise development, and marketing. Specific areas where staff are currently undertaking research are:

- Input economics – labor, land/soil, herbicides.
- Economics of Soil and Water Management (Fertilizer, OM, etc)
- Using Farmer Resources to Improve Banana productivity
- Banana production as a commercial enterprise
- Marketing – export strategies
- Development communication
- M&E of farmer participation in OFR
- Dissemination approaches

REFERENCES

Chandler, S. 1995. The nutritional value of bananas. In: *Bananas and plantains*; Gowen, S.R. ed.. Chapman & Hall, London, 68-480.

FAO. 2001. *FAOSTAT agricultural data. Food and Agriculture Organisation of the United Nations*, Rome, Italy. http://apps.fao.org/default.htm

IITA. 1995. *Plantain and banana improvement programme -Annual report for 1994*. Onne, Nigeria: International Institute of Tropical Agriculture.

Karamura, D.A. 1998. Numerical taxonomic studies of the East African highland bananas Musa AAA-East Africa in Uganda. Ph.D thesis University of Reading, U.K, 344 pp.

Tushemereirwe.W, Kangire.A, Smith .J, Nakyanzi.M, Kataama, D., and Musiitwa. C. 2001. *An out-break of banana bacterial wilt in Mukono district: A new and devastating disease.* Kampala, Uganda: National Agricultural Research Organisation (NARO) and National Banana Programme, Kawanda Agricultural Research Organisation (KARI),

SOCIO-ECONOMIC IMPORTANCE OF BANANAS IN TANZANIA

Jackson Nkuba and Mgenzi Byabachwezi Said

This paper describes the socioeconomics of bananas in Tanzania. For the past ten years, the area under bananas fluctuated from 250,000 hectares to 350,000 hectares and its production ranged from 1,200,000 metric tonnes to 2,000,000 metric tonnes per annum. Banana is important as a food as well as a cash crop. In terms of major crops consumed in Tanzania, banana crop ranks third after maize and cassava. The expansion in acreage and increase in productivity of bananas are limited by declining soil fertility, increased incidences of pests and diseases, and poor marketing systems. The major producing areas are Lake Zone (Kagera Region), followed by Northern Zone (Kilimanjaro and Arusha), Southern Highland Zone (Mbeya) and Eastern Zone (Morogoro and Coast Regions). In these areas banana is a staple food for about 70 to 95 percent of the total population. Since the crop is harvested throughout the year, it ensures food and income security at the household level. The banana crop is increasing in importance as a cash crop, whilst traditional cash crops grown by farmers are decreasing their contribution to household income. Apart from being a potential food and cash crop, the banana plant provides medicines, feeds for animals and decorations. Starch from the fruit can be used in industrial works, and leaves are used for making utensils, mats, etc. and for thatching. A banana field also gives a high social status to the owner.

There are basically four banana types grown by farmers; cooking, brewing, dessert and roasting. Their occurrence varies per location, depending on farmers' preferences, demand and climatic conditions. In general the cooking banana type dominates in most areas followed by dessert, brewing and last roasting types. The choices of bananas cultivated by farmers are based mainly on traditional customs and less on market demand, a situation that leads to farmers failing to sell their harvest particularly during peak seasons. On the other hand the situation helps to reduce genetic erosion of banana diversity.

Aside from biophysical constraints, the banana industry is faced by several socioeconomic constraints including poor marketing system, lack of appropriate and effective marketing information channels, poor distribution and high prices of farm inputs, lack of credit facilities and poor infrastructure (including roads and processing industries). Efforts to increase banana productivity should go hand in hand with those to reduce socioeconomic constraints. Through the development of marketing opportunities and increasing the value of banana products direct

incentives will be created for producers to invest further in banana production. The diversification of banana products will also attract consumers. Ultimately the livelihood of people both in rural and urban areas will be improved.

BIOSAFETY AND REGULATORY FRAMEWORKS

José Falck-Zepeda, John Komen and Joel Cohen

Living Modified Organisms (LMOs) produced by biotechnology offer potential benefits, costs and risks to individual producers, communities and society as a whole. Biosafety regulatory systems and other risk management measures are designed to ensure that applications of modern biotechnology are safe for human health, agriculture, and the environment. However, existing biosafety regulatory systems have concentrated on examining the risks, rather than benefits. We are using here the economic concept of risk defined as the situation in which more than one possible outcome exists, some of which may be unfavorable. This is somewhat different from the process of risk assessment, where the degree of risk is measured by identifying the hazard, exposure and the probability of occurrence.

There is very little information about the cost of compliance with biosafety regulations in developing countries. To provide some guidance of the potential costs involved with regulation processes, the International Service for National Agricultural Research (ISNAR) organized a consultation entitled "Next Harvest: Advancing Biotechnology's Public Good". In this conference, representatives from 15 countries from Latin America, Asia and Africa contributed to the creation of a database that lists all biotechnologies currently in the research pipeline, as well as their status in the regulatory process. Four definite categories were used laboratory/greenhouse, small-scale field trials, scaled-up field trials and commercialization. Along with a list of outputs, some preliminary data regarding the cost of biosafety procedures were presented. For example, in Latin America, compliance with biosafety regulations varied from 700,000 US dollars to 4 million US dollars per event. The variation in cost occurs because of the types of testing that need to be done for a particular crop. Animal studies increase the cost of compliance significantly.

Biosafety regulations need to be examined within the context of the international treaties and agencies involved with the use of LMOs. International treaties should be examined in order to determine their scope, utility, inconsistencies and most importantly what are the implications for the country under discussion. These implications may involve international trade, research priority setting, and inventories of expertise and policy-making capabilities.

The main international treaty guiding biosafety is the Cartagena Protocol to the Convention on Biological Diversity that was adopted in January 2000. The scope of this protocol is to guide

trans-boundary movements, transit, handling and use of LMOs that may have adverse impacts on biodiversity and human health. It is important to point out two major considerations about the implementation of the Protocol. The first one is that pharmaceuticals, LMOs destined for contained use, or in transit to a third country are exempt from the requirements set by the Protocol. The second consideration is that the Protocol establishes simplified procedures for LMOs intended for direct use as food or feed, or for processing.

For banana breeding research the most significant question is whether or not the products from techniques used in banana breeding will be classified as LMOs. Currently this is not the case, but there may be local or regional policies and laws that may affect this status. For example, proposition 27 was submitted for voting by the citizens of the state of Oregon in the United States. This proposition would have mandated labeling of food in order to include information about whether it contained LMOs. The problem with this proposition is that the definition of what constitutes an LMO is so broad that crop varieties created using most current techniques would be classified as an LMO. This proposition was defeated by a wide margin in the state elections. However, a scenario may occur where a country in Europe or elsewhere may adopt a similar labeling policy, and exporting countries from Developing Countries sensitive to this issue, may need to comply with this regulation.

ISNAR has completed two major studies examining national biosafety systems in Egypt and Argentina. Two additional studies in Kenya and Uganda are currently underway. The objectives of these studies are to assess biosafety policies efficacies, develop recommendations for biosafety system's operation and identify areas where ISNAR and other international providers may assist further. Important lessons from the Egypt and Argentina studies are that in both countries unpaid volunteers are implementing national biosafety systems and that the review processes in these countries tended to concentrate on risk.

After examining the Egypt and Argentina experiences, ISNAR determined the need to have a conceptual framework to help countries design and implement their own biosafety regulatory system. Because of differences in risk preferences, agro-ecological, social and political conditions it was determined that there is no single best approach to the design and implementation of biosafety regulations.

However, there were 6 common elements that became the components of a biosafety decision framework developed by ISNAR and partners. These 6 components are:

1) National policies, strategies & research agendas
2) National inventory & evaluation
3) Scientific knowledge, skills & capacity base
4) Development of regulations
5) Implementation of regulations
6) Crosscutting issues

The National Policy and Inventory constitute the foundation of ISNAR's biosafety decision framework. Knowledge of these two components help frame the questions and key decision points to be considered during the implementation phase of a country specific biosafety system. Scientific knowledge, skills, and the capacity base to perform appropriate biosafety processes will demand discussion of alternatives and their associated trade-offs. These components eventually converge into three crosscutting elements: a) Transparency, b) Public participation and c) Human, financial and infrastructure resources. The success and credibility of a regulatory system will be intricately related to these three components.

The process has to be transparent by clearly indicating why and how products are regulated and how decisions are made. In addition, the public needs to participate in the evaluation of the safety of a particular technology. Critical decisions have to be made to determine what opportunities the public will have to voice its concerns and opinions and at what level of decision making. Finally, all of the components of a regulatory process are predicated on the availability and quality of human, financial and infrastructure resources. The ISNAR conceptual framework is not a definitive how-to guide for building a national biosafety system. It is a tool for building capacity in countries as they develop or re-evaluate their biosafety systems. Further details about the ISNAR Biosafety Conceptual Framework can be found on ISNAR's Briefing Paper 57 "A Conceptual Framework for Implementing Biosafety: Linking Policy Capacity and Regulation" in http://www.isnar.org. Or alternatively at ISNAR-FAO Decision Support Toolbox for Biosafety Implementation in (http://www.isnar.cgiar.org/ibs/biosafety/index.htm).

VARIETY CHOICE AND ATTRIBUTE TRADE-OFFS IN HOUSEHOLD PRODUCTION MODELS: THE CASE OF BANANAS IN UGANDA

Svetlana Edmeades, Melinda Smale and Mitch Renkow

The purpose of this research is to contribute to the understanding of farm-level determinants of farmers' choice of banana varieties[1], including both traditional and improved types. Adoption of agricultural innovations is a widely studied farm-level decision in both developing and developed countries. Understanding the underlying determinants of the adoption decision is a challenging task, to which an extensive economics literature has been devoted over the past 50 years. The seminal work of Griliches' (1957) in the development of an econometric model of hybrid maize diffusion in the U.S. corn belt was succeeded by other theoretical models and a plethora of empirical studies during and following the "green revolution" of the 1970s (see reviews by Feder, Just, and Zilberman 1985; Feder and Umali 1993). Different theoretical approaches to understanding farmers' motivations and hypotheses about their adoption decisions have been proposed and tested econometrically over the decades, each with its own strengths and weaknesses.

Since the focus of earlier studies was on innovations, such as higher-yielding varieties, and many were undertaken in the context of commercialized agriculture, theoretical frameworks often embodied the assumption that farmers maximized profits, their seed and other complementary inputs were well-delivered by traders or government services, and their outputs were tradable on markets. Emphasis was placed on how differences among farmers and their resource endowments explained adoption choices or how constraints in their access to credit or to complementary inputs, such as water or fertilizer, impeded their ability to benefit from innovations. Where attributes of varieties were treated in models of farmer decision making, these were typically limited to agronomic characteristics such as the mean and variance of grain yield, or yield response to fertilizer and water.

Recognition that in most developing countries farm production is organized within a household whose members produce partly for their own consumption and partly for sale, by combining both their own resources and purchased inputs, led to the elaboration of the agricultural household model (Singh, Squire and Strauss 1986). Implicit in this approach is the notion that

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[1] In the context of this research, variety can be understood as a locally named variety, as a biologically unique variety (cultivar) or as a genetically unique variety (genotype).

when some of the goods produced by households are not traded on the market, preferences over consumption goods cannot be separated from production choices. That is, if households cannot rely on markets to provide them with the consumption items that they need or consider important, production within their farm household must be organized to assure its provision. If we think that preferences are ordered over the attributes of goods rather than the goods themselves, then the consumption attributes of varieties may also affect adoption choices.

Relatively little of the economics literature on variety adoption has treated the specific attributes of varieties directly (for example Adesina and Zinnah 1993; Baidu-Forson, Ntare and Waliyar 1997). The analytical goal of the present research is to investigate the consumption and production attributes of banana varieties as factors affecting farmers' variety choices, controlling for other relevant factors, such as the availability of human and physical capital and the institutional and agro-climatic environments in which households make their decisions. The analytical framework must therefore enable us to test the importance of attributes while controlling for other explanatory factors in the context of an econometric model.

The theoretical approach is to model the role of variety consumption and production attributes (Lancaster 1966; Ladd and Suvannunt 1976) within a household production framework (Strauss 1986; Sadoulet and de Janvry 1995). This household production framework, as compared to a profit maximization framework, better represents decision making in developing countries where members of the farm household organize their labor time and other inputs in complex ways, producing partly for their own consumption and partly for sale. Implicit in this approach is the notion that preferences over consumption goods cannot be separated from production choices due to market or other imperfections. If we think that preferences are ordered over the attributes of goods rather than the goods themselves, then the consumption attributes of varieties, such as their suitability for making various banana productions, may also affect adoption choices.

Recognizing farmers' perceptions of variety attributes in this framework allows for the formulation of theoretically-based hypotheses about factors influencing adoption of new banana varieties that can be tested empirically using econometric analysis. The relative importance of attributes and the extent to which farmers' perceive that they are provided by recognized banana varieties can be elicited from banana-growing households using ranking or rating methods. Responses can then be used to predict adoption of improved varieties with single or multiple genetic traits (attributes), while controlling for other relevant physical and economic factors. For

example, other relevant factors are known to include the social and economic characteristics of the farm household and its members, the state of market infrastructure where they farm, and the costs of their transactions in banana markets, as well as the quality of soils and topography in their banana plots.

This research is designed not only to advance economic methods but also to address an important practical problem. In recent years there have been significant changes in the location and intensity of banana production in Uganda. Geographic shifts in production away from traditional areas and overall reduction in the volume produced have been identified, preferences for growing non-traditional banana varieties have been observed, and the incidence of pests and diseases has become an important element in farm-level production decisions. Understanding the role of banana attributes and integrating them into an economic model may provide the key to identifying the reasons for the observed changes in banana production and can subsequently be used to predict both the types of new banana varieties that are most likely to be adopted and the types of farmers most likely to adopt them. Thus, the practical goal of this research is to provide banana researchers in Uganda with additional insights into farmer decision making that they can use in setting research priorities. Since the data collection necessary to conduct the analysis must be statistical, the descriptive data will also provide a baseline for monitoring the adoption and impact of future banana innovations.

In summary, the research seeks to (1) identify the factors that encourage and constrain the adoption of new banana varieties; (2) profile the characteristics of the farmers most likely to adopt new banana varieties; and (3) provide insights for scientific researchers concerning the attributes most important to different types of farmers. The present research is associated with other economics research undertaken on this project. The farm household analysis provides parameter estimates to calibrate the economic surplus model for estimating the *ex-ante*, national economic impact of banana innovations. At the same time, the sampling frame and model development will be assisted by a geo-referenced database currently assembled for that analysis.

REFERENCES

Adesina, A. and M. Zinnah. 1993. Technology characteristics, farmers' perceptions and adoption decisions: A tobit model application in Sierra Leone. *Agricultural Economics* 9 (4): 297-231.

Baidu-Forson, J. B.R. Ntare, and F. Waliyar. 1997. Utilizing conjoint utility analysis to design modern crop varieties: empirical example for groundnut in Niger. Agricultural Economics 16: 219-226.

Griliches, A. 1957. Hybrid corn: An exploration in the economics of technological change. *Econometrica* 25(4): 501-522.

Feder, G., Just, R.E., and D. Zilberman 1985. Adoption of agricultural innovations in developing countries: A survey. *Economic Development and Cultural Change* 33(2): 255-298.

Feder, G. and D. Umali. 1993. The adoption of agricultural innovations: A review. *Technological Forecasting and Social Change* 43: 215-239.

Ladd, G. and V. Suvannunt. 1976. A model of consumer goods characteristics. *American Journal of Agricultural Economics*: 504-510.

Lancaster, K. 1966. A new approach to consumer theory. *The Journal of Political Economy* 74 (2): 132-157.

Sadoulet, E. and A. de Janvry. 1995. *Quantitative development policy analysis*. Baltimore, M.D., USA: The Johns Hopkins University Press.

Singh, I., L. Squire, and J. Strauss (ed.). 1986. *Agricultural Household Models: Extensions, Applications, and Policy.* Washington,D.C., and Baltimore, M.D.: The World Bank and Johns Hopkins University Press,

Strauss, J. 1986. The theory and comparative statistics of agricultural household models: a general approach. In *Agricultural household models: extensions, applications and policy*, ed. Singh, L. Squire and J. Strauss. Baltimore and London: The John Hopkins University Press.

MARKET ACCESS AND BANANA PRODUCTION: THE CASE OF CENTRAL AND SOUTHWESTERN UGANDA

Fredrick Bagamba

Banana production provides suitable options for subsistence and income generation in the East African Mid- and high elevation areas. In Uganda, production has been on the decline in the central area, which is the traditional growing region, and increasing in the southwest of the country. Despite the decline in the central region, expenditure on bananas is still higher than on other food crops, implying that market access is not the driving force behind farmers' decision to reduce banana production in favor of annual crops in central Uganda (UNHS 1994). Limited access to factor markets (labor, land and credit) is hypothesized to be one of the major reasons behind decline in banana production. Biophysical factors, including pests, diseases and soil degradation have been reported to play a key role in banana production decline in central Uganda (Gold et al. 1999). On the other hand, increased access to product markets contributed to an increase in production in southwestern Uganda.

The aim of this study is to analyze the development of banana production in Uganda, in particular, the household response to changes in commodity and factor prices and access to off-farm employment opportunities. Specifically, the study will be carried out to:

- Analyze the supply and demand for farm labor in central and southwestern Uganda
- Analyze the effect of off-farm employment on resource utilization, crop and banana variety choice and intensification
- Evaluate the impact of selected policy instruments (new technology, factor and product prices, and infrastructure development) on banana production and soil quality/soil degradation.

A bioeconomic model will be formulated to analyze the likely impact of selected policy instruments (technology, product prices, input prices, infrastructure and credit supply) on banana production and soil quality/degradation. Bioeconomic modeling is at the interface between social and biophysical sciences, enabling the accommodation of biophysical data in economic analysis. It involves a formulation of a production function that captures on the one hand the interaction between biological processes and environment and on the other hand the choice between different

technologies and allocation of production factors. Whereas economists use the production function to analyze household decisions as regards technology choice and input levels to achieve desired outputs, agronomists use the production function to analyze the processes that determine yield and externalities. The bioeconomic model developed here is based on the household production framework.

HOUSEHOLD MODEL

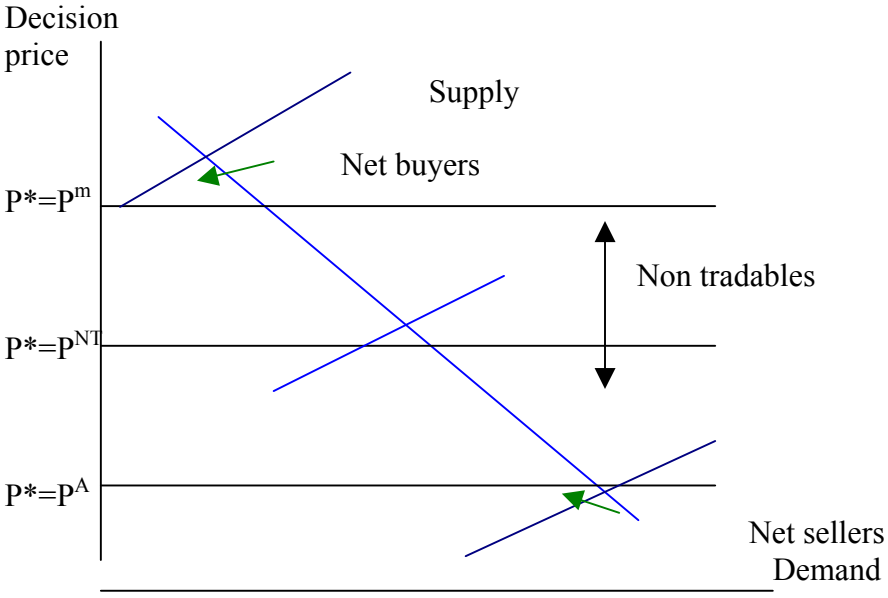
Under perfect market conditions, production and consumption decisions are assumed to be made separately. On the production side, the household chooses the levels of labor and other variable inputs that maximize farm profits given the current configuration of capital and land, and an expenditure constraint. Optimal input choices depend on input prices, output prices, and wage rates, as well as the physical characteristics of the farm technology.

On the consumption side, the household maximizes utility over consumption goods and leisure time in the presence of a budget constraint and a time constraint. Optimal choices depend on the prices of the goods consumed, wages, total time available, and the characteristics of the family members who are consumers and workers, such as their gender, age, ethnicity, income and asset levels.

In developing countries, perfect market conditions rarely exist. Not all products and factors of production can be traded on markets because of the high costs of transactions, shallow markets, and risks and uncertainty about infrastructure and weather conditions. Limited access to credit is a frequent cause of market failure, as the household cannot satisfy an annual cash income constraint, with expenditure greater than revenue at certain periods of the year (Sadoulet and de Janvry 1995).

In these conditions, the purchase price is higher than the selling price. Production and consumption decisions are no longer taken in response to given, exogenous prices that are the same for all households. Prices (p^*) are endogenized, being determined by the household's demand and supply conditions (Figure 1).

Figure 1--Household supply and demand under market imperfections



When markets are missing or not perfectly functioning, consumption decisions affect production decisions. Production choices depends on the price of consumer goods and household preferences (de Janvry et al. 1991; Strauss 1986). The quantity produced for a non-tradable commodity corresponds to an unobservable internal shadow price, the decision price $\overline{p}_i$, at which supply equals demand. Under these conditions, the factors that affect consumption choices, including the characteristics of the farm household, also affect production choices.

ADAPTATIONS OF THE HOUSEHOLD MODEL IN THIS STUDY

In the basic household model, soil quality and technologies are considered exogenous factors which do not change with time. In this study, the model is extended to have soil quality affected by farmers' decisions, since quality declines in terms of soil nutrients and soil organic matter during the production process. Soil quality is affected by two types of inputs, yield increasing inputs (such as new banana varieties) and soil conserving inputs. The model is also adapted to take into account changes in soil quality. Production levels depend on soil quality and levels of yield increasing inputs, as well as the level of technology, which changes over time. Lastly, farmers are assumed to consider soil degradation in future periods in their current decision making.

The adapted household model is used to analyze (i) the effect of price changes, (ii) the effect of technology change and (iii) the effect of market participation on the choice of banana varieties, banana production, intensification and soil quality.

Both econometric techniques and mathematical programming will be used in the empirical estimation. However, econometric analysis suffers from a number of limitations. These include (i) difficulty in specifying the functional forms, (ii) difficulty in getting the required data and (iii) capturing the changes in soil quality as a result of production would require long time series (panel) data which is costly to collect in terms of time and money. A mathematical programming approach is proposed for this study, though the parts of the model will be estimated econometrically. The model is optimized using non-linear programming. The advantages of mathematical programming include: (i) it enables the prediction of break points in trends, (ii) complex relationships related to technology choice can easily be managed and (iii) there is no need for panel data. Nutrient and soil organic matter (SOM) balances will be estimated using the NUTMON program. Econometric analysis will be done using the Eviews program. Optimal solutions from a dynamic non-linear programming model will be generated using the GAMS computer software (Brooke et al. 1988).

REFERENCES

Brooke, A., D. Kendrick and A. Meeraux. 1988. *GAMS: A user's guide*. Redwood city, Calif., USA: Scientific Press.

de Janvry, A., M. Fafchamps and E. Sadoulet. 1991. Peasant household behaviour with missing markets: some paradoxes explained. *The Economic Journal* 101:1400-1417.

Gold, C.S., E.B. Karamura, A. Kiggundu, F. Bagamba and A.M.K Abera. 1999. Geographical shifts in highland banana production in Uganda. *The International Journal of Sustainable Development and World Ecology* 6: 45-59.

Kruseman, G. and J. Bade. 1998. Agrarian policies for sustainable land use: bio-economic modeling to assess the effectiveness of policy instruments. *Agricultural Systems* 56: 465-481.

Sadoulet, E. and A. de Janvry. 1995. *Quantitative development policy analysis*. Baltimore, M.D., USA: The Johns Hopkins University Press.

Strauss, J. 1986. The theory and comparative statistics of agricultural household models: a general approach." In *Agricultural household models: extensions, applications and policy*, ed. Singh, L. Squire and J. Strauss. Baltimore and London: The John Hopkins University Press.

UNHS. 1994. *Uganda National Household Survey, 1993/94*.

INFORMATION ABOUT FARMERS USE OF BANANA VARIETIES IN IFPRI'S UGANDA POLICY DATABASE

Melinda Smale and Ephraim Nkonya

In 1999 and 2000, IFPRI and national partners implemented a sample survey as part of a project to identify policies to encourage sustainable land management practices. The sampling frame for this research was stratified by factors hypothesized to affect the direction of changes in livelihoods strategies of smallholder farmers in Uganda, or "development pathways" (Pender et al. 2001; Sserunkuuma et al. 2001). The survey instruments included extensive plot, household, and village schedules, and variables related to quantitative and qualitative measurement in the sustainable livelihoods framework. Some banana-specific information was collected as part of this survey, such as named varieties and areas cultivated, production, and prices.

A preliminary assessment was made of the suitability of this comprehensive household database for analyzing farmers' decisions about banana varieties and adoption potential. Additional analysis of this database may also provide insights concerning the factors influencing the farmers' decisions about named banana varieties and the complexity of cultivation patterns. However, it is likely that the sampling scheme for social science research on banana will need to differ slightly from that used in IFPRI's policy project, and a number of key banana-related parameters will require more detailed investigation.

SAMPLING FRAME

Six agricultural productivity zones were defined based on potential for perennial crop production, average length of growing period, rainfall pattern (bimodal vs. unimodal), maximum annual temperature, and altitude[2]. Regions were also classified according to the level of market

[2] Of all of the possible outcomes in the stratifications scheme only seven zones were unique: the high potential bimodal rainfall area at moderate elevation (the Lake Victoria crescent), the medium potential bimodal rainfall area at moderate elevation (mot of central and parts of western Uganda), the low potential biomodal rainfall area at moderate elevation (lower elevation parts of southwestern Uganda), the high potential biomodal rainfall area in the southwestern highlands, the high potential eastern highlands, the medium potential unimodal rainfall region at moderate elevation (much of northeastern Uganda). Unimodal low and unimodal medium potential regions were combined since similar development pathways and land management practices are pursued in these areas (Pender et al. 2001).

access and population density. Market access was classified according to the measure of potential market integration estimated by Wood et al.(1999), who weighted the travel time from any location to the nearest five towns or cities by the population of the towns of cities. Areas of high market access are mainly in the Lake Victoria region, the densely populated southwestern and eastern highlands, and parts of the north and west close to major roads and towns. Population density was classified as low or high relative to the average rural population densities of parishes in the 1991 census of Uganda.

These three "generic" factors are also those that economists have long associated with the prospects for crop variety change in agriculture, at least for major "green revolution" cereals like rice and wheat. Population density is related to the ratio labor to land, and rising ratios may induce technical change in agriculture (Boserup 1965). The rising ratio of labor to land has been a major factor explaining the transition from low-yield, land-extensive cultivation to land-intensive cropping (Hayami and Ruttan 1985; Pingali and Binswanger 1987). The genetic changes embodied in seed or planting material constitute one type of intensification, which refers more broadly to the increase in output per unit of land (yield) used in production.

The impact of market access in crop variety change is known to be important but depends on the crop, time period, and context. For a cereal such as maize, where improved seed types are predominantly hybrids and private companies dominate the commercial seed industry rather than public institutions, the importance of market access has been critical for adoption (Morris 1998). Banana planting material may be transferred primarily from farmer to farmer in informal markets, though access to the physical infrastructure and information may facilitate these exchanges. In general, market access is a major determinant of the comparative advantage in producing a crop given agricultural productivity potential, promoting production for cash where price ratios are favorable. Yet changes in commodity prices have ambiguous effects on some investments such as those related to soil conservation, and may increase negative effects associated with the demand for agricultural chemicals or water (Pender et al. 2001).

Stratification serves both sampling efficiency and analytical purposes for hypothesis testing. We might ask whether this stratification scheme is meaningful for the population parameters of interest in research focused more specifically on banana. First, areas with high agricultural productivity potential for one crop may not be classified that way for another. Preliminary analysis by principal investigators of IFPRI's Uganda policy project suggests that

agricultural productivity zone was not significant in explaining the share of banana in total production. Second, it will be important to consider the incidence and distribution of banana pests and diseases in the research currently being designed. Scientists in the banana improvement program are targeting resistance traits and the benefits farmers expect from adopting new varieties will depend very much on the disease pressure in the area. On the other hand, the relevance of testing hypotheses concerning markets is clear for this bulky, perishable crop for which we know relatively little about exchange of planting material among farmers and communities.

SURVEY INSTRUMENT

Within each of the 107 communities selected in 16 development domains, a survey was conducted with a group of individuals representing the community to collect information on the concerns and priorities of community members, population change, access to infrastructure services, presence of activities and organizations, land rights and restrictions, and collective resource management. A second schedule elicited information on livelihood strategies; perceptions of changes in welfare and natural resource conditions; land use; factor markets; crop and livestock management; production and commercialization. The household schedule included detailed information on the human capital (training, education, membership in organizations); income sources and levels, debt and asset position of the household; labor and animal hire; farm production and distribution of production, as well as plot-specific production data.

Variables included in this survey have been operationalized from concepts included in the Sustainable Livelihoods Framework. They are likely to encompass most of the major economic and physical parameters of interest in our research. However, the farm-level modeling approach envisaged by Edmeades et al. (in this workshop) requires some particular attention to variables that are not included in this otherwise comprehensive database.

For example, in the Uganda policy questionnaire, banana varieties were recorded by name. As is known in Uganda for banana, and in other countries for other crops, names are not unique, and differences in name may not represent genetic differences as measured by either agro-morphological descriptors or molecular analyses. In general, to understand either the prospects for adoption or the potential impact of adoption on variety diversity and diversity of uses, we also need to be able to relate the units farmers choose to grow and manage to those

recognized by taxonomists and geneticists. This linkage must be made in the statistical sample. That is, the descriptors and/or other physical samples that can be used to classify types must be recorded for named varieties actually grown by the households in the community during survey implementation.

To test hypotheses about the relative importance of agronomic (bunch size, disease resistance) versus consumption attributes (beer, *matooke*) data will also be needed on farmers' perceptions of the extent to which the banana varieties available to them provide these attributes. Finally, the measurement of the share of planted material by banana types must be accomplished with care, since this is the dependent variable in the farm level analysis. Given the degree of intercropping, some combination of area measurement with GPS units and mat counting, combined with data on spacing, will be necessary in order to represent the density and numbers of banana types and their distribution across farms and communities.

DESCRIPTIVE DATA ON BANANA CULTIVATION PATTERNS

Selected social and economic characteristics of communities surveyed are shown in Table 1. Nearly two-thirds of these households are reported as having inadequate food, with about one-thirds of households with children eating less than two meals per day. Though the range in land tenure arrangements is considerable, on average about half of the village land is held under customary private tenure, and half of households own land under freehold.

Mean fallow periods have declined from only two years to less than one, and the longest fallow reported was six years, suggesting a high rate of population pressure on arable land. Village representatives estimated that an average of 63% of households had used one type of improved seed or another, and this percentage is reported to have increased over the previous decade. In over 95 percent of villages, banana yields are perceived to have declined over the past decade, and in 90 percent of villages, soil fertility is thought to have decreased. Market access has improved since 1990, as measured by a reduction in the average distance of about 1 mile to the primary banana market. Credit is universally available, in one form or another.

In the community survey, respondents were asked to list only the three most important crops grown. In 84%, of 90 of the 107 survey villages, bananas were listed among the three. Among these, the most frequent number of named types reported at the village level was three, with up to five types grown. The average number of banana types per community (2.8) was the

highest reported for any of the major crops, though banana was cited as a major crop less frequently than beans, maize, sweet potato, and cassava.

The mean number of named types or varieties grown by farm households is also greater for banana (2.3) than for other crops at the farm household level. On average, households grew 12 crops with a maximum of 58 total crops and named varieties. Fifty-eight percent of the 451 households surveyed (261) grew bananas. The list of named varieties found among households sampled differs somewhat from those identified at the village level, as would be expected, though the total numbers are not much larger and there are clearly some duplications or spelling differences for the same names. Table 2 lists varieties named by farmers according to their genome, clone set and use. The results illustrate the difficulty of identifying types through name only and the importance of understanding the relationship between farmer and scientist taxonomies in analyzing the variety choice decisions of farmers.

Exotic beer bananas Kayinga (ABB), Kivuvu (spelled Kivulu, ABB), Kisubi (AB), as well at the roasting banana (Gonja, AAB or ABB), and the tetraploid FHIA hybrids were identified in the household survey. Of these, Kayinga and Kisubi were among the highest among all types in terms of mean kilograms sold by the household and value of production. On average, Kibuzi (AAA-EA) was the largest producing type with the largest value of production, as well as largest volumes given away or sold. Most of sales occurred on farm, followed by nearby rural markets. Overall, 15 percent reported using new types. This finding is significant for adoption, since it indicates that planting materials are indeed “introduced” by or exchanged among farmers. The incidence is much higher in the household survey than was apparent in the results of the community survey, highlighting the limitations of small group reporting for quantitative data on variety use.

Table 1--Selected social and economic characteristics of surveyed communities

Village characteristic	Mean across villages	SDev	Range
Number of households in 1999	155.62	145.57	23-980
Reported percent of households without adequate food	63.9	27.7	10-100
Reported percent of households with children eating less than 2 meals per day	34.36	33.09	0-100
Percent village land held under customary private tenure	49.6	48.23	0-100
Percent households owning land under freehold tenure	50.47	48.76	0-100
Average fallow period in late 1980s (years)	1.99	1.81	0-6
Average fallow period in late 1990s (years)	0.68	0.98	0-6
Reported percent of households using improved seed (any crop)	62.95	38.14	0-100
Proportion of banana crop sold in 1999	46.71	28.18	0-100
Distance to primary banana market in 1990 (miles)	3.34	3.56	0-16
Distance to primary banana market in 1999 (miles)	2.48	2.25	0-7
Number of named banana types	2.8	1.26	0-5
		Percent of communities	
Citing banana as one of three major crops		84.11	
Perceived declining trend in banana yields since 1990		95.56	
Perceived decline in soil fertility		89.72	
Increased use of improved seed (any crop)		60.00	
Formal credit sources available in village		100.00	
NGO/Microfinance credit available in village		100.00	
Informal credit available in village		100.00	

N=107 communities.

Table 2--Banana cultivars named by farmers and classified by Karamura (1998)

Name reported by farmer	Genome Group	Subgroup	Clone set if East African highland banana	Use
Agogo	unknown	unknown	unknown	unknown
Agugi	unknown	unknown	unknown	unknown
Biri	unknown	unknown	unknown	unknown
Bitiga	unknown	unknown	unknown	unknown
Bogoya (Gros Michel)	AAA	Gros Michel	-	Dessert (d)
Embire/Embidde	AAA-EA	L-M	Mbidde	Beer(b)
Enyamwonyo	AAA-EA	Lujugira-Mutika(L-M)	Nfuuka	Cooking(c)
FHIA 1	AAAB			
Gonja	AAB	Plantain	-	roasting (r)
Gonzowa	AAA-EA	L-M	Nakitembe	c
Kabalagala, Ndiizi, Ndiika, Kanana, Nakazungu	AB	Ney Poovan	-	Dessert (d)
Kamashi	unknown	unknown	unknown	unknown
Katetema	AAA-EA	L-M	Nfuuka	c
Kayinja	ABB	Pisang Awak	-	b
Kibiddebidde	AAA	Green Red	-	Dessert (d)
Kibiddebidde	AAA-EA	L-M	Nfuuka	c
Kibuzi	AAA-EA	L-M	Nakabuluu	c
Kidoozi	AAA-EA	L-M	Nakitembe	c
Kisansa/Namayovu	AAA-EA	L-M	Nfuuka	c
Kisubi	AB	Ney Poovan	-	b
Kivuvu	ABB	Bluggoe	-	c, b
Likhago	AAA-EA	L-M	Nfuuka	c
Lisindalo	AAA-EA	L-M	Nakitembe	c
Malira	AAA-EA	L-M	Nakitembe	c
Mangomo, nanjomo	unknown	unknown	unknown	unknown
Manjaya	AAB	Plantain	-	roasting (r)
Mbidde, Mbiire type	AAA-EA	L-M	Mbidde	b
Mbwazirume	AAA-EA	L-M	Nakitembe	c
Mukazi Mugumba	AAA-EA	L-M	Nfuuka	c
Mulule,Mutule, Budwale, Mudwale	AAA-EA	L-M	Musakala	c
Musa	ABB	Pisang Awak	-	b
Musakala	AAA-EA	L-M	Musakala	c
Mushana	unknown	unknown	unknown	unknown
Muvubo	AAA-EA	L-M	Musakala	c
Muziranyama	AAA-EA	L-M	Nfuuka	c
Nabusa	AAA-EA	L-M	Nfuuka	c

Nakabululu,Nyakabululu, Zimbululu	AAA-EA	L-M	Nakabululu	c
Nakawere	AAA-EA	L-M	Nfuuka	c
Nakijumbi	AAA-EA	L-M	Nfuuka	c
Nakinyika	AAA-EA	L-M	Nfuuka	c
Nakitembe	AAA-EA	L-M	Nakitembe	c
Nambogo	AAA-EA	L-M	Nfuuka	c
Namwezi	AAA-EA	L-M	Nfuuka	c
Nasaba	AAA-EA	L-M	Nfuuka	c
Nfuuka type	AAA-EA	L-M	Nfuuka	c
Ntika	AAA-EA	L-M	Nfuuka	c
Nyamongo, Mkago (general name for cooking banana)	AAA-EA	L-M	Nfuuka	c
Siira	AAA-EA	L-M	Nfuuka	c

REFERENCES

Boserup, E. 1965. *Conditions of agricultural growth*. Chicago: Aldine Publishing Company.

Hayami, Y. and V.W. Ruttan. 1985. *Agricultural development: An international perspective.* Revised and Extended Edition. Baltimore, M.D., USA: Johns Hopkins University Press.

Karamura, D. A. 1998. Numerical taxonomic studies of the East African Highland bananas (Musa AAA-East Africa) in Uganda. Ph.D. Thesis, University of Reading.

Morris, M.L. 1998. *Maize seed industries in developing countries*. Boulder: Lynne Rienner and CIMMYT.

Pender, J, P. Jagger, E. Nkonya, and D. Sserunkuuma. 2001. *Development pathways and land management in Uganda: Causes and implications.* Discussion Paper No. 85. Environment and Production Technology Division. Washington, D.C.: International Food Policy Research Institute

Pingali, P.L., and H.P. Binswanger. 1987. Population density and agricultural intensification: a study of the evolution of technologies in tropical agriculture. In *Population growth and economic development--Issues and evidence*, ed. D.G. Johnson, and R.D. Lee. Madison, Wisc., USA: University of Wisconsin Press.

Sserunkuuma, D., J. Pender, and E. Nkonya. 2001. *Land management in Uganda: Characterization of problems and hypotheses about causes and strategies for improvement.* Washington, D.C.: International Food Policy Research Institute.

Wood, S., K. Sebastian, F. Nachtergaele, D. Nielsen, and A. Dai. 1999. *Spatial aspects of the design and targeting of agricultural development strategies.* Environment and Production Technology Division Discussion No. 44. Washington, D.C.: International Food Policy Research Institute.

STRATEGIC *EX ANTE* EVALUATION OF THE POTENTIAL ECONOMIC BENEFITS OF IMPROVED BANANA PRODUCTIVITY

Stanley Wood

Designing worthwhile agricultural R&D initiatives requires some capacity to assess the potential benefits of R&D outputs relative to their cost. Study of the potential acceptance and impact of specific new technologies in communities and households is likely to provide the most reliable means of gauging those benefits at the local scale. However, it is unlikely that such studies can be carried out in all the potential communities where the new technology might provide significant impacts. It would also be valuable to test *a priori* what might be likely range of impacts for a number of different technology options using available information before conducting time-consuming and costly field surveys. And finally, we need to be able to assess some of the other positive and negative impacts of technology adoption that local surveys may shed little light on. Positive externalities include technology spillovers to geographic areas not intentionally targeted by the R&D investment, e.g., the acquisition and adoption of Uganda developed and funded banana germplasm by farmers in Kenya. Negative effects, from a producer perspective, include the downward pressure on prices caused by expanding output faster than demand. At an aggregate level new technologies are likely to bring economic benefits to consumers and to producers who are willing and able to adopt, but economic losses to those who are unable to do so. Uneven distribution of production and consumption patterns across social groups will therefore result in patterns of benefit distribution that may or may not be desirable with regard to the mandate of R&D funders. Thus, factors that effect the overall scale and distribution of economic benefits and losses associated with the adoption of new technologies are important in assessing the utility of R&D investments.[3]

In the INIBAP/IPGRI/NARO/IFPRI Regional Biotechnology program, of which the Uganda banana biotechnology study is a key component, IFPRI's DREAM (Dynamic Research Evaluation for Management) model is being used to perform the type of strategic technology evaluation outlined above. DREAM is multi-region, *ex ante* economic model that generates estimates of aggregate and distributional economic consequences of technical change (Alston et

[3] In a broader context the cost and benefit assessment should include valuation of the environmental impacts of new technology.

al 1995; Wood et al 2000). The model is being applied initially using district level biophysical, household, and market information to assess the potential payoffs to a number of banana biotechnology interventions (as yet not characterized). A number of the model parameters, most notably projected levels of technology adoption, as well as production and consumption responses to price changes (elasticities) will initially be estimated from available literature and expert judgment. But a unique aspect of the study is the complementary use of the *ex ante* model with on-farm survey work so as to gradually refine such parameters using empirical data. In this way, and because it is linked to a detailed georeferenced database, the DREAM analysis can help inform the design of field activities, extrapolate survey results, and improve the reliability of the DREAM analysis over time as the survey data is collected and interpreted. Thus, the likely aggregate impacts of R&D that is yet to be done will be assessed by a triangulation of complementary methods.

The baseline data being used for banana production and consumption are taken from the 1999/2000 Uganda National Household Survey (UNHS). The Uganda National Household Survey of 1999/2000 covers 10696 households (approximately 8400 crop households) and contains information on participation in banana production and consumption at the household level. The surveyed households are geographically referenced which allows for a relatively detailed overview of the spatial representation of banana production and consumption throughout Uganda. This complements the less extensive, but more in-depth information in IFPRI's own (450) household and (107) community surveys. The IFPRI survey data have been used extensively in designing the field survey work for this study. (See Figure 1.) Using the agricultural production data from the 1999/2000 UNHS we can calculate the total value of agricultural production and determine the share of that value that is drawn from banana production. These can be represented geographically to support analysis of spatial patterns of production. Figure 2 shows the shares of banana in total agricultural value of production at both household and district levels.

Figure 1--Sources and distribution of household survey data

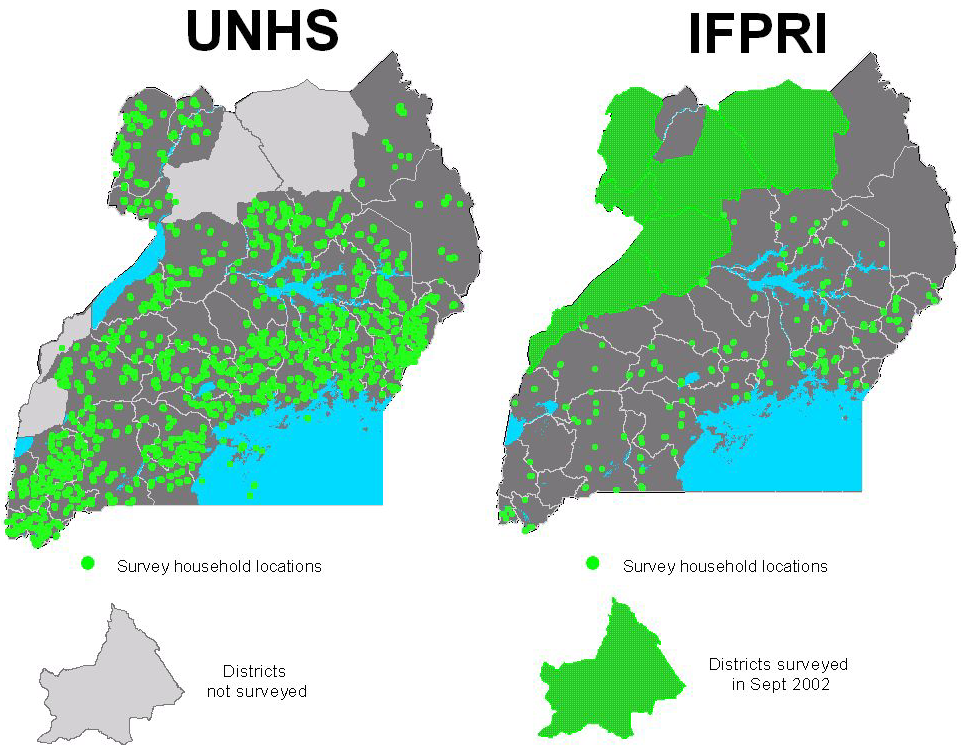
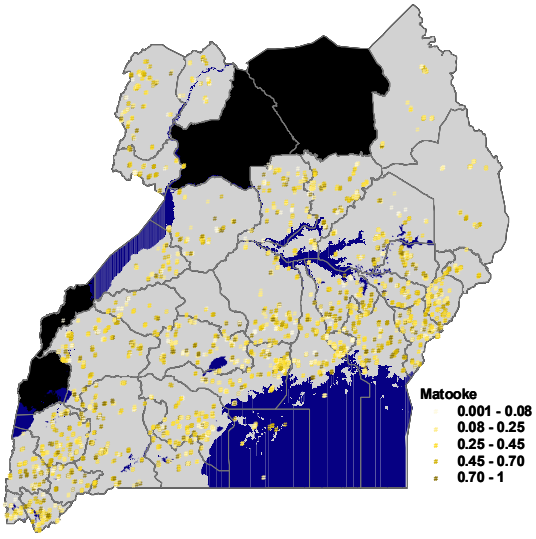
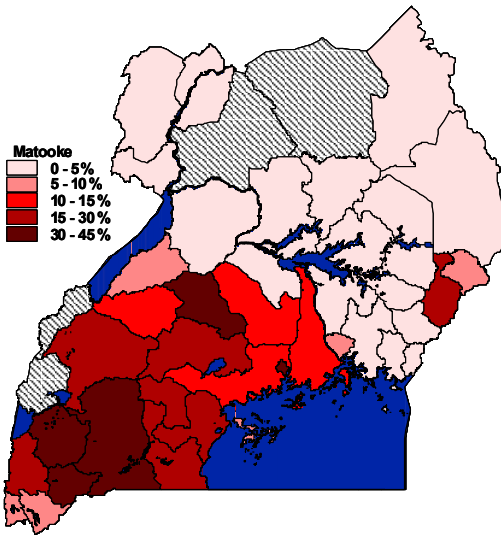


Figure 2--Banana share of the total value of agricultural production 1999/2000

(a) Household



(b) District



In the preliminary DREAM simulations performed to support this study we use Uganda districts as our unit of analysis (Figure 3). The base year production and consumption data are drawn from the UNHS data. We treat Uganda as a closed economy because little banana is traded outside Uganda, but we allow free trading among districts within Uganda. In practice, there exist different technology adoption profiles for different farm households as shown in Figure 4. While we currently have assumed a constant profile of likely banana biotech adoption for all producers, we will revise this over time, particularly as a consequence of data analyses from field survey. For example, better-off farmers with great access to market, information and resources are likely to adopt new technologies earlier and to a greater extent, while poorer, more remote poor farmers might be late adopters with lower adoption rates. Such multiple district and farmer "type" adoption profiles can be constructed within DREAM.

Figure 3--DREAM scenario screen: Preliminary banana simulations for Uganda

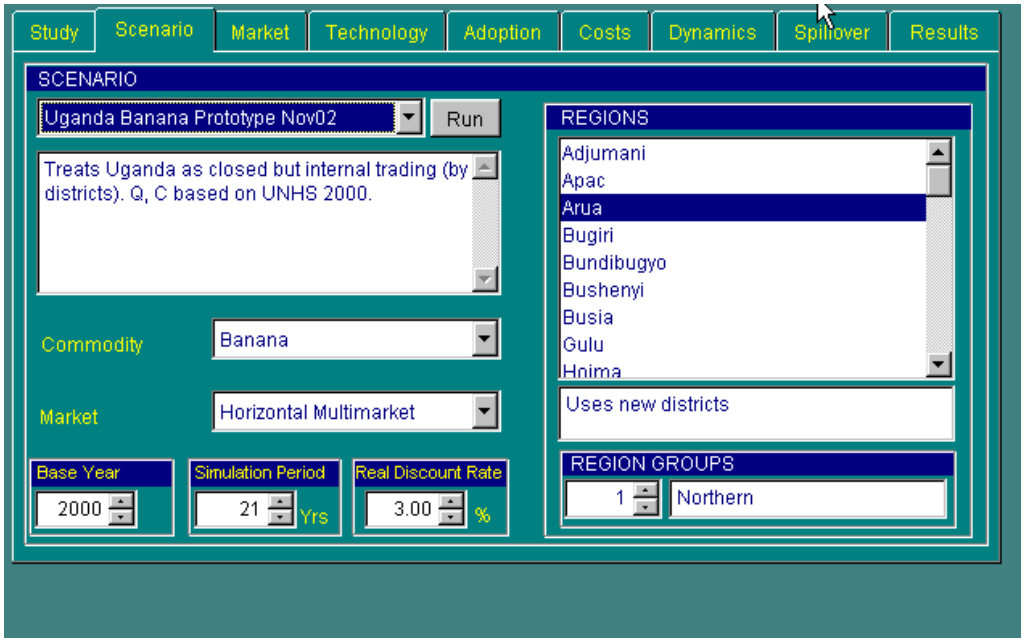
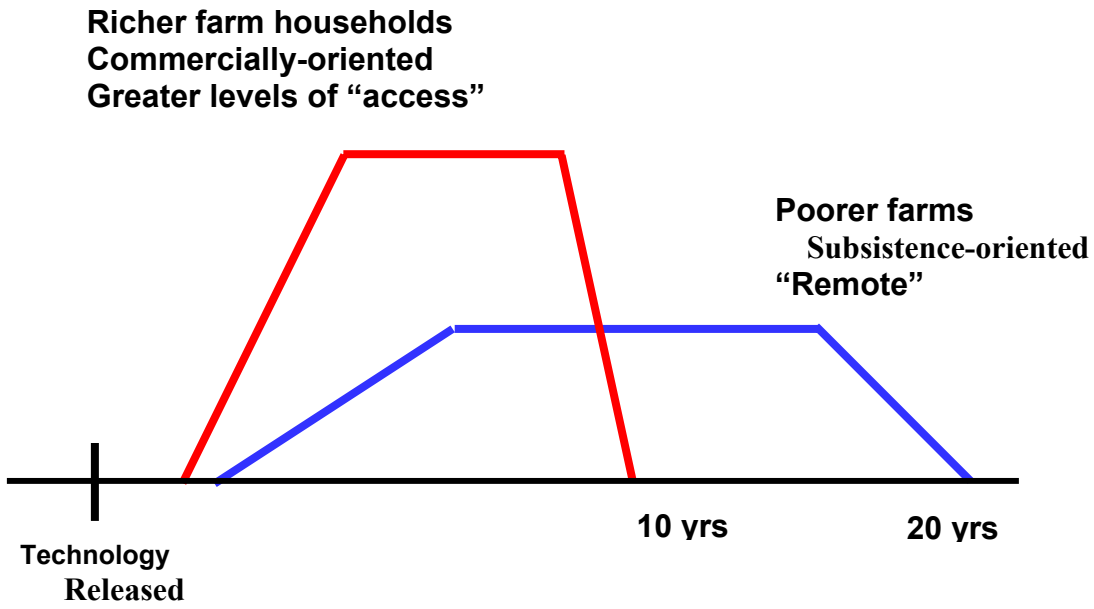


Figure 4 Stylized Adoption Profiles



DREAM simulates the shifts of market supply and demand over time. Supply shifts are attributable in whole or in part to the adoption of new technology, while demand shifts arise from

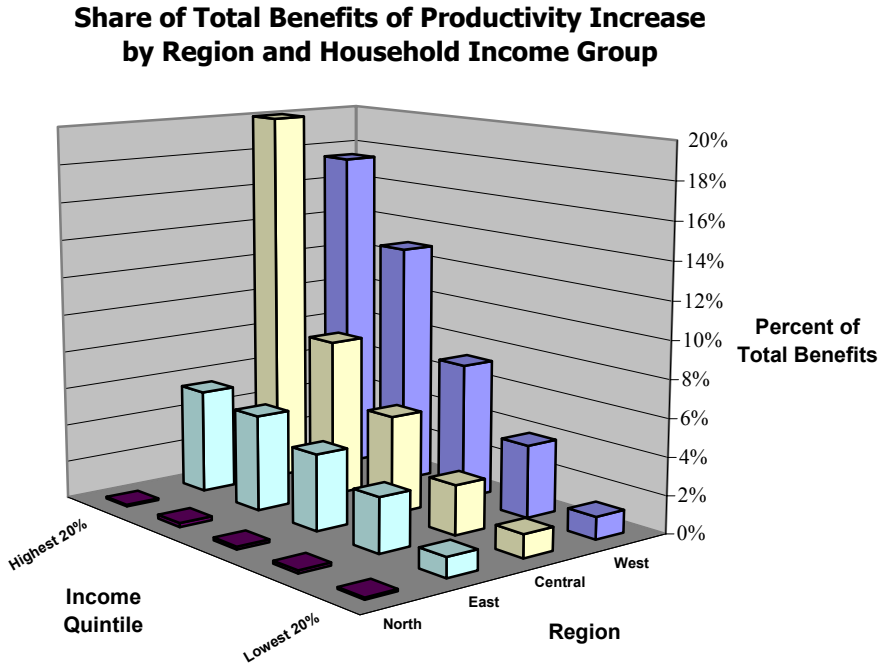
increasing population and income changes. The analysis is performed both "with" and "without" the technology intervention, and the resulting difference in production, consumption, and prices those two cases provides the basis for estimating the overall economic benefits (or losses) to the producers and consumers in each DREAM analysis unit (districts in the current model formulation).

The outputs from DREAM are the following:

- For each district and year
  - Change in prices ad quantities produced and consumed both with and without technology
  - change in value of production and consumption
  - change in quantity and value of trade
  - change in government income or expenditure (if taxes or subsidies specified)
- For each district and region for each year
  - Total Benefits (and cost) of R&D
  - Benefits for producers, consumers and governments
  - Benefits of local versus spillin technologies
- For each district and region over the simulation period (if R&D cost data is provided)
  - Net present value of benefits(B), costs(C), and B-C
  - B/C and Internal Rate of Return (IRR)

In the initial (and rather simplistic) set of simulations undertaken for this workshop, we assumed a 1% productivity increase in all districts in Uganda. Figure 5 shows the shares of total benefits of that single "benchmark" productivity increase by region and by household income group. Consumption expenditure quintiles are defined using expenditure data from the UNHS household data. As we can see, the potential benefits of (bio)technology-induced productivity changes are much larger in central and western Uganda than in Eastern Uganda, while North Uganda gains little. In addition, the gains to richer households (the upper two income quintiles) are about 3 to 5 times of those to relatively poor households (the lower two income quintiles). This begs important questions about the efficiency of banana technology as a means of targeting poverty alleviation efforts, and such questions and targeting options can be examined in this framework.

Figure 5--Regional and household income distribution of the total benefits of a constant (1%) increase in banana productivity in all banana producing districts



Finally, we are extending the analysis of economic impacts in this study through the use of a CGE (Computational General Equilibrium) model constructed to analyze aggregate and feedback effects across commodities and sectors, including employment, wages, poverty rates, transport costs, foreign exchange and trade. This CGE model has been developed by IFPRI with specific emphasis on a detailed treatment of the agricultural sector. The model includes 12 agricultural activities including matooke production, 7 industries (including coffee and cotton processing) and 6 services. It also divides Uganda's agricultural land into 6 agroecological zones. Initial runs show that an (arbitrary) 20% increase of banana productivity could (1) Reduce banana prices by 14 percent, (2) Increase overall household consumption by 1.2-2.0 percent (1.6-1.9 Urban poor, 2.4-3.0 Urban non-poor, 0.6-2.3 Rural), (3) Increase the costs of services, transport, and utilities by 1.5-3.5 percent, and (4) result in a -1 percent to + 2 percent change in the price of other commodities.

The approaches presented for Uganda are seen as prototypes for assessing strategic biotechnology R&D options on a sub-regional basis at a later stage in the project. However, there is still much to be done to improve, harmonize and calibrate the existing databases and analytical approaches before they can be applied across countries. Our tasks at this stage involve improved

characterization of banana production and utilization so as to establish norms to be used for further regional extrapolation. We must also review evidence and expert judgment on the scientific opportunities for biotechnology to overcome constraints as experienced by farmers, traders, and consumers, and to diversify utilization options, as well as gauge the extent to which expansion of output may effect banana prices both locally and nationally. Finally it is critical to assess evidence on the joint incidence and severity of pest and diseases (the primary target of planned biotechnology interventions).

These strategic approaches might be of great relevance to NARO within Uganda, while BARNESA would be instrumental in developing regional applications. The methods and outcomes proposed here might also make a significant contribution to the strategic planning and priority setting study currently being initiated by ASARECA. Undoubtedly, the combination of approaches being applied in this study is both challenging and exciting!

REFERENCES

Alston, J.M., G.W. Norton, and P.G. Pardey. 1995. *Science under scarcity: principles and practices for agricultural research evaluation and priority setting*. Wallingford, U.K: CAB International (CABI).

Wood, S., L. You, and W. Baitx. 2000. DREAM User Manual 2000. Washington, D.C.: International Food Policy Research Institute.

INTRODUCTION TO THE SUSTAINABLE LIVELIHOODS FRAMEWORK AND ITS SUPPLICABILITY TO AGRICULTURAL RESEARCH AND DEVELOPMENT

Ruth Meinzen-Dick

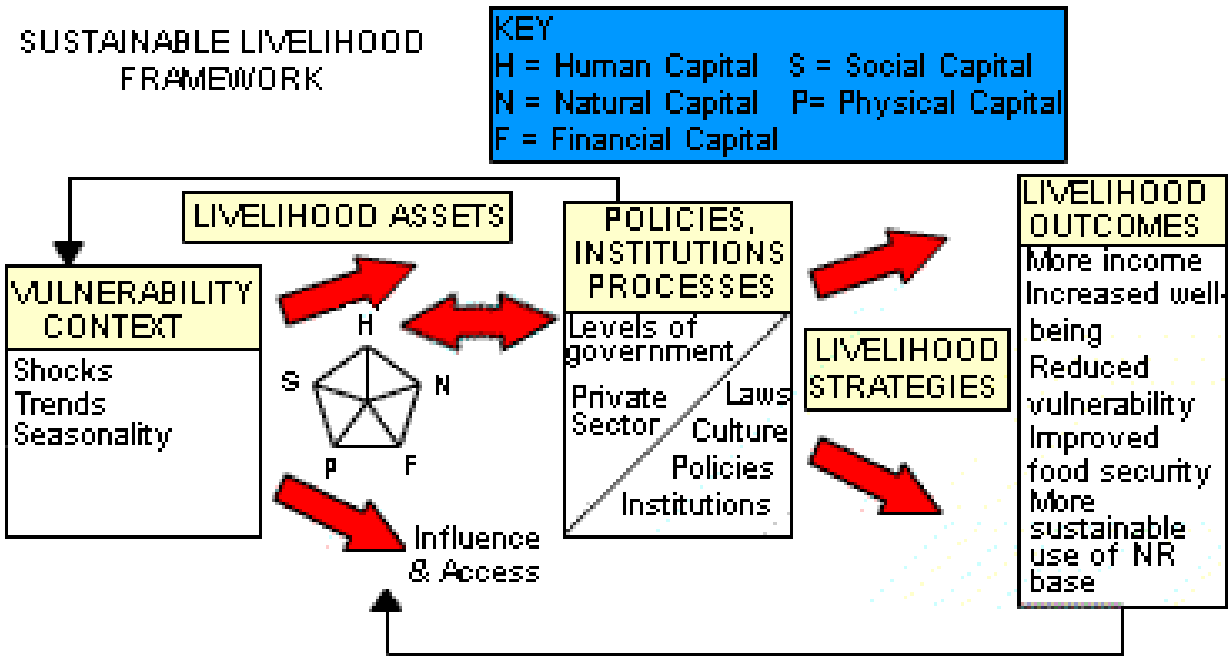
INTRODUCTION

The sustainable livelihoods framework comprises a conceptual approach that expands the standard understanding of poverty, commonly defined by income, nutrition and consumption, to encompass many other factors that poor people in different contexts define as contributing to their well-being. It introduces a dimension of time and vulnerability by asking the question are "tomorrow's poor" the same as "today's"? In the case of the current project to assess the "Impact of banana improvement on livelihoods in East Africa", the approach will be used to examine the ways in which an agricultural technology fits into the livelihood strategies of households or individuals with different types of resources, taking account of sociological differences that may exist between gender and ethnic groups.

The application of the sustainable livelihoods framework is wide-ranging and the approach has been adopted by various organizations, including the UK's Department for International Development (DfID), CARE, the United Nations Development Programme (UNDP) and Oxfam. The International Food Policy Research Institute (IFPRI) and the Standing Panel on Impact Assessment (SPIA) of the Consultative Group on International Agricultural Research (CGIAR) also launched in 1999 an initiative to analyze, through the sustainable livelihoods framework, the impact of introduced technologies of the CGIAR centers on poverty.

ELEMENTS OF THE APPROACH

Figure 1--Illustrating the elements of the sustainable livelihoods framework



The **Vulnerability context** represents the element of change that may be brought about by trends, for instance, in demographics, economics and technology, or by shocks in health or the environment and also seasonality in markets and production. The aim of this usually negative element is to take account of the members of the community who may not be conventionally poor but would easily become poor given changed circumstances. Vulnerability needs to be considered because it shapes people's responses to a technology. It also brings an appreciation of the spiraling nature of poverty, poorer people being more vulnerable.

The **Asset base** upon which people build their lives includes a wider range of assets than are usually considered. The framework takes into account six different types:

- Natural capital (land, water, forests, marine resources, air quality, erosion protection, biodiversity)
- Physical capital (transport, roads, buildings, shelter, water supply and sanitation, energy, technology, communications)
- Financial capital (cash savings, liquid assets, formal and informal credit, state transfers and remittances)
- Human capital (education, skills, knowledge, health, nutrition, labor power)

- Social capital (networks that increase trust, ability to work together, access to opportunities, reciprocity, informal safety nets, membership in organizations)
- Political capital (citizenship, enfranchisement, political parties).

Policies, Institutions and Processes influence access to assets, the vulnerability context and the livelihood strategies that are adopted. They include all elements of exchange and relationships of power or trust within public or private lives at formal and informal levels. They tend to be highly influenced by culture.

The **Livelihood Strategy** represents the methods or combination of methods taken up by poor people to deal with their individual or community situations. Commonly overlooked, for instance, is the fact that farmers frequently improve their situation through non-farming means. The strategy that people adopt affects their labor, security and overall survival.

The **Livelihood outcome** symbolizes the impact under study. If positive, it involves improved food security, more sustainable use of natural resources, increased well-being (including health, education, self-esteem, security, sense of control, political enfranchisement, maintenance of cultural assets), strengthened assets (increased income; physical assets) and reduced vulnerability.

Agricultural R & D fits into the framework by reducing or increasing vulnerability, for example through changes in the environment or in the prices of produce or purchased inputs. It links to the asset base through land, water, transport, knowledge, collective action assets, and it may shape policies, institutions, processes through dissemination processes and options to change assets to livelihoods.

Through the use of the sustainable livelihoods framework a level of complexity is introduced that necessitates interdisciplinary methods, while also providing better comparability across disciplines and projects. The approach may also capture different findings; new perspectives, for instance, on the stability of production versus maximizing average production, non-economic values, assets required and who might be excluded access to them, and also on other livelihood strategies that are outside the confines of "farming".

THE WORKSHOP PROCESS

This workshop was designed so that stakeholders of the current project are provided with orientation to the sustainable livelihoods approach. Then participants were led through a process

of mapping research questions to this framework, identifying new questions and issues, considering what data exist, what new data are required and which sources are relevant.

SOCIAL SCIENCE RESEARCH METHODOLOGIES FOR CONSIDERATION IN RESEARCH DESIGN

Applying the sustainable livelihoods framework in a credible manner for impact assessment requires going beyond any single research method. To cover everything through a statistical sample survey of households, for example, requires substantial investments in quantitative data collection that may still leave key qualitative aspects unexplored. Often, qualitative information improves the formulation of sample survey questions and contributes new hypotheses.

By integrating quantitative and qualitative methods in a judicious way it is possible to address much of the sustainable livelihoods framework. In addition, it is possible to cross-reference and compare findings across methods, which may contribute to their reinterpretation and enhancement of credibility. Furthermore, the needs of this research extend beyond the confines of narrow hypothesis tests (e.g. for a PhD thesis in economics or sociology). It will be critical to draw on a baseline for monitoring future impacts that is established more broadly than would be the case with any single method.

Potential methods for data collection in this study include:

- Sample survey of farm households, including biophysical measurements
- Focus group interviews
- Key informant interviews
- Household case studies (participant observation)
- Secondary data

Sample surveys generate data collected through structured questionnaires, or by direct observation, GPS or other direct measurements. However, data collection is highly structured to bring together comparable information from every household. When carefully carried out so that rapport is built up with household members, household or individual-level surveys can elicit sensitive information or opinions, but care must be taken to take account of who is present during an interview. For example, women may not be as forthcoming if their husbands or in-laws are

present. Sample sizes are usually large for sample surveys, so they lend themselves to quantitative analysis. Analysis is usually carried out independently from data collection (i.e. done by different individuals).

Focus group interviews are usually conducted at the community level, but may be disaggregated according to gender, wealth categories, or other relevant characteristics. As with household interviews, it is important to ascertain who is absent during the interviews, as well as the representation of those who are present. Data can be collected through semi-structured questionnaires or data check-lists, as well through other exercises such as seasonality mapping, village mapping, transect walks through the village, or ranking of varietal preferences. Data from the focus groups can be linked to those of the survey for quantitative analysis, but much of the analysis of focus group interviews relies on comparisons (e.g. between women and men, or between villages), and on qualitative analysis of quotations, etc. Analysis begins at the time of the interviews, as the enumerators/facilitators need to be able to follow up on certain points as they emerge. Thus, it is helpful if those who will be doing the analysis are involved in the data collection.

Key informant interviews are conducted with people who, because of their position, are expected to have particular information. Depending on the topic, these might be village elders, farmer group leaders, schoolteachers, extension workers, or even staff of banana improvement programs. Data collection is usually carried out through semi-structured interviews or checklists. Key informants may also be useful in less structured data collection, especially in designing the study or in interpreting results.

Household case studies or participant observation provide in-depth information through less structured discussions and direct observation that occur while the data collector spends time in a village and with particular households. By spending several weeks or months in a village, and focusing on just a few households, the enumerators can build confidence and get beyond "public" information to gain greater understanding of, for example, intrahousehold decision making. By taking part in activities such as visits to improved banana plots or food preparation, the enumerators can develop a better understanding of the cultural beliefs or issues that are play an important role in varietal choice. However, because of the time and skill required for such case studies, it is usually not possible to cover many households. Thus, for data to

provide more than anecdotal information, it is important to select households that are representative of the larger population.

Secondary data are often available at higher levels of aggregation, such as the village or higher administrative units. Where such data are available, secondary information is usually the cheapest to collect, although the quality should be checked, preferably with "ground truthing" for sample areas. However, because secondary data usually cover larger areas, they are valuable for extrapolating and relating study areas to the broader population.

Biophysical data collection such as plant taxonomies, soil quality measures, or other aspects can be combined with one or another of these data collection instruments. For example, soil measures may be collected with plot-level data in the household sample survey; plant taxonomies may be used in focus group discussions to identify varieties grown at the village level; climate information may be collected with secondary data.

Table 1--Profile of social science tools for collecting information

Method	Level	Advantages	Disadvantages
Sample survey of farm households	individual, household, plot	replicable, so quantitative analysis is possible	need to pre-specify questions, short answers
Focus group interviews	community, may be disaggregated by gender, wealth	can explore topics, group insights	"public" information, not sensitive topics, can be dominated by some members
Key informant interviews	community, other	expert knowledge	potential bias of informant
Household case studies (participant observation)	household, individual	sensitive topics, source of insights	costly, skill-intensive, need to check representation
Secondary data	community or higher	relatively low cost, wide coverage, link to GIS	need to verify quality

Collecting data from all these sources and methods allows a study to triangulate, compare, and build a more convincing case in impact analysis. However, this also requires careful structuring of the data collection, first to ensure that appropriate data on all key issues are

collected from one source or another, and then to coordinate the data entry and recording so that the information from all sources can be accessed and analyzed in a coherent manner.

SAMPLE STRATIFICATION AND SITE SELECTION

Choice criteria

In choosing the scheme for stratifying the sample of survey households, it is important to consider statistical criteria, research hypotheses, and the availability of data required to generate the frame. The statistical purpose of sample stratification is to achieve gains in sampling efficiency through dividing the study population into groups that are more alike within the group than in the population as a whole, with respect to variation in the parameters of interest. Parameters of interest in this research are those that relate to whether or not bananas with disease resistance traits are economically and socially important. Economic theory and past empirical evidence suggest three very important regional variables that affect the adoption decisions of individual farmers but over which they themselves have no control. These are 1) the level of development in market infrastructure; 2) the density of population; and 3) banana productivity potential.

There is no question in this research that sites must be selected where bananas are important to rural livelihoods in terms of their share in farm production, household consumption and income, and social status. To establish the counterfactual for predicting the impact of future releases of improved banana varieties we also need to select sites within strata in such a way that farmers who have been exposed to new types can be compared to those who have not, while controlling for other factors. Another issue is the extent to which the sampling frame used in the previous survey work conducted by IFPRI can or should be utilized. Budget constraints will affect the final sampling frame and number of sites in which the research can be conducted.

Scheme

After extensive discussion, the workshop participants decided on the following scheme for sample stratification and site selection. First, the production regions will be purposively selected to cover areas specialized in banana production, including those with declining, increasing and intermediate current levels of production. These correspond roughly to the

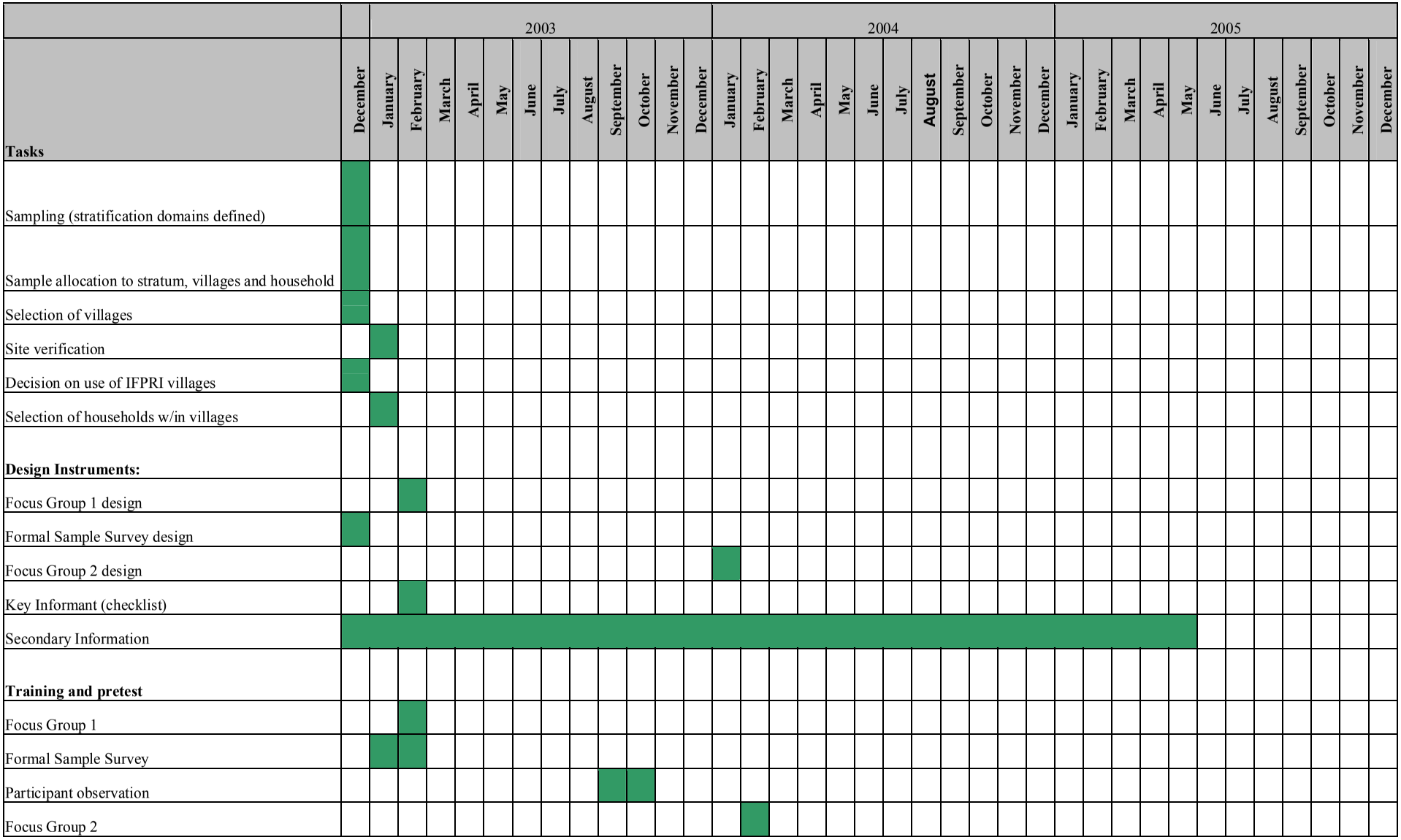
central, southwest and intermediate geographical zones in Uganda, spilling over into the Kagera District of Tanzania. Data from the Uganda National Household Survey (UNHS) will be used to assess the geographical boundaries of banana production, comparing these to maps already generated by INIBAP and NARO.

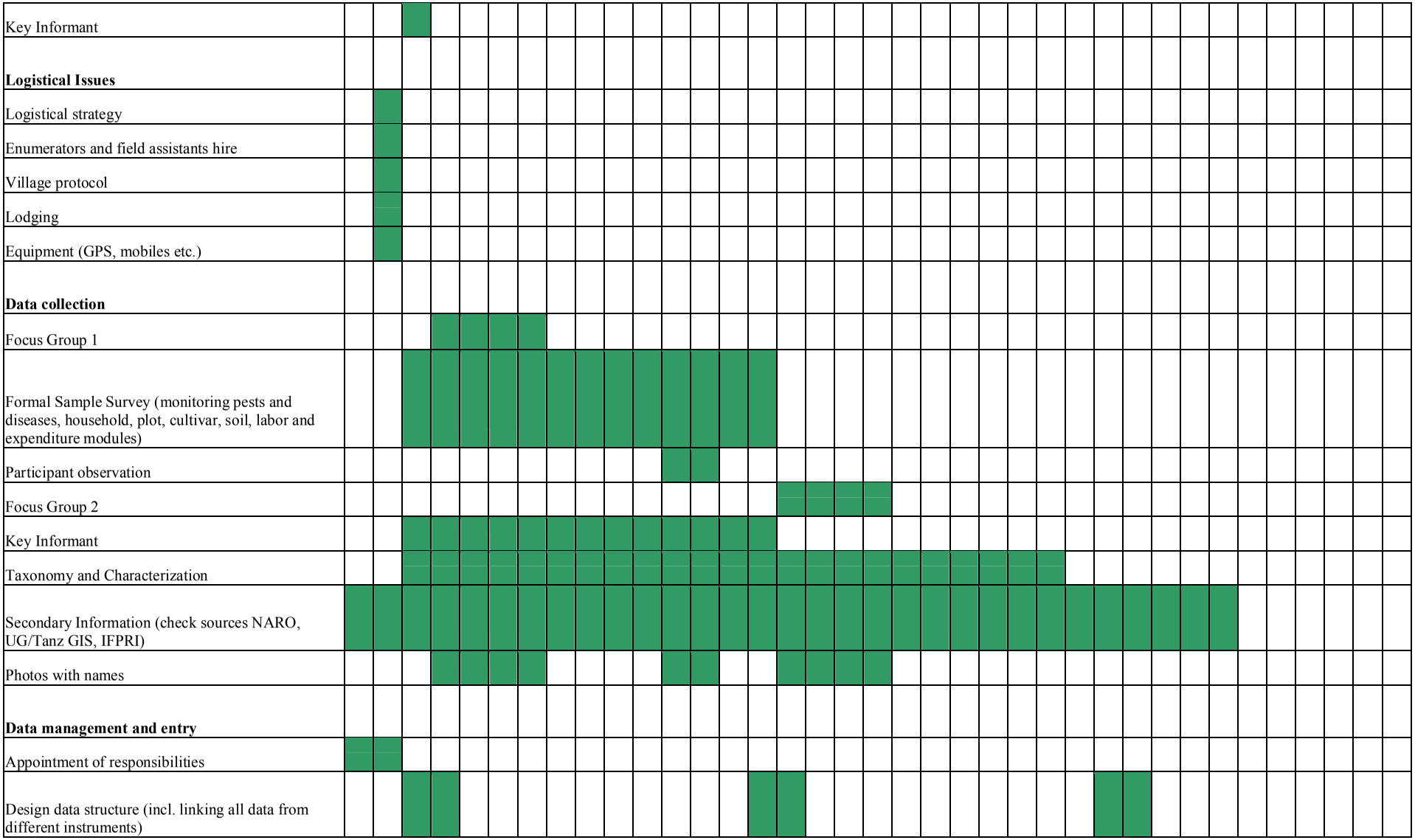
Elevation is highly correlated with the incidence and severity of most of the pests and diseases that scientists in the banana improvement program are seeking to address. Rainfall varies relatively little in these environments, and elevation is also related to soil quality. Two extremes in elevation (high, low) will be used in order to delineate strata.

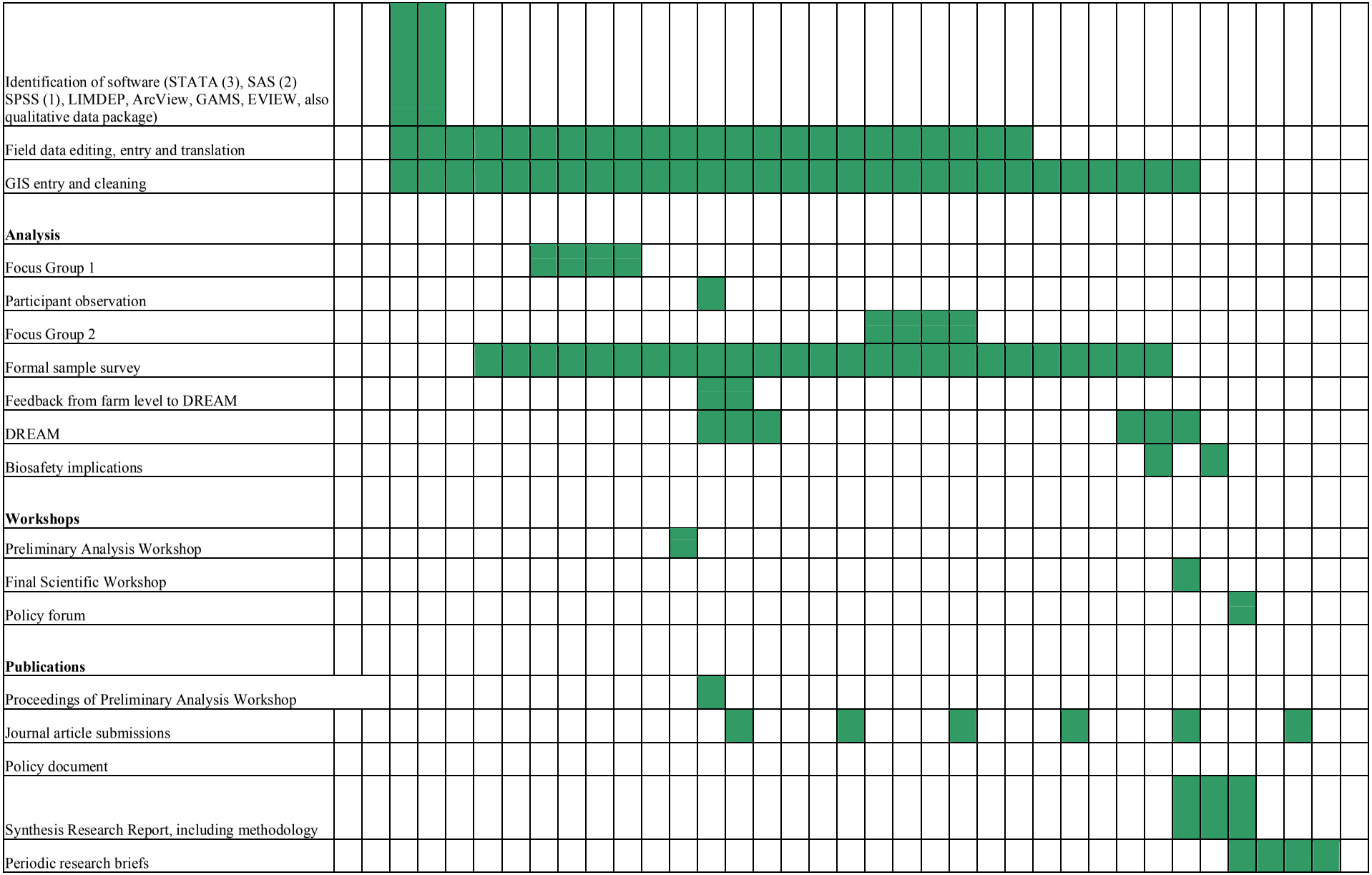
Next, the banana production system and elevation contour lines will be intersected by classes of market access, and frequencies examined in order to select boundary values representing high and low ranges of access to market infrastructure. Though population density is an important variable, the construction of the market access variable controls for population density and the two are expected to be correlated. A total of four strata is sought.

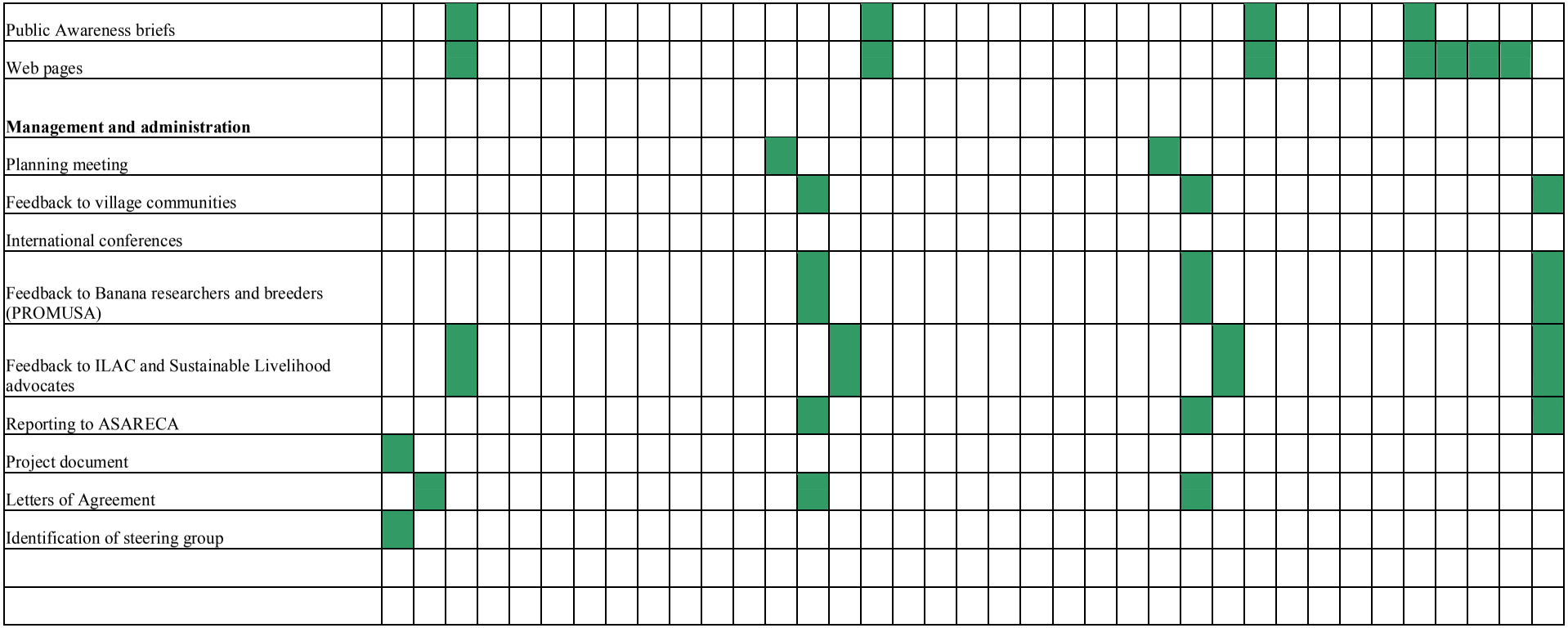
A map of human settlement patterns will then by overlaid on the four strata, as well as a map of the diffusion areas for banana planting material. A minimum of 20 communities ("sites") will be selected within and outside the diffusion areas in each stratum. Whether or not the communities were correctly classified will be verified in initial site visits. Within each community, a minimum of 20 households will be selected from a household listing or area frame. The exact allocation of sample to strata and community will be decided during implementation. The expected total sample size is 40 communities, with 20 households per community, or a total of approximately 800 households.

Integrated workplan




Key Informant
Logistical Issues
Logistical strategy
Enumerators and field assistants hire
Village protocol
Lodging
Equipment (GPS, mobiles etc.)
Data collection
Focus Group 1
Formal Sample Survey (monitoring pests and diseases, household, plot, cultivar, soil, labor and expenditure modules)
Participant observation
Focus Group 2
Key Informant
Taxonomy and Characterization
Secondary Information (check sources NARO, UG/Tanz GIS, IFPRI)
Photos with names
Data management and entry
Appointment of responsibilities
Design data structure (incl. linking all data from different instruments)


Identification of software (STATA (3), SAS (2) SPSS (1), LIMDEP, ArcView, GAMS, EVIEW, also qualitative data package)
Field data editing, entry and translation
GIS entry and cleaning
Analysis
Focus Group 1
Participant observation
Focus Group 2
Formal sample survey
Feedback from farm level to DREAM
DREAM
Biosafety implications
Workshops
Preliminary Analysis Workshop
Final Scientific Workshop
Policy forum
Publications
Proceedings of Preliminary Analysis Workshop
Journal article submissions
Policy document
Synthesis Research Report, including methodology
Periodic research briefs


Public Awareness briefs
Web pages
Management and administration
Planning meeting
Feedback to village communities
International conferences
Feedback to Banana researchers and breeders (PROMUSA)
Feedback to ILAC and Sustainable Livelihood advocates
Reporting to ASARECA
Project document
Letters of Agreement
Identification of steering group

APPENDIX 1--ISSUES IDENTIFIED BY WORKSHOP PARTICIPANTS AS POTENTIALLY RELATING TO THE LIVELIHOODS OF SMALLHOLDER BANANA FARMERS IN TANZANIA AND UGANDA

VULNERABILITY

Land erosion
Climate
Pests & diseases (level of…)
Declining yields
Market access (difficult to sell products)
Soil fertility (decrease)
Decreasing land availability (increase in population)
Frequent droughts
HIV AIDS, Malaria, TB (human diseases)
Price risk element
Access to inputs
Political stability
Perishable nature of banana
Ratio of bulk to value
Seasonality (food security, banana all year?)

ASSETS

Natural capital

Soil quality and type
Degree of fragmentation
Heterogeneity of land on the farm
Land tenure
Livestock assets
Agroforestry
Genetic resources and their diversity
Mulch/manure

Physical capital

Transport means (bikes, trucks)
Roads (road density) + structure
Radios
Farm equipment

Social capital

Access to information (household level)
Diffusion network
Exchange planting material
Political capital
Social status
Community group membership

Human capital

Level of education
Access to labor
Household size
Lack of youth (rural urban migration)
Intra-household decision making
Access to information
[Erosion of] Traditional norms / knowledge
Demographic structure (age of household members)
Education

Financial capital

Access to credit
Wealth
Savings
Remittances

POLICY/INSTITUTIONS

Culture/religion (positive or negative)
Taxation
Ethnic groups
Attitudes towards technology
Diffusion processes (direct/indirect)
Dissemination organizations & trust of
Extension services access
Exchange of planting material
Trade restrictions (international)
Biosafety regulations
Biosafety implementing agencies
Local post harvest processing
Availability of processing companies (Agroprocessing)
Change in demand for banana
Management strategies for different varieties
Decision making intrahousehold
Seed market

LIVELIHOODS STRATEGIES

Commercial versus subsistence farming
Commercial or subsistence banana production
Adoption
Post harvest uses/ processing (peel)
Intercropping / mixed farming
Diversification of activities
Uses of products / by-products
Competing crops
Off-farm income
Non-farm income

OUTCOMES

Food security
Income generation
On farm employment
Results feeding back on research/investment
Health
Reclaiming fields
Better husbandry
Nutrition
Family confidence
Change in gender divide in decision making
Changing endemic biodiversity & resilience
Increasing diversity where little previously
Strengthening knowledge and skills
Susceptibility to pest & disease
Increased use of other new technologies
Strengthening social capital
Soil fertility (complementary technologies)
Distribution of benefits in the community
Trade possibilities
Uses of products and by-products
Yield of complementary crops
Changes in land value
Changes in yields for banana & related crops
Changes in acreage of banana
Change in acreage of other crops
Changes in standard of living
People's perceptions of change in well-being
Changes in diffusion pathways, magnitude
Diffusion (indirect diffusion)

APPENDIX 2--RESULTS OF WORKING GROUP DISCUSSIONS IDENTIFYING APPROPRIATE GENERAL METHODS AND FORMAT FOR EXPLORING THE POTENTIAL ISSUES RELATING TO THE LIVELIHOODS OF SMALLHOLDER BANANA FARMERS IN UGANDA AND TANZANIA

SL categories	Survey themes and questions	Survey instrument	Comments
Vulnerability	Soil erosion	Survey	**Plot/biophysical**
	Climate	Secondary data sources	
	Pests & diseases (by category of disease, plot, yield and damage)	Survey	**Plot/biophysical/Individual**: Perceptions of farmers, including their taxonomy and perceptions of the frequency of occurrence; some measurement of damage at plot level.
		Secondary data	
	Declining yields	Focus Group	**FG1:** Have yields of banana declined in the last 10 years? Why? How have farmers tried to counteract the problem?
		Secondary data	
	Market access: a. Distance to primary banana output and input market b. Distance to roads by quality c. Prices (input, wage, output) d. Access to information (frequency by type of source) e. Frequency and volume of sales by banana type	Survey	**a. Household**: walking time, miles **b. Plot/Biophysical** **c. Household:** by season, by type of bananas, by transaction place and by type of labour input.
		Key informant	**a-e. Farmer, middleman:** What is the most common means of access to markets? What is the best means? How could it be improved? From where do farmers obtain information about markets and prices? Is there an active effort to diffuse information?
	Soil fertility	Survey	**Plot/Biophysical:** Soil samples, nutrient flows
		Focus Group	**FG1:** Declines over last ten years; severity and response
		Secondary data	
	Decreasing land availability	Secondary data	Population pressure derived from population density
	Frequent droughts	Focus Group	**FG1:** When? Check secondary data beforehand; severity and response
		Secondary data	
	Days of sickness	Survey	**Household & Individual**
		Focus Group	**FG2:** Type of illness, what is the impact?

SL categories	Survey themes and questions	Survey instrument	Comments
	Trends in wellbeing	Focus Group	**FG2:** Trends in wellbeing: food security, health, overall wellbeing and wealth? Have they improved or deteriorated? Is it related to banana production?
	Perishable nature of banana/Price risk element : a. Percentage loss (pre-harvest and post-harvest) b. Variation in % loss over time c. By cultivar/variety	Survey	**Household & Plot/Biophysical**
		Key Informant	**Marketing agent:** Price by variety and fluctuation over time, including seasonal change and trends. Form in which bananas are traded [bunch, finger, processed]. Attitudes to risk
	Access to inputs	Survey	See "Market access" (Vulnerability)
		Key Informant	**Extension staff and input traders:** What inputs do farmers have access to? What is their availability and what is their cost?
	Theft	Focus Group	**FG2:** Questions to explore whether there is general problems with theft and more specific questions to discover if this is a problem with bananas
	Political/Social instability	Focus Group	**FG1:** Are there sources of instability that are affecting production?
	Food security/seasonality (Estimated self-sufficiency)	Survey	**Household & Plot/Biophysical:** Subjective & objective yield estimates. Expected number of months of self-sufficiency
		Focus Group	**FG1:** When are shortages or surpluses of bananas experienced? What is eaten when there are no bananas?
Assets ***Natural capital***	Village map	Focus Group	**FG1:** Map of village and separate map of institutions within the community (see figure)
	Soil type a. heterogeneity b. quality c. topography d. folk taxonomy	Survey	**Plot/biophysical:** soil samples
		Secondary data	
	Degree of fragmentation (how many plots or parcels is land divided into?)	Survey	**Household & Plot/Biophysical:** Calculate indices of fragmentation over the areas measured
	Land tenure (area by type)	Survey	**Household, Plot/Biophysical & Individual:** Identify primary decision maker at plot level for banana
		Focus Group	**FG1:** Consult as to how the question should be phrased (Makerere)
		Key Informant	**Elders:** General information on land tenure, how people acquire land, security of tenure

SL categories	Survey themes and questions	Survey instrument	Comments
	Land use a. Banana varieties b. Crops c. Pasture d. Forest e. Fallow	Survey	**Household, Plot/Biophysical & Individual:** Farmer taxonomy (distinguishing characteristics, attributes and preferences); genomic and clone set identification by scientists; mat count (tree) and area measurement for banana plots with GPS. Farm enterprise budgets (part of expenditures survey).
	Livestock assets	Survey	**Households**
	Cropping patterns a. Banana inventory b. Classification c. Trees d. Other crops e. Cultural practises	Survey	**Plot/Biophysical:** Taxonomy and agriculture scientist to measure banana cultivar diversity, mat count.
	Genetic resources and their diversity	Survey	See "Cropping patterns" (above)
		Focus Group	**FG1:** What is the folk perception of banana biodiversity? Varieties discarded; varieties introduced. Were banana cultivars different in the past than they are today – in what ways? Are there recognizable banana experts (and sucker suppliers) in the community? What are the attributes recognized in bananas? (agronomic; consumption) Are these the use groups most frequently recognized or not? Which attributes are of greatest importance to banana growers? Which are minor?
		Key Informant	**INIBAP/NARO**
		Secondary data	
	Mulch/manure	Survey	See "Cropping patterns" (above)
	Water (wells, ponds)	Survey	**Household**
Physical capital	Transport means (bikes, trucks)	Survey	**Household** See also "Market access" (Vulnerability)
	Roads (road density) & structure	Key Informant	**Driver**: note distance from village to tarmac road, distance on tarmac and dirt road to nearest market
		Secondary data	
	Household durables and non-durables (radios)	Survey	**Household**
	Farm equipment	Survey	**Household**
	Agroprocessing centre	Focus Group	**FG1:** Availability, do they operate
		Secondary data	

SL categories	Survey themes and questions	Survey instrument	Comments
Social capital	Access to information (household level)	Survey	See "Market access" (Vulnerability) & "Extension services" (Policy and institutions)
	Diffusion network/Exchange of planting material	Focus Group	**FG1:** Is there a formal network for diffusion of new varieties?
		Survey	**Household** See also "Exchange of planting material" (Policy and institutions)
	Social/Political status	Survey	**Household & Individual**
		Focus Group	**FG2:** Person(s) in the community with good outside connections (e.g. politician). Is there an influential person in the community?
	Community group membership	Survey	**Household & Individual**
		Focus Group	**FG1:** What kinds of community groups are there (institutional map of the village)?
Human capital	Level of education	Survey	**Household & Individual**
	Labour availability and allocation	Survey	**Household & Individual**
		Focus Group	**FG1:** Are there seasonal changes in labour availability?
	Household composition (number, age, sex, ethnic group and tribe)	Survey	**Household & Individual**
	Lack of youth (rural/urban migration)	Survey, Focus Group	See "Migration" (Livelihood strategies)
	Intrahousehold decision making	Survey, Focus Group, Participant Observation	See "Intrahousehold decision making" (Policy and institutions)
	Skills and experience a. Farming b. Planting bananas c. New banana d. Existing technologies e. New technologies f. Post-harvest processing	Survey	**Household & Individual**
	Perceptions (knowledge) of importance of variety attributes and rating of variety provision of attributes	Survey	**Household & Individual:** Variety input-banana output relationships and shares
Financial capital	Access and origin of credit	Survey	**Household & Individual**
		Focus Group	**FG2:** What are the sources of credit? How easy are they to access?

SL categories	Survey themes and questions	Survey instrument	Comments
	Income by source a. farm b. non-farm c. remittances	Survey	**Household & Individual:** Net farm income, total income. Watch out for sources of non-farm income – maybe get information on the concentration for source and perhaps a range
		Participant Observation	
	Savings (wealth)	Survey	**Household & Individual:** How to get this information (usually very sensitive)?
Policy and institutions	Dissemination organisations and trust	Focus Group	**FG1**: What are the disseminating organisations? How well are they trusted?
		Key Informant	**Dissemination organisation staff:** What organisations are involved, what are the formal rules and process for dissemination?
		Survey	**Household & Individual:** Perceptions could be recorded at household and individual levels.
	Extension services	Survey	**Household & Individual:** Perceptions could be recorded at household and individual levels.
		Focus Group	**FG1?** What extension services are available? How well are they trusted?
	Exchange of planting material/Diffusion processes (direct and indirect)	Focus Group	**FG1**: Source and practise, especially concerning the introduction of new material into the community?
		Survey	**Household & Individual:** Type, source and frequency of all transactions and exchanges of planting material
	Culture/religion	Focus Group	**FG2:** What beliefs and cultural practises affect banana production (open question)? Are people still adhering to these?
	Taxation (legal or illegal?)	Survey	**Household & Individual**
		Focus Group	**FG1:** What taxes touch banana production? (legal only)
		Key Informant	**Marketing agent**
	Ethnic groups	Survey	**Household & Individual:** Calculated in "Household composition" (Human capital)
	Attitudes towards technology	Survey	**Household & Individual:** Calculated in "Land use" (Natural capital) in preferences on variety attributes
		Focus Group	**FG2:** Use of new varieties in general (any crops)
	Agroprocessing companies	Key Informant	**Agroprocessing company staff:** Suitability of different varieties for utilization, demand patterns.
	Local post-harvest processing	Survey	See "Change in product utilization" (Livelihood outcomes)
	Land tenure	Key Informant	See "Land tenure" (Natural capital)
	Farmers' organizations	Focus Group	**FG1:** Is there a banana group in the village? If so, what are the activities?

SL categories	Survey themes and questions	Survey instrument	Comments
	Demand for bananas	Focus Group	**FG1:** Change in time? Change in utilization and demand within and outside the village
		Key Informant	**Traders/Processors:** Variation over time and seasons
	Management strategies for different varieties	Survey	**Household, Plot/biophysical & Individual:** Calculated in detail in "Cropping pattern" (Natural Capital)
		Key Informant	**Research organisations/Extension officers:** Recommended practises for new varieties, results of ongoing projects, e.g. IPM.
	Intrahousehold decision making a. planting b. selling c. destination of income	Survey	**Household & Individual**: Calculated by comparing banana plot management, product utilization, and marketing.
		Focus Group	**FG2:** Sensitive issue that may need separation of sexes. Who generally decides about banana planting for household use and for sale, who decides on selling, who controls the output or income?
		Participant Observation	
	Planting material markets	Survey	**Household & Individual:** Calculated in "Exchange of planting materials" (Policy and institutions)
		Key informant	**Farmer leader or marketing agent:** See "Market and supply structure" below
	Market and supply structure	Key informant	**Farmer leader or marketing agent:** Draw an institutional map and structure of sucker and product markets, traders and stockists.
	Frequency and volume of sales	Key informant	**Marketing agent**
Livelihood strategies	Commercial versus subsistence farming	Survey	**Household:** Calculated in survey of "Income by source" (Financial Capital)
	Migration	Survey	**Household & Individual**
		Focus Group	**FG1:** Are young people staying in farming?
	Adoption	Survey	**Household, Plot/Biophysical & Individual:** Calculated in "Cropping patterns" (Natural Capital)
		Secondary data	**Disseminating organizations**
		Key Informant	**Extension agent:** History
	Post-harvest processing and utilization (including byproducts)	Survey	**Household & Individual:** Calculated in survey of "Change in product utilization" (Livelihood outcomes)
		Focus Group	**FG2:** How are bananas processed? How are they used? What is the use of the byproducts?
	Intercropping/mixed farming	Survey	**Household, Plot/Biophysical & Individual:** Calculated in survey of "Cropping patterns" etc. (Natural Capital)

SL categories	Survey themes and questions	Survey instrument	Comments
	Diversification of activities	Survey	**Household:** Calculated in survey of "Income by source" (Financial Capital), "Land use" (Natural Capital) and "Change in product utilization" (Livelihood Outcomes)
	Marketing strategy (where, when, how?)	Survey	**Household & Individual:** See under "Diversification".
	Enterprise mix (including livestock)	Survey	**Household:** See under "Diversification".
	Off-farm employment (agriculture/non-agriculture)	Survey	**Household & Individual:** See under "Diversification".
Livelihood outcomes	Food security	Survey	**Household & Plot/Biophysical:** Estimated self-sufficiency: subjective and objective yield estimates, expected no. of months when self-sufficient.
	Income generation	Survey	Computed from "Income by source" (Financial Capital), marginal effect of new banana on production
	Employment generation – Change in enterprise	Survey	**Household** See also "Labour availability and allocation" (Human capital). Computed from comparison of enterprise mixes and labour use.
		Focus Group	**FG2:** Have changes in banana production affected employment opportunities; specify on farm, hired farm labour, trading, processing?
		Secondary data	
	Household consumption (expenditures)	Survey	**Household & Individual:** Yearly, also a proxy for cash income
	Feedback to research/investment	Key Informant	**NAADS group leaders, NARS, INIBAP**
		Secondary data	
	Health (change in pesticide use)	Survey	Calculated in "Days of sickness" (Vulnerability)
	Area of revived banana fields	Survey	Calculated "Change in yields" (below)
		Focus Group	**FG2:**Is there land that used to grow banana that went out of production at some point? How much area? Has any of that land returned to banana production?
	Better crop husbandry	Survey	Calculated in "Cropping patterns" (Natural Capital)
		Focus Group	**FG2:** Are people taking better care of their farms than previously? Is this related to introduction of new banana varieties? (Watch out for communities where none have been introduced)
		Secondary data	
	Food consumption (#meals/week, seasonality of variety, share in food basket)	Survey	Calculated in "Food security" (Vulnerability)

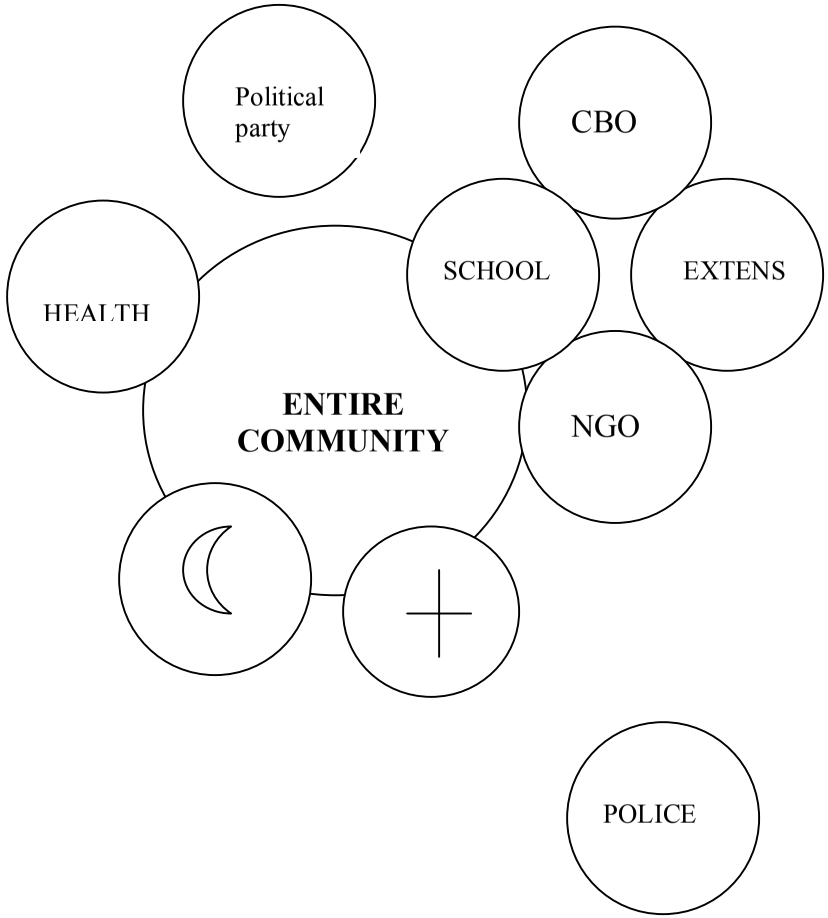
SL categories	Survey themes and questions	Survey instrument	Comments
	Change in human/social capital a. knowledge b. skills c. confidence d. intra-household marketing decision	Survey	**Household & Individual:** Computed from variables measured above, add some perceptions questions
	Change in gender participation in decision making (selling suckers, output, food preparation)	Survey	Calculated in "Intrahousehold decision making" (Policy and institutions II)
		Focus Group	**FG2:** Changes in roles, labour, participation in decision making, selling suckers, output, food preparation due to banana introduction
	Change in biodiversity & resilience	Survey	**Household** Computed from "Cropping patterns" (Natural capital)
		Focus Group	**FG1:** Changes due to introduction of new varieties
		Key Informant	**Taxonomists:** (Deborah Karamura)
	Strengthening knowledge and skills	Survey	See "Change in human/social capital" (above)
		Focus Group	**FG2:** Have banana farming skills improved or deteriorated over time, is this related to the introduction of new varieties? (Watch out for communities where none have been introduced)
		Participant Observation	
	Change in susceptibility to pests & diseases (including perceptions)	Survey	**Household:** Calculated from "Pests & diseases" (Vulnerability)
		Focus Group	**FG1:** How are black Sigatoka, Fusarium wilt, nematodes and weevils recognised and classified? Changes in susceptibility - Are bananas more or less susceptible to diseases, and is this related to new varieties?
	Increased use of other new technologies	Survey	Calculated in "Skills and experience" (Human Capital) and in "Cropping pattern" (Natural capital)
	Strengthening social capital	Survey	See "Change in human/social capital" (Livelihood Outcomes)
		Focus Group	**FG2:** Test phrasing – social contacts, community solidarity, tensions, cooperation
	Distribution of benefits in the community	Survey	**Household & Individual:** Calculated from other variables measured above.
		Focus Group	**FG2:** How have the benefits or costs of new banana varieties been shared in the community, e.g. between men and women, poorer and richer? (Watch out for communities where none have been introduced)
	Trade possibilities	Focus Group	**FG2:** Have possibilities to sell or buy banana changed? What has been the role of new varieties in this change? (Watch out for communities where none have been introduced)

SL categories	Survey themes and questions	Survey instrument	Comments
	Changes in product utilization	Survey	**Household & Individual:** Major use category (food, beer/wine, juice, other uses) Check for changes in major use shares and opportunities for future product development
		Focus Group	**FG2:** How has use of bananas and byproducts changed? What has been the role of new varieties in this change? (Watch out for communities where none have been introduced)
	Changes in yield, acres, output: a. Banana b. Complementary crops c. Competing crops (including perceptions)	Survey	**Household** Calculated from "Land use" (Natural capital)
		Secondary data	
	Changes in standard of living (perceptions)	Focus Group	**FG2:** Is the community better off than 5 years ago? What factors contributed to that? What role has banana played? What has been the role of new varieties? (Watch out for communities where none have been introduced)
	Changes in diffusion pathways, magnitude	Survey	**Household:** Calculated in "Exchange of planting material" (Policy and institutions)
		Focus Group	**FG2:** Has the introduction of new varieties changed the methods of obtaining banana suckers? (Watch out for communities where none have been introduced)

Focus groups 1 & 2 (**FG1** & **FG2)** are proposed. FG2 will be gender disaggregated. The survey will include three types of schedule: **Household**, **Plot/biophysical** and **Individual**. The latter will allow further gender disaggregated data to be collected.

the village through group discussion

What institutions are operating in the village (list the ones that have many members and the ones that have the least members)?
e.g. Religious (Roman, Catholic, Moslems, Born again, Seventh day Adventists, Lutherans etc), Governmental (agriculture extension services, primary schools, secondary schools, health centers, police etc), CBO (banana farmers' group, credit and serving group etc).



SECONDARY DATA SOURCES

Climate
Pests & diseases (levels of…)
Declining yields
Soil fertility (decrease)
Decreasing land availability (increase in population)
Price risk elements (fluctuations + attitude to risk)
Trade restrictions (international)
Biosafety regulations
Biosafety implementing agencies
Change in demand for banana
Soil quality (type and heterogeneity)
Land tenure
Genetic resources and their diversity
Roads (road density) + structure
Schools and health centers
Agro-processing center
Adoption
Marketing strategy (where, when, how)
On farm employment/employment generation
Results feeding back on research/investment
Better crop husbandry
Changes in yields for banana
Changes in acreage of banana & other crops

PARTICIPANT OBSERVATION

(POTENTIAL TOPICS TO BE PURSUED IN A SMALL NUMBER OF VILLAGES WHERE NEW VARIETIES HAVE BEEN INTRODUCED):

Cultural beliefs/practices
Intra-household decision making
Uses of banana
Strengthening knowledge and skills
Diffusion practices
Attitudes toward technology

APPENDIX 3—WORKSHOP PROGRAM

Day 1 Thursday, November 7

Session 1: Opening Session (Chair: E. Karamura)

9:00 Welcoming remarks, workshop objectives and research partners (E. Frison, Director, INIBAP)

9:30 Welcoming remarks (J. Mukiibi, Director General, NARO)

9:45 Introduction of participants

10:15 Presentation of research concept (M. Smale, IFPRI/IPGRI)

10:45 *Tea*

11:15 **Session 2: Synopses of past and current research assessing the impact of improved banana in Uganda and Tanzania (Chair: E. Karamura)**

- Overview by INIBAP/IPGRI (H. Laurence)
- Socioeconomics of banana production in Uganda (R. Kalyebara)
- Socioeconomics of banana production in Tanzania (J. Nkuba)
- Impact of improved banana varieties in Kagera, Tz (KCDP)

12:15 Open discussion

13:00 *Lunch*

Session 3: Synopses of proposed methods (Chair: E. Frison)

14:00

- Strategic *ex ante* evaluation of the potential economic benefits of improved banana productivity (S. Wood)
- Market access and banana production in Uganda (F. Bagamba)
- Variety choice and attribute trade-offs in household production models: the case of bananas in Uganda (S. Edmeades)
- A preliminary assessment of the suitability of IFPRI's Uganda Policy database for analyzing farmers' decisions about banana varieties (M. Smale)
- Sustainable Livelihoods framework (R. Meinzen-Dick)
- Biosafety and regulatory frameworks (J. Falck-Zepeda)

16:00 *Tea*

16:30 Open discussion

18:00 *Cocktails*

Day 2 Friday, November 8--*SUSTAINABLE LIVELIHOODS FRAMEWORK*

9:00 Presentation of Sustainable Livelihoods framework (R. Meinzen-Dick)

10:00 Open discussion (led by R. Meinzen-Dick)

11:00 *Tea*

11:30 Application of SL framework to smallholder banana farmers in East Africa: specific issues relevant to each aspect of the framework and identification of research questions

13:00 *Lunch*

14:00 Working groups to map SL research questions according to data collection type

16:00 *Tea*

16:30 Plenary discussions and preparations for the next day

Day 3 **Saturday, November 9--*RESEARCH DESIGN (*FACILITATOR: R. MEINZEN DICK*)***

9:00	Break out sessions to determine data collection strategy and information needs: Working Groups to be divided according to discipline/data collection strategy according to outcome of previous day's discussions
11:00	*Tea*
11:30	Continue in working groups to outline workplans
13:00	*Lunch*
14:00	Presentations of working groups in plenary
15:00	Open discussions
16:00	*Tea*
16:30	Open discussions
19:00	*Dinner*

Day 4 **Sunday, November 10--*FIELD TRIP TO JINJA HOSTED BY JIDDECO***

Day 5 **Monday, November 11--*DEVELOPMENT OF DETAILED INTEGRATED WORKPLAN (FACILITATOR: R. MEINZEN-DICK)***

9:00	Resumé and revisit of project aims
9:30	Discussion of field sites, roles and responsibilities
11:00	*Tea*
11:30	Determination of integrated workplan with timeframe and outputs
13:00	*Lunch*
14:00	Budget and funding
15:00	Wrap-up session

APPENDIX 4—LIST OF PARTICIPANTS

1 Dr. Eldad Karamura
Regional Coordinator for Eastern and Southern Africa, INIBAP
P.O. Box 24384
Kampala, Uganda
Tel: + (256) 41 28 62 13
Fax: + (256) 41 28 69 49
Email: E.Karamura@inibap.co.ug

2 Prof. Edward Kirumira
Dean, Faculty of Social Sciences, Makerere University
P.O. Box 7062
Kampala, Uganda
Tel: + (256) 41 54 06 50
Fax: + (256) 41 53 36 65
Email: kirumira@starcom.co.ug

3 Ms. Charlotte Lusty
Impact Assessment and Public Awareness Specialist, INIBAP
Parc Scientifique
Agropolis II
34397 Montpellier
Cedex 5 – France
Tel: +33 (0)4 67 61 13 02
Fax: +33 (0)4 67 61 03 34
Email: c.lusty@cgiar.org

4 Dr. Ephraim Nkonya
Research Analyst, IFPRI
Lower Kololo Plot 18, K.A.R Drive
P.O. Box 28565
Kampala, Uganda
Tel: + (256) 41 23 46 13
Fax: + (256) 41 23 46 14
Email: e.nkonya@cgiar.org

5 Dr. Emile Frison
Director, INIBAP
Parc Scientifique
Agropolis II
34397 Montpellier
Cedex 5 – France
Tel: +33 (0)4 67 61 98 02
Fax: +33 (0)4 67 61 03 34
Email: e.frison@cgiar.org

6 Dr. Joseph Karugia
ICRISAT/University of Nairobi Kabete Campus
P.O. Box 29053
Nairobi, Kenya
Tel: +(254) 2 632150
Fax: +(254) 2 631815
Email: j.karugia@cgiar.org
j.karugia@insightkenya.com

7 Ms. Hélène Laurence
Impact Assessment Project, INIBAP
P.O. Box 24384
Kampala, Uganda
Tel: + (256) 41 28 62 13
Fax: + (256) 41 28 69 49

8 Mr. Jackson Nkuba
OFFICER IN CHARGE, ARDI-Maruku
Lake zone ARDI-Maruku
P.O. Box 127
Bukoba, Tanzania
Mob: 07 44 760 443
Email: jmnkuba@yahoo.com

9 Prof. Joseph Mukiibi
Director General, National Agricultural Research Orgarnization (NARO)
P.O. Box 295
Entebbe, Uganda
Tel: + (256) 41 32 05 12
Fax: + (256) 41 32 10 70
Email: mukiibi@imul.com

10 Mr. Kephas Nowakunda
Post-Harvest Specialist, NARO - Kawanda Agricultural Research Institute
P.O. Box 7065
Kampala, Uganda
Tel: + (256) 41 56 71 58
Fax: + (256) 41 56 63 81
Email: kephas@mail.kari.go.ug
Nowakunda@yahoo.com

11 Mr. Patrick Gervase
Technician, KCDP
P.O. Box 1745
Bukoba, Tanzania
Tel: + (255) 28 2221537
Fax: + (255) 28 2221538
Email: kcdp@bukobaonline.com

12 Mr. Respichius Mitti
Technician, KCDP
P.O. Box 1745
Bukoba, Tanzania
Tel: + (255) 28 2221537
Fax: + (255) 28 2221538
Email: kcdp@bukobaonline.com

13 Mr. S.N. Samali
Sr. Agric. Research Officer
HORTI TENGERU
P.O. Box 1253
Arusha, Tanzania
Tel: + (255) 27 25053 67/94
Fax: + (255) 27 25053 67
Email: silivesta@yahoo.com

14 Mr. Mgenzi Byabachwezi Said
ARDI-Maruku
Lake zone ARDI-Maruku
P.O. Box 127
Bukoba, Tanzania
Mob: + (255) 744 887 949
Email: msrbyabachwezi@yahoo.com

15 Dr. Ruth Meinzen-Dick
Senior Research Fellow, IFPRI
2009 Medicine Bow Drive
Wildwood MO 63011 U.S.A.
Tel: +(1) (636) 405-1711
Fax: +(1) (636) 405-1711
Email: r.meinzen-dick@cgiar.org

16 Dr. Robert Kalyebara
Economist, Banana Programme
NARO – KARI, P.O. Box 7065
Kampala, Uganda
Tel: + (256) 41 56 71 58
Fax : + (256) 41 56 63 81
Email : banana@imul.com

17 Dr. Melinda Smale
Senior Economist, IPGRI and Research Fellow, IFPRI
2033 K Street, N.W.
Washington DC, 20006 U.S.A.
Tel: +(1) (202) 826-8119
Fax: +(1) (202) 467-4439
Email: m.smale@cgiar.org

18 Mr. Fredrick Bagamba
Ph.D. Fellow, NARO - Kawanda Agricultural Research Institute
P.O. Box 7065
Kampala, Uganda
Tel: + (256) 41 56 71 58
Fax: + (256) 41 56 63 81
Email : fbagamba@kari.go.ug

19 Ms. Svetlana Edmeades
Ph.D. candidate
North Carolina State University (NCSU)
711-D HIBBARD DR.
CHAPEL HILL, NC 27514,USA
Tel: (919) 914-7735
Email: soedmead@unity.ncsu.edu

20 Mr. Stanley Wood
Senior Scientist, IFPRI
2033 K Street, N.W.
Washington DC, 20006-1002 U.S.A.
Tel: +(1) (202) 862-8122
Fax: +(1) (202) 467-4439
Email: s.wood@cgiar.org

21 Dr. José Falck-Zepeda
Research Officer, ISNAR
P.O. Box 93375,
2509 AJ The Hague
The Netherlands
Tel: +31 (0) 70-3496100
Fax: +31 (0) 70-3819677
Email: j.falck-zepeda@cgiar.org

22 Dr. Deborah Karamura
Germplasm Specialist, INIBAP
P.O. Box 24384
Kampala, Uganda
Tel: + (256) 41 28 62 13
Fax: + (256) 41 28 69 49
Email: D.Karamura@inibap.co.ug

23 Mr. Sam Wandukwa
Ph.D. candidate, Sociology
P.O. Box 8477
Kampala, Uganda
Tel: + (256) (0)77 693427
Email : wankwa@yahoo.com

Ms. Betty Mategeko
M.Sc. candidate, Sociology
African College of Commerce
P.O.Box 301
Kabale, Uganda
Tel : +(256) (0)77 675688
Email: mategekobett@yahoo.co.uk

25 Ms. Dorcus Atieno
JIDDECO- Programme Officer
Plot 38 Nile Garden
P.O. Box 868
Jinja, Uganda
Tel: +(256) 43 12 25 57
Fax: +(256) 43 12 25 58
Email: jiddeco@utlonline.co.ug

26 Ms. Liz Drake
Rural Livelihoods Assistant
DFID-Uganda
Department for International Development
Rwenzori Courts, 3rd floor, Lumumba Avenue
P.O.Box 7306
Kampala
Mob: +(256) (0)77 700037
Email: lc-drake@dfid.gov.uk

27 Mr. Adiel Mbabu
Technical Officer, ASARECA
P.O. Box 765
Entebbe
Tel: +(256) 41 32 02 12
Mob: +(256) 077 33 81 83
Email: asareca@imul.com

29 Dr. W.K. Tushemereirwe
Acting Programme Leader
NARO - Kawanda Agricultural Research Institute
P.O. Box 7065
Kampala, Uganda
Tel: + (256) 41 56 71 58
Fax: + (256) 41 56 76 49
Email: banana@imul.com

30 Ms. Pamela Nahamya
Research Assistant, IFPRI
Lower Kololo, Plot 18, K.A.R Drive
P.O. Box 28565
Kampala, Uganda
Tel: + (256) 41 23 46 13
Fax: + (256) 41 23 46 14
Email: p.nahamya@cgiar.org
pnahamya@yahoo.com

31 Ms. Doris Kakuru
Ph.D. candidate, Sociology
Dept. of Sociology
Makerere University
P.O. Box 7062
Kampala, Uganda
Tel: + (256) 41 54 06 50
Fax: + (256) 41 53 36 65
Email: Muhwezi@hotmail.com

32 Dr. A.P. Maerere
Sokoine University of Agriculture
Dept. of Crop Science and Production
P.O. Box 3005
Morogoro, Tanzania
Tel: + (255) 23 2603511
Fax: + (255) 23 2604562
Email: maerere@suanet.ac.tz

33 Herbert Mbuga
INIBAP-ESA
Programme Assistant
P.O. Box 24384
Kampala, Uganda
Tel: + (256) 41 28 62 13
Fax: + (256) 41 28 69 49
Email: H.Mbuga@inibap.co.ug

28 Julius Kamulindwa
INIBAP
Biotechnology Project Administrator
P.O. Box 24384
Kampala, Uganda
Tel: + (256) 41 28 62 13
Fax: + (256) 41 28 69 49
Email: inibap-naro@infocom.co.ug
J.Kamulindwa@inibap.co.ug

34 Mr. Charles A. Eledu
GIS Specialist, INIBAP
P.O. Box 24384
Kampala, Uganda
Tel: + (256) 41 28 62 13
Fax: + (256) 41 28 69 49
Email: C.Eledu@inibap.co.ug

35 Siifa B. Lwasa
INIBAP-ESA
Programme Assistant
P.O. Box 24384
Kampala, Uganda
Tel: + (256) 41 28 62 13
Fax: + (256) 41 28 69 49
Email: L.Siifa@inibap.co.ug

36 Aziz Kigozi Akokulya
INIBAP-ESA
Messenger/Driver
P.O. Box 24384
Kampala, Uganda
Tel: + (256) 41 28 62 13
Fax: + (256) 41 28 69 49
Email: Admin@inibap.co.ug

LIST OF EPTD WORKSHOP SUMMARY PAPERS

13 *Policies for Sustainable Land Management in the East African Highlands,* edited by Samuel Benin, John Pender and Simeon Ehui, September 2002.

14 *Policies for Sustainable Land Management in the Highlands of Tigray, Northern Ethiopia,* edited by Berhanu Gebremedhin, John Pender, Simeon Ehui, and Mitiku Haile, March 2003.