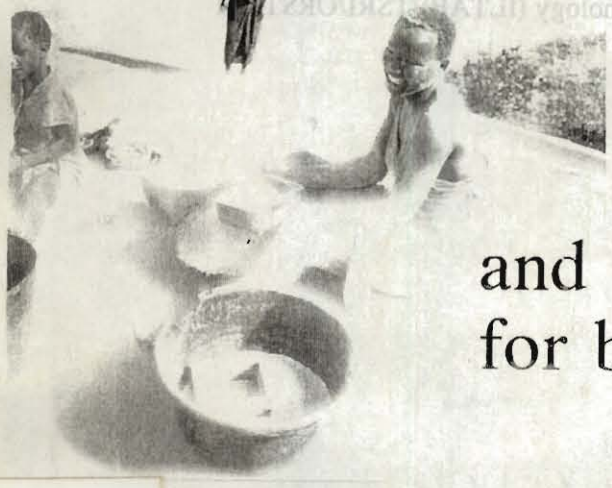
Cassava Biotechnology Network **CBN**

Village Perspectives on Cassava



and implications for biotechnology research

CIAT Centro Internacional de Agricultura Tropical
International Center for Tropical Agriculture

CBN

Village perspectives on cassava and implications for biotechnology research

A CBN Case Study in the Lake Zone of Northern Tanzania

October 1993

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Cover photos

Top: Women and children planting cassava, northern Mara District, Tanzania

Center: Harvesting cassava, Sarawe village, Mara District, Tanzania

Bottom: Pounding cassava udaga into flour for ugali (porridge) on a natural flat rock outcropping, northern Mara District, Tanzania

All photos: CBN/CIAT, October 1993

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Contents

Tables and Figure in Text

Methods Section:

Findings Section:

Mwanza Region

Mara Region

Kagera Region

Figure, Methods Section:

Tables in Appendices

Village perspectives on cassava and implications for biotechnology research

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SUMMARY

The CBN approach

The Cassava Biotechnology Network (CBN) emphasizes its role in providing biotechnologists with information on the needs of developing country producers, processors, marketers, and consumers of cassava (i.e., the users of cassava). Needs assessments across all phases of the producer-to-consumer channel is combined with other information, such as the cost of research and likelihood of success, to develop research priorities.

A need for structured involvement of cassava users

In Latin America, CBN has had access to farmer contact through CIAT's involvement in participatory research with members of farmer-processor cooperatives organized around small-scale local processing facilities. In search of direct farmer contact in other regions, CBN chose to conduct a first case study in Africa, a region where cassava is critical not only to economic prosperity but to survival.

The present CBN case study explored the potential for obtaining the perspectives and opinions of cassava users directly, informally, and quickly, in a way that could be repeated at intervals or in different regions by any program like CBN whose main investment must be in research but which requires for its direction a practical method of current interaction with end-users.

The production-processing link

The CBN case study gave equal attention to cassava production and processing. In cassava any needs assessment must consider harvesting (the last step in production), processing, and in many situations marketing as well, as a single continuous activity. This is a result of cassava's unique biology.

Cassava's food security value in a cropping system derives from unique characteristics which give a farmer insurance and flexibility at important points in the production cycle. The cassava plant can recover from damage to aerial parts caused by drought, insects, diseases, or war; and mature edible roots can persist unharvested for months or even years in the soil--in contrast with other staples, which deteriorate if not harvested during a narrow window at maturity.

Once harvested, however, cassava deteriorates rapidly, within 24 hours to several days. Once the decision to harvest is taken, the farmer no longer has flexibility and must have a specific plan for prompt

processing or marketing to another processor. Cassava harvesting and processing, with or without a short intermediate marketing step, are considered together by the farmer--and consequently by the investigator.

Case study methods

The CBN case study was conducted in the Mwanza, Mara, and Kagera Regions of the Lake Zone of northern Tanzania, a cassava-dependent subsistence farming area. Most of the Lake Zone is a lowland, seasonally dry area with four to six months of dry season, high population density, and relatively good access to the central part of the Zone (Mwanza Region). Away from Mwanza, access deteriorates. Agriculture is the major economic activity in the Lake Zone and cassava and maize are the dominant food crops. The Tanzania Lake Zone is a study area of the international COSCA (Collaborative Study of Cassava in Africa). CBN site-selection was based on COSCA research, and included both COSCA and "non-COSCA" villages.

The approach known as Rapid Rural Appraisal (RRA) was chosen for its fit to CBN's needs for a cost-effective and relatively quick method of gathering information from cassava users about their needs and preferences. The CBN case study will serve one of the functions for which the RRA methodology was developed: to provide information for the interim research decisions that will be made before the results of more complete studies are available. The full analysis of COSCA data for Tanzania and other African countries, when completed, will permit cross-validation and fuller interpretation of CBN findings. This will permit linkage between the local farmer opinions and CBN's need to conduct its research priority setting on a global, or at least continental, scale.

After a one-week planning meeting, the CBN teams spent two weeks in the field, followed by a team write-up meeting during the fourth week. CBN case study participants were chosen and distributed to represent a range of expertise (see Table 1 for list of participants), and, in an effort to put villagers at ease, to provide at least one woman and not more than one "outsider" on each team.

Group interviews in villages were considered the most efficient means of gaining information, particularly because, due to a government "villagization program", very few rural people in Tanzania live outside villages. The team had little control over representativeness of village groups. However, though differences in relative prosperity surely existed, all villagers were small farmers struggling with a harsh environment, poverty, and isolation. Generally, men made up the majority of the village groups. Women's opinions were obtained because CBN team questions about cassava processing resulted in women being called or, often, in movement of the group to areas where women were processing cassava.

Findings

A crop under stress The Lake Zone region has experienced several successive years of delayed and inadequate rains. Mealybug has been a severe pest in most of the region and was said to have completely wiped out the cassava crop for two years in Mara. The pest and the drought interact to cause greater damage than each one alone. Even varieties described as resistant are only tolerant, able to produce some yield even in the presence of mealybugs. Scale insect and green mite were commonly observed.

Cassava yields in at least one village were declining. In this village, close to the Serengeti National Park, farmers said they did not have enough land to open new fields and that soil fertility was wearing out with continuous cropping.

Varietal diversity to satisfy many needs Lake Zone farmers grow many varieties, in separate fields, to satisfy a range of needs: early maturity for food in a hurry; long-term in-ground storage ability for food security; processing into the staple ugali; for quick preparation as raw snacks or boiled; leaf production (an important green vegetable) and firewood. Some varieties were grown for extreme "bitterness" that repelled predation from wild pigs and rats, frequently-mentioned causes of crop loss. Most villages grew two or three "bitter" varieties on most of their cassava area, and two to five or more "sweet" varieties.

Lack of planting material, and desire to get planting material of new varieties, were both often mentioned by villagers. Stories told about variety names showed that the villagers were eager collectors and testers of new cassava varieties.

The designations "bitter" or "sweet" were in some cases used analogously to high and low cyanogen content. In other cases there are discrepancies between the reported uses and effects of "bitter" and "sweet" varieties, compared with uses and effects expected from high or low cyanogen varieties.

Porridge, beer, and local experimenters In the Lake Zone, most of the cassava crop is processed into a storage form, generally "udaga", pieces of dry-fermented, sun-dried cassava ranging from the size of an egg to much smaller that is later pounded to flour and made into "ugali" (stiff porridge). Beer is commonly made. "Sweet" varieties are eaten boiled or raw. A packed-heap open-air dry fermentation process using prefermented inoculum, shown to the CBN team in two villages, was not previously known to any team member.

Both women and men frequently asked how the speed, safety, and nutritional value of their village's cassava processing methods could be improved. Some women had experimented (unsuccessfully) with mixtures of cassava and wheat flour, in an attempt to sustain their production of baked goods for sale in the local market during a time of wheat flour shortage.

Gender roles in cassava production and processing

Men are traditionally responsible for most decisions related to cassava production and processing. Comments by villagers suggested that decision-making actually involves consultation between men and women in a household. Decisions concerning cultivation, planting, weeding, and large sales are generally made or finalized by men. Decisions about small-scale daily harvest, processing, and sales are generally made by women.

Women are responsible for most labor except land preparation. In Mara, planting is done by women and children, while in the other two regions, planting is considered men's work. In female-headed households, women do all decision-making and labor, though when possible, male neighbors assist with land preparation. The team saw many women preparing land alone.

Except for making beer, cassava processing is exclusively a women's activity in the Lake Zone. Small-scale sales of cassava are entirely women's responsibility, as is the use of proceeds from such small sales, which are usually spent on household necessities (soap, matches). Large-scale sales, generally involving the sale of cassava rows in the field, sometimes for cash and sometimes for cattle, are made by men. In villager's comments these large-scale in-field sales were associated with large cash needs such as school fees, or situations of food stress or other hardship.

Visualizing solutions to problems "What if" questions generated little discussion. It was difficult to imagine implications of totally new innovations. Some constraints that may be amenable to technical solutions through research are not seen as problems by villagers, but rather as part of the background. For example, villagers mentioned the heaviness of planting stakes and the slow rate of multiplication of new varieties, but did not speculate about seed-propagated cassava.

Implications for Cassava Research

Confirmation for research in progress Many of the CBN case study findings based on village discussions reinforce the importance of research already being conducted, for example, research on the nature and effects of cassava cyanogenesis, on village-level cassava processing methods (both traditional and new) for cassava for home consumption and for small or home-based commercial activities, and on enhancing the adaptation of cassava to environments with long dry seasons and/or irregular rainfall.

Mealybug resistant or tolerant varieties have been the object of much research, and no real resistance has been found. Biocontrol methods developed for mealybug have been introduced in the Lake Zone and their effect may just now be becoming noticeable, because mealybug pressure has decreased. Villagers did not mention cassava green mite as a problem, however, CBN teams observed the combined presence of cassava green mite and chlorosis in many fields, suggesting that current research in cassava green mite may be important to forestall a problem that farmers may not recognize until mealybug has been controlled.

Research for women Women's responsibility for harvesting and processing suggests these as targets for specific efforts to improve women's circumstances. Root shape for ease of harvesting, a criterion in cassava improvement programs, is of direct benefit to women. Research on improving and diversifying processing, on reducing rate of postharvest root deterioration, and on processing-related aspects of cyanogenesis, will have specific effects on women, some of which could be difficult to anticipate or evaluate. Processing innovations should be tested with women at the village level in diverse situations and for some time before dissemination.

New research directions New areas for cassava research suggested by these findings include nutrient use efficiency and the association between early maturity and in-ground storability. Early maturity and in-ground storability, both highly important to Lake Zone villagers, are negatively associated in their varieties. Further work is needed on optimum ways to gather information about the possible effects of totally novel innovations and their suitability for a given system.

Research participants Lake Zone villagers appear to be keenly interested in obtaining and testing new cassava varieties and processing methods. This suggests that they could be good research collaborators.

Potential role of biotechnology In the short term, microbial biotechnologies should be improved for faster, safer, more nutritious cassava fermentation products. Cassava tissue culture is a mature technology that can dramatically speed up variety multiplication and should be assessed, along with other methods, for possible integration into the technology transfer program for increased availability of desirable varieties. Molecular marker fingerprinting can provide accurate information on distribution of cassava genetic diversity in Lake Zone fields.

In the medium term, unique experimental genotypes created through gene cloning and genetic transformation will be ready for initial testing and will permit study of critical aspects of cassava biology

including cyanogenesis and its relationship to cassava productivity, plant defense, and processing quality; postharvest deterioration; and altered root protein or vitamin content. This strategic research could be done in the Lake Zone or in ecologically similar areas.

In the long term, molecular marker-assisted selection may permit faster and farther progress in cassava breeding for *all* villager concerns than is possible with present breeding tools, including such complex research objectives as adaptation to stress environments or development of early-maturing varieties with long in-ground storability. A local breeding program may use source populations, improved for desired traits using molecular marker-assisted selection at a larger research center, for breeding with local varieties. Selected genetically transformed plants may be used in breeding with locally-adapted varieties to improve traits for which there is little or no genetic variation available in cassava, such as specifically altered cyanogen metabolism, postharvest deterioration, or root nutritional value.

Cassava biotechnology research in Tanzania Cassava biotechnology research in Tanzania is concentrated in the area of microbial biotechnologies, and it is in this area where the present case study information will find immediate use. Currently, there is no other biotechnology research on cassava in Tanzania, and little biotechnology research capacity.

There are, however, national institutions in place that will be able use the information obtained in this case study. Both organizations immediately concerned with research for cassava production and utilization in Tanzania contributed to the Lake Zone study. These are the Tanzania Ministry of Agriculture (MOA), which has reponsibility for plant breeding and agricultural technology diffusion, and the Tanzania Food and Nutrition Centre (TFNC), which is responsible for cassava processing research including microbial biotechnologies. In addition, Tanzania has founded a Commission on Science and Technology (COSTEC) to assess potential research investments across institutions in Tanzania. It is hoped that COSTEC, MOA, and TFNC will find that this study contains information useful to them in planning national research for cassava and biotechnology.

Toward a CBN methodology for farmer interaction A second case study will be conducted in South China, a region very different from the Tanzanian Lake Zone. The RRA methodology used by CBN in Tanzania will be reviewed and revised before that study. Collaborative review after the second study will further refine a "CBN methodology" to facilitate CBN's direct interaction with small-scale cassava farmers, processors, and users.

Table 1. CBN Tanzania Case Study Team Members

October 1993

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Village perspectives on cassava production, processing, and use

A CBN Case Study in the Lake Zone of northern Tanzania
October 1993

INTRODUCTION TO THE CASE STUDY

Why a CBN case study in villages?

Since its inception, the Cassava Biotechnology Network (CBN) has provided biotechnologists with information on the needs of developing country producers, processors, marketers, and consumers of cassava (that is, the users of cassava). CBN has obtained this information from collaboration with national cassava research programs, through the international centers CIAT in Latin America and Asia and IITA in Africa, and through networks such as the Asian Cassava Research Network, Panamerican Cassava Breeders Network, and Latin American Integrated Projects Network. In Latin America, CBN has had access to farmer contact through CIAT's involvement in Cassava Integrated Projects, cooperatives of farmer-processors organized around small-scale local processing facilities. In these projects, national program and CIAT scientists work together with members of the cooperatives to expand opportunities for cassava and to solve marketing, processing, and production problems in Latin American contexts.

As yet, no integrated projects are operating in Africa, where many of the poorest people who depend on cassava live. The very difficulty of learning about cassava users in rural areas of Africa has prompted considerable research, both intensive (e.g., Fresco, 1986) and extensive. The Collaborative Study of Cassava in Africa (COSCA) (IITA/ Rockefeller Foundation) covers multiple countries and has gathered both measurement data and farmer/processor opinions from structured research in villages and fields. A new study (IITA/ORSTOM), now in the planning stages, intends to investigate field-to-market channels of cassava in several additional west and central African countries.

Analysis of farmer responses in COSCA interviews will give a more complete and accurate picture than any yet available, of what farmers consider to be advantages and disadvantages (for production, marketing, processing, and use) for cassava varieties in each locality. While COSCA data is being analyzed, cassava biotechnology research continues. A rapid method was needed to provide interim guidance to on-going research.

CBN chose to conduct its first case study in Africa, because this is a region where cassava is critical not only to economic prosperity but to survival, and where the difficulty of collecting accurate, standardized data has resulted in a scarcity of pre-COSCA information. The present CBN case study explored the potential for obtaining the perspectives and opinions of cassava users directly, informally, and quickly, in a way that could be repeated at intervals or in different regions by any program like CBN whose main investment must be in research but which requires for its direction a practical method of current interaction with end-users.

Objectives of the CBN Case Study

1. Obtain information from the village perspective

   Enhance the depth and immediacy of communication between CBN and cassava users, through contact with small-scale cassava farmer/processors in Africa, and,

   Obtain opinions of small-scale cassava users in Africa about the value and implications of specific characteristics or possible characteristics of cassava varieties

2. Enhance the value of existing information

   Determine if direct CBN-to-cassava user contact can heighten CBN awareness of aspects of existing information on cassava production and utilization in Africa, or, new perspectives on that information

3. Assess the value of this type of case study to CBN

   Assess the value to CBN research priority setting of the information and perspectives gained from this rapid, minimal-investment method, relative to the cost of the method in time and funds

Objective 3 (*Assessment of the net value of this type of study to CBN*), is a post-case study activity, and will be accomplished jointly by the CBN case study team, the CBN Steering Committee, and the CBN membership, in their subsequent discussions of this report and its implications.

The Rapid Rural Appraisal Approach

The value and use of Rapid Rural Appraisal

Setting research priorities based on developing country needs is an important objective of CBN. However, CBN is primarily a *biotechnology research* network, and therefore must limit the proportion of its time, funds, and expertise committed to priority setting, including cassava user contacts. CBN sought a method to optimize the amount and quality of information obtained from a relatively small investment.

The approach often known as Rapid Rural Appraisal (RRA) was chosen for its fit to CBN's needs for a cost-effective and relatively quick method of gathering information from cassava users about their needs and preferences. RRA can be thought of as "a way of organizing people and time for collecting and analyzing information where time constraints demand [research] decisions before a local situation can be fully understood" (Beebe, 1985). RRA is generally used (i) as a heuristic device to precede and guide subsequent in-depth socioeconomic baseline studies, and (ii) to provide interim information for setting research priorities, those priorities to be confirmed and refined based on the results of the complete studies and analyses when available.

An RRA in the Lake Zone of Tanzania, an area carefully studied by COSCA, might seem to be an inverse RRA, because it followed the baseline study. HOwever, though COSCA field data collection has been completed, COSCA is now in the thick of the data analysis phase. Thus the CBN case study, though it was not able, because of its timing, to serve a heuristic function for the design of COSCA, will yet serve the second function of an RRA: it will provide information for interim research decisions that must be made while COSCA analyses are still in preparation. The full set of COSCA data for the Tanzania Lake Zone, when analyzed, will permit cross-validation and fuller interpretation of CBN findings, and vice versa.

The full COSCA analyses will also permit the placement of the CBN's findings, and findings of other RRAs, in the larger national and African context. It can be expected that farmers in different localities will have different priority sets depending on their region and its variables. Information on cassava characteristics, and to whom and where they are considered important, may help to show if those priorities can be related to identifiable objective conditions faced by the farmer. This becomes a link to CBN's need to conduct its research priority setting on a global, or at least continental, rather than local scale.

The principles of Rapid Rural Appraisal

RRA studies generally require from several days to no more than several weeks in the field region. Teams are small, to facilitate discussions and interaction with local people. A mix of technical backgrounds, and of "insiders" (local people) and "outsiders", is sought, to ease interaction with local residents and to stimulate exchange of perspectives among the team members in reaction to what they hear and observe. Special training and experience are valuable but not necessary; common sense, good observational skills, and alertness are more important. Preparations, including of careful site selection and development of general guidelines for on-site observation and discussion, are also important but are not considered a fixed experimental design. Rather, teams adapt to the unanticipated opportunities and constraints which are invariably met.

METHODS

CBN's RRA methodology

Schedule

Week 1 (Dar es Salaam): Team briefing, methodology development.

Week 2 (first field week): The two teams shared a common base in Mwanza town, centrally-located in the Lake Zone and capital of Mwanza Region. Teams met together each evening to exchange the day's findings and experience. Membership of the teams changed each day, to further enhance exchange of experience and to permit all team members to have some common experiences as reference points during the final report preparation (team "calibration" or "synchronization") (Table 3).

Week 3 (second field week): Teams separated to two opposite ends of the Lake Zone, the Mara and Kagera Regions. Membership in teams was now fixed for the week.

Week 4: Write up: Return to Mwanza town. All team members participated in plenary sessions in which findings were tabulated and summarized, implications for research were assessed, and the methodology was once again evaluated.

In addition to the group report, in which the contributions of each discipline are interwoven and assessments and conclusions reached by consensus, each individual prepared a brief specialist report. One purpose of these reports was to allow each different perspective to be clearly expressed; another was to ensure that any quiet but observant team members would have every opportunity to contribute to the findings. The reports also provided each team member with a quick interim report to their own institution while the full report was edited.

(Weeks 5 & 6 at CBN Headquarters, CIAT: one team member and secretary typed, edited, and summarized the team's draft).

Planning meeting

The planning meeting was led by John Cropley, NRI Agricultural Economist with experience in similar studies in Africa. Cropley was a "resource person" kindly loaned to CBN for the planning week by NRI, because of their interest in the possible implications of CBN's findings for a new NRI/TFNC project of transfer of technologies for research needs assessment and cassava post-harvest processing. NRI also contributed the collaboration of Philip Digges, a second agricultural economist, who accompanied us throughout the entire case study.

With the exception of Lunna Hemed, whose addition to the Mara team the second week was a last-minute inspiration of Dr. Lorri of TFNC (flexibility!), all team members were able to attend at least one day of the planning meeting. However, only "outsider" team members without local responsibilities were able to concentrate their time on the planning meeting. Unexpected urgencies and short-notice national program imperatives required much attention from Tanzanian team members. Tanzanian national team members were qualified, experienced people in positions of responsibility, whom their programs could hardly do without.

Design and pretest of semi-structured interviews

During the planning meeting, team members developed a plan for a semi-structured interview style and prepared a checklist of topics (Table 2) to guide and focus the study. Team members were briefed in the use of open questions and a flexible approach, to permit probing of areas of interest as they arose. The team also adapted a matrix recording method to give an idea of cassava varietal characteristics and their relative importance based on farmer's knowledge and perspectives. It was hoped that the matrices would also provide a starting point for "what if..." questions to speculate about novel innovations that could not be considered before but may be possible through biotechnology (for example, cassava that does not deteriorate for several months after harvest). In the CBN village interview matrices (Appendix I), both the varieties and their characteristics are listed in the order given by villagers. Only when a criterion of interest to CBN was not mentioned by villagers in the course of the discussion, did CBN team members ask about it toward the end of the discussion. Blank spaces occur when villagers did not mention the characteristic for the given variety. (Note, the term cassava "variety" as used in this report is synonymous with cassava "cultivar" or "clone", following the popular usage).

Continuous Evaluation of Methodology and Information

The interview method was pretested during the planning week at Miswe, a COSCA village near Dar es Salaam. The decision to concentrate in one part of Tanzania (see below, Choice of region...) gave CBN teams the opportunity to stay in contact during their first week in the field, and to work together to improve their methodology as they went along.

Choice of Region and Site Selection

Scaledown to one region

The original plan, to set up three teams and visit the three distinctly different important cassava-growing regions of Tanzania, was scaled down to one region, principally in recognition of the amount of time being lost--and yet to be lost--due to other demands on the time of national team members within the time available. Of the three regions originally chosen, the coastal region near Dar es Salaam was dropped because the proximity of cassava farmers to the city market makes this area of particular interest to other research projects both for its easy accessibility and its economic importance. Thus, it was felt that some other project might eventually conduct a rapid appraisal in that area, even before COSCA results become available.

The southern Mtwara Region was dropped, in spite of its interest as one of the few semiarid areas where cassava is presently grown, and a region that exports dried cassava chips to Europe, because it had been difficult for the in-country case study coordinator, Ministry of Agriculture Lake Zone Zonal Director Dr. Msabaha, to identify a team at that distant location. This was, again, largely because of sudden imperative demands on his attention: in August, Dr. Msabaha had been unexpectedly transferred from the Lake Zone to the Southern Highlands Zone. Thus he had to begin a completely new job, as Zonal Director with responsibilities for all agricultural research for an entire zone (which was not a cassava growing zone, and consequently had no cassava research program), only two months before the CBN study was to begin! It is hoped that Dr. Hans Rosling, International Child Health Center, Uppsala, Sweden (and CBN member), who has been working with cassava-growing villages in Mtwara, will be able to find the resources for a similar study of the Mtwara region.

The Lake Zone, a cassava-dependent subsistence farming area, with the advantages of Dr. Msabaha's long familiarity with the region, and the excellent NARS/NGO team he had been able to identify there, offered CBN the best chance of a successful RRA with minimum additional loss of time, and in an area not likely to be studied soon by any other RRA team.

Site selection within the Lake Zone

CBN benefitted greatly from the careful site selection work done to prepare for the COSCA surveys (Carter and Jones, 1989). Site selection for COSCA was based on consideration of cassava production geographic distribution, ecological zones (defined by variables including mean temperatures, daily temperature range, and length of dry season), population density, and accessibility.

The Lake Zone is divided into three administrative Regions (see map, Fig. 1). Mwanza Region, the area due south of Lake Victoria, is characterized by COSCA as lowland semi-hot, seasonally dry with four to six months of dry season, high population density, and good access. Kagera Region, west and north around the lake, is also described as lowland semi-hot, seasonally dry with four to six months of dry

season, but with population density lower than Mwanza and access poor. Mara Region is east and north along the lake, separated from Mwanza by the narrow north-western wedge of Serengeti National Park. Northern Mara, on the Kenyan border, is lowland humid, while southern Mara, rough hilly country bordering the Serengeti Plain, is lowland semihot and seasonally dry with the longest dry season in the CBN study. Population density in Mara is lower than Mwanza and access is poor, though better than access to Kagera.

Within the three regions, CBN attempted to visit an approximately equal number of COSCA and "non-COSCA" villages. First, COSCA villages were selected for distribution over the Lake Zone. Of 15 COSCA villages in the Lake Zone, CBN visited eight, plus five non-COSCA villages (Table 3).

Non-COSCA villages were selected for varying reasons. Tunyenye, the only non-COSCA village of five villages visited in Mwanza, was chosen because it was close to Buguluga (not visited), the most remote COSCA village in Mwanza. No other nonCOSCA village was visited in Mwanza because the first field week was unexpectedly cut to 3 1/2 days by the National Root Crops Annual Planning Meeting, at which Dr. Msabaha (the former Root Crops Breeder and Lake Zone Director) and Mr. Kulembeka (Acting National Root Crops Coordinator) (the present Coordinator, Regina Kapinga, was completing her doctorate at IITA) were indispensable participants.

In Mara, two COSCA and two non-COSCA villages were visited. Of the non-COSCA villages, Nyambori was chosen because it was one konzo (cassava cyanogen toxicity) study sites used by Rosling, and Sarawe because of its proximity to Mbiso, a COSCA village that the team did not visit, and its location in the driest part of the Lake Zone. In Kagera, the team visited the only two COSCA villages in the Region plus two non-COSCA villages.

The Tanzania Villagization Program

After independence, the socialist government of Tanzania decided that the most effective way to provide health care, water, schools, and other services to rural Tanzanians was to forcibly resettle the dispersed population in villages. This was effective; in even the remotest parts of the Lake Zone we found both historic and new villages with primary schools. In the process of villagization, each village has been organized into cells with ten-cell leaders, a chairman, a village treasurer, and a Secretary of the socialist party, the CCM (Chama Cha Mapinduzi).

One result of villagization is that Lake Zone farmers are accustomed to meetings and long discussions on important local issues such as schools, political candidates, and agricultural programs. In some villages, the farmers were quite articulate. Villagers of Sarawe prepared a formal message to CBN membership, which is presented in the section on Findings.

A second result of villagization is that there are few isolated farms. The shortage of land in the vicinity of the villages is beginning to cause some farmers to move back out from the villages. The government, recognizing the seriousness of the problem for food supply, is doing nothing to stop them. CBN stopped at a few of these rare isolated farms to ask about particular cassava cultivation or processing practices that were taking place. For the most part, however, at this time, talking to villagers and talking to farmers are more or less equivalent in the Lake Zone.

Team Composition

CBN case study participants were chosen to represent a range of expertise (Table 1). Participants were divided into two teams of three to four members. Team members were distributed to provide balanced expertise on each team. In addition, in an effort to keep the village situations as relaxed as possible, at least one woman and not more than one non-Tanzanian were distributed to each team. The exceptions were the pretest in Miswe and the interview at Lubungo, in which both "outsiders" participated for purposes of "calibration" between them.

Each team had a discussion leader and translator. The remaining one or two members supported the discussion leader in observing, note taking, providing questions, and following information leads.

The Village Interviews in Practice

The limited amount of field time meant that the use of group interviews assumed great importance. These group interviews were considered as the most efficient means of gaining information in the time available. Group size ranged from 11 to 35 farmers, with 2 to 13 women present.

Interviews started with formal introductions, including a brief presentation of why we were there. The CBN teams pointed out that they had been sent by scientists around the world to learn about the research needs of cassava users, because the research was long-term and expensive and the scientists wanted to be sure to be working on the right targets. We hoped the interviews would guide research to help, if not the villagers present today, then their children. This was said to give some immediacy and personal dimension to our mission, while avoiding raising unrealistic expectations.

During the planning week, we had expected interviews to last about 1 1/2 hours; in fact they were always at least 2 hours and sometimes much longer. Generally the end of the conversation was signalled by villagers' loss of interest. As long as villagers were interested and continued to talk, the team found that there was always more to be learned. Later in the field work, discussion of variety characteristics was started first, and the background discussions on village size, history, land use, and availability (see checklist, Table 2) were left for last, as time permitted. This was after it became evident that it was easily possible to spend an hour or two on those topics and find villagers losing interest when the team was ready to move on to discuss cassava.

The reliance placed upon group interviews emphasized the importance of group composition. District Extension Officers and Village Chairmen were made aware of the need for a wide cross-section of participants. Generally, men made up the major share of the group, with the exception of Luchelele, where the direct involvement of the team NGO member with a women's group in this village influenced the group make-up. How representative were the groups? And could the results have been different? Though differences in relative prosperity surely existed in the villages, all were small farmers struggling with a harsh environment, poverty, and isolation.

Attempts were made to include participation by as many members of the village group as possible. The inclusion if a woman in each CBN team is thought to have helped facilitate participation by women. Discussion of processing and requests to see processing were an effective means of drawing women into the group and actively involving them. Also, absence of women was often due to the fact that they were busy--carrying water, processing cassava, preparing meals. A request to learn about cassava processing often led us directly to where the women were working. This was ideal for our purposes, and the value

of the ensuing demonstrations and conversations may have more than compensated for the smaller number of women represented in the interview groups initially assembled in each village.

Following local protocol, teams were always accompanied by a District Extension Officer (DEO). It is recognized that this may have influenced the villager's responses. Emphatic requests to villagers to speak freely, and requests to the DEOs to keep a low profile after the initial introductions, were used in the hope of reducing this potential bias. The team was told that villagers would be more comfortable in presence of the DEO, since official visits and meetings are well known in Tanzania, where elections and politics are active at the real grass-roots level (CBN teams several times came across local political meetings).

[Editor's comment: When the team stopped along the roads at a rare isolated farm to ask about various cultivation or processing operations, the absence of a DEO escort never seemed to be a problem. Nor could an "outsider" notice any difference in freedom of expression when the DEO was or was not around].

Table 2. Checklist used by CBN teams in Lake Zone, Tanzania
October 1993

I. Discuss with village leader(s) or group

1. Climate/seasons - (may be asked of local extension agent)
2. Soils; how large are farms
3. Non-farming activities

II. Discuss with village group

1. Crops/farming system
   a. Food crops
   b. Cash crops

2. Role of cassava
   a. Home consumption, sale
   b. Products, processes
   c. Decision makers for each step
   d. Who does what in production, processing, selling

3. Cassava characteristics
   a. In general, "what are your important cassava varieties?" "what is important to you about this cassava variety?"

   b. Ask if not mentioned:
      i. Yield
      ii. Pests/diseases
      iii. Drought tolerance
      iv. Maturity
      v. Soil adaptation
      vi. Competitive ability (weeds, companion crops)
      vii. Cyanogen, HCN, bitter/sweet
      viii. Processing/cooking quality
      ix. Keeping quality, before and after harvest
      x. Leaves: uses, quality
      xi. Labor requirements
      xii. For sale vs. home use
      xiii. Other _____

III. What else is important to you about cassava?

IV. "What if..." questions (to be developed on site)

Table 3. Lake Zone villages visited and group discussions, Tanzania, CBN Case Study, October 1993

Village name	Date	Team members (see separate list for names and affiliations)	No. of farmers in the group		No. of house-holds in village	Length of discussions	Individual visits or walkaround (enroute or after)
			M	F			
MWANZA							
Luchelele[c]	Oct 13	PD, AK, WS	5	13		9:30am-3:00pm	Fields
Yitwimila[c]	Oct 13	AMT, HK, NM	12	4		10:30am-1:30pm	Fields
Jojiro[c]	Oct 14	PD, AK, NM	10	2			Two group interviews
Tunyenye	Oct 14	AMT, MM, WS	24	2	288	12:15pm-2:40pm	Isolated farm-processing
Lubungo[c]	Oct 15	AMT, MM, PD, HK	8	12	345	11:50am-2:20pm	Storage structures for dried sweet potato chips; fields
MARA							
Nyambori	Oct 18	AMT, HK, WS	11	4		9:30am-4:30pm	Fields, processing
Kyangasaga[c]	Oct 19	AMT, HK, WS, LH	16	3		10:30am-3:20pm	(")
Utegi[c]	Oct 20	AMT, HK, WS, LH	8	3	(small town)		Fields, processing, ploughing, planting
Sarawe	Oct 21	AMT, HK, WS, LH	30	5		(shorter; ± 2 hours)	Fields, harvesting
KAGERA							
Katoke[c]		MM, PD, AK	16	8	365		
Kasenga	18 to	MM, PD, AK	15	5	542	11:30am-2:30pm	Village markets and cassava fields
Buseresere[c]	21 Oct	MM, PD, AK	27	4	632	9:15am-1:30pm	Village market and cassava fields
Kibumba		MM, PD, AK	30	4	250	10:45am-3:00pm	Family processing cassava

[c] indicates a village included in the COSCA Phase I village survey

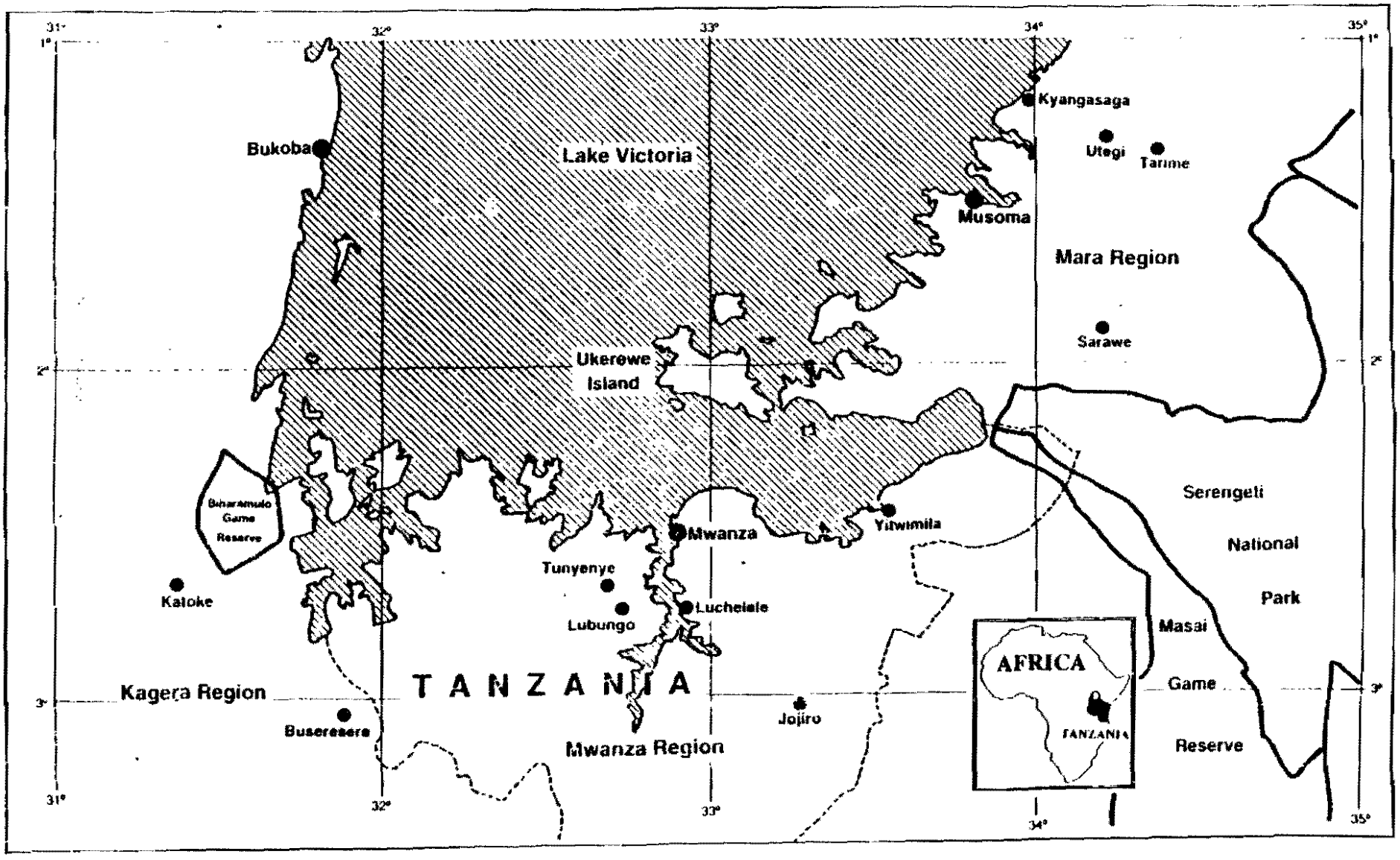

Figure 1. Map of the Lake Zone of Tanzania.
Not located Nyambori (N E of Shirati in Mara), Kasenga and Kibumba (near Kaloke and Buseresere in Kagera)

FINDINGS

All villages visited in the Lake Zone reported a bi-modal rainfall pattern with both a short and a long dry season. The short dry season lasted from one to two months and the long dry season lasted from 3 to 5 months, depending on the location. The driest (Sarawe) and least dry (Utegi) sites visited by CBN were both in Mara District.

Farmland in some villages is limited, as in Buseresere in Kagera, and in Sarawe, in Mara, where there is not enough land to practice fallow. Sarawe elders brought forward a young man and told us "He is still farming the fields his father farmed," with consequent yield decreases.

The CBN case study teams were in the field at the end of the long dry season. The rains were late this year: they were expected in late September to early October but had begun "on schedule" in only one of 13 villages visited (one other village, Sarawe, did not expect rain until November). Cassava was the only harvestable crop at that season, and was under severe stress from the combined effects of drought and dry season pests. CBN teams were told by villagers and missionaries that the rains have been late, or sparse, for the last few years.

The three Lake Zone regions, Mwanza, Mara, and Kagera, were found to be agriculturally distinct. Mwanza and Kagera grew many of the same cassava varieties, while Mara varieties were quite different. This might imply climatic or soils similarity, or frequent travel among the two Districts. Study of the continent-wide COSCA summary of soils of cassava-growing regions in Africa (Carter et al., 1992), suggests that soils in Mara may be less acid than soils in Mwanza or Kagera.

Economic Activities in the Lake Zone of Tanzania

Agriculture was the main activity in all three regions visited, as reported by villagers and observed by the CBN teams. Fishing was important in villages close to the Lake shore. Even in Utegi, actually a small crossroads town where villagers practice many trades, agriculture was considered the primary livelihood of most of the population.

Livestock, both goats and cattle, were common. Although Lake Zone villagers are settled farmers, unlike the Masai herders who live immediately to the southwest, Lake Zone people too have traditionally measured wealth by the number of their cattle.

Cassava and livestock are not directly inter-related in the Lake Zone farming systems (the team observed only one instance of feeding cassava peels (plus ash) to cattle, and use of manure on fields was apparently rare (it was mentioned at Luchelele). But in the overall economic system, cassava and cattle are related. It was said that in time of hunger, one heifer can be bartered for ten "stands" (plants) of cassava in the field, or enough cassava to feed a family of five for a week. A large area of cassava will thus ensure that a family can keep their cattle during hard times.

Food and Cash Crops in the Lake Zone of Tanzania

Cassava and maize were the dominant crops in the Lake Zone. Finger millet was a traditional favorite in some places, and sorghum is growing in importance as the unusually dry conditions persist.

Cash crops included cotton in all three regions, rice in Mwanza, tobacco in Kagera, and in some places coffee. Cassava was a cash crop everywhere to a varying extent. In some villages in Mwanza and Mara it was the major or one of two major cash crops; in Kagera it was a minor cash crop.

Villagers in the Lake Zone of Tanzania use the word *ugali* (the cassava-based stiff porridge that is the basis for almost every meal) as a synonym for food, just as "bread" is a synonym for food in some cultures. The District Commissioner of Biharamulu District, in which all four villages visited by CBN in Kagera were located, told the team that he feels there will be a food shortage in Kagera due to the drought, but that "cassava will enable them to manage."

Cassava in the Lake Zone of Tanzania

Cassava varieties

Variety names and numbers. In Lake Zone languages, the letters "L" and "R" are used interchangeably, and many variety names are given variably. Lumalampunu, Rusmula, Lumara, Lumala: all are the same variety. Lafaeli is the same as Rafaeli. This variability in variety names must account for the large number of varieties, many with similar names, found in the computer tabulations of the raw COSCA I Tanzania data sets. The Lake Zone COSCA field teams were of course aware of the situation.

Farmers in all three regions visited were always interested in new cassava varieties. Many new varieties are collected on travels, whenever someone (male or female) sees a good-looking field. The variety is often renamed after the place it was found or the person bringing it, a second cause (in addition to L/R interchanges) of the profusion of variety names. Other varieties were found to be named after their memorable attributes, for example, Lumalampunu was said to mean "finishes wild pigs;" Lumalanzana to mean "hunger relief". Hans Rosling (International Child Health Center, Uppsala) concludes that the best currently available way to sort out the cassava variety situation in East Africa is to use molecular marker "fingerprints".

In all, CBN observed or was told of about 20 cassava varieties. It is difficult to get an exact count, due to the fluctuating name situation. Most villages grew two or three "bitter" varieties on most of their cassava area, and two to five or even more "sweet" varieties on smaller parts of the area.

Farmer criteria

Farmers grew many types of varieties to satisfy a range of needs that no one variety could meet: early maturity for food in a hurry, especially important at the present time; long-term in-ground storage ability for food security; some varieties that are better for processing into the staple ugali, others for quick preparation as raw snacks or a boiled vegetable; others because of their value for leaf production (an important green vegetable) and firewood. Some varieties were grown because their extreme "bitterness" made them resistance to predation from wild pigs, rats, and monkeys, a significant source of loss of vermin-susceptible ("sweet") varieties (Tables 10, 11, 17, 18, 28, and 29; and Appendix I). Different varieties were grown in different fields; crops were mixed within a cassava field but the cassava in one field was always the same variety.

In-ground storability was highly valued, but mentioned as not relevant in the current situation of food shortage. Currently, early maturity is more important to the villagers and cassava is harvested as soon as it is ready. Lyongo, an early maturing variety, is widely grown in spite of its poor in-ground

storability, because of the urgent need for food. Based on actual reported variety choices, yield *per se* was also a primary criterion, though sometimes not mentioned by farmers until specifically asked.

In some villages, men and women listed varieties in different orders of preference, even when using the same criteria (such as productivity or quality of ugali).

"Bitter" and "sweet". The designations "bitter" or "sweet" were used by all villagers in the Lake Zone. This was often one of the first things to be mentioned about a variety. In some cases these terms seem to be used analogously to high and low cyanogen content, and were so considered by the villagers. For example, at Sarawe, in Mara, "bitter" and "poison" were explicitly equated.

In other cases there are discrepancies between the reported uses and effects of "bitter" and "sweet" varieties, compared with the uses and effects expected from high or low cyanogen varieties. For example, the Mara variety Rangohera was described as "bitter" but one that "can be chewed" raw as a snack while working in the fields. The widely-grown variety Lyongo was everywhere described as "bitter" and at Yitwimila as "a killer", but in Tunyenye as "bitter, but turns sweet after drying" and "can be chewed raw" (this was not a misunderstanding, as the team verified the statement with the Tunyenye villagers). All this suggests that the bitter/sweet taste principle may not always be associated with cyanogen level, as some investigators have in fact stated. However that may be, I am not going to chew Lyongo raw until I see someone else do it first, and live.

Villagers distinguish leaves, as well as roots, of bitter and sweet varieties, and do not eat leaves of bitter varieties because of "poison". Villagers also stated that grazing livestock are killed if they consume cassava leaves of some varieties, but leaves of some varieties are safe for livestock (Tables 10, 11, 17, 18, 28, and 29; and Appendix I). These reports are curious in view of analysis data from many countries showing that all cassava varieties are similarly high in leaf cyanogens, regardless of root cyanogen level.

Sarawe was the only village visited in the Lake Zone that reported a "sweet" variety as first in area cultivated, though the villagers later decided that it was actually only second in area, or equal. The "sweet" variety, Muganda, is an unusual one that can be both boiled fresh or processed to preferred quality ugali, and is tolerant of the mealybug. Before the mealybug, the "bitter" variety Rumara (now either first or second) was relatively more dominant.

Planting material. Villagers at Jojiro mentioned a system used in British colonial times whereby "key" farmers received planting material of new varieties to increase and distribute. They requested that the system be started again. Lack of planting material, and desire to get planting material of new varieties, were both often mentioned by villagers. Villages in Lubungo had recently started back-yard stake multiplication plots, as a step in recovery from the mealybug devastation. One variety (Msitu Zanzibar) from the Ministry of Agriculture Institute for Agricultural Research at Ukiriguru had been brought to the village of Luchelele and farmers were enthusiastic about it, though it was not yet widely grown, reportedly because there was not yet enough planting material.

Cassava production

In October, the CBN teams were able to see all phases of the agricultural cycle of cassava, from planting through harvest and processing, though the fields were as bare of all other crops as if we had been on the moon.

Throughout the Lake Zone, cassava was invariably planted on ridges, and the ridges were oriented along the contour lines (across the slope). No one knew how long this had been practiced. It was said to be to permit easier harvest. Erosion control was not mentioned, though the practice would certainly be effective to that end. Manure was not used on fields, though in many villages it was available in the corrals where cattle were penned at night. In Sarawe, one of two villages where this topic was explored in detail (the other was Tunyenye), villagers said they would use manure on their fields if they had wheelbarrows to transport it. Since Sarawe was a village in which declining yields on repeatedly-farmed land were an expressed concern, and manure can be carried in baskets which are locally made, the team wondered if this implied a labor limitation during the growing season, or the absence of certainty that the extra labor would bring benefits in increased or sustained yields.

Planting time is staggered to have cassava ready to harvest at different times. Cassava was commonly intercropped during the rains, with maize, beans, and groundnuts. In October, after the companion crops had been harvested, cassava stood as a temporary monocrop in the dry fields. Villagers did not make any distinctions among cassava varieties on the basis of intercropping suitability.

Harvest for home consumption is piecemeal, a few roots or plant at a time. The cassava that is "stored" in the field must be kept weeded to prevent extensive rat damage. Pigs are not deterred by clean fields, and men in the Mwanza and Kagera Regions reported taking turns hunting the wild pigs in the fields at night, to protect the cassava roots. The men reported this night watching as burdensome.

The cassava mealybug and other pests in the Lake Zone

Mealybug has been a severe, even starvation-threatening, pest in Mwanza and Mara since 1989, but in Kagera farmers do not find it to be serious, suggesting some factor that is common between Mwanza and Mara, and different in Kagera. Throughout the Zone, normal rainfall would improve cassava's ability to tolerate mealybug damage. Mara villagers informed us that since mealybug is a dry season pest, the pest and the drought interact to cause greater damage than each one alone.

Mealybug was observed by the CBN team in most fields seen in Mara, often in combination with green mite and scale insects. It was mentioned in all villages as the second most important factor causing depressed cassava yields, after the drought and delayed rains. Villagers in North Mara said it was unusually severe in that area. A villager in Utegi asked, "Why is the mealybug was so serious here, is it our varieties? our soils?" They reported that cassava had been completely wiped out in Utegi for about two years, and that in the last one to two years cassava has come back somewhat.

In Lubungo, Mwanza, there was concern that scale might become worse than mealybug "because it kills the plant; mealybug just stunts the plant". Other Lubungo villagers disagreed, and the final consensus opinion was that mealybug was worse. Farmers in one village (Sarawe) brought the team field samples of mealybug- and scale-infested stakes, but did not mention green mite. When asked, they stated that green mite was not a major problem. Because field observations of chlorotic plants showed green mite to be widely present, the CBN team wondered if this was correct, or if effects of green mites were too confounded with those of drought, mealybug, and scale, to be distinguishable.

When asked about rainy season pests, villagers stated that there were none comparable in damage to the dry-season pests mealybug and scale insects. In Kyangasaga, villagers showed examples of hail-damaged leaves but stated that hail was not a serious problem. Grasshoppers were seen on cassava in the field at

Yitwimila. Farmers seemed not particularly concerned at this time, though they said that grasshoppers could at times do serious damage.

Mealybug devastation has caused shifts in the varieties grown in Mwanza and Mara, because of changes to more resistant or tolerant varieties, and because planting material of original varieties was not always available. In Kyangasaga, for example, villagers brought new planting material from the district capital town of Tarime, but could not get the same varieties there that had been grown in Kyangasaga before.

Eradication of infested cassava was recommended by the extension service in Mara at one time, as a desperate means of reducing mealybug numbers. The plan was to replant cassava after two years or so. Farmers rarely complied, because the drought left them with few alternative crops. At the time, extension promoted sorghum in Mara for this purpose.

When land availability permits, Mwanza farmers fallow after a severe mealybug infestation. In Luchelele, farmers believed that cassava mealybug has an alternate host on a local *Compositae* weed. This could be confusion; Ministry of Agriculture staff told us that there are many types of mealybugs, specific to (for example) mangoes, and other plants.

The importance of the mealybug problem on the south side of Lake Victoria differs from the situation along the north of the Lake, in Uganda, where one of the CBN team (AMT) found ACMV to be a much-discussed source of alarm to farmers during a visit in 1992, while mealybug was not mentioned. The cassava production situation in Africa changes over time, sometimes rapidly, as well as in space, as shown by the differences found in Tanzania over the time period from COSCA I, through COSCA II and III to the CBN study (approximately 6 years). The importance of COSCA's goal of wide and careful coverage of cassava production in Africa becomes apparent, as does the need to maintain the resultant contacts in each area in order to keep track of changes.

A small wasp, *Epidinocarsis lopezi*, had been released in Mwanza Region by the Tanzanian national biological control program (the team did not learn if the wasp had been released in Mara). This wasp was discovered and collected in Paraguay through the work of CIAT, GTZ, and IITA. In collaborative biocontrol research by IITA and African national programs, the wasp was found to be an effective obligate parasite of the cassava mealybug, and methods were developed to rear and release the wasp as a biocontrol agent. In general, the villagers, who are familiar with the rapid effects of insecticides on cotton, were not impressed with the results of the wasp release. There was no way for them or us to know if this was because the wasp had been ineffective, or possibly because its effect builds up slowly, not quickly enough to satisfy hungry people who do not know what to expect, or to be noticeable at all at first. Both the observations of CBN's local team members, and the villager's own reports, confirm that the mealybug, though still very much present, is no longer as severe as it was, to the point that cassava can again be grown in regions where it was wiped out two years ago. The COSCA III team saw the first stages of the recovery: young cassava plants in the field but not yet any cassava harvesting or processing; the CBN team saw harvesting and processing everywhere.

Something is causing the improvement in the situation--and this could be evidence that the wasp is slowly but surely reducing the mealybug population. Villagers at Yitwimila asked for a second release of the wasp in their area, because the first release had coincided with cotton spraying season and they believed the wasps had probably been killed. Villagers in Lubungo said the wasp had not been released in their area and specifically requested it.

Gender roles in decisions and labor in cassava production

In Mwanza and Kagera, villagers reported that all decisions were the responsibility of the male head of the household, except in households were there was no man. CBN team members asked how men could make decisions about harvesting and processing, which were described as more or less daily operations adjusted to household food needs, when they were not involved in these operations and would not be likely to know with the household day by day needs. The villagers replied that women make an initial assessment, then consult with men before going ahead.

Initial land preparation was done by men in all regions using ox-drawn ploughs (two to four small oxen to a plough). Subsequent ridging was done by men in Mwanza and Kagera, and by both men and women in Mara. In female-headed households, male neighbors may help with the ploughing. If there is no neighbor to help, it may be as we saw, women attacking unopened fields with nothing but a hoe and a flock of children.

Planting, considered strictly a man's job in Mwanza, was done mostly by women and children in Mara, and by both men and women in Kagera. Weeding is an activity for everyone, harvesting is mainly women's work with some help from men, and processing is entirely women's work, except for making beer, which is done by either women or men. CBN observations agreed with villager's descriptions of these responsibilities (Tables 9, 16, and 26).

In Lubungo, men stated that men plant cassava because women cannot tell when the nodes on the stakes are correctly oriented. Another explanation is that the stakes are heavy. Both comments seem strange, since the cassava crop has not yet been destroyed by upside-down planting by women in neighboring Mara, and the fresh roots harvested by women are as heavy as stakes (and nothing is as heavy as carrying water, a women's task all over the world).

In two villages, Nyambori and Kyangasanga, cassava was planted in separate men's and women's fields. This was said to prevent dispute in households with more than one wife. Separation of fields did not change labor patterns. However, women made decisions about large-scale sales from their own fields, but had no role in decisions or use of proceeds from small-scale sales of cassava from men's fields (Table 16).

In Utegi, where there were alternative economic activities due to its location at a main-cross roads on the road to Kenya, villagers reported participation by both men and women in most aspects of decision-making and labor. This might have been associated with greater opportunity costs for both men and women's time and attention. Harvesting and processing, however, were exclusively women's activities in Utegi as elsewhere.

Cassava processing and use

Every village description of a processing method began with, "First, you pull up some roots ... ". Because of the rapid deterioration of cassava roots once they are harvested (though roots keep for long periods unharvested), harvesting and processing are not thought of or carried out as distinct steps but as part of a single process.

Most of the cassava crop produced in the Lake Zone is processed. A distinction was formerly made between the best harvest stages for processing (1 1/2 to 2 years) and for boiling (9-12 months). Now, because of the food shortages, no distinction is made and harvest is as soon as possible for all uses.

Women in Yitwimila said they had time to process more cassava if it were available. The men pointed out that increased maize yields carry a cash cost of paying the mill for grinding, whereas increased cassava yields did not. Home processing and home labor, not requiring cash for their purchase, were not given a monetary value.

The storage form of processed cassava was generally "udaga", pieces of dry-fermented, sun-dried cassava ranging from the size of an egg to much smaller. This is later pounded to flour and made into "ugali" (stiff porridge; or "grits", as it would be recognized in the Southeastern USA).

Ugali. Ugali is prepared from a mixture of cassava plus sorghum, maize, or millet flours. Villagers in Utegi commented "If you eat ugali made only from cassava, continuously, you will get backache, stomach noises, and bloody diarrhoea similar to that caused by amoebas." Villagers prefer cassava varieties that give ugali that will stick to itself but come out of the pot in a ball, leaving the pot clean. In Utegi, villagers preferred flour with high water absorbance capacity, giving more ugali per unit of flour. They also stated a preference for varieties low in fiber for making udaga.

One large feed sack of udaga was said to be sufficient for three meals for five people. Villages in Lubungo kept three or four sacks at a time. At two meals per day, this is four or five days food reserve.

Just before noon in each village, most of the women had to leave the CBN village interview groups to prepare ugali for lunch for the primary school children. This was one reason for the length of some interviews: women would leave to prepare lunch, then return later. In Kyangasanga, the CBN team women asked to accompany the village women to help make the children's lunch. The women welcomed this suggestion and cordially invited us to join in eating the lunch also.

Other cassava products. Ugi is a thin porridge consumed as a beverage. Mara villagers recognized two types of cassava beer: "machicha", the common beer (Tables 12, 19, and 20), and "gongo", said to be high in alcohol, illegal, bad for the liver, and unhygienic.

During the first severe mealybug attack, when all cassava had to be harvested at once, villagers in Nyambori prepared "makopa" by splitting, peeling, and sun drying roots until hard. Makopa stores longer than udaga, and is quicker to make, but has poor eating quality. There was no comment on its safety. Mealybug in Jojiro similarly necessitated the emergency harvest of the entire cassava crop to prevent total loss. The harvested cassava was processed to udaga and sold; the villagers did not mention any glut on the market or price losses, though they mentioned the subsequent loss of the food security that having a cassava crop in the field provides.

Villagers frequently asked the team to recommend improvements in their processing methods and to give them information about the best processing methods to produce nutritious end-products. In Nyambori, as in other places, the women asked about their processing method, "are they doing it correctly or badly? Can the team recommend any improvement?". These women had experimented with mixing cassava flour with wheat flour for making breakfast buns, in an attempt to keep the small village tea restaurant open during a shortage of wheat flour.

All these observations suggested to the team that these villages would be highly receptive to learning improved methods of processing and new uses of cassava, anything that could be done in their local conditions. The cassava processing research of Essers (LU Wageningen) and Bokanga (IITA), and of TFNC and NRI, among others, comes to mind as the type of research on African cassava processing methods whose results would be of interest and potential value to Lake Zone villagers.

In the Mara villages of Nyambori and Kyangasaga, we were shown a processing method that none of the team members knew of previously, a variation on dry fermentation (Table 19). To make udaga, fresh cassava root pieces are mixed with prefermented root pieces and left to ferment out of doors in a packed heap on one of the many large flat rocks that are a feature of the Lake Zone landscape. The heap is mixed and repacked after two days, then after four days the pieces are spread out to sun dry, stored, and later pounded into flour as needed for making ugali. If the method is followed using only fresh cassava, without adding some black-mouldy cassava roots, pre-fermented indoors, the ugali will be too sticky. The villagers also said that heap-fermented cassava could cause konzo, even if left to ferment for 8 days, if the pre-fermented pieces were not added.

Gender roles in cassava marketing

Villagers explained that their decisions as to the area of cassava to be planted are based on the expected potential for cash sales of cassava, as well as expected household food needs. In Kyangasaga, villagers had a traditional regulation that no one could sell all of the cassava unless all other crops had been consumed or sold. In Nyambori, some villagers mentioned large sales of fresh cassava, in the field, to traders from the Kenya border. Villagers in Sarawe mentioned lack of market opportunities, at the same time that they were worried about declining yields.

Sales decisions and transactions involving large proportions of a household's cassava were everywhere said to be the responsibility of male heads of households, except in households without a man. Small sales, on the other hand, were the woman's decision and activity. Observations along the roads and in local markets suggested that small-scale cassava transactions were frequent, at least in October at the end of the dry season, possibly because of the handy way in which a few plants of cassava can be harvested, processed, and taken to the market to sell for cash for small necessities such as soap, salt, matches, cups and spoons, or notebooks for schoolchildren.

Ukerewe Island: an Unknown Cassava Cornucopia

Villagers in Mwanza and Mara Regions of the Lake Zone spoke of the island of Ukerewe, in Lake Victoria, where cassava was said to be highly productive. In Luchelele, the CBN team was told that cassava from Ukerewe had saved the villagers from starvation during the first season of the mealybug. Both villagers and locally-based team members urged CBN to go to Ukerewe. Interesting though this would surely have been, the decision was made, with general regret, that CBN could not justify using a week of its already-short field time to go Ukerewe, because of the cost in time (a day there and a day back on the ferry from Musoma, which was itself a day away from Mwanza; plus, the island was large and none of us knew what to expect of its roads and villages). More importantly, it was felt that CBN should be more concerned with potentially representative rather than exceptional circumstances. It may be important for the Tanzanian national programs, in their mandate to serve Tanzania, to be able to visit and study this region reported to be highly productive of cassava.

Sarawe Village Message to Cassava Biotechnology Network Members

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The cassava farmers of Sarawe village send the following list of their most serious cassava constraints to CBN members:

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1. "A mealybug-resistant cassava variety or a pesticide [inexpensive or donated, locally available] is needed"

2. "Land is limited. We request fertilizer to increase productivity of worn-out land."

   [CBN challenge: how can this constraint be addressed through biotechnology?]

3. "The rains are not reliable. Irrigation is needed."

   [Another CBN challenge. Can biotechnology help to improve the ability of a crop to tolerate irregular *and* scarce rainfall?]

4. "The market for cassava is limited."

   [Sarawe was the only village to make this statement. The Tanzania Food and Nutrition Center, and others, are working on developing new cassava products for both traditional and developed markets]

5. "There is a problem with poison [cyanogens] in cassava. Research is needed to find out if "bitter" cassava gives "thin blood".

   [Better understanding of the role and effects of cassava cyanogens in the cropping and food system is an important CBN research objective. A number of projects are working on this]

Sarawe villagers also requested to receive the semiannual CBN newsletter, through their village post office box in the district town. They have been put on the CBN mailing list.

TABLES BY REGION

Information provided by Lake Zone villagers on:

Rainfall and Soils

Non-Farming Activities

Food and Cash Crops

Decision-Making and Labor in Cassava Production and Processing

Cassava Marketing

Cassava Variety Selection Criteria

Characteristics of Commonly-Grown Cassava Varieties

Cassava Processing Methods

Table 4. Mwanza Region Summary

Villages: Luchelele, Jojiro, Yitwimila, Tunyenye

ACCESS
All villages had good access with the exception of Lubungo during the wet season. All had access good access to the Mwanza market.

LAND AVAILABILITY
Land available at Lubungo, Luchelele, Jojiro for villagers and outsiders. Outsiders must go through hierarchy. Inadequate land availability cited at Yitwimila, Tunyenye.

Soils in Mwanza Region, Tanzania, October 1993

Type	Remarks
Sand	Preferred for cassava, easy to work, cassava stores longer in field in sandy soil
Red - (Nduke)	
Black clay (Ibush)	Preferred soil for cotton

OBSERVATION FROM VILLAGE INTERVIEWS:
Water more limiting than soil type

Table 5. Non-Farming activities mentioned by villagers, Mwanza Region, Tanzania, Oct 1993

Activity	Remarks
Fishing	Important at Luchelele and Lubungo
Livestock	Important at Lubungo
Brewing	All villages, traditional
Reforestation	At Jojiro, households plan to plant at least 50 trees, with Forestry Department
Charcoal	

Table 6. Bimodal rainfall pattern in Mwanza Region, as described by villagers, Tanzania, October 1993

Short Dry Season	Wet	Long Dry	Wet
Jan-Feb (2 months)	March-May (3 months)	June-Sept (4 months)	Oct-Dec (3 months)

6 months total dry 6 months total wet

Table 7. Major food and cash crops mentioned by villagers in CBN discussions, Mwanza Region, Tanzania, October 1993

Food crops	Remarks	Cash crops	Remarks
Cassava	Major crop all villages	Cotton	Major cash crop at all villages
Maize	(")	Rice	Second important cash crop at Luchelele and Tunyenye
Rice	Luchelele, Jojiro, Tunyenye	Maize	
Beans	Important at Luchelele	Groundnuts	Important at Tunyenye
Sorghum	Prominent crop at Lubungo	Cassava	Second important cash crop at Lubungo and Yitwimila
Millet	Prominent crop at Lubungo	Sweet potato	
Sweet potato		Vegetables	
Cowpeas		Sorghum	At Jojiro

CROP OBSERVATIONS BASED ON VILLAGE INTERVIEWS:

The crop pattern was stable at Lubungo, Tunyenye and Yitwimila. At Luchelele and Jojiro, problems with mealybug, and with pigs at Luchelele, have adversely affected cassava production. There was evidence of a switch toward cotton (a drought tolerant crop) at Jojiro

In time of drought, cassava and sorghum assumed important cash crop status at Jojiro.

Table 8. Marketing of cassava as mentioned by villagers, Mwanza Region, Tanzania, October 1993

Sold by whom	Form sold	Where sold	When	Use of Income
Women (small quantities) Men (large quantities)	Udaga and ngunule	Village markets, Mwanza market (")		Salt, soap, and sugar; school fees, clothing
Men and women	Beer	From own house Locally	When require large amount of money	School fees, clothing, etc
Women (small quantities) Men (large quantities)	Fresh roots	In field (sold by the ridge); markets (")		In times of food shortage, exchange of fresh roots for cattle
Market women vendors	Leaves	Seen in district market	Market day	

Table 9. Decision making and labor in cassava production as described by villagers to the CBN teams, Mwanza Region, Tanzania, October 1993

Activity	Decision	Labor	Remarks
Land Preparation	Head of household	Family, hired workers	
Planting	Head of household	Men	Traditionally a man's job
Weeding	Head of household	Family	
Harvesting	Head of household	Women	
Processing	Men/women	Women	

Table 10. Summary of variety characteristics mentioned by villagers to CBN team, Mwanza Region, Tanzania, October 1993

Characteristic	Number of villages (of 5)
Maturity	5
Storability (field)	5
Mealybug	5
Processing quality	5
Yield	4
Drought tolerance	4
Fresh eating quality	4
Vermin resistance/theft resistance	4
Branching (Planting material, firewood, leaves for vegetable)	2
Weed resistance	1
Leaf Quality	1
Easy of harvesting	1
Soil adaptation	1

Table 11. Summary of villager's characterization of varieties they considered the most commonly grown, CBN discussions, Mwanza Region, Tanzania, October 1993

Characteristics	Lumalampunu	Lyongo	Ngalabuto	Rangimbili	Lafaeli	Muganda
Maturity	1-2 years	8-9 months	early	-	1-2 years	1 year
Storability (field)	2-5 years	<1 year	-	-	poor	2-3 years
Mealybug resistance	resist/susc (conflicting reports)	average to poor	good	-	moderate	good
"Bitter"/"sweet"	"bitter"	"bitter"	"sweet"	"sweet"	"sweet"	"sweet"
Processing quality (ugali)	good heavy ugali	good to average	-	-	good flour	good heavy flour
Yield	average	high	-	-	-	average
Drought tolerance	good to average	average	-	-	-	good
Fresh eating quality	-	-	good	-	good	good
Vermin/theft resistance	high	high	-	-	-	-
Weed resistance	average	average	-	-	-	-
Leaf quality	good (many leaves, fast regrowth)	poor	-	-	-	average
Branching (effects planting material, wood and leaves)	-	-	-	-	-	-
Ease of harvesting	-	-	-	-	-	-
Soil adaptation	better than others on clay soils	not as good as Lumala on clay soils	-	-	-	better on clay soils

OBSERVATIONS BASED ON VILLAGE INTERVIEWS:

High fibre is undesirable to villagers as it reduces flour/udaga ratio

Lyongo was said by Lubungo villagers to have been received from a government truck

Table 12. Cassava processing methods described by villagers, Mwanza , Tanzania, Oct 1993

Processing Method	Product	Remarks
1. Dry fermentation Uproot--->peel--->sun dry--->heap inside house and cover (3 days) --->scrape mould and wash with water, sun dry 1-2 days, pound into pieces	Mbute Udaga	Fermentation time varied between varieties. Lyongo (2/3 days), Luma (3-5 days) Mbute: after removing mould, roots can be boiled Most common/traditional method and less time consuming, stores max 6 m
2. Water fermentation (i) Uproot--->peel--->soak in water 4/5 days--->remove and wash--->squeeze out water--->sun dry until dry (ii) Soak in water with peels (10 days)---> remove skin/peels---> squeeze out water---> sun dry until dry/brittle	Kivunde Kivunde	Less common because time consuming Loss of nutrients (taught at school Bad smelling flour Not a traditional or established method in the area Not a rapid method, i.e. number of days
3. Uproot--->peel--->sun dry (for 3 days)--->pound/break into pieces	Ngunule	Can store for 1 year when pounded Unbroken root pieces deteriorate faster, i.e., store for <1 year
4. a) Uproot--->peel--->pound into small pieces---> sun dry until very dry--->make into flour--->mix with water into paste--->ferment for 7 days during which molds grow--->roast the paste b) Water-soaked, germinated maize is dried and milled and then mixed with the roasted fermented cassava flour. c) Add water, ferment 1 or 2 days. Taste and foam indicate readiness. Filter	Beer	When someone requires quick income (large amount of money), beer provi a greater return than udaga Women and men participate This is the only processing mention where men stated they are involved

OBSERVATIONS BASED ON VILLAGE INTERVIEWS:

Udaga, ngunule, kivunde can be processed into flour. Flour is not easily stored

Sun dried unfermented cassava was said to have poor texture when cooked (Yitwimila)

Root softness and amount of mold visible are used as indicators of when cassava is sufficiently fermented

Cooking time of sweet varieties was said to range from 30 min to 1 hour depending on the variety (size of pieces not determined)

Table 13. Non-farming activities mentioned by villagers, Mara Region, Tanzania, October 1993

		Non-farming activities	
Village	Proportion of income from non-farming activities	Men	Women
Nyambori	small	Cattle Fishing Brick-making	Small restaurant Make and sell beer Retail vegetables and fish which they fetch from other villages
Kyangasaga	small	Fishing Livestock Sell tea in small restaurant At least one carpenter (works outside village)	Sell tea in small restaurant Grow and sell cabbage and tomatoes
Utegi	variable (large in some households, small in others)	Shop keeping Brick-making Masonry Carpentry Small-scale retailing of fish and tomatoes Shoe repair Tailoring Livestock	Small-scale retail of fish and tomatoes Making clay pots Needlework
Sarawe	small	Livestock	

NOTE "Non-Farming" used in broad sense to include everything other than cultivation of major food and cash crops

OBSERVATION Farming activities are the single major source of income for all villages except Utegi. Utegi was in fact a small town located at an important cross road between the main road to Kenya and the road to the district capital Tarime.

Table 14. Climate and major food and cash crops as described by villagers, Mara Region, Tanzania, October 1993

Village	Long rains	Long dry season	Short rains	Short dry season	Food crops	Cash crops
Nyambori	Mar-June	July-Sept (3 mos)	Oct-Dec	Jan-Feb (2 mos)	cassava, sorghum, finger millet	cassava, sorghum
Kyangasaga	Feb-May	June-Sept (4 mos)	Oct-Dec	Jan (1 mo)	cassava, sorghum, maize	rice, maize, cassava
Utegi	Mar-May	June-Sept (4)	Sept-Dec	Jan-Feb (2 mos)	cassava, sorghum, maize	cassava, sorghum, maize
Sarawe	Feb-May	June-Oct (5 mos)	Nov-Dec	Jan (1 mo)	cassava, maize, sorghum	cotton, sugarcane

OBSERVATIONS:

Seasons: The long dry season is longer in Sarawe (Bunda district) then in the other villages (Tarime district) and the total number of dry months in Sarawe is 6 (other villages, 5 mos total dry)

CBN visited the villages in late October, when the short rains had begun in Utegi, but not yet in Nyambori or Kyangasaga. Sarawe did not expect rain until November

Cassava planting had begun in Utegi

Crops: Few specialized cash crops were mentioned or observed

Table 15. Marketing of cassava as described by villagers to the CBN team, Mara Region, Tanzania, October 1993

Village	Proportion of total production sold (farmer estimate)	Form sold	Source (Men's or women's fields)	Where sold	Sold by whom	Market price	Use of income
Nyambori	"One field out of four"	Fresh and udaga	Men's and women's fields	Locally Outside Village To Kenya border	Women Both Men	- (no information)	Women's fields: food, school fees, clothing Men's fields: men's discretion
Kyangasaga							
Formerly ("before mealybug")	"Large amount"	Udaga	Generally women's fields	Mwanza and Musoma	Women	-	"Small items"
	(")	Fresh	Gen. men's fields	(")	Generally men	-	-
Now	"Less"	Udaga	As formerly	-	Women	-	"Small items"
	(")	Fresh	As formerly	-	Generally men	-	-
Utegi	"Much"	Udaga Fresh	(N.A.) (N.A.)	Local Local	Women Men	- -	
Sarawe							
Formerly	"Much"	-	(N.A.)	-		-	-
Now	"Little or none"	(N.A. = Not Applicable)	(N.A.)	(N.A.)	(N.A.)	(N.A.)	(N.A.)
Shirati (Market survey only)						50 shillings per tin of Udaga 110 shillings per tin of sorghum grain	

ADDITIONAL OBSERVATIONS BASED ON VILLAGE INTERVIEWS:

1. Nyambori: sales to Kenya border: cassava sold in field to buyers or as udaga
2. Nyambori: only village that mentioned substantial sales of "in field" (fresh) cassava to outsiders; other villages generally sold "in field" (fresh) within the village
3. Sarawe: villages stated they had no market (contrast with Kyangasaga, which had a market but not enough cassava to sell)

MARKET OBSERVATION:

Shirati market prices of udaga and sorghum grain were based on volume, but sorghum is heavier, so the price difference is not as great as it seems. We were unable to get any information on the weight of the amounts sold. The tins were approximately the size of a US five-pound coffee can

Table 16. Decision-making and labor in cassava production in male-headed households, as described by villagers to the CBN team, Mara Region, Tanzania, October 1993

	Land Preparation	Planting	Weeding	Harvesting	Processing
Village	Decision/Labor	Decision/Labor	Decision/Labor	Decision/Labor	Decision/labor
Nyambori Men's fields Women's fields	 Men/men Men/men	 Men/women Men/women	 Women/women Women/women	 Men/women Women/women	 Women/women Women/women
Kyangasaga Men's fields Women's fields	 Men/men Men/men	 Women/ Women and children Women/women	 Women/women and children Women/women and children	 Men/women and children Men/women and children	 Women/women Women/women and children
Utegi	Men and women/ Men or women	Men and women/ Men and women	Men and women/ men and women	Women/women	Women/women
Sarawe	Men/men	Women/women (men may help)	Women/Women and men	Women/women	Women/women

ADDITIONAL OBSERVATIONS BASED ON VILLAGE INTERVIEWS:

1. Land preparation often includes ploughing with oxen
2. In female-headed households (said to be "many"), women make all decisions and do all labor. Male neighbors may help by ploughing
3. In Nyambori and Kyangasaga, villagers stated that fields within a household were divided into Men's/women's when there was more than one wife, to avoid disputes
4. When cassava was purchased "in the field," the buyer was responsible for harvesting (Nyambori)
5. Men may help plant the men's fields if there is only one wife (Kyangasaga)
6. Harvesting often not a distinct activity but rather the first step in processing
7. Harvest decisions based on crop maturity, food status of household, and need for cash

Table 17. Summary of variety characteristics mentioned by villagers to CBN team, Mara Region, Tanzania, October 1993

	No. of villages (out of four total)
- "Bitter"/"Sweet"	4
- In-ground storage	4
- Resistant/susceptible to foraging monkeys, wild pigs, rats, or livestock	4
- Early maturity	4
- Resistant/Susceptible to mealybug	4
- Leaf quality (as vegetable)	4
- Yield or number/size of roots	3
- Fresh cooking quality	3
- Processing quality	2
- Scale insects (attacked by)	2
- Needs longer processing to avoid konzo or "poisoning"	2
- Safety for grazing livestock	2
- Children can easily prepare for chewing or roasting	2
- Attractive/unattractive to thieves	1
- Productivity on poor soils	1
- "Makes blood thin"	1
- Good for firewood	1
- Drought tolerant (effects of drought compounded with effects of mealybug)	1
- Problems with rainy season pests	
- Weed tolerance	
- Green mite resistance/susceptibility	
- Yield with normal rains	

Table 18. Summary of villager's characterization of varieties they considered the most commonly grown, CBN discussions, Mara Region, Tanzania, October 1993

	"Bitter" Varieties			"Sweet" Varieties		
Characteristic	**Rumara**	**Kigoma**	**Ndiare**	**Rwanda**	**Obarodak**	**Muganda**
Sweet/Bitter		More bitter than Rumara	Toxic			
In-ground storability	12 mos (short)	"Only 2 months after maturity" (poor)	"long" >24 mos	"long" 24 mos	1 1/2 yrs (short)	
Resistance to foraging wild or domestic animals	good	good	very good - kills them	susceptible (poor)	poor/susceptible	poor
Maturity	6 mos (early)	6-9 mos (early)	12 mos (not early)	8-9 mos (early)	6-8 mos	12 mos
Mealybug resistance or tolerance	Susceptible but less so than Obarodak	Susceptible	more resistant than Obarodak	more resistant	more susceptible than Rumara	resistant
Leaf eating quality	poor	poor	poor		good	good
Yield (or number of size of roots)	High to Average			high	High, average	good
Fresh cooking quality					good	good

Continued ...

Table 18, continued. Summary of villager's characterization of varieties they considered the most commonly grown, CBN discussions, Mara Region, Tanzania, October 1993.

	"Bitter" Varieties			"Sweet" Varieties		
Characteristic	**Rumara**	**Kigoma**	**Ndiare**	**Rwanda**	**Obarodak**	**Muganda**
Processing quality	average to poor					Average
Length of processing to remove cyanogens ("poisons")			long			
Safety for grazing livestock						good
Ease of preparation by children				good	good	good
Resistance to thieves		good				
Productivity on poor soils	good					
Makes blood thin	yes					

VILLAGER COMMENT: Nyambori received 'Rumara' from the island of Ukerewe 3 years ago.

Table 19. Processing of cassava as described by villagers, Mara Region, Tanzania, October 1993

Method I. Udaga (storage form)

1. Uproot and peel a few roots
2. Sun dry one day
3. Ferment inside (dark), covered
4. Uproot and peel a large amount of roots
5. Mix together with pre-fermented roots, pound into irregular pieces on a rock using wooden mallet
6. Leave to ferment on a rock in a packed heap, uncovered for 3 or 4 days (after 2 days: invert, mix and repack)
7. Spread to sun dry on rock; result is udaga (intermediate product)
8. When needed, pound into flour (used to make ugali, see below)

Notes:

1. In Utegi, the four-day fermentation step was done in an uncovered container inside the house (dark), including inversion and mixing after two days
2. Large flat-topped rocks are common in the Mara landscape and are part of local processing methods
3. Villages used the same word used for beer making, for the cassava fermentation step

Method II. Udaga (storage form)

Uproot, peel, and split into two parts
Sun dry one day
Ferment in a covered container four days
Wash or scrape off mold
Sun dry on rocks or mats as split roots or pounded into irregular pieces
Udaga (intermediate product)

Method III. Ugali (stiff porridge)

Udaga is pounded into flour and added to boiling water while mixing, until the mixture becomes stiff

Note: Udaga flour preferred mixed with sorghum or maize flour; sorghum and maize ugali cited as not sufficiently filling without cassava added.

Method IV. Uji (liquid porridge)

Made as ugali, but mixture is left thin (fluid). Milk and sugar can be added if available.

Method V. Beer

One group in Nyambori stated they made beer with maize, sorghum, and cassava. Another group in the same village stated they do not make beer.

Note: COSCA III (just after height or mealybug attack) saw no processing of cassava, no harvesting, only young plants in the field. CBN saw much processing and harvesting. Villagers said this was a sign of the partial recovery from the mealybug.

Table 20. Kagera Region Summary

Villages: Katoke, Kasenga, Kibumba and Buseresere, all in the Biharamulo District

Access: Good access to main roads except at Kibumba where the road is only passable during the dry season. No commercial vehicles pass regularly along the Kibumba road

Land: Land is available in all villages except Buseresere. Reason in population pressure after villagization program 1974. This has influenced migration to other villages with available free land.

Farm size: (Available land per household):

Villages with adequate land, farm size 3 to 4 acres. (Available land per household 3-10 acres).

In Buseresere:
a) farm size 2 acres (available land 2 acres)
b) Pre-villagization farm size was 5 acres

Table 21. Non-farming activities in the Kagera District, based on CBN discussions, Tanzania, October 1993

Activity	Remarks
Livestock	
goats	Goats kept for dowry and security in all villages except Katoke
	Kept by most households in all villages except Katoke where lack of grazing land and purchasing power were cited as constraint
cattle	Few cattle kept. Reasons given: lack of grazing land, purchasing power, and tse-tse fly at Kasenga village
Brewing	Undertaken in all villages. For celebrations, for cash income and payment in kind for labor; predominantly women
Timbering	Undertaken in all villages
Petty business	Undertaken in all villages
Fishing	Important at Kibumba only
Gold mining	At Buseresere

Table 22. Bimodal rainfall pattern in Kagera Region, as described by villagers, Tanzania, October 1993

Dry	Wet
Jan to Feb (2 mos) short dry season	Feb to May (3 months)
June to Sept (4 mos) long dry season	Oct to Dec (3 months)
Totals: 6 months	6 months

Table 23. Soils of the Kagera Region, CBN farmer information, October 1993

Type	Distribution	Utilization	Main Crops	Remarks
Sand	All villages	Many fields	Cassava, beans, maize, cotton, ground nuts, sweet potatoes	Easy to work Less fertile; use of organic and inorganic fertilizers
Sandy-Loam	Katoke and Kasenga	Few fields	Beans, sweet potatoes, banana, cassava	Sticky, difficult to wo in wet season
Clay (Black)	All villages	Few fields	Maize, beans, rice and sorghum	Waterlogging, cracks (dry), difficult to wor less fertile
Red	Kibumba	Few fields	Cassava, maize, beans, ground nuts, finger millet	Less fertile

OBSERVATIONS BASED ON VILLAGE INTERVIEWS:

Increased pressure on land (continuous cropping) in Buseresere has contributed to declining fertility.

In Kibumba, use of fallow in rotation to improve soil fertility is practiced: 3 years cassava; 1 year fallow; 1 year finger millet/beans/swt. potatoes and maize; 1 year fallow; cotton or cassava

Table 24. Food and cash crops mentioned by villagers in CBN discussions, Kagera Region, Tanzania, October 1993

Food Crops	Remarks	Cash Crops	Remarks
Cassava	Major food in all villages except Buseresere where cassava was third in importance	Cotton	Major cash crop in all villages except Katoke
Maize	Major food in Buseresere village and second in importance in other villages	Tobacco	Second important cash crop in Kasenga and Buseresere
Cooking banana (Matoke)	Traditional food in Katoke		
Beans	Most important common vegetable	Beans	In all villages
Finger millet	Minor but common food crop	Ground nuts	(")
Sorghum	(")	Maize	(")
Sweet Potatoes	(")	Cassava	(")
Legumes	(")	Coffee	Only in Katoke

OBSERVATIONS BASED ON VILLAGE INTERVIEWS

Food crop pattern is stable in all villages except Katoke where banana is the traditional food crop. Cassava has recently assumed importance because of drought and incidence of serious pests and disease attacks on banana.

Cash crop pattern is stable. Most common cash crop for women is groundnuts. However, women can also obtain income from a wide range of crops.

Table 25. Village notes, Kagera District, Tanzania, October 1993

Katoke	A leprosy treatment centre: majority of the group interviewed had leprosy. Led to specific problems for these people, particularly with respect to labor. Labor had to be hired; they relied on donations
	Root rot cited as widespread
	Cassava is intercropped with banana, the traditional food
	Prefer ugali that tastes like matoke (banana)
	No well-established cash crop
	No problem with theft
Kibumba	Poor accessibility year round; 20km from main road. Problem is worse in the wet season, when rivers cross the road
	Serious problem with pigs uprooting cassava. Sweet varieties are grown near the homestead to combat this. Two sweet varieties, Sheri-sheri and Toboha, were abandoned due to pig problem
	Root configuration was cited as aiding pig resistance, as in the case of variety Ngalabuto, which has long "neck" length on the tubers, such that deep roots are left behind which the farmer can recover
	Use of fallow in rotation cycle
	Use of association labor
Busere-sere	Maize is the major staple food
	Land shortage cited as a constraint
	Cassava receives indirect fertilization applications because it is intercropped with maize
	The village is well-connected to the Mwanza market

Continued ...

Table 25, continued. Village notes information, Kagera District, Tanzania, October 1993

Kasenga	Cotton and tobacco are well-established cash crops in this village
	Mealybug is a recent problem
	Planting material for Lumalapunu was provided from Kasenga to other villages in the district in 1984 and 1990 [a government initiative]. Cassava is now important in those villages
	Lack of middlemen
	Villagers requested processing machinery to save time and effort
	Villagers asked, which processing method gives the most nutritious product?

Table 26. Decision-making and labor in cassava production, as described by villagers to the CBN team, Kagera Region, Tanzania, Oct 1993

TASK	DECISION MAKER	LABOR	REMARKS
Land Preparation	Head of household	Family (both genders) Hired labor Association labor mentioned only at Kibumba	Mostly men, except for female-headed households
Planting	Head of household	Men/Women Hired labor	Mostly men except for female-headed households. Men's job, "traditionally heavy work". Very few men as hired labor
Weeding	Head of household	Family Hired labor Association (Kibumba)	Hired labor, payment in kind (brewing) and cash. Requires supervision to assure correct weeding practices. Age-group associations for group work. Common weeds cited: Couch grass, striga (Katoke), twining weed (dodder?)
Harvesting	Head of household Women	Family Hired labor Association (Kibumba)	Small quantities: decisions taken by women and family labor is used. Large quantities: decision taken by men (head of household); family labor used
Processing	Head of household Women	Women	Small quantities, decision by women. Large quantities, decision by men (head of household)
Marketing	Head of household Women	Men/women	Small quantities, decision by women. Large quantities, decision by men (head of household)

OBSERVATIONS BASED ON VILLAGE INTERVIEWS:
In Kagera, in households led by men, cassava is a man's crop
FIELD OBSERVATION:
Cassava is predominantly planted in ridges

Table 27. Marketing of cassava, as described by villagers to the CBN team, Kagera Region, Tanzania, October 1993

Sold by whom	Form sold	Where sold	When sold	Use of income
Women/ Men	Udaga	Village market Neighbors	Market days/ any day	Small quantities, women: housekeeping Large quantities, Large expenditures: men
Women/ Men	Ngunule	Village market Neighbors	Market days/ any day	
Women	Flour	Lake shore (Kibumba)	Early morning	
Men/ Women	Fresh (roots and stands)	Village market Neighbors By field/ridges	Market days/ any day	
Men/ Women	Beer	Village market	Market days/ any day	Housekeeping Larger purchases

OBSERVATIONS BASED ON VILLAGE INTERVIEWS:

Most cassava is sold in dry form (udaga)

No price differential as regards quality and different types of dried chips

Cassava is used primarily for home consumption. The exception is at Kibumba where up to half of production is marketed.

A wide variety of brews are manufactured, spirits and beers using combinations of cassava with cereals (maize, finger millet and sorghum).

Table 28. Summary of variety characteristics mentioned by villagers to CBN team, Kagera Region, Tanzania, October 1993

Characteristic	No. of times mentioned
Eating quality of raw roots	4
Field storability	4
Maturity	4
Eating quality - ugali	3
Eating quality - boiled	3
Drought tolerance	3
Processing quality - udaga	3
Resistance to pigs/rats/monkeys	3
"Bitter"/"sweet"	3
Ease of harvesting	2
Eating quality - leaves	2
Mealybug resistance	2
Scale insect resistance	2
Soil adaptation	2
Yield	2
Root rot resistance	1
Theft resistance	1
Intercropping suitability	1
Root shape	1
Green spider mite resistance	0
Marketing	0
Planting material production	0
Weed resistance	0

Table 29. Summary of villager's characterization of varieties they considered the most commonly grown, CBN discussions, Kagera Region, Tanzania, October 1993

	"Bitter"		"Sweet"			
Characteristics	**Lumarampunu**	**Lyongo**	**Sherisheri**	**Rushura**	**Ngalabuto**	**Toboka**
Storability (field)	3-6 yrs	1 1/2-2 yrs	1 1/2-3 yrs	2-5 yrs	2 yrs	1 1/2-2 yrs
Maturity	2-3 yrs	9 mos-1 yr	9 mos-2 yrs	1-2 yrs	1 yr	9 mos-1 yr
Eating quality - raw	-	-	Good (not bitter in dry season)	Good	Good	Good (becomes bitter in dry season)
- boiled	-	-	Good	Good	Good	Good
			(Fast cooking, good dry matter and starch)			
- ugali	Very good	Very good	Poor	Poor	Poor	Poor
	Heavy, non-sticky, white color, tasty		Light, sweet, not tasty			
- leaves	Best (produces well, many leaves during dry season)	Good	Good	Good	Good	Good
Drought tolerance	Yes					
Resistance - pigs	Good	Good	Poor	Poor	Poor	Poor
- mealybug	Yes	No	No	No	No	No
- scale	No	No	Not observed			
- theft	Yes	Yes	Susceptible	Susceptible	Most susceptible (easy to harvest)	Susceptible
Yield	High	High		Medium		
Processing quality (udaga)	Very good	Very good				

Table 30. Cassava processing as described by villagers to the CBN team, Kagera Region, Tanzania, October 1993

PROCESSING METHOD	PRODUCT	REMARKS
1. Dry fermentation [uproot--->peel--->sun dry (1-2 days)--->heap in shade cover with moist materials (3-4 days)---> remove cover--->remove mould--->dry---> pound--->remove fibre--->sun dry until brittle	Udaga	Commonly practiced in all villages. Traditional method of processing. Does not require water. Good product for sale. For good quality, the method requires anaerobic (air tight) conditions and adequate moisture resulting in black mould growth. Poor conditions cause growth of yellow/orange molds--->poor quality udaga Storage--->6 months to 1 year in sacks, tins, or traditional containers.
2. Direct sun dry (uproot--->peel ---> sun dry to brittle)	Ngunule	Used in Buseresere and Kibumba Easy method, does not require water, mostly used for processing large quantities for sale Gives bitter dried chips. Stores for 3 months, or 4 months if mixed with insecticides.
3. Water fermentation 2 methods: (i) Uproot-->direct soaking unpeeled in water until soft--->remove peel--->sun dry to brittle. (ii) Uproot--->peel--->soak in water in container --->cover with leaves or lid (4 days)--->remove lid--->wash--->sun dry to brittle.	Kivunde	Used in Buseresere and Kibumba where water is readily available. Few households practice this method. Gives white flour but smells or tastes sour. Loss of nutrients. Storage <1 month.

FIELD OBSERVATION:

Processing is used mostly for bitter varieties

CONCLUSIONS

Implications for Cassava Research

Lake Zone villagers were keenly interested in cassava varieties and eagerly sought and tried new ones. They had adopted new varieties when these were superior, but slow multiplication hindered their efforts. Villagers were also very interested in better or new processing methods and cassava products appropriate to their conditions. Research results that reach these villagers should have a good chance of being tested by them and adopted if useful. The interest in some of the villages might make them good candidate sites for participatory research in variety, process, or product development.

All of the potential research topics listed below, which apply specifically to the Lake Zone of Tanzania, are derived from information mentioned by villagers, except where noted. In combination with other data, this information can be used for establishment of African and global cassava research priorities.

1. Villager varietal selection criteria:

   Good field storability: desire 2-3 years
   Maturity: desire both short and long maturing
   Drought tolerance: ability to survive long dry season, irregular rains
   Nutrient use efficiency: ability to sustain good yields when land is farmed repeatedly (i.e., when land shortage prevents fallow)
   Eating and processing quality: raw vs. processed, high dry matter and starch content, less fiber
   Pig/monkey/animal resistance: "bitter" varieties deter animals, but have other drawbacks
   Mealybug resistance: most varieties appear susceptible
   Scale insect: not considered as serious as mealybug, but a problem; affects stem of mature plant
   High yield, associated by villagers with many large roots
   Green spider mite resistance: mites common in many fields, associated with chlorosis (CBN team field observation; possibly more serious than villagers recognized)

2. Variety dissemination:

   Shortages of planting material of traditional standard varieties decimated by mealybug (research/extension implication: faster multiplication *and* ways of getting material to farmers). Farmers in one village had started their own plots for planting material increase. Farmers in another village requested to be involved in multiplication schemes.
   Slow multiplication rate of new varieties (research implication: faster methods of multiplication)

3. Processing

   (i) New and traditional village-level processing methods
   Women requested better and new processing methods for home consumption of cassava and products for sale in small-scale commercial activities

(ii) Conservation/enhancement of nutritional value
Women requested information on "better methods to improve nutritional quality of their products"

(iii) Processing equipment and materials: Both women and men requested: knives, peelers, pounding mallets, fermenting instruments, drying machines; researcher observation: raised platforms for drying mats, to keep sand out of final product

(iv) Information on nutritional value of udaga, kivunde, ngumule: requested by women and men

(v) Influence of black or yellow mold growth (cyanogen removal, speed, taste, texture):
Women and men requested research and more information
Safety (researcher observation; villager comment in Mara)

4. Cyanogen removal:

Villagers mentioned both negative (toxicity) and positive (resistance to vermin and theft) aspects of "bitterness" and "poison". Mentioned sufficient length of processing time, (and, in Nyambori use of prefermented cassava as a starter) as essential to avoid toxicity.

Researcher observation: methods that reduced cyanogen level faster would be welcome; methods involving use of new improved starter cultures could be acceptable and practical for Lake Zone villagers.

5. Storage: Situation needs to be explored (villagers mentioned storage length as a concern)

Storage of fresh roots: not much of an issue in Lake Zone where little cassava is marketed fresh and most is left in field until processed

Udaga, ngumule, kivunde: improve shelf life, improve storage conditions/structures (team observation)

- Kivunde: explore improvements in this lactic acid fermentation process to reduce smell from water fermented cassava (villager request, Kagera)

Research for women Additional research topics are suggested by the information given by villagers, that cassava harvesting and processing are almost exclusively women's activities:

Root shape and any other factors affecting ease of harvesting

Processing improvements, including:
- reduction in labor requirement
- low cost implements
- faster fermentation
- increased nutritional value
- diversity of products

Management of cyanogenesis for reduced or safer processing
(if not accompanied by loss of plant protection and productivity factors)

The potential role of biotechnology

What tools does biotechnology offer to address cassava research needs, in particular, the needs of Lake Zone cassava users? What would be involved in applying biotechnology to Lake Zone research needs?

Some of the biotechnological tools available or being developed include molecular marker-assisted selection and molecular marker fingerprinting; tissue culture; gene cloning and genetic transformation; and microbial biotechnologies. Relevant applications, advantages, and the present status of each of these biotechnologies is examined below, with an assessment of their usefulness for cassava improvement in the Lake Zone.

Molecular marker-assisted selection

Applications
- Applicable to all of the villager's varietal criteria
- Could enhance breeder's ability to manipulate complex genetic traits for improved adaptation of cassava for stress environments such as the Lake Zone

Advantages
- This refinement of a classical plant breeding tool increases effectiveness of selection, because molecular markers are independent of external environment and plant developmental stage, so permit selection in any environment and screening of mature-plant and root characters in seedlings
- Applicable to both simply and quantitatively-inherited traits

Present status: Developing
- In use in special situations in some crops, including maize, soybeans, rice, tomato, potato
- Preliminary work on individual trait markers and a cassava molecular map, which facilitates use of molecular markers, is in progress. Establishment of markers for each trait will require about 3 years close collaboration between breeders, relevant trait experts, and biotechnologists

To permit maximum usefulness of the technology, faster, less expensive methods for visualizing molecular markers should be developed, concurrently with marker establishment research

Assessment

Ready for collaborative research to develop and characterize experimental cassava lines and populations for use as international sources of certain critical traits, i.e., Lake Zone information suggests that combined early maturity and long in-ground storability, drought tolerance, and nutrient use efficiencies could be priority traits

Routine use in breeding programs to refine local adaptation awaits faster, cheaper methodology

Molecular marker fingerprinting

Applications

To identify Lake Zone varieties, many of which have different names in different villages

To guide breeding by assisting in interpretation of where and when--and thus why--certain varieties are widely used; and by improving efficiency of parent selection by confirming genetic relationships

To guide conservation and use of cassava diversity for local needs by assessing how much diversity is represented in Lake Zone farmer's fields

On the international scale, to improve efficiency of cassava germplasm conservation and use by assessing diversity of cassava in Africa, where the crop is introduced, compared to its origins in South and Central America; and to reduce the cost of conserving cassava diversity by identifying duplicates

Advantages

Distinguishes between varieties at the DNA level, regardless of visual similarities; identifies duplicates vs. similar varieties

Useful information can be gained from one-time studies, thus can be obtained through national-international collaboration even for countries lacking facilities for molecular marker research

Present status: Available

Has been used to characterize diversity and relationships among cassava genotypes

Assessment

A ready-for-use technology that can provide information to guide national and international cassava breeding and conservation and use of genetic diversity

Tissue culture

Applications

Applicable to villagers' need for more planting material of desired varieties

Applicable to all villager criteria indirectly, through its role in germplasm conservation and safe international exchange of clean germplasm (in combination with antibody and other diagnostic technologies)

Advantages

Cassava varieties can be maintained only by forms of vegetative propagation. Maintenance in tissue culture is less expensive in the long term than field plantings, and there is less risk of loss from disease, adverse weather, or accidents

Cassava's multiplication rate is slow (one plant produces ten to thirty planting stakes per year); tissue culture can increase this to thousands of plantlets per year

Present status: Available

More than a dozen national programs use cassava in-vitro tissue culture applications. Tanzania currently does not use tissue culture in cassava research but is developing the scientific planning capability that will permit it to evaluate the application of this technology for Tanzania

Cryopreservation, a development of tissue culture, would permit further decreases in cost of long-term germplasm conservation in national and international institutions. Experimental methodologies exist; long-term tests of germplasm stability are needed

Assessment

Tissue culture is an established, widely-affordable technology; currently serves cassava users by reducing cost and improving effectiveness of conserving cassava diversity and international exchange of germplasm.

Tissue culture could be integrated into variety release programs to increase availability of desired planting material to Lake Zone villagers

Gene cloning and genetic transformation

Applications

Genetic alteration of cassava traits for which there is little or no diversity within cassava, such as root protein and vitamin content; or to alter traits beyond the naturally occurring range, generally by up or down regulation of enzymes, such as to obtain completely cyanogen-free varieties or varieties with several month's resistance to postharvest deterioration (the latter directly affects women's work schedule)

Novel experimental genotypes produced via genetic transformation can also be used as tools for biological research, e.g., for defining relationships between cyanogen content and "bitterness" and between cyanogens and important plant defense, production, and processing quality factors; or, for study of plant nutrient uptake and use, etc.

Advantages

Increases available genetic diversity by accessing genes not found in cassava or close relatives, and by qualitatively changing expression patterns of cassava genes

Could increase selection efficiency by permitting direct addition of simply-inherited traits to advanced varieties before release, allowing plant breeding to concentrate on improving combinations of more complex traits

Present status: Developing

Gene cloning research is in progress for cassava cyanogenesis and root protein metabolism. Biochemical research, preparatory to gene cloning, is in progress for cassava postharvest deterioration pathways and for carbon assimilation/ photosynthesis (affects total yield).

Current bottleneck: cassava genetic transformation protocol. An initial transformation protocol is close and, once effective with model genotypes, will permit introduction of cloned genes and gene promoters into cassava

Assessment

Transformed lines with modified cyanogenesis, postharvest metabolism, or protein could be ready in several years for testing totally new plant types and studying aspects of cassava biology
Several years later, useful new types would be identified, characterized, and ready for breeding with locally-superior varieties
Direct use to transform advanced selections before release will require extension of the method to a wide range of genotypes, possibly at about the time that the first experimental varieties have been tested

Microbes and microbial processes

Applications

Speed and safety of fermentation are a concern of villagers, particularly women. Superior microbe strains would permit faster fermentation and could increase safety through promoting efficient cyanogen breakdown and repression of any indigenous toxin-producing fermentation organisms

Nutritional value of cassava products was frequently mentioned by village women. Specific microbes could increase protein and/or vitamin content of fermentation products

Advantages

Existing practice of indigenous microbial biotechnologies by villagers could be an advantage for technology transfer efforts involving new starter cultures. These might be received more like stakes of a new variety than like a new insecticide (for example)
Research costs may be lower than for other biotechnologies

Present status: Available

Developed and used by villagers in the Lake Zone and throughout Africa
Research in progress in many international and international programs
In commercial microbial biotechnology where initial advances through strain selection have already been made, biotechnological tools such as molecular marker-assisted selection and genetic transformation are being used to enhance microbial effectiveness for specific applications

Assessment

A proven, affordable technology that serves several important villager needs and can be improved to serve them better

Cassava biotechnology priorities for the Lake Zone

Based on the above assessments of biotechnologies and on cassava research needs identified by Lake Zone villagers, some present and future priorities for the use of biotechnology can be derived, specific to the Lake Zone.

This information will be combined with other information to assist in formulation of cassava biotechnology priorities having regional (African) and global importance.

Short term

1. Microbial biotechnologies can be improved for faster, safer, more nutritious cassava products

2. Tissue culture should be assessed for its contribution to increased availability of planting material of desirable cassava varieties. Tissue culture could be used on a one-time basis to increase a specific needed variety, or could become an integral component of the cassava technology transfer system, depending on costs and benefits in the specific situation.

3. Molecular marker fingerprinting can be indirectly applied to villager concerns by providing genetic information for optimum conservation and use of cassava genetic diversity.

Medium term

1. Molecular marker-assisted selection could be used to assess existing variability and heritability in cassava of any of the villager varietal selection criteria, i.e., early maturity, in-field storability, and their combined expression; drought tolerance, nutrient use efficiency, cooking quality, and insect and pest resistance. This information could be used to refine identification of traits most amenable to improvement and to begin to develop improved source populations or parental lines. Applicable molecular markers would have to be established in the Lake Zone, or in a similar environment and confirmed in the Lake Zone.

2. For certain cassava traits that concern Lake Zone villagers, genetic transformation will provide new tools for study of trait biology and impact. Appropriate approaches may include comparisons of high ("bitter")- and low ("sweet")-cyanogen cassava varieties with transgenic cyanogen-free varieties; and similar comparisons for postharvest root deterioration and root protein and vitamin content. This strategic research could be conducted in the Lake Zone or in ecologically-similar environments.

Long term

1. Molecular marker-assisted selection, by increasing selection effectiveness, may potentially permit long-term genetic advances for *all* villager criteria, ultimately beyond the progress possible using present breeding tools. If not practical for local application, this biotechnology could contribute to research needs of Lake Zone farmers through continued improvement, at a collaborating research center, of source populations expressing the desired traits, to be used in crosses with Lake Zone cassava varieties.

2. Experimental genotypes from gene cloning/genetic transformation research which showed promise in medium-term research could be used in breeding programs to provide optimum genetic solutions for management of cassava cyanogenesis, for reduced rate of postharvest deterioration of cassava, and for enhanced cassava root protein and vitamin content

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APPENDICES

I. Village-level cassava data:

Villager-named cassava varieties and criteria (tables compiled during CBN group interviews)

A. Mwanza Region
B. Mara Region
C. Kagera Region

II. Implications for future users of similar RRA methodology

III. List of acronyms and abbreviations

Appendix I A

Mwanza Region villager-named cassava varieties and criteria

Tables compiled during CBN group interviews

A note on the tables:

In the CBN village interview matrices in Appendix I. A, B, and C, both the varieties and their characteristics are listed in the order given by villagers. Only when a criterion of interest to CBN was not mentioned by villagers in the course of the discussion, did CBN team members ask about it toward the end of the discussion. Blank spaces occur when villagers did not mention the characteristic for the given variety. (Note, the term cassava "variety" as used in this report is synonymous with cassava "cultivar" or "clone", following the popular usage).

Table 31. Cassava varieties and characteristics: summary of CBN discussion, Luchelele, Mwanza Region, Tanzania, October 1993

Characteristic	Ngalabuto	Rangimbili	Muganda	Msitu Zanzibar	Lyongo	Lumala	Njima
Mentioned by villagers							
Maturity	3	1	4	1	1	3	2
Storability (field)	3	2	1	4	2	1	2
Weed resistance	1	1	1	1	1	1	1
Yield	4	1	2	3	1	3	2
Drought resistance	2	1	2	2	1	2	3
Mealybug	1	1	1	1	1	1	1
Branching ability	3	4	2	1	1	2	3
Eating quality	2	1	4 "too hard"	3	1	1	1
Pigs/Vermin	1	1	1	1	1	2	2
Processing quality (flour)					1	2	2
"Bitter"/"sweet"	"sweet"	"sweet"	"sweet"	"sweet"	"bitter"	"bitter"	"bitter"

1 = best, 4 = worst

OBSERVATIONS BASED ON VILLAGE INTERVIEWS

Villagers stated that if they could only grow one "sweet" variety, it would be Rangimbili, because of its early maturity and high yield.

If they could only grow one "bitter" variety, it would be Lyongo, because of its early maturity, high yield, and pig resistance due to its extreme "bitterness"

Among the variety characteristics, the order in which "bitter" and "sweet" was mentioned was not recorded. All other traits recorded in order mentioned.

Table 32. Cassava varieties and characteristics: summary of CBN discussions, Yitwimila, Mwanza Region, Tanzania, Oct 1993

Characteristic	Lyongo	Lumala	Muganda	Nghwenunkila	Moshi
Mentioned by villagers					
Diseases & ACMV	disease susceptible	disease free	disease free	disease free	disease free
Maturity	8-9 mo: plant Nov, harvest early July; food security	12 mos	12 mos	8 mos	8 mos
Mealybug damage	Mealybug severe	average	slight	slight	slight
In-ground storability	poor, <1 yr.	good, 2-3 yrs.	good, 2-3 yrs.	"keeps in ground"	"keeps in ground"
"Bitter"/"sweet"	bitter-kills	bitter	sweet	sweet	sweet
Processing quality	poor, "light" flour	good, "heavy" flour	good, heavy flour	poor light flour	good, heavy, heavy flour
Subsequently asked by CBN team members					
Yield	more	less	less	less	less
Drought tol/ resistance	less	more	more	less	
Leaves	not used because of mealybug damage	used	used	used	used
Adaptation to clay/sandy soils	these 2 better survive than others in clay soils				
Processing time	Same (when udaga is made from fermented flour)				
Uses	Ugali	Ugali	boil, raw Ugali=fermented		
Intercropping	cowpeas, maize, sweet potatoes				
Post harvest deterioration	2/3 days	2/3 days	2/3 days	2/3 days	2/3 days

OBSERVATIONS BASED ON VILLAGE INTERVIEWS

Villagers stated that if they could only grow one variety, it would be the early-yielding Lyongo, IF the mealybug problem were absent. They did not prefer Nghwenunkila (another early yielder) to Lyongo because it has lower yield and poor flour quality.

Table 35. Cassava varieties and characteristics: summary of CBN discussions, Lubungo, Mwanza Region, Tanzania, Oct 1993

Characteristic	Lyongo	Lumalumpunu/Lumara	Shibamba	Ngarabuto
Mentioned by villagers				
Mealybug response	somewhat susceptible	somewhat resistant	"no differences among sweet varieties"	
Maturity	"red" earlier than "white"	later (poor)	early maturity	earlier than Shibamba
Drought tolerance	good	poor, needs lots of rain	"more than Ngarabuto"	"less than Shibamba"
Strains within one variety	"red" petioles; "white"			
Yield	red strain yields more		"better than Ngarabuto"	(less than Shibamba)
Quantity of roots	red has more roots			
In ground storability	"only 3 yrs", both strains (poor)	more than 5 years		
"Bitter"/ "sweet"	"bitter"	more bitter (a disadvantage)	sweet	sweet
Ease of harvest	roots near surface, good			
Subsequently asked by CBN team members				
Theft resistance	good, very "bitter"		poor: stealing, wild pig damage	
Labor requirement	needs closer spacing, so, more work to plant			
Processing quality		good, "as good as millet"	"no sweet ones make good flour", watery cortex (poor)	poor (better than Shibamba)
Leaf use	leaves bitter, slippery, resprout slowly	best leaves, resprouts rapidly	leaves not as good as Ngarabuto	better than Shibamba
African cassava mosaic virus			less than others	more than others

Note: Labor requirement was discussed relative to other varieties with same maturity

APPENDIX I B

Mara Region villager-named cassava varieties and criteria

Tables compiled during CBN group interviews

Table 36. Cassava varieties and characteristics: summary of CBN discussions, Nyambori, Mara Region, Tanzania, Oct 1993

Characteristic	Ndiara	Rumara	Obarodak	Kigoma	Ruranda	Nyabasukuma	Opontomoro
Mentioned by farmers							
"Bitter"/"Sweet"	"bitter"	"bitter"	"sweet"	"bitter"	"sweet"	"sweet"	"sweet"
In ground storage	long, 24 mos	12 mos.			24 mos (long)		
Theft resistance	good						
Animal resistance	good		poor - a problem		poor - problems		
Maturity	Men: 1 1/2-2 yrs Women: 12 mos	6 mos, early	6 mos, early		early "8-9 mos" (men); "1 1/2-2 yrs" (women)		6 mos
Mealybug response	more resistant	more resistant	more susceptible		more resistant		
Causes Konzo if not well processed	yes						
"Chew it and die"	yes						
Eating quality boiled			good				
Number, size of roots			More roots		large and long		
Subsequently asked by CBN team members							
Yield	high						
Drought response	no variation; depends on soil type						
Processing quality	no differences						
Leaf quality					best	good	good
Weeding	ylds better than others w/ weeds						

ADDITIONAL OBSERVATIONS BASED ON VILLAGE INTERVIEW

In Nyambori, men and women ranked varieties differently for area grown and maturity. For area grown, men's ranking: Ndiare, Rumara; women's ranking: Ndiare, Obarodak, Ruranda, Opontomoro.
The variety Rumara was said to have come from the Island of Ukerewe via the lakeshore town of Musoma
Rumara, Kigoma mentioned as widely-grown varieties; later, other villagers stated they were same variety
Long? large? roots were preferred because it takes fewer to fill a market tin

Table 37. Cassava varieties/characteristics: summary of CBN discussion, Kyangasaga, Mara, Tanzania, Oct, 1993

Characteristic	Rangohera/Rwanguhilo	Mariongo	Wamasuka	Kigoma	Nyabasukuma	Lulanda/ Ruranda	Nyarik-opondo
Mentioned by villagers							
"Bitter"/"Sweet"	"bitter" but less; can chew raw	"bitter"	"bitter"	"bitter"	"sweet"		"sweet"
Mealybug response	"not attacked"	susceptible	not affected	susceptible			
Maturity	early, 6-8 mos	1 year	early, 6-8 mos	8-9 mos, early			
Leaf quality		sheds more leaves than Kigoma	preferred		good		
Drought response			tolerant				
Keeping quality			poor, becomes watery				poor
Root size							
In ground storage		long, 3-4 yrs	poor, >2 yrs				
Processing quality	preferred, white udaga	very good udaga					
Firewood	best, 3-4 branches						
Preparation fresh					easy		
Safe snack					handy for children		
Animal predation					serious; wild pigs, porcupines, monkeys		
Root number	8-10; "more than Wamasuka"	8-10 large roots/plant	few, large				
"Good harvest"		yes					
Subsequently asked by CBN team members							
Weeding	second in yield w\out weeding	highest yield w/out weeding					
Rainy season pests	None serious						

ADDITIONAL OBSERVATIONS BASED ON VILLAGE INTERVIEW Four more sweet varieties said to be grown, names not known
Mariongo and Rwangohera would be preferred for desirable white udaga "if there were no mealybug"
Wamasuka leaves preferred as vegetable because it "does not shed leaves in the dry season"
Lulanda/Ruranda mentioned as "liked but uncommon because of planting material shortage"
Rwanguhilo, Mariongo and Kigoma considered similar in importance before the mealybug; Kigoma "comes from Kigoma"

Table 38. Cassava varieties/characteristics: summary of CBN discussions, Utegi, Mara Reg., Tanzania, Oct 1993

Characteristic	Obarodak	Ndiare	Nyarwasukuna	Opong-tomoro
Mentioned by villagers				
Roots per plant	many			
Maturity	8 mos, early	1 year	1 year	
Leaf quality	leaves eaten	do not like	preferred	leaves eaten
In ground storability	short, 1 1/2 yrs	good, 3 yrs	short, 1 1/2 yrs	
Mealybug response	seriously affected	tolerant	susceptible	susceptible
Animal predation	susceptible			attacked by rats
"Bitter"/"sweet"		very "bitter", a "killer" repellent to animals	"sweet"	"sweet
Eating quality fresh			good	
Root shape			long roots, good	
Subsequently asked by CBN team				
Taste	sweet at first then bitter at maturity			
Drought tolerance	#1			
Yield with good rains	no difference in yield between varieties, with good rains			
Weeds	#1		#3	#2
Processing quality		best: yields more flour and flour absorbs more water in cooking. Less fibrous		

1, best; 3, worst

ADDITIONAL OBSERVATIONS BASED ON VILLAGE INTERVIEWS

Villagers grow other varieties "here and there"

Meaning of weed ranking is unclear: this variety has the most weeds? best yield in the presence of weeds?

Table 39. Cassava varieties/characteristics: summary of CBN discussions, Sarawe, Mara Reg., Tanzania, Oct 1993

Characteristic	Rumara	Muganda	Kigoma	Ryongo/Lyongo
Mentioned by villagers				
Yield	high	"grows well," high		
Mealybug response	"easily attacked"	not attacked		
"Bitter"/"sweet"	"bitter"	"sweet"	more "bitter" than Rumara	the most "bitter"
Can eat raw		chewed raw, field snack		
Can eat boiled		"eat a lot" boiled		
Leaf eating quality	not eaten	eaten	not eaten by animals or humans	
Safe for grazing livestock		livestock not affected by roots, leaves or peel		
Maturity		one year	6 mos, early	6 mos, early, "its only good character"
Animal predation	not attacked	susceptible		
Soil adaptation	productive in poor soils			
In ground storage			only good 2 mos after maturity	deteriorates rapidly in soil
"Makes blood thin"	"inhibits blood"			
Subsequently asked by CBN team members				
Processing quality	bitter, sticky udaga; poor	Udaga sweet, not sticky		
Fed to livestock?		no		
Drought response		"best tolerance because pest-free"		

ADDITIONAL OBSERVATIONS BASED ON VILLAGE INTERVIEWS

Muganda, a "sweet" variety, is "a tradition," it is eaten raw as a snack in the field, and also processed into Udaga. The ugali made from Muganda is preferred, but "less common" than the less preferred ugali from Rumaga.

Sarawe was the only village to mention a "sweet" variety (Muganda) first, although in area ranking, villagers put Muganda second.

Villagers brought samples of cassava stakes from the field to show severe mealybug and scale insects

APPENDIX I C

Kagera Region villager-named cassava varieties and criteria

Tables compiled during CBN group interviews

Table 40. Cassava varieties and characteristics: summary of CBN discussion, Katoke, Kagera Region, Tanzania, October 1993

Characteristic	Lumala	Lyongo	Rushura	Sherisheri	Marekani	Bukalasa	Remarks
Mentioned by farmers							
"Bitter"/"sweet"	"bitter"	"bitter"	"sweet"	"sweet"			
Storability (field)	2-5 yrs	1 1/2-2 yrs	1-5 yrs	1-3 yrs	1-2 yrs	1-2 yrs	
Drought resistance	Good	Avoids drought	-	-	-	-	Lyongo matures early, avoids drought
Maturity	2-3 yrs	1-1 1/2 yrs	1-2 yrs	1-2 yrs	1-2 yrs	1-2 yrs	
Intercropping (bananas, sorghum, pigeon pea)			suitable in banana fields	suitable	suitable	suitable	Rushura suitable in banana fields: tall not leafy, few branches
Scale insect resistance	susceptible						
Leaf brown spots			susceptible				
Root rot		susceptible	susceptible				
Green spider mite		susceptible	susceptible				
Monkeys							Problem, all varieties, not very serious because hunting takes place
Root quality							
Subsequently asked by CBN team							
Mealybug	not a problem	not a problem					
Weed resistance	tolerant		susceptible				
Cooking quality			very good		very good		Rushura cooks in 30 minutes, stores for 1-3 years
Plant height			tall not many branches				
Processing quality	preferred	preferred	light and sweet				

OBSERVATIONS BASED ON VILLAGE INTERVIEWS:

Villagers preferred a large number of varieties, short- and long-term maturing because of food security/supply
Desired in varieties for sale for fresh roots: sweet, good dry matter content, less moisture

Most common variety was Rushura because of its good dry matter content

Table 41. Cassava varieties and characteristics: summary of CBN discussions, Kasenga, Kagera Region, Tanzania, October 1993

Characteristic	Lumala	Rubona	Lyongo	Sherisheri	Toboka	Kabumba
Mentioned by villagers						
"Bitter"/"sweet"	"bitter"	"bitter"	"bitter"	"sweet"	"sweet"	"sweet"
Yield	high			5-8 roots, high yield		
Drought tolerance	yes					
Vermin resistance	yes	yes	yes	no	no	no
Mealybug tolerance	tolerant					
Storability (field)	high	1 1/2 yrs	1 1/2 yrs	1 1/2-2 yrs	1 1/2-2 yrs	1 yr
Theft resistance	yes	yes	yes	no	no	no
Flour quality	good	very good	very good (white, fine)			
Maturity	late	early, 10 mos	early, 10 mos	early, 9 mos	early, 9 mos	early, 9 mos
Eating quality (fresh)				not bitter in dry season; low fiber; dry matter good	starch, good	less dry matter, bitter in dry season
Subsequently asked by CBN team members						
Weed resistance	3 weedings	2	2	2	2	2
Leaf eating quality				good, olive green	good	good

ADDITIONAL OBSERVATIONS BASED ON VILLAGE INTERVIEWS:

"Bitter"/"sweet": this trait was mentioned by villagers in Kasenga, but the order in which it was mentioned was not noted, i.e., though it is placed first in the table it may not have been the first trait mentioned in this village. Other traits are in order.
Why grow more "bitter" cassava? Because they resist vermin, e.g. rats and pigs
Most important criterion for "bitter: variety selection: early maturing (quick food) for security. Kasenga villagers grow at least 2 "bitter" varieties for this reason
Most important criteria for "sweet" varieties: early maturing, drought resistance, remain sweet in dry season. Worst weeds: couch grass, "Rusozo", and an unidentified twinning weed (dodder?)

Table 42. Cassava varieties and characteristics: summary of CBN discussion, Buseresere, Kagera Region, Tanzania, October 1993

Characteristic	Lumala	Lyongo	Mundebha	Kagenzanda	Toboka	Sherisheri
Villager criteria						
"Bitter"/"sweet"	"bitter"	"bitter"	"sweet"	"sweet"	"sweet"	"sweet"
Storability (field)	3-5 yrs	10 months	3 yrs	2 yrs	2 yrs	-
Maturity	2-3 yrs	8-9 months	1 yr	1 yr	1 yr	1 yr
Pig resistance	good	good	poor	poor	poor	poor
Processing quality	good	good	NA	NA	NA	NA
Height	tall	very short to medium	very tall	-	-	average
Eating quality (fresh cook 30 min)	NA	NA	good; (tastes like Matoke)	good; not like Matoke; little dry matter	good	good
Leaves (for eating)	good	good	good	good	good	good
Quality, eating raw	NA	NA	good	good	good	good
Marketed fresh?	no	no	good	good	good	good
Marketed processed?	yes	yes	no	no	no	no
Subsequently asked by CBN team members						
Theft problem?	-	-	yes	yes	yes	yes
Number of roots/stand	> 10	3	-	-	-	-

NA = not applicable

Table continued (additional varieties) ...

FIELD OBSERVATIONS:

A "stand" is one plant

Matoke are cooking bananas

Table 42, continued. Buseresere cassava varieties, Kagera Region, Tanzania, October 1993

Characteristic	Rushura	Mabare	Ngalabuto
Villager criteria			
"Bitter"/"sweet"	"sweet"	"sweet"	"sweet"
Storability (field)	2 yrs	5 yrs	2 yrs
Maturity	1 yr	2 yrs	1 yr
Pig resistance	poor	poor	poor
Processing quality	NA	good (not sticky)	NA
Height	-	-	-
Eating quality (fresh cooked 30 min)	good	very poor; hard, does not soften in cooking	good
Leaves (for eating)	-	-	-
Raw eating quality?	good	good	good
Fresh marketing quality?	best	good	good
Marketed processed?	no	yes	no
Subsequently asked by CBN team members			
Theft	yes	yes	most stolen
Number of roots/stand	3-4	2-3	(short roots)

NA = not applicable

"Bitter"/"sweet": this trait was mentioned by villagers in Buseresere, but the order in which it was mentioned was not noted

Table 43. Cassava varieties and characteristics: summary of CBN discussion, Kibumba, Kagera Region, Tanzania, October 1993

Characteristic	Lyongo	Lumala	Mabare	Ngalabuto	Mulogoro	Mafutagandege
Villager criteria						
"Bitter"/"sweet"	"bitter"	"bitter"	"sweet"	"sweet"	"sweet"	"sweet"
Maturity	1 yr	-	1 yr	1 yr	1 yr	1-2 yrs
Storability	2 yrs	5-6 yrs	6 yrs	2 yrs	2 yrs	2 yrs
Pig resistance	moderate	good	poor	poor	poor	poor
Resistance to mealybug, scale	susceptible	tolerant	-	-	-	-
Processing quality	good (white flour)	good	-	-	-	-
Eating quality (fresh)	not applicable	not applicable	-	good	good	good
Leaf eating quality	poor, bitter	best	good	good	good	good
Soil adaptation	"not soil specific"					
Root shape			long roots, difficult to harvest			
Fresh cooking quality	-	-	-	good; high dry matter	good	good
Subsequently asked by CBN members						
Weed resistance	None resistant, not variety-specific					
Root length	8" to 1 ft	1 1/2 feet	2-3 feet			

ADDITIONAL OBSERVATIONS BASED ON VILLAGE INTERVIEWS:

"Bitter"/"sweet": this trait was mentioned by villagers in Kibumba, but the order in which it was mentioned was not noted

"Sweet" varieties 'Toboka' and 'Sherisheri' abandoned many years ago due to pigs.

Sweet varieties are grown near homesteads, so that pigs can be scared away

Long neck assists pig resistance, i.e. some roots left behind because too deep for pigs to get

Planting material production: no information given on variety specific but prefer non-bushy type easy weeding, easy handling

'Lumala' is the same variety as 'Lumalanzala' and 'Lumalampunu'. Lumalanzala said to mean "hunger relief." The variety is said to have come from Sudan in 1943.

Appendix II

Lessons learned and implications for Future Users of Similar Methodology

Lessons learned

CBN's planned use of the lessons learned A second case study will be conducted in South China, a region in which cassava is grown as an industrial crop. The RRA methodology used by CBN in Tanzania will be collaboratively reviewed and revised before that study by the NRI agricultural economists involved in the Tanzania study, the CBN Steering Committee Member for Socioeconomics, and the CIAT Cassava Economist (the leader of the South China case study). Collaborative review after the second study will further refine a "CBN methodology" for direct interaction with small-scale cassava farmers, processors, and users.

Interview methodology The matrix tool used by the CBN teams involved the ranking of varieties from "grow the most of" to "grow the least of". Trait were ranked within each variety in order of their importance to villagers. However, traits were not ranked independently of varieties, nor were the areas grown of each variety quantified in any way.

The discussions of individual varieties, trait by trait within each variety, were time consuming, yet they may have had an important function. It was in these detailed conversations about real varieties, that the discussions became concrete and the team derived insights as to the types of trade-offs that villagers had to make when choosing between the varieties available. However, follow-up to these variety-specific discussions with independent trait rankings would have taken little additional time and could have provided important further insights. Independent trait rankings would have gained accuracy from the understanding built up through the detailed communication between villagers and team members in the variety-by-variety discussion. This would have given additional dimension to more abstract discussions of trait importance, hypothetical "ideal" varieties, and acceptable vs. unacceptable trade-offs.

Simple relative ranking of variety areas, such as by using pie diagrams or squares of various sizes, would have quickly provided a more quantitative idea of the relative importance of different varieties.

Amount of time allocated to the survey The CBN case study cost less than expected in funds, but should have been more costly in time than it was.

To accomplish two weeks in the field, two additional weeks had been "budgeted" in Tanzania: one week in advance to plan and prepare, and one week afterward to write up. In fact the survey coordinator for CBN should have been in the country a month in advance. Not because preparations and planning would require an entire month, but because some things (for example, lining up team members and blocking out their time) must be done with at least that amount of lead time, and that means that someone should be present whose main responsibility is the field study. A planning visit six months in advance, as CBN did, is essential, but is not sufficient to expect things to be up and running a week before the field work, with no further undivided attention. This is especially true in some developing country situations, where national program schedules may be fixed one month, but not six months, in advance and unexpected changes--such as Dr. Msabaha's transfer to a station far from the study site--may occur.

Planning meeting The planning meeting should be scheduled to last two weeks, following the example of an NRI RRA planning meeting in Uganda earlier in the year, so that each national member of the team

member can participate in sufficient sessions to get a good briefing and contribute to the plans. This will be especially important when some team members are at the site of their offices, research, or headquarters, and thus likely to be distracted. When the total number of participants is small, as in this case, sessions could be repeated if necessary.

Wrap-up meeting The two days given to wrap up and write up the study were barely sufficient. In fact, four days had been scheduled for this work, but because of the infrequency of flights out of Mwanza, the CBN write-up had to be accomplished in two very arduous days. It can be expected that by this time some team members will be sick, some will be exasperated by the hard and long hours of the preceding two weeks, and those whose home base it is will have urgent needs to attend to their families and offices. Everyone will be greatly in need of a gentler pace for the write-up.

The team together prepared all of the tables and the sections on methods, findings, and research implications, in the form of hand-written drafts. An additional two weeks were required for two persons, one person transcribing and another editing and summarizing the report. This time also must be "budgeted".

Team comments

Team availability. RRA requires intensive use of skilled people. Competing demands placed on national members of the team can disrupt the work of the RRA team. And of course, it must be expected that their regular responsibilities of all team members are disrupted during their RRA participation. Thus team availability becomes a major factor in RRA design.

Group interviews. With reliance on group interviews, possibly-important inter-household variation in preferences and constraints may not be adequately covered. Time for individual interviews to compliment group discussions should be allowed for when undertaking RRA's. Follow-up interviews with selected participants allows for a greater depth of understanding. This probably would require two days per village.

Translation. Team members not conversant with the local languages missed out on the intricacies of conversation and were unable to spot potential lines of enquiry whose possible importance did not similarly strike the translator. There was a tendency to translate only consensus opinions, after long and animated discussions.

In many ways, the translator's job was the most demanding position on the team. Though the translators were briefed in the importance of complete translation, frequent translation was generally not possible due to the nature of the group dynamics. Villagers wanted to cover topics exhaustively before pausing. Each speaker was anxious not be interrupted, possibly losing their chance to continue. It sometimes appeared that the audience of other villagers was more important than communicating with the CBN team. Translator interruptions were consequently unpopular. Once or twice, but very rarely, a villager would turn to the translator and say, "Translate what I said, so the Mzungu (foreigner) will understand."

Team dynamics. With reliance on group interviews at each village, there was a danger of interviews becoming routine. As familiarity with issues and concepts developed, that contributed to a tendency (depending on the individuals on the team on a given day) for the translator to dominate questioning, reducing participation and involvement of other team members. Alternation of group and individual interviews might help avoid this problem.

CBN Coordinator's comments

What if... questions The matrix tool was an excellent guide to organizing our thoughts and our discussions. The team found, however, that "what if" questions were very hard to introduce or to get discussion going. Would participatory research be more fruitful as a way to generate ideas about new innovations, difficult for both researchers and villagers to conceive in advance? This would require applied research projects in the villages, similar in philosophy, if not in content, to the Cassava Integrated Projects in Latin America. That is, the projects must be "do-able" in villages and generate ideas about biotechnology research and/or use the villages as testing and feed-back sites for biotechnology innovations. RRA is no substitute for working together, for mad scientists, or for entrepreneurial dreamers.

Disruptions to the work of Tanzanian team members and villagers The CBN study was costly in terms of disruptions to the work of our professional collaborators and to the lives and work of villagers. Given an RRA, there seems little way to avoid the disturbances to the on-going responsibilities of team members, once they and their supervisors have agreed to their participation. There are no full-time RRA cadres!

Interruptions to villagers would have been less if each village could have had several days advance notice of our coming and objectives. This was prevented because site selection could not be done until the entire team was assembled to pool their experience of what can be accomplished and their knowledge of the region and the study objectives. Even had early site selection been possible, notification of villagers would have required, in effect, duplicating the time and expense of the field work, since someone would have had to drive to each village, the same long distances over the same poor roads. (For COSCA this may have actually been done, showing the importance COSCA placed on proper procedure, and the amount of time and funds dedicated to that study).

In fact, we were able to "muddle through", and it is hard to see how the study results would have been improved by advance notice. In most cases we found many cordial villagers willing to talk with us. It might have permitted women to plan their work differently so that they could attend the interviews, but the solution, of asking to be taken to them, worked much better anyway, as it permitted us to see the cassava processing and even participate, which led to richer discussions.

The most serious consequence of short notice to everyone was probably not any loss of quality of the survey, but rather, simply the discourtesy implied and the inconvenience imposed. The villagers (and team members!) were gracious, but they might not be so if we repeated the interruption too often.

APPENDIX III

List of Acronyms and Abbreviations

ACMV	African Cassava Mosaic Virus
CIAT	Centro Internacional de Agricultura Tropical
COSCA	Collaborative Study of Cassava in Africa
DGIS	Directorate-General for International Cooperation, The Netherlands
IITA	International Institute of Tropical Agriculture
MOA	Ministry of Agriculture (Tanzania)
NRI	Natural Resources Institute, United Kingdom
ORSTOM	L'Institut français de recherche scientifique pour le développement en coopération
TAHEA	Tanzania Home Economics Association
TFNC	Tanzania Food and Nutrition Centre