

Preemptive management of the virulent cassava mosaic disease in Nigeria

Annual Report

July 2003 to June 2004

The International Institute for Tropical Agriculture
Ibadan, Nigeria

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Contents

Acronyms and abbreviations.....	vii
List of collaborators and addresses	viii
Executive summary	xvi
Project introduction	1
Project vision.....	1
Project objectives.....	2
Project results/outputs	2
Project beneficiaries.....	3
Expected results.....	3
Achievements: July 2003—June 2004	5
Output 1. Sustainable and competitive cassava production technologies generated, disseminated, and adopted.....	7
Diagnostic baseline survey of the cassava agroecosystems to determine the distribution, severity, and identity of various cassava biotic constraints and monitoring of the health status of cassava.....	7
Participatory identification and evaluation of appropriate production technologies such as improved germplasm, soil amendments, integrated pest management options and technologies	7
Development, evaluation, maintenance and provision of diversified germplasm for the establishment of strategic stocks of CMD-resistant varieties for food, feed and agroindustrial uses	16
Establishment of sustainable network of community-based private sector driven cassava planting material production scheme of high yielding CMD and other multiple pest-resistant varieties to supply high quality planting materials to farmers.	20
Output 2. Demand driven cassava postharvest technologies generated, integrated with competitive production and IPM technologies, promoted and adopted	24
Assessment of postharvest and processing technology and product development needs and identification of appropriate technologies for household and small to medium-scale businesses.....	24
Introduction, demonstration, adaptation, and promotion of improved value-adding postharvest technologies and products for expanded utilization, and income generation opportunities.	26
Promotion of integrated value-adding postharvest technologies, competitive best-bet cassava production, and integrated pest management strategies for viable commercial enterprise through decentralized community/village-oriented technology transfer centers	27

Output 3. Viable private sector agribusinesses promoted, diversified cassava markets developed, and access to credit institutions enhanced	29
Identification of cassava market (domestic and export) and investment opportunities to promote production, processing and trade.....	29
Inventory of agro industries and processors groups.....	30
Development and strengthening of effective agroindustrial and traders associations.....	31
Stimulation and promotion of advocacy (through participatory mechanisms) for strategic policies to enhance cassava commercialization and trade.	33
Facilitation of the development of agri-input and service delivery systems (fertilizer, agro-chemicals, tractor services, machine fabricating, processing, etc.) to support cassava commercialization.	34
Development of an active market information acquisition and dissemination and intelligence system for use by stakeholders (producers, processors, researchers, input dealers, product marketers and end-users) in the cassava commodity chain to make informed decisions.....	34
Geo-spatial analysis of cassava product markets in Nigeria.....	36
Promotion and linkage of small and medium scale enterprises to financial institutions for credit, and to appropriate domestic and export markets.....	38
Output 4. Human and institutional capacity to promote private sector investment in the cassava industry enhanced.....	40
Establishment and maintenance of cassava development and resource centers for zonal technology transfer and training	40
Development and strengthening of the capacity of cassava producers and processors for sustainable production, processing and utilization technologies	40
Development of the capacity of entrepreneurs in market identification, product development, storage, and enterprise development	41
Enhancement entrepreneurial capacity to adopt cassava product standards and grades for local industrial and export markets.....	42
Training of farmers and processor groups in credit management, group organization and management, and microenterprise development.....	42
Training of fabricators for fabrication and servicing of postharvest and processing machines for widespread dissemination on a sustainable basis	42
Development, production, and dissemination of training and extension support materials.....	43
Output 5. Cassava stakeholders network and coordination strengthened and impact of project activities monitored and evaluated	44
Organization of annual stakeholders consultative forum for project sensitization and focus.....	44
Definition of target communities and partners, and their involvement in project implementation design.....	45

Establishment of a national project advisory committee for administrative and technical oversight.....	45
Collation and updating where necessary, of detailed baseline information and development of performance and monitoring indicators	45
Organization of workplanning and review meetings for refinement of project activities	48
Monitoring of project implementation and conducting mid-term project evaluation.....	49
Updating studies to determine level and factors responsible for adoption of cassava production, processing and marketing technologies.....	50
Organization of biennial cassava trade show to foster cooperation among industry stakeholders around a common objective	50
Evaluation of impact of project activities on productivity, rural incomes, and employment	51
Organization of two zonal stakeholders' workshop to review achievements and lessons learned.....	51
Organization of a national stakeholders end of project workshop to review achievements and lessons learned	51
Procurement: capital equipment for project implementation and processing equipment for 12 CMD States	51
CMD Logical framework	58

Tables

1. Distribution of multilocational trials of 40 CMD resistant genotypes and 3 checks by state, agroecological zone and collaborating agencies in the 2003/2004 season.....	17
2. Distribution of on-farm trials of 33 CMD resistant genotypes by state and by gender in the 2003/2004 season	18
3. Distribution of demonstration plots of 36 CMD resistant genotypes by state and by group in the 2003/2004 season.	19
4. Provision of new multiple disease and pest resistant germplasm in the 2003/2004 season for multiplication, in preparation for participatory evaluation in selected locations in the south-south and south-east in 2004/05.	19
5. Multiplication of planting materials of 46 diverse CMD-resistant genotypes and three popularly grown improved varieties at various agroecological zones in Nigeria in 2002/2003 season.	21
6. Multiplication of CMD-resistant genotypes in 17 states in the 2003/2004 season	22
7. Estimated quantities of planting materials (planting size cuttings 25cm long) to be available from on-going activities for the 2004 season	23
8. Linkages established with some targeted and potential investors for cassava processing, marketing and export.....	38

9. Summary table of selected survey villages, Nigeria.....	46
10. Distribution of selected villages by States.....	47
11. Distribution of villages surveyed in the baseline study.	47
12. Field plot visited by the various teams in different states.....	49
13. Procurement of capital items for implementation of the project	52

Figures

1. Distribution of ACMV, EACMV and mixed infection of ACMV and EACMV in Nigeria.	8
2. Distribution of severity cassava mosaic disease in Nigeria	9
3. Distribution of whitefl (vector of CMD) abundance in Nigeria.....	9
4. Map of Nigeria showing the distribution of CBB across the various agro ecological zones.	11
5. Severity of CBB and CAD in various states of Nigeria.....	12
6. Nigeria showing the distribution of CAD across the various agroecological zones.	12
7. Nigeria showing the distribution of CLB across the various agroecological zones.	13
8. Nigeria showing the distribution of cassava brown leaf spot across the various agroecological zones.....	13

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ADPs	Agricultural development projects
AIDU	Agro Industrial Development Unit (Now merged with NCAM)
ARCEDEM	African Centre for Engineering Design and Management
NCGA	Cassava Growers Association of Nigeria
CAPAN	Cassava Processors Association of Nigeria
CEFAN	Cassava Equipment Fabrication Association of Nigeria
FUTO	Federal University of Technology, Owerri
FIIRO	Federal Institute for Industrial Research, Oshodi
LCCI	Lagos Chamber of Commerce and Industry
NARs	National agricultural research systems
NCAM	National Centre For Agricultural Mechanization
NRCRI	National Root Crops Research Institute
NSPRI	National Stored Products Research Institute
PRODA	Project Development Agency
SON	Standards Organization of Nigeria
UNN	University of Nigeria, Nsukka

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Executive summary

The goal of this project is to contribute to sustainable increase in food availability, reduction of rural poverty and unemployment, and enhancement of agroindustrial and socioeconomic growth in Nigeria. The following summarizes the achievements the project made after one year of implementation (July 2003 to June 2004).

Production component

A diagnostic survey was conducted in 2002 and 2003 to determine the status of cassava mosaic disease (CMD) and cassava mosaic begomoviruses in Nigeria and to ascertain if the virulent Ugandan strain of the *East African cassava mosaic virus* (EACMV-Ug2) was already present in the country. Most farms in the South-south and Middle belt geopolitical zones showed mild CMD symptoms. On the contrary, most farms in the Southeast and Northeast zones showed either moderately severe or severe symptoms. Although the virulent Ugandan variant was not detected, the high proportion of mixed infections by ACMV and EACMV and the occurrence of variants of ACMV demand appropriate measures to safeguard cassava production in the country. With the increasing production of cassava in Nigeria, disease management will become crucial as production expands to the marginal zones.

Forty-three genotypes, comprising 40 newly selected CMD-resistant genotypes and three other improved checks commonly grown by farmers in Nigeria were planted at each of 19 locations in 18 states in the 2003 planting season to identify specific and broadly adapted CMD-resistant genotypes with desired end user' characteristics. Thirty-three CMD-resistant genotypes have been planted in 1320 on-farm trials in 110 communities in 12 states to identify CMD-resistant genotypes that are adapted to farmer's agronomic and cultural practices and with high economic returns in terms of high root yields and root quality characteristics. Individual farmers, with technical backstopping provided by IITA, NRCRI, and state extension agents, evaluated the trials. Thirty-six CMD-resistant genotypes including checks were planted between June and July 2003, in 100 community-based demonstration trials in 12 states to identify and disseminate new varieties and production technologies through farmers' field day activities.

Some of these trials are now being harvested and they will be replanted in more locations as a means of diffusion and a strategy to identify convincingly genotypes with stable and specific adaptation. Characterization of these varieties for specific food, feed, and industrial properties are ongoing. Trial monitoring was conducted in February after all the trials were planted. Three teams each made monitoring trips to four states. Team reports were received and have been pooled together with a full list of all the trials in the 12 states into a report. States submitted their lists of trials over a wide period of time after much follow-up.

Baseline and need assessment

A baseline study has been completed in all the 12 CMD states. Soils samples were collected in selected villages during the baseline studies and analyses are in progress in collaboration with AGIP, Port Harcourt. Likewise, weed samples were collected and identification has been completed. Data entry on baseline is complete, data validation and verification is in progress while the draft report on the baseline survey is in progress.

A needs assessment survey in the 12 CMD states has been completed. Final reports will be presented to various stakeholders before final selection of the processing centers per senatorial districts in each state.

Inventory

An inventory of postharvest and processing technologies has been completed. A copy is under review. An inventory of standards for cassava products (national and international) has been completed. An inventory of cassava products is ongoing and a final document will be used as the project output. This material will serve as a training manual and a guide for cassava businesses. An inventory on the availability of best practices for cassava production is in progress. Compilation of the directory of cassava industries and end users has been concluded.

Sensitization, training, and demonstration

IITA has been involved in the introduction of some value adding postharvest technologies and products to farmers, processors, and investors at various fora like a training workshop organized on food security under the control of the Presidential Special Adviser on Food Security in Calabar, Umuahia, and Akure, while IITA also demonstrated these products during the Presidential cassava stakeholders forum at Abuja. Arrangements have been completed to start a training workshop on cassava utilization from the second week in July at designated centers. Arrangements are in top gear to mount a training workshop on fabrication of equipment to meet small and medium-scale enterprises (SMEs) in the South-south (SS) and South-east (SE) using reputable fabricating centers. The project is planning to train operators from each ADP and Ministry of Agriculture in CMD states on the use of power tillers just acquired for CMD work from Hong Kong/China.

Processing equipment acquisition for technology transfer centers in 12 CMD states

The project has acquired postharvest processing equipment for each state in the SS and SE. The equipment will be deployed after the stakeholders meeting on the needs assessment report.

Capital equipment acquisition for project implementation in 12 CMD states

The project has equipment and vehicles to facilitate the project implementation at IITA-Onne, NRCRI-Umudike, and 12 CMD states. These include vehicles, computers, power tillers, and postharvest equipment that have capacity for 2–3 t/day.

Establishment of cassava resource and development centers

Renovation of classrooms, offices, and houses/dormitories at Onne is in progress. Construction of a training classroom for stakeholders in the Niger Delta region was completed at IITA Onne. The design of two model processing centers for the zonal hubs was completed. Construction of model processing centers at Onne and Umudike is in progress.

Industrial subsector analysis

The project has completed a subsector analysis of the cassava industry. This activity has identified cassava markets that exist in Nigeria, regionally and internationally. Draft copies of the book entitled *Cassava statistical handbook and cassava revolution in Nigeria* were presented to the President during the Cassava Stakeholders' forum held at Aso Rock, Abuja, 7–8 June 2004.

Development and strengthening of organizations

IITA has further facilitated the formation and recognition of various organizations. CAPAN attended the Prisms stakeholders meeting at the Sheraton Hotel, Abuja while NCGA, CAPAN, and CEFAN attended the cassava stakeholders' forum at the Presidential Villa, Abuja.

National cassava market information system

The project has commenced the design of the National cassava market information system that will take care of commodity prices from 25 cassava products from over 27 states. The prices will be farm and factory gate. The market information system will have information on cassava market analysis and forecasts. The project is in discussion with credit institutions in Nigeria and abroad about how farmers' group will secure credit.

Technical assistance

Technical assistance for large-scale cassava production by the private sector has also been provided to a number of investors. Technical assistance is also being given to farmers in the Southeast to organize and supply fresh roots at 300 t/day to the Nigerian Starch Mills, Ihiala from June 2004. Also, farmers in Ubiaja in Edo State and Ibadan in Oyo State have already been organized and mobilized to supply healthy planting materials to large farms including the Nigeria Starch Mill farm site at Egbema in Imo State, Ekha Farms in Benin, Edo State, Akwa Ibom State, Dewo Foods in Niger State, and Hill View Farms in Kaduna State.

Database management and resource centers

Electronic databases have been developed to store information on varietal deployment and characteristics, farmer locations, market prices, and other relevant documents. The project is currently developing materials such as a project flyer; a trials monitoring report; a cassava statistical handbook; a postharvest equipment inventory; information on processing cassava products, the benefits from the CMD project activities, and best-bet agronomic practices; and the project document that will be utilized in resource centers in each state.

Computers have been acquired that will facilitate this process. In collaboration with CEFAN/ARCEDEM, the project is coming up with equipment standards and training modules that meet farmers and processors' needs.

Interactions with policy makers and development agencies

The project has been active in influencing government policy makers to put up policies that will enable the cassava industry to develop. The project has given 100% support to the cassava Presidential initiative, and the NEPAD cassava initiative. Through the stakeholders' workshop, several media interviews, and the Presidential initiative on cassava, an estimated 100 000 farmers have received information and are waiting impatiently for planting materials of the new varieties for the 2004 planting season.

Planning meetings

The project had organized some work planning meetings (5–7 May 2003; June 22–25 2003; July 15–17 2003; 27–30 Jan 2004; 22–28 Feb 2004; March 2004; 22–24 April, 2004; 3–5 May 2004 in Port Harcourt). The fora assisted in refining the project document and execution.

National Advisory Committee

The project is in the final state of establishing a national project advisory committee for administrative and technical oversight.

Preemptive management of the virulent cassava mosaic disease through an integrated cassava development approach for enhanced rural sector economy in the South–South (SS) and Southeast (SE) zones of Nigeria

Introduction

The Federal Government of Nigeria, 11 state governments of the SS and SE zones, the Niger Delta Development Commission (NDDC), the Nigerian National Petroleum Corporation (NNPC), and its joint venture partners endorsed an action plan in October 2002 to address the critical threat of an outbreak of CMD disease in Nigeria. Funding of US\$16.5 million was committed for a four-year project “Preemptive management of CMD in Nigeria”. The 11 states originally earmarked to benefit from this project are to collectively pay the counterpart funding of 40% (US\$6.6 million at US\$600 000 per state), while the Federal Government would provide 15% (US\$2.475 million), NDDC 20% (US\$3.3 million), and NNPC and its joint venture partners 20% (US\$3.3 million). The shortfall (5% or US\$830 000) should be sourced from other development investors by IITA. In late 2003, Ondo State was added as one of the beneficiary states, and the state government would be required to contribute its share of the matching funds of US\$600 000, bringing the total funding required to implement the project to US\$17.1 million.

The Federal Government paid in full its share (US\$2.475 million), together with Akwa Ibom State (US\$ 600 000), while NDDC has paid 50% of its commitment (US\$1.65 million) and Ondo State has paid 10 million Naira of its share, thus bringing the total provided so far for the project to US\$ 4.7 million +10 million Naira. The commitments of the state governments and NNPC are at various stages of approval for disbursement.

The project started in the fiscal year 2003 and it is an integrated cassava development project operational in the 11 states of the SS and SE zones, and Ondo State in the Southwest (SW) zone of Nigeria. The project will address all constraints from production to consumption using the commodity chain approach. IITA will administer and coordinate the project activities and funds, provide technical backstopping, and train extension agents and other key players in the cassava commodity chain. Close partnerships will be established with a wide range of stakeholder partners from both public and private sector institutions.

Project vision

This project responds to an urgent and increasing need of resource-poor farmers, processors, and consumers to increase and sustain cassava-based agricultural production, food systems, commercialization, and trade, thereby spurring rural and agroindustrial development in Nigeria.

Project goal

The goal of this project is to contribute to sustainable increase in food availability, reduction of rural poverty and unemployment, and enhancement of the agroindustrial and socioeconomic growth in Nigeria.

Project purpose

Through preempting an imminent CMD-associated production crisis, the project aims at promoting sustainable and competitive cassava production, improved value-added postharvest technologies, marketing and agroenterprise development, commercialization, agroindustrial development, and trade in collaboration with a wide range of stakeholders (public/private), thereby ensuring food availability, increased economic opportunities, and reduction of poverty in rural areas.

Project objectives

The objectives of the project are as to:

- Mitigate the impact of cassava mosaic disease and prevent its spread throughout Nigeria and West Africa.
- Increase cassava productivity through deployment of high yielding, multiple pest- and disease-resistant cultivars and proven sustainable crop and soil management technologies.
- Promote the adoption of improved and profitable postharvest and processing technologies as well as new product development.
- Improve value adding to cassava through increased private sector investment in production, processing, storage, and marketing.
- Increase incomes and improve livelihoods in rural areas through the development of effective and active market information acquisition and dissemination systems, and increased commercialization of cassava.
- Strengthen human and institutional capacity to produce, process, and market cassava efficiently.

Project results/outputs

In implementing this project the following results/outputs are expected:

- Sustainable and competitive cassava production technologies generated, disseminated, and adopted.
- Demand-driven cassava postharvest technologies generated and integrated with competitive production and IPM technologies promoted.
- Viable private sector agribusinesses promoted, diversified cassava markets developed, and access to credit institutions enhanced.
- Human and institutional capacity to promote private sector investment in the cassava industry enhanced.
- Cassava stakeholders network and coordination strengthened and impact of project activities monitored and evaluated.

Operational locations

1. South–south zone: Rivers, Cross River, Akwa Ibom, Edo, Delta, and Bayelsa states including Ondo State (Onne, Rivers State as zonal hub).
2. Southeast zone: Abia, Anambra, Enugu, Imo, and Ebonyi states (NRCRI, Abia State as zonal hub).

Project beneficiaries

The primary beneficiaries of this project are the resource-poor, smallholder farmers in the SS and SE states as well as Ondo State, many of whom are women. They will benefit from improved access to higher quantity and quality planting material of diverse, high yielding, and multiple-resistant cultivars. Together with their increased knowledge and capacity as well as the adoption of integrated methods of competitive production, disease and pest management, and improved postharvest processing of the perishable cassava roots to more shelf-stable and various high-valued products for either food or use in industry, the result will be better management of the cropping systems, the reduction of disease and pest problems and losses both in the field and during storage, and more and higher quality processed products. The resultant increased on-farm yields of cassava per unit land area and time, labor, and cash expenditure, stabilization of productivity, and increase in area of production, will be a major contribution in improving the food supply situation in the whole country. The beneficiaries will also gain from improved productivity, growing demand for the crop resulting from increased postharvest processing and trade, employment, and higher output prices and income.

All other producers (small- and medium-scale processors, fabricators, commodity traders, consumers, national institutions and government, and private sector agribusiness entrepreneurs) involved in cassava production, processing, handling, marketing, and consumption in the cassava subsector will benefit as a result of increased availability of a range of marketable cassava products, creation of local employment opportunities, reduced exodus of young people to urban areas, and improved rural and urban food security and livelihoods.

Expected results

It is expected that at the end of the project, the following would have been achieved:

- Health status of cassava would have been determined and intervention technologies implemented for sustainable control.
- Several cassava genotypes would have been comprehensively evaluated and recommended for official variety release/farmer production with high expectation of wide-spread adoption.
- Improved multiple-disease and pest-resistant clones with specific end-use characteristics identified and available for multiplication and distribution to farmers.
- Cassava yield increased by at least one-third from deployment of diverse improved CMD-resistant germplasm in farmers' fields.
- Capacity of extension and NGO staff and farmers increased in rapid multiplication

techniques, pest and disease identification and management, good production practices, and postharvest utilization technologies.

- Improved transformation/processing technologies and appropriate cassava-based products disseminated to farmers and target/contact processors in selected domains.
- Food security enhanced, income generating capacity increased, and nutrition and well being improved.
- Effectiveness and efficiency through better integration and collaboration among cassava stakeholders enhanced.
- Pre- and end-of-project surveys demonstrate positive impact in selected domains on cassava production and utilization in terms of increased productivity, job creation, and rural income generation.

Project Achievements July 2003–June 2004

Output 1. Sustainable and competitive cassava production technologies generated, disseminated, and adopted

Diagnostic baseline survey of the cassava agroecosystems to determine the distribution, severity, and identity of various cassava biotic constraints and monitoring of the health status of cassava

AD, FO, JO, MA, RO, in collaboration with RB and BB

A diagnostic survey was conducted in 2002 and 2003 to determine the status of cassava mosaic disease (CMD) and cassava mosaic begomoviruses in Nigeria and to ascertain if the virulent Ugandan variant of *East African cassava mosaic virus* (EACMV-Ug2) is present in the country. The survey was an activity of a CMD project on measures to protect cassava production in Nigeria from potential devastating effects of a severe form of disease. Routes were selected in states of the six geopolitical zones in Nigeria and 418 farmers' cassava fields were visited. The CMD status in each field was rated as mild, moderately severe, or severe. Cassava leaf samples were collected from 1397 plants on which CMD severity was also rated on a 5-point scale. Leaf samples of some weeds showing characteristic CMD-like mosaic were also collected. Whitefly count was made in each farm and samples of this insect vector were collected. The leaf and whitefly samples were tested by polymerase chain reaction for *African cassava mosaic virus* (ACMV), EACMV, the Ugandan variant of EACMV (EACMV-Ug2), *Indian cassava mosaic virus* (ICMV), and *South African cassava mosaic virus* (SACMV).

Cassava in most farms in the SS and Middle belt geopolitical zones showed mild CMD symptoms. On the other hand, most farms in the SE and Northeast (NE) zones showed either moderately severe or severe symptoms. The number of farms with cassava with either moderately severe or severe symptoms was about the same as the number of farms with cassava with mild symptoms in the Southwest (SW) and Northwest (NW) zones. Taking the entire country, 48% of the farms had cassava with either moderately severe or severe symptoms, which was about the same as the proportion of farms (52%) with cassava with mild symptoms. The farms appeared to be randomly distributed.

Of the 1397 cassava leaf samples, 1106 had symptoms of which 74.1% tested positive for ACMV alone, 0.3% for EACMV alone, 24.4% for mixed infections by the two viruses, and 1.2% did not react with any of the primers used (Fig. 1). The two viruses were also detected in 32% of the 291 symptomless plants. ACMV and EACMV were also detected in the whitefly vector samples. EACMV-Ug2, ICMV, and SACMV were not detected in any of the whitefly or leaf samples. Farms in which ACMV occurred in single infection as well as in mixed infections with EACMV predominated. Most doubly infected plants showed severe symptoms (Fig. 2). Two biological variants of ACMV based on symptom expression

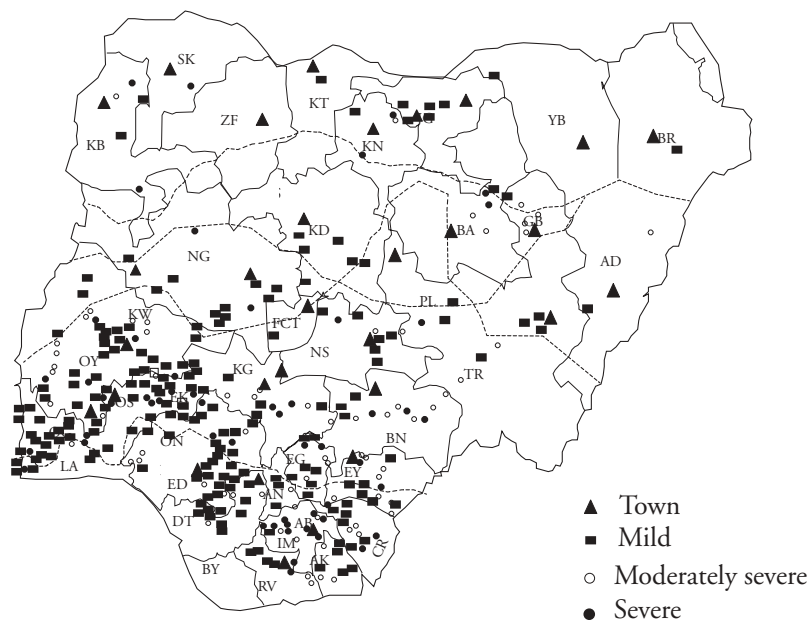


Figure 1. Distribution of ACMV, EACMV, and mixed infection of ACMV and EACMV in Nigeria.

on cassava in the field were identified. A high number of plants expressed symptoms indicative of mixed infections by the two biological variants and in most cases the symptoms were severe. ACMV and EACMV were detected in a leguminous plant *Senna occidentalis* (L.) Link and a weed *Combretum confertum* Lams., which are new natural hosts of the viruses.

Most farms in southern Nigeria had whitefly populations of between 5 and 500 per plant compared to farms in the north, which had whitefly populations of between 0 and 4 per plant. A lot of the farms in the northeast and northwest had no whiteflies (Fig. 3).

The virulent Ugandan variant of CMD was not detected. However, the high proportion of mixed infections by ACMV and EACMV, which could result in recombination events such as the one that produced EACMV-Ug2, and the occurrence of variants of ACMV, demand appropriate measures to safeguard cassava production in the country. The CMD project is therefore timely to provide resistant cassava genotypes to the Nigerian farmers to forestall any outbreak of severe CMD, either by natural spread from outside Nigeria or by spontaneous recombination between virus strains already present in the country.

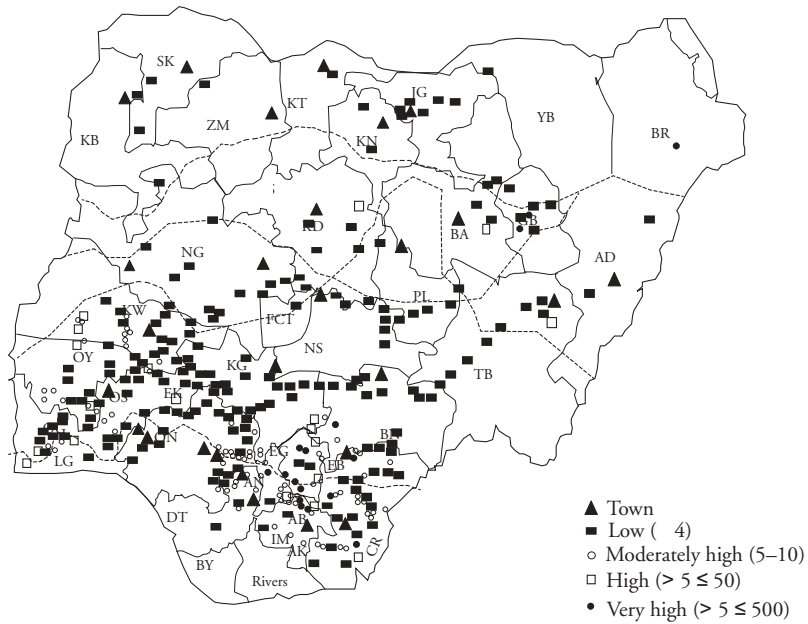


Figure 2. Distribution of severity cassava mosaic disease in Nigeria.

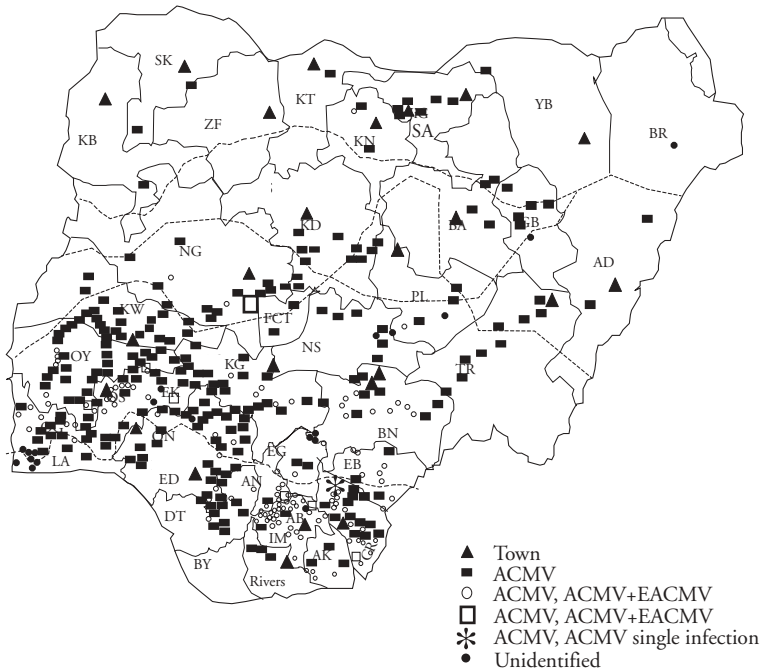


Figure 3. Distribution of whitefly (vector of CMD) abundance in Nigeria.

Distribution and current status of bacterial blight and fungal diseases of cassava in Nigeria

Farmers' fields from the 36 states of the Federation and the Federal Capital Territory were surveyed across the seven agroecological zones of Nigeria between May and November 2003 (Fig. 4). The survey followed the method described by Ogbe et al. (2003). The number of cassava farms examined in each ecozone varied depending on availability. A total of 277 farmers' fields were surveyed: derived savanna (143); humid forest (83); northern Guinea savanna (10 farms); midaltitude (1); Sahel savanna (1); southern Guinea savanna (22); and Sudan savanna (17). In each farm, the assessment of disease severity was made on 30 randomly selected plants. Each plant was rated on the scale of 1–5 for cassava bacterial blight (CBB), cassava anthracnose disease (CAD), and *Cercospora* leaf blight; and on a scale of 1–4 for brown leaf spot (BLS), following the scoring system described by Wydra and Msikita (1998) as follows:

CBB: 1 = no symptom; 2 = only angular leaf spots; 3 = angular leaf spots, wilting, blighting, defoliation, and some exudates on stem/petioles; 4 = blighting of leaves, wilting, defoliation, exudates, and tip dieback; 5 = blighting of leaves, wilting, defoliation, exudates, tip dieback, and plant stunting.

CAD: 1 = no symptom; 2 = cankers only on lower parts of the stem; 3 = cankers spread from lower to mid-parts of the stem; 4 = cankers spread from lower to green parts of the stem and stem wilting; 5 = severe leaf wilting, leaf and stem distortions.

Cercospora leaf blight: 1 = no symptom; 2 = necrotic leaf area < 5%; 3 = necrotic leaf area 5–25%; 4 = necrotic leaf area > 25%; 5 = blighted leaf area over 50% and leaf fall.

Brown leaf spot: 1 = no symptom; 2 = leaf spots only on older and lower leaves; 3 = spots on older and green young leaves on the upper portion of the plant; 4 = spots on older and younger leaves, blighting and defoliation from upper and lower parts of the plant.

In addition to these diseases, samples of cassava root rot were collected where present for identification of the associated pathogens. Leaf and stem samples with CBB and CAD symptoms were also collected for the isolation of pathogens. The geographic position of the each farm was recorded with the aid of a GPS.

Assessment of the health status of stem cuttings from farmers' fields

To assess the health status of stem cuttings from farmers' fields, stems were obtained from representative farms for establishment in the greenhouse. These stems were cut to planting sizes and planted on sterilized soil in plastic pots. The pots were watered every alternate day and maintained for six weeks. The plants were assessed for CBB, mosaic disease, and fungal wilt at 3, 4, 5, and 6 weeks after planting.

*Isolation and identification of *C. gloeosporioides* f.sp. *manihotis* isolates*

Cassava stems with anthracnose cankers were collected from infected fields during the survey. Small pieces of the infected stems were cut from the edges of the cankers, surface sterilized for 3 min in 10% sodium hypochlorite solution and rinsed in five changes of sterile distilled water. The stem pieces were dried on sterilized filter paper and placed on acidified

potato dextrose agar (PDA). The inoculated plates were incubated at 27 °C. Identification of the fungus was carried out under the microscope and confirmation made using the procedure of Barnett and Hunter (1987)¹.

Single spore isolation of C. gloeosporioides isolates

To obtain single spore cultures of *C. gloeosporioides* isolates, a pure culture of each isolate was obtained on quarter strength PDA for seven days. Conidia from sporulating acervuli were transferred into a sterile test tube containing 1 m of sterile distilled water (SDW). The test tube was shaken thoroughly and a drop of the suspension was streaked on water agar. The plates were incubated at 19 °C for 17 h. Using a binocular microscope, colonies originating from single conidia were identified and transferred to PDA plates. Two colonies from single conidia were transferred for each isolate to different PDA plates.

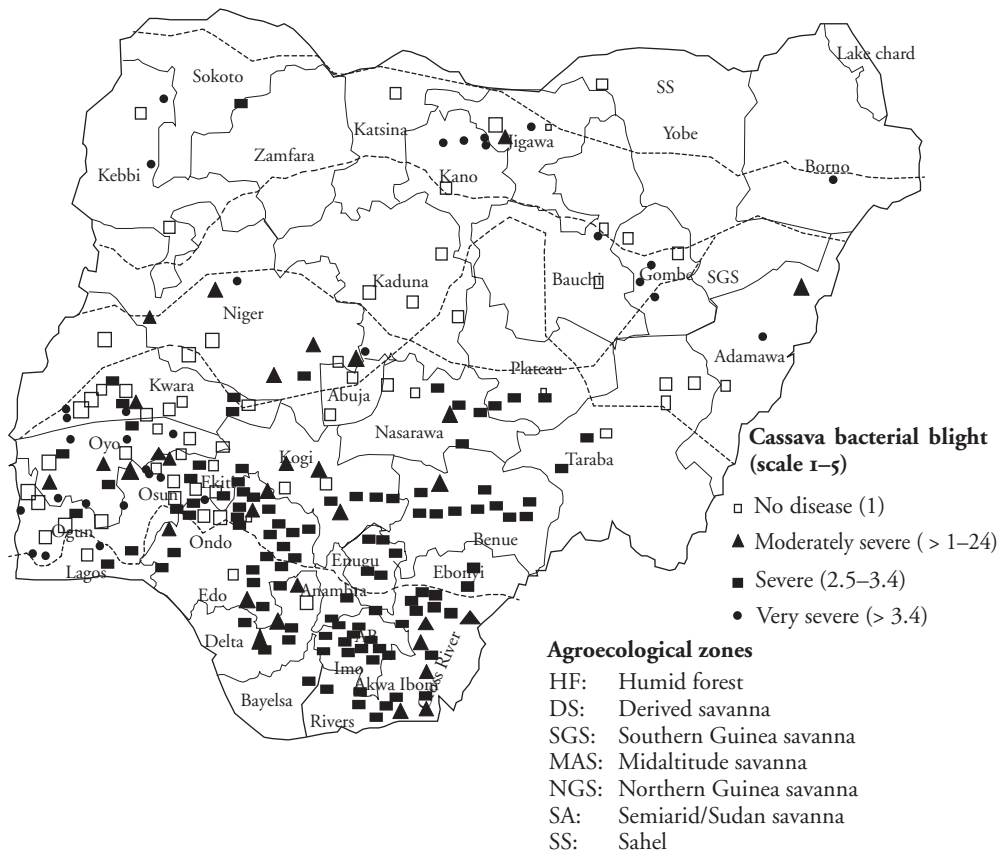


Figure 4. Map of Nigeria showing the distribution of CBB across the various agroecological zones.

¹Barnett, H.L. and B.B. Hunter. 1987. Illustrated general of imperfect fungi. Macmillan Publishing Company, NY. 218 pp.

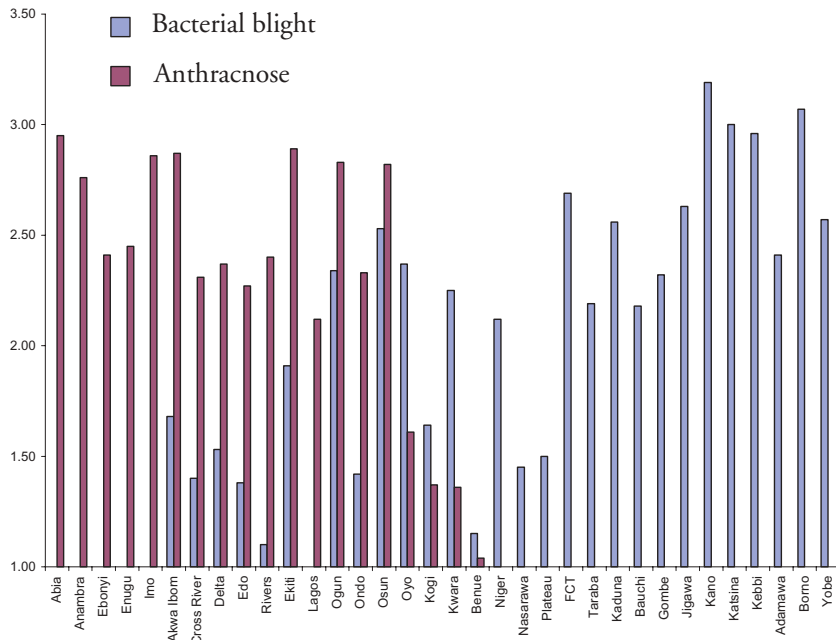


Figure 5. Severity of CBB and CAD in various states of Nigeria.

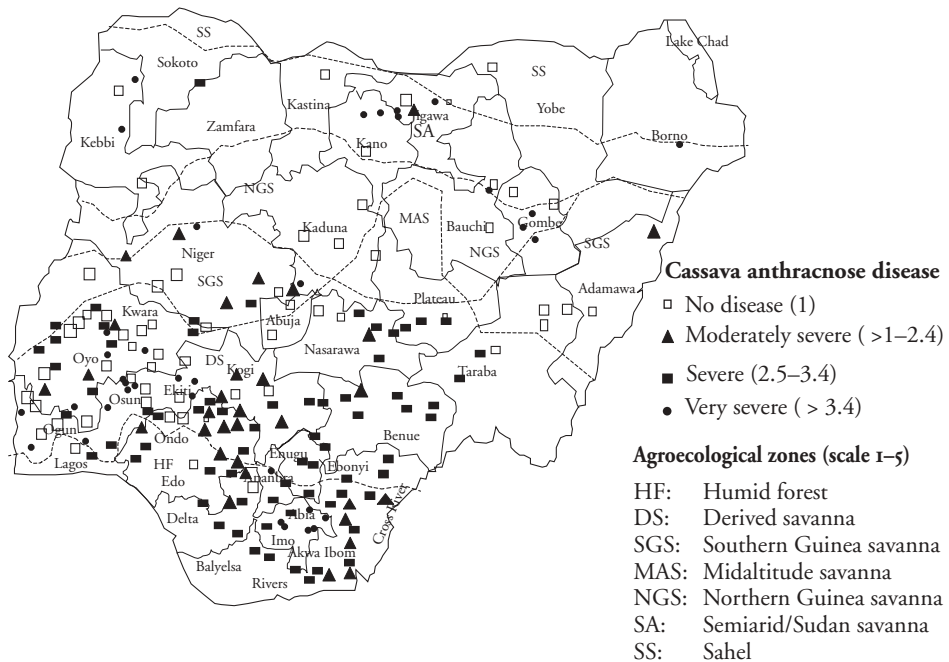


Figure 6. Nigeria showing the distribution of CAD across the various agroecological zones.

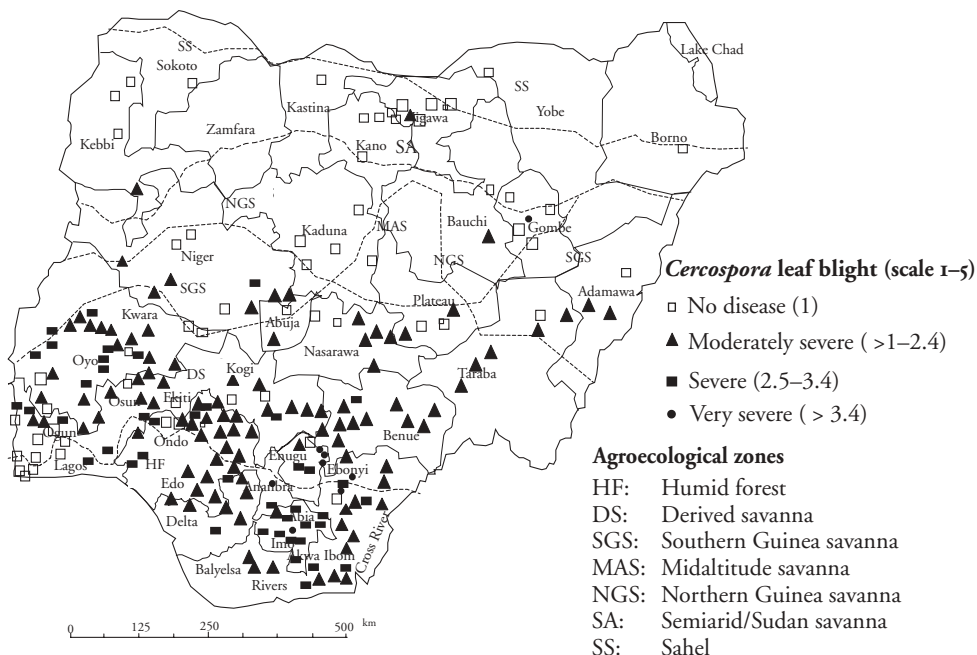


Figure 7. Nigeria showing the distribution of CLB across the various agroecological zones.

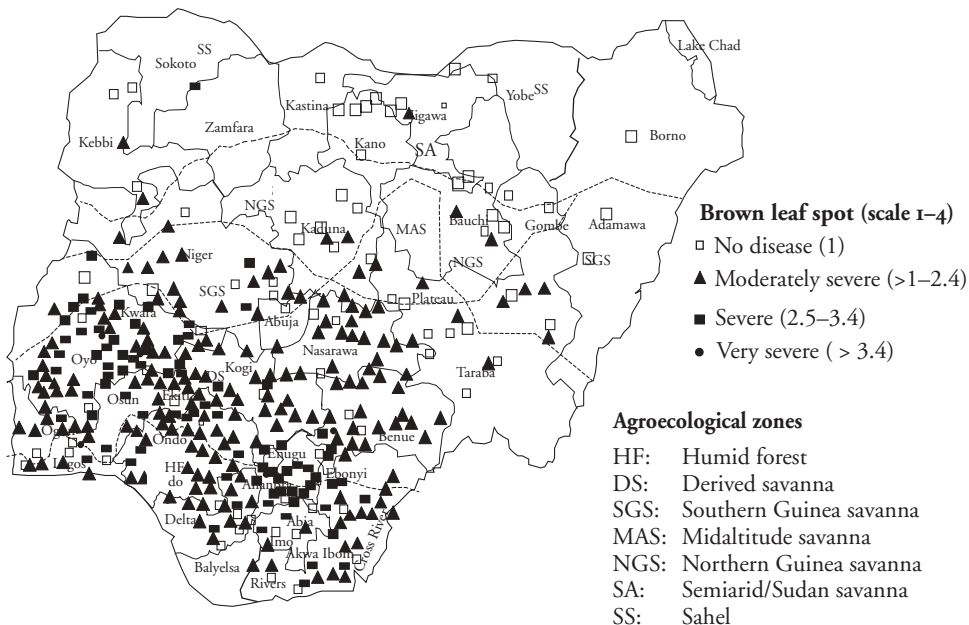


Figure 8. Nigeria showing the distribution of cassava brown leaf spot across the various agroecological zones.

Isolation and identification of Xanthomonas campestris pv. manihotis
(*X. axonopodis pv. manihotis*)

The culture medium used was potato yeast glucose agar (PYGA); 20 g of agar, 10 g of calcium carbonate, 5 g of glucose, and 5 g of yeast were added to one liter of SDW in a conical flask. The flask was plugged with nonabsorbent cotton wool and wrapped with aluminum foil. The mixture was stirred, heated to boiling, and sterilized for 15 minutes in an autoclave at 1.05 kg/cm². The medium was allowed to cool to about 45 °C before being poured aseptically into sterile plastic petri dishes and allowed to solidify.

Leaves and stems showing CBB symptoms were collected from infected fields during the survey. The plant materials were cut into 2–3 mm pieces, sterilized for 2 minutes in 10% sodium hypochlorite and rinsed in sterile distilled water. The treated plant materials were aseptically transferred with a pair of sterile forceps to a few drops of SDW contained in sterile petri plates. The tissues were triturated and the suspension was allowed to stand for up to 5 minutes (Bradbur 1978). Loopfuls of the suspension were streaked on freshly prepared potato yeast glucose agar. The plates were incubated at 28 °C for 72 h and observed for bacterial growth. The colonies were purified three times by single colony transfer on fresh medium plates until an axenic culture was obtained.

CBB was observed in 32.53% of the fields in the humid forest, 66.43% of the fields in derived savanna zone, 95.45% of the fields in southern Guinea savanna, 90% of fields in northern Guinea savanna, and 94.12% of fields in the Sudan savanna zone (Fig. 4). CAD was observed in the humid forest and derived savanna zones but not in any of the other ecological zones. Hence CBB was of regional importance in the savanna ecozones and CAD in the humid forest zone (Figs 5 & 6). CLB and BLS were observed in all the ecological zones, but their severity was generally low and did not seem to pose a serious threat to cassava storage root yield (Figs 7 & 8). Cassava root rot was recorded in 35.6% of the fields surveyed in the southeast and 28.2% of the fields in the southwest, but was not recorded in any of the farms surveyed in the middle belt and northern states. Fungal pathogens isolated from root rot samples included *Aspergillus niger*, *Botryodiplodia theobromae*, *Fusarium* spp., *Rhizopus* sp., *Sclerotium rolfsii*, and *Trichoderma* spp. *B. theobromae* which was the most frequently isolated pathogen was obtained from 84.48% of the collected samples while *Fusarium* spp. was observed in 39.66%.

With the increasing production of cassava in Nigeria, disease management will become crucial as production expands to the marginal zones.

Participatory identification and evaluation of appropriate production technologies such as improved germplasm, soil amendments, integrated pest management options, and technologies

MA, PI, AD, CE, RO, JL, FO in collaboration with DC, MM, AGIP, ADPs, NRCRI, Universities

Inventory on availability best practices for cassava production is in progress. This will capture information in the areas of:

- Land development, conservation, clustering to have larger areas.
- Soil: mapping, conservation, fertilizer use.
- Variety selection targeted to specific end-uses.
- Stem management for 100% plant stand survival.
- Use of stem dips to reduce termite/rots and herbicides to control weeds.
- Harvest factors for optimum recovery of roots after 10.5 months.
- Increasing replacement of labor with mechanization/tractorization.

Arrangements have been completed on fertilizer trial arrangements with Crystalizer Fertilizer in acid soils of the SS and the SE zones of Nigeria. In addition, a specific fertilization for cassava production, which was developed by the French in the Republic of Benin, has been developed for testing in SS and SE Nigeria.

Soils samples have been collected in selected villages during the baseline studies and analyses are in progress in collaboration with AGIP, Port Harcourt. Likewise, weed samples were collected and identification is completed.

The focus was principally on varietal identification, rapid multiplication of healthy planting materials, and productive crop management practices. Through participatory pest and disease evaluation, extension agents and farmers have learnt to identify and estimate the severity and incidence of CMD and CBB on-farm. Approximately 250 extension agents in 12 state ADPs, 100 final year students in the universities of Calabar and Uyo, and 6500 individual and group farmers received orientation. Additional training on pest and disease identification and evaluation, rapid multiplication of planting materials, and strengthening of cassava growers association to supply planting materials is planned for the rest of the growing season.

The impressive performance of the new genotypes in evaluation trials at some locations has encouraged farmers to get interested in the complete applied agronomic package. Thousands of farmers are now requesting for information on new varieties, agronomic practices, and potential markets.

Through the stakeholders' workshop, several media interviews, and the Presidential Initiative on Cassava, an estimated 100 000 farmers have received information and are waiting impatiently for planting materials of the new varieties for the 2004 planting season.

Development, evaluation, maintenance, and provision of diversified germplasm for the establishment of strategic stocks of CMD-resistant varieties for food, feed and agroindustrial uses

MA, AD, PI, LS, JL, FO, RO in collaboration with NRCRI, Universities, Shell, ADPs, Private entrepreneurs

Participatory multilocational trials to identify specific and broadly adapted CMD-resistant genotypes with desired enduser characteristics

Forty-three genotypes, comprising 40 newly selected CMD-resistant genotypes and three other improved checks commonly grown by farmers in Nigeria have been planted at each of 19 locations in 18 states in the 2003 planting season to identify specific and broadly adapted CMD-resistant genotypes with desired enduser characteristics. The states, locations, agroecological zones, geopolitical zones, agencies involved, and land area (ha) of the trials, currently undergoing evaluation, are shown in Table 1.

These multilocational trials are now being harvested and they will be replanted in more locations as a means of diffusion and a strategy to identify convincingly genotypes with stable and specific adaptation. It is estimated that the number of trials would increase to 30 this season through collaboration with the private sector particularly industries that are using cassava as raw materials. This collaboration will enable industries to evaluate the new genotypes and identify the most suitable varieties for their products. As a means to further guarantee supply of raw materials, industries have been encouraged to develop cluster farmers in collaboration with the project. Selected genotypes will be multiplied and distributed to accredited suppliers of cassava roots. Such support is now being provided for the Nigerian Starch Mill Ihiala, Matna Foods Akure, and Nigeria Allied Atlantics, the makers of Bacchus wine and Schnapps.



Comparable yield from IITA varieties (Current national best—top left)

Table 1. Distribution of multilocal trials of 40 CMD-resistant genotypes and three checks by state, agroecological zone, and collaborating agencies in the 2003/2004 season.

State	Location	Agroecological zone	Geopolitical zone	Agency	Land area (ha)
		Forest-savanna transition		Nat. Root Crops Res. Institute (NRCRI)	
Abia	Umudike	Forest-savanna transition	Southeast	NRCRI	0.7
Akwa Ibom	Uyo	Humid forest	Southsouth	University of Uyo	0.7
Anambra	Awka	Forest-savanna transition	Southeast	Nigeria Starch Mill (NSM)	0.7
Benue	Otobi	Southern Guinea savanna	North-central	NRCRI	0.7
Cross River	Calabar	Humid forest	Southsouth	University of Calabar SHELL Agric Demo. Farm	0.8
Delta	Warri	Humid forest	Southsouth	Farm	0.7
Ebonyi	Ishiagu	Forest-savanna transition	Southeast	NRCRI	0.7
Edo	Ubiaja	Forest-savanna transition	South-south	IITA	0.8
Enugu	Nsukka	Forest-savanna transition	Southeast	University of Nigeria	0.7
FCT	Kubwa	Southern Guinea savanna	Federal Capital	IITA	0.8
Imo	Egbema Sabo	Forest-savanna transition	Southeast	Nigeria Starch Mill (NSM)	0.7
Kaduna	Ngida	Northern Guinea savanna	Northwest	Hill View farms	0.7
Kwara	Ilorin	Southern Guinea savanna	North-central	Kwara state ADP	0.7
Niger	Mokwa	Southern Guinea savanna	North-central	IITA	0.8
Ogun	Ikenne	Forest-savanna transition	Southwest	IITA	0.7
Osun	Oshogbo/Ife	Forest-savanna transition	Southwest	Osun state ADP	0.8
Oyo	Ibadan	Forest-savanna transition	Southwest	IITA	0.8
Rivers	Obrikom	Humid forest	South-south	Green River Project of NAOC	0.7
Rivers	Onne	Humid forest	South-south	IITA	0.8

On-farm adaptive trials

Thirty-three CMD-resistant genotypes have been planted in 1320 on-farm trials in 110 communities in 12 states to identify CMD-resistant genotypes that are adapted to farmer's agronomic and cultural practices and with high economic returns in terms of high root yields and root quality characteristics. Individual farmers, with technical backstopping

Table 2. Distribution of on-farm trials of 33 CMD resistant genotypes by state and by gender in the 2003/2004 season.

State	Geopolitical zone	No. of CMD-resistant genotypes per farmer	No. of new genotypes in evaluation	No. of on-farm trials established	No. of male farmers	No. of female farmers
Abia	Southeast	3	33	110	60	50
Akwa Ibom	Southsouth	3	33	110	89	21
Anambra	Southeast	3	33	110	70	40
Bayelsa	South-south	3	33	110	80	30
Delta	South-south	3	33	110	87	23
Edo	South-south	3	33	110	90	20
Ebonyi	Southeast	3	33	110	100	10
Cross River	South-south	3	33	110	72	38
Imo	Southeast	3	33	110	72	38
Ondo	Southwest	3	33	110	95	15
Rivers	South-south	3	33	110	77	33
Enugu	Southeast	3	33	110	78	32
Total				1320	970	350

provided by IITA, NRCRI, and state extension agents, evaluated the trials. Table 2 shows the distribution of on-farm trials by state, geopolitical zone, and gender in the 2003/2004 season. Out of the 1210 farmers directly involved in on-farm trials, 26.5% are women. In Bayelsa State, over 110 farmers have also been identified for the establishment of on-farm trials in December when the water level in the soil would have receded enough to permit arable farming.

On-farm trials in all the states except Bayelsa will be harvested in June/July 2004. Meanwhile arrangements have been made to replant these trials at new locations in all the states. Similarly selected genotypes by farmers will be multiplied in “farmer resource centers” in each state where farmers will be trained to produce cassava competitively using the correct agronomic package for high root yield in cassava.

Community-based demonstration plots for identification of new varieties and production technologies through farmers’ field day activities

Thirty-six CMD resistant genotypes including checks were planted between June and July 2003 in 100 community-based demonstration trials in 12 states to identify and disseminate new varieties and production technologies through farmers’ field day activities. Table 3 shows the distribution of demonstration plots by state, geopolitical zone, and farmers groups.

Germplasm development

To ensure a continuous flow of the new CMD-resistant genotypes into farmers’ fields, a new set of 35 genotypes has been selected and 2.1 ha of multiplication plots have been planted in three states (Oyo, Niger, and Rivers) (Table 4). IITA estimated operation cost over the years (excluding infrastructure) of developing these improved and diverse CMD-resistant

Table 3. Distribution of demonstration plots of 36 CMD-resistant genotypes by state and by group in the 2003/2004 season.

State	Geopolitical zone	Leading farmers	Cassava Growers Association	Women Association	ADP demonstration sites	Total per state
Abia	Southeast	2	2	4	–	8
Akwa Ibom	South-south	5	3	2	–	10
Anambra	Southeast	8	–	–	–	8
Bayelsa	South-south	5	–	1	2	8
Delta	South-south	5	–	–	3	8
Edo	South-south	2	4	–	2	8
Ebonyi	Southeast	6	2	–	–	8
Cross River	South-south	3	1	1	3	8
Imo	Southeast	2	–	1	7	10
Ondo	Southwest	8	–	–	–	8
Rivers	South-south	6	–	2	–	8
Enugu	Southeast	4	–	4	–	8
Total		56	12	15	12	100

varieties currently being multiplied in the preemptive management of the cassava mosaic disease in Nigeria is US\$3.4 million. This includes IRS and NRS staff and operational costs. This is considered part of IITA's contribution to the CMD management program.

Trial monitoring The monitoring was conducted in February after all the trials were planted. Three teams each made monitoring trips to four states. Team reports were received and have been pooled together with a full list of all the trials in the 12 states into a report for publication. States submitted their lists of trials over a wide period of time after much follow-up.

Trials data collation for characterization The project partners on the trials (multilocational) are collecting varied data on disease incidence and severity as well as other characteristics on the varieties that they observe in the each of the 19 locations in different agroecological areas. The database manager is working hard to computerize all the information we have received so far.

Table 4. Provision of new multiple-disease and pest-resistant germplasm in the 2003/2004 season for multiplication, in preparation for participatory evaluation in selected locations in the South-south and southeast in 2004/05.

Location	Germplasm	No. of genotypes	Land area (ha)
Ibadan, Oyo State	Multiple pest resistance	31	0.5
Ibadan, Oyo State	Multiple pest resistance	35	0.4
Ubiaja, Edo state	Multiple pest resistance	31	0.2
Mokwa, Niger State	Multiple pest resistance	35	1.0
Total		35	2.1



Planting of 2004/05 multilocal trial commenced at IITA Onne



CMD agronomist with collaborators from NRCRI, AGIP, & College of Agriculture Umuagwo

Harvest of the 2003/04 trials The multilocal trials at Obrikom, Ibadan, and Onne have been harvested. Harvest arrangements for several other demonstration trials have been completed and harvesting has started in June 2004.

Planting of new trials for 2004/05 season Four multilocal trials have completed plans to plant the new trials for the 2004/05 multilocal trials and the new sites for the planting of demonstration and on-farm trials have been identified for several states.

Criteria for institutions that will multiply cassava stems in 2004/05 for the project are:

- Possession of a large parcel of land.
- Good farm security.
- Ease of distributing stems to farms within the same zone as the institution.
- Labor is available and can be controlled.
- Only institutions or very large commercial agents.
- Acceptance of CMD price for multiplying stems per hectare.

Establishment of sustainable network of community-based private sector driven cassava planting material production scheme of high yielding CMD and other multiple pest-resistant varieties to supply high quality planting materials to farmers

MA, AD, PI, LS, CE, JL, FO, RO in collaboration with NRCRI, Universities, NCGA, ADPs, Private entrepreneurs

Multiplication of CMD-resistant varieties

Primary multiplication centers with 46 new and diverse CMD-resistant varieties and three improved cassava varieties popularly grown by farmers were established in eight locations within three agroecologies (Onne, Ubiaja, Umudike in the humid Forest, Ibadan, Mokwa, and Zaria in the moist savanna; and Kano, Mallam Madori in the Sudan savanna) in the

2002/2003 growing season (Table 5). A total of 251486 plants were established in 17 ha of land and provided planting materials for all the trials (multilocational and on-farm trials and demonstrations) and establishment of new multiplication plots in 2003.

Multiplication of CMD-resistant genotypes to increase planting materials for expanded on-farm trials, demonstration plots and for large-scale distribution of healthy planting materials to farmers from 2004

Approximately 84 hectares of 41 CMD-resistant genotypes have already been planted in 17 states in collaboration with a broad spectrum of agencies (Table 6). Additional late season multiplication is on going at IITA-Onne and Ibadan stations and with the Niger Delta Development Commission (NDDC), Nigerian Starch Mill, Bayelsa State ADP, Cross River State ADP, and Akwa Ibom State ADP. Table 7 gives the estimated quantities (almost 11 million planting cuttings 25-cm long) of planting materials to be available for the 2004 planting season from ongoing activities This quantity of planting materials will plant over 1000 hectares in 2004.

Multiplication of 40 varieties Besides the 93 ha of land under multiplication across the 12 CMD project states in 2003/04, contacts for new multiplication in different hubs are being made for 2004/05. Several other sites have been identified in the humid forest and moist savanna agroecologies to bring planting materials as close as possible to the farmers. In the humid forest, 360 bundles of improved planting materials have been supplied to 150 farmers while 100 bundles have been supplied to 40 farmers in the moist savanna. The farmers were trained on rapid multiplication and they are expected to practice this technology using the materials received. On a larger scale, 500 bundles of improved cuttings were supplied to Akwa Ibom for multiplication and another 300 bundles in Lagos. As soon as the demonstration and on-farm trials in the 12 states are harvested, it is projected that over 50 farmers in each of the states will be assisted to multiply stems commercially for large-scale distribution from 2005.

Table 5. Multiplication of planting materials of 46 diverse CMD-resistant genotypes and three popularly grown improved varieties at various agroecological zones in Nigeria in 2002/2003 season.

Agroecological zone/location	No. of genotypes	No. of plants	Area covered (ha)
First cycle			
Humid forest (Onne and Ubiaja)	37	49880	2.7
Moist savanna (Ibadan, Mokwa, and Zaria)	49	117274	6.8
Dry savanna (Kano and Mallam Madori)	9	9300	0.9
Subtotal	49	176454	10
Second Cycle			
Humid forest (Onne)	49	51150	4.0
Humid forest (NRCRI, Umudike)	38	11000	1.0
Moist savanna (Ibadan)	30	12882	2.0
Subtotal	49	75032	7
Total	49	251486	17

Table 6. Multiplication of CMD-resistant genotypes in 17 states in the 2003/2004 season.

State	Geopolitical zone	IITA	NRCRI/ Univer- sities	Oil/ Private sector	Farmers groups/ NGOs	State ADPs/ Min. of Agric	Total land area (ha)
Abia	Southeast	–	5.0	–	2.5	–	7.5
Akwa Ibom	South-south	–	1.2	–	1.0	3.2	5.4
Anambra	Southeast	–	–	–	–	2.0	2.0
Benue	North-central	–	–	–	–	1.0	1.0
Cross River	South-south	–	–	–	–	3.0	3.0
Delta	South-south	–	–	–	–	2.0	2.0
Ebonyi	Southeast	–	–	–	–	3.0	3.0
Edo	South-south	3.0	–	1.5	1.5	0.5	6.5
Enugu	Southeast	–	1.7	–	1.3	–	3.0
FCT	Federal Capital	8.0	–	–	–	–	8.0
Imo	Southeast	–	1.0	2.0	2.0	–	5.0
Niger	North-central	4.0	–	–	–	–	4.0
Ogun	Southwest	1.0	–	–	–	–	1.0
Osun	Southwest	–	–	–	–	0.5	0.5
Ondo	Southwest	–	–	–	–	2.0	2.0
Oyo	Southwest	1.5	–	–	–	–	1.5
Rivers	South-south	13.0	1.0	3.0	3.0	–	20.0
Subtotal		30.5	9.9	6.5	11.3	17.2	75.4
Planting materials supplied to NDDC for multiplication in 8 ha of land							8.0
Total							83.4

Table 7. Estimated quantities of planting materials (planting size cuttings 25 cm long) to be available from ongoing activities for the 2004 season.

State	Multi-locational trials-2003	Demonstration trials 2003	First season Multiplication (new field)2003	Second season planting (new field) in 2003	Multiplication (old field-ratoon crop) 2002	Total
Abia	45 000	86 250	60 0000	200 000	100 000	1 031 250
Akwa Ibom	43 000	108 000	225 000	200 000	–	576 000
Anambra	43 000	86 250	150 000	–	–	279 250
Cross River	–	86 250	225 000	–	–	311 250
Delta	43 000	86 250	150 000	–	–	279 250
Ebonyi	43 000	86 250	22 5000	–	–	354 250
Edo	47 500	86 250	150 000	40 000	100 000	423 750
Enugu	43 000	86 250	165 000	–	–	294 250
Imo	43 000	108 000	475 000	–	–	626 000
Rivers	90 500	86 250	1 397 000	940 000	570 000	3 083 750
Ondo	–	86 500	150 000	–	–	236 500
FCT	47 500	–	675 000	–	–	722 500
Niger	47 500	–	600 000	–	30 0000	947 500
Kwara	43 000	–	–	–	–	43 000
Oyo	47 500	–	120 000	40 000	500 000	707 500
Ogun	43 000	–	150 000	–	–	193 000
Benue	43 000	–	75 000	–	–	118 000
Kaduna	43 000	–	–	–	50 000	93 000
Multiplication by NDDC	–	–	–	600 000	–	600 000
Total	755 500	992 500	5 532 000	2 020 000	1 620 000	10 920 000

Output 2. Demand-driven cassava postharvest technologies generated, integrated with competitive production, and IPM technologies, promoted and adopted

Assessment of postharvest and processing technology and product development needs and identification of appropriate technologies for household and small- to medium-scale businesses

LS, CE, JL, FO, RO, AD in collaboration with MD, ADPs, NARs, Universities, CEFAN, SON, Private fabricators

A meeting of postharvest specialists from the target ADPs of mandate states, fabricators, NRCRI, relevant universities, and selected people outside the 12 mandate states was held from the 19 to 22 April at IITA-Onne. The meeting discussed needs assessment checklists, criteria for needs assessments in target states, and other logistics for inventory, formation of linkages for local fabricators, and documentation.

An inventory of postharvest and processing technologies has been completed. The draft which is around 105 pages, is under review.

The inventory of postharvest and processing technologies was carried out through:

- Desk research including Internet browsing.
- Factory/workshop visits.
- Attendance at various trade fairs/workshops and conferences (nationally and internationally).
- Discussions and interviews with relevant public agencies in Nigeria.
- Group discussions with selected fabricators.

Inventory of standards for cassava products (national and international) had been completed and a draft of the output has been scheduled for review with the Standards Organization of Nigeria on 17 June 2004.

The inventory of standards for cassava products was carried out through:

- Desk research including Internet browsing.
- Interactions with regulatory agencies.
- Interactions with food practitioners and professional bodies.
- Attendance at drafting of document on major standards for cassava and cassava products in Nigeria.
- Group discussions with selected scientists.

Inventory of cassava products is ongoing and a final document will be used as the project output. This material will serve as a training manual and a guide for cassava business.

The work is been carried out through:

- Desk research and brainstorming.
- Community visits.

- Factory visits.
- Discussions and interviews.
- Food preparation.
- Sensory and consumer acceptability studies for the selected products (new and local).
- Focus group discussions.
- Resolutions.

A needs assessment survey in the 12 CMD project states started on 24 May and was completed on 11 June 2004. Final reports will be presented to various stakeholders before final selection of the processing centers per senatorial districts in each state.

The project designed the needs assessment survey to identify processing and marketing needs/opportunities and promote postharvest technologies (processing and storage) to reduce crop losses and drudgery and improve the quality of marketable cassava products for defined markets (domestic and export) and trade.

To achieve this, a meeting of postharvest specialists from Abia, Akwa Ibom, Anambra, Bayelsa, Cross Rivers, Delta, Ebonyi, Edo, Enugu, Imo, Ondo, and Rivers states and selected scientists from selected universities and research institutes was held with a view of resolving major criteria to conduct a needs assessment in major cassava producing LGAs within the CMD states.

Survey design and tools

A team of three/four multidisciplinary scientists carried out a needs assessment survey in the 12 states. The purpose of the study was to select potential communities with the objective of setting up viable small- and medium-scale cassava processing plants.

The survey was carried out in nine communities from the three senatorial zones of the 12 states. The team relied on existing information at state ADP headquarters to choose the three local government areas, which occupy the position of the highest concentration of cassava production in their respective senatorial zones.

A purposive rapid rural appraisal (RRA) was used to generate information at the community, institutional, and market levels for the needs assessment. Key points per community are product, ownership, viability, profitability, available market and access, institutional support, commitment to commercial cassava production systems including large area production, mechanization, and use of improved inputs.

The survey also assessed the institutional and political support for the promotion of improved cassava postharvest technologies and expanded utilization in the state. Using a demand-driven approach, the survey evaluated the market for selected cassava-based products at the community, state, and regional level. The survey also assessed possible recommendations for the selection, introduction, and establishment of community-based cassava processing plants based on products, returns on investment, income generation, and positive impact. A monitoring strategy was employed by the CMD team, which includes unscheduled visits to survey sites, occasional telephone calls using GSM, and validation visits to already survey communities. Secondary data collected from the state ADPs on the

status of best cassava production local government area guided the choice of the communities visited by the study teams.

Introduction, demonstration, adaptation, and promotion of improved value adding postharvest technologies and products for expanded utilization, and income generation opportunities

LS, CE, JL, FO, RO, AD in collaboration with MD, ADPs, NARs, Universities, CEFAN, SON, Private fabricators

IITA has been involved in the introduction of some value adding postharvest technologies and products to farmers, processors, and investors at various fora.

The regional workshop/exhibition on postharvest technology as a panacea to food security and economic development was organized by the office of the special assistant to the president on food security in all the six geopolitical zones of the country. IITA participated as a major collaborator to promote cassava postharvest technologies already developed.

The South-south zone workshop was held from 22 to 23 March 2004 at the Cultural Centre, Calabar, Cross River State. An exhibition was mounted on cassava products ranging from dried prepackaged to freshly prepared snack/baked foods. Among the array of products exhibited and demonstrated were cassava chinchin, doughnuts, meat-pie, queen cakes, strips, flakes, composite bread, cookies, flour, starch, chips, tapioca, salad cream, dried *lafun*, dried *fufu*, *gari*, and livestock-feed pellets.

Training papers presented were:

- The Integrated cassava project: the road map to commercialization and utilization of cassava in Nigeria (J Lemchi and E Okoro).
- Appropriate processing technologies for cassava: key to food security and economic development (A. Okoruwa and B. Maziya-Dixon).
- Cassava as an economic crop: its production, utilization, and marketing (C. Ezedinma).
- Appropriate processing equipment: a vehicle for effective postharvest system (L. Sanni).

These activities were replicated in the other regions (except North-central) as follows:

Southeast - Umuahia, 29–30 March 2004

Southwest - Akure, 5–6 April 2004

Northeast - Katsina, 3–4 May 2004

Northwest - Bauchi, 10–11 May 2004

Also on display were posters showing the IITA high quality cassava flour production method and new food products from cassava products, which generated some interesting discourse.

Many of the visitors were thrilled by the palatability and economic potential of the products. To demonstrate their willingness to continue using the technologies after the workshop, many of them bought copies (125) of the cassava recipe book but some government and protocol officials, students, ADPs, and NGOs were given free copies (80).

Arrangements have been completed to start a training workshop on cassava utilization from the second week in July at designated centers. The target participants include bakers, caterers, processors, and women in agriculture in each state. This activity will stimulate SME cassava business and microfinance.

The project has acquired several postharvest processing equipment for each state in SS and SE. They are durable and cheap, and there are trained personnel who can repair them in every locality. The equipment can process cassava roots into flour, chips, pellets, and *gari* at the farm gate. The equipment will be deployed on the outcome of a needs assessment study.

In collaboration with CEFAN/ARCEDEM, the project is coming up with equipment standards and training modules that meet farmers' and processors' need.

Methodologies for achieving this are:

- Desk research and brainstorming.
- Internet browsing.
- Equipment designing.
- Workshop visits.
- Focus group discussions with selected fabricators and engineers.
- Resolutions.

Promotion of integrated value adding postharvest technologies, competitive best-bet cassava production, and integrated pest management strategies for viable commercial enterprise through decentralized community/village-oriented technology transfer centers

MA, LS, CE, JL, FO, RO, AD in collaboration with MD, NRCRI, ADPs, universities, SON, private processors, private entrepreneurs

Forty CMD-resistant varieties of cassava are presently being characterized at the farm, laboratory, and industrial levels. Agronomic properties are being assessed in the country using CMD multilocational, on-farm, and demo fields. Most of the agronomic variables being assessed are color of cortex F, color of cortex B, ease of peeling, cortex–peel ratio, knife peeling loss, number of plants harvested in the four central rows (a max of 16 plants), number and weight of roots harvested, weight of shoots (all plant parts apart from roots), number of 1-m stems that can be sold as planting material, number of main stems per planted stem cutting, and average of plants taken around the center of the plot (cm). Other variables include blue-green streaks in root cortex on day one after harvest, blue-green vascular streaks in root cortex on day two after harvest, blue-green vascular streaks in root cortex on day three after harvest, proportion of roots rotten on day 3, 4, 5, 6, and 7 after harvest from soil, number of plants showing root rots at harvest, and number of rotten roots.

The postharvest characterization of the CMD varieties is taking place in five locations representing the agroecological zones of the country. Some of the properties are:

- moisture
- starch
- root dry matter
- root mealiness
- proximate (fat, moisture, protein, fibre, ash, carbohydrate) composition
- amylose and amylopectin
- cyanide
- pasting properties

Outputs from this will guide the selection of the best-bet cassava varieties for different agroecologies and different food uses (food, feed, and livestock). The IPM approach involves the use of CMD-resistant varieties and good agronomic practices like weeding. The project has acquired postharvest processing equipment that will be used on the farms. They are durable, cheap, and there are trained personnel who can repair them in every locality. The equipment will be deployed on the outcome of the needs assessment study.

Output 3. Viable private sector agribusinesses promoted, diversified Cassava markets developed, and access to credit institutions enhanced

Identification of cassava market (domestic and export) and investment opportunities to promote production, processing, and trade

AD, MA, LS, CE, RO, in collaboration with TP, DT

The project has completed a subsector analysis of the cassava industry. This activity has identified cassava markets that exist in Nigeria, regionally, and internationally. The output reflected issues like:

- Production cost for cassava per hectare in each of the cassava producing states in Nigeria.
- Cassava varieties available and their actual and potential yield in each state.
- Existing and potential volumes, prices, quality standards, and delivery schedules for cassava-based products used by the various industries in Nigeria.
- Price trends for cassava and cassava-based products relative to other dry grain products like maize, sorghum, and rice.
- Status of existing and potential industries (e.g., food, animal feed, textile, paper, plywood, glue, pharmaceuticals, starch, and alcohol) that use or can potentially use cassava products.
- Competitiveness by industry using private cost ratio, domestic resource costs, nominal protection coefficient for output, and profitability coefficient to ascertain the degree of cassava competitiveness in Nigeria.
- Current status of processing technology and local maintenance capacity in Nigeria.
- Transportation costs from rural to urban areas for cassava tubers, *gari*, etc. on kilometer per tonne basis for 30-km, 60-km, and 90-km radii.
- Conversion ratios for different cassava products.
- Current status of processing technology and local maintenance capacity in Nigeria.
- Supply chain requirements and identify preliminary logistic framework for cluster development in the SE, SW, and middle belt of Nigeria.
- Availability and existing use of secondary cassava products and the key agribusiness firms as well as their supply chain structure (e.g., farmer groups, processor groups, etc.).
- Market share and size of use of cassava as raw material in these identified industries in Nigeria.
- Export quality requirements, delivery schedule, shipping costs and requirements, international prices for cassava-based products, and niche markets for Nigerian cassava (e.g., composite pellets).
- Economics of existing cassava processing equipment and new equipment such as flash dryer, solar dryer, centrifuge, washing machine, peeling machine, etc.

- Identify and assess the status of existing and potential industries (e.g., food, animal feed, textile, paper, plywood, glue, pharmaceuticals, starch, and alcohol) that use or can potentially use cassava products.

Copies of the book *Cassava statistical handbook and cassava revolution in Nigeria* were presented to the President during the Cassava Stakeholders' forum held at Aso Rock, Abuja, 7–8 June 2004.

Inventory of agro industries and processor groups

CE, LS, RO, JL, FO, MA, EO, AD in collaboration with AIDU (SAMEG/FAMEG), ADPs, FIIRO, LCCI

Introduction

There is limited information on the size of the domestic (industrial) market for cassava in Nigeria. Existing information from two subsector studies conducted by IITA were based on import substitute estimates and/or informed “guestimates”. This justifies the need for careful identification and documentation of baseline information on the status of existing cassava industries. Such information also enables identification of market opportunities and potential cassava markets in Nigeria as well as helping to plan on how to improve supply chain constraints and market information service for the agroindustries.

Objectives

- Identify all agroallied industries using cassava as raw material in Nigeria..
- Identify all agroallied industrial end users using cassava commodities (fresh tuber, chips, pellets, flour, ethanol, starch, etc.).
- Assess the constraints and needs of cassava agroindustries and end users.
- Determine the size of the cassava industry in Nigeria.



Agronomy harmonization meeting at IITA Onne.



CMD agronomist and postharvest specialist (with caps) with PRODA team at Enugu.

Methodology

Over the last two years, IITA through its RUSEP project had identified major agroindustries using cassava in Nigeria. Recently, the RTEP project through AIDU concluded a national survey of agroprocessors and end users. Information was also obtained from a relatively recent directory entitled *The major 5000 companies in Nigeria* published by Gold Star Publication, Lagos in 2002. Information from both (RUSEP and AIDU) projects and a directory on agroindustries, agroprocessors, and end users has been compiled into an inventory. The validation of the inventory of cassava agroindustries and industrial end users will commence in August in all the states of the Federation.

The validation exercise will be done in collaboration with the ADPs, the Lagos Chamber of Commerce and Industry, and the Nigerian Institute for Food Science and Technology and will involve enumeration visits to existing and operational small, medium, and large cassava industries and industrial end users in the following categories: animal feed mills, flour mills, biscuit/bakery/confectionary industries, adhesives/dextrin industries, pharmaceuticals, soft drinks, starch factories, ethanol factories and blending plants, food and beverages (Indomie, Nestle, UAC, Cadbury), textiles and leather, and paper industries.

The validation exercise will be used to update the database, assess the constraints, and ascertain the needs of the cassava agroindustries and industrial end users. A questionnaire for this purpose has been prepared. Training for the validation of the agroindustry database has been fixed for 26–30 July 2004.

The directory of cassava agroindustries and a report on the status of the cassava agroindustry in Nigeria will be published after the validation exercise in September 2004. Information from the directory will also be fed into the national cassava market information service and be used for planning activities in the cassava projects.

Development and strengthening of effective agroindustrial and traders' associations

LS, CE, AD, MA, RO, JL, FO, in collaboration with NCGA, ARCEDEM, NCAM, AIDU, PRODA

In order to promote viable private sector agribusinesses, improve access to markets, and diversify the utilization of cassava in micro, small-, and medium-scale industries, there is need to develop and strengthen agroprocessor associations. Evidence suggests that small farmer multipurpose cooperatives exist in many local villages but such cooperatives are focused only on primary production especially for food processing and, to a very limited degree, in the processing of cassava chips/chunks (Nassarawa State). There are no associations at the small-scale level especially for the processing of cassava into adhesives, dextrin, ethanol, HQCF, and starch even though such agroprocessing industries exist in Nigeria. Even were such associations exist, they lack state and national coordination and information is not usually shared about existing markets for cassava within and outside Nigeria. The absence of such a private sector led association is one of the major gaps in the development of the cassava downstream sector.



President Obasanjo at IITA stand during the cassava stakeholders' forum and exhibition at Abuja



Visitors to the IITA stand bought IITA cassava recipe book and ate up the snacks on display



IITA therefore has further facilitated the formation and recognition of the various organizations such as NCGA, CAPAN, and CEFAN. The Cassava Processors Association of Nigeria (CAPAN) attended the Prisms stakeholders meeting at the Sheraton Hotel Abuja while Nigeria the Cassava Growers Association (NCGA), CAPAN, and the Cassava Equipment Fabrication Association of Nigeria (CEFAN) attended the cassava stakeholder's forum at the Presidential Villa, Abuja.

IITA had completed arrangements with ARCEDEM, NCAM, AIDU, and PRODA to allow individual fabricators to use their centers for the fabrication of processing equipment for a small fee. This will promote standardization and effective delivery.

The following activities have also been concluded by the Interim working committee of CAPAN:

- The Bye laws, articles, and memoranda of association are in print.
- The Board of Trustees for the Association has been appointed.
- The Registration of the Association is in progress.
- A Secretariat has been tentatively identified at Abuja.

The Association in the next couple of months plans the following activities:

- Sensitization and setting up of state chapters of CAPAN or co-opting existing groups at the state level.
- Election of officers into the national association of CAPAN.
- Training of state chapter associations in group organization, management, and micro enterprise development.

- Organization of associations around commodities to produce for specific (identified) industries or specific small industries (e.g., small ethanol plants).

Stimulation and promotion of advocacy (through participatory mechanisms) for strategic policies to enhance cassava commercialization and trade

AD, CE, LS, MA, RO, EO, in collaboration with NRCRI, Ministry of Commerce

The project has been active in influencing government policy makers to put up policies that will enable the cassava industry to develop. A Law on the inclusion of 10% cassava flour in bread in Nigeria was facilitated by CMD. The project has given 100% support to the Presidential Initiative on Cassava, the NEPAD cassava initiative, the National Agricultural Policy Review: a private sector perspective, and review of the NEEDS document on agriculture and especially cassava.

CMD chaired the technical committees on drafting of standards for cassava root, chips, flour, starch, and composite flour on 17 June 2004 at Standards Organization of Nigeria office, Lekki, Lagos.

IITA attended a 2-day cassava stakeholders' forum and exhibition held at the Banquet Hall of the State House, Abuja from 7 to 8 June 2004. Dr Victor Mayong represented DG Hartmann at the occasion and welcomed President Olusegun Obasanjo to IITA's stand and presented two recent IITA publications on cassava data in the country to the President.

IITA presented the following lead papers:

- Sustainable commercial cassava cultivation in Nigeria (MA, RO, LS, CE, JL, EO, AD).
- The cassava market and market information service in Nigeria (CE, RO, LS, MA, JL, EO, AD).

Dr Bussie Maziya-Dixon coordinated the product exhibition at the IITA stand, which attracted a lot of visitors and dignitaries including policymakers, industrialists, and peer scientists. Over 700 participants tasted IITA cassava products. The products displayed were:

- high quality cassava flour
- cassava starch
- cassava chips
- cassava meat pie
- cassava fish rolls
- abacha
- cassava bread, composite bread 20% cassava flour
- cassava biscuit
- cassava flour chinchin and cake
- cassava flour doughnuts
- grated cassava doughnuts
- orange drop cookies
- tapioca from starch
- dried *abacha* (African salad)

- *gari*—1-day and 4-day fermentation
- soy-*gari*
- fresh *fufu*
- *lafun* and *fufu* flours
- cassava starch salad dressing
- cassava croquettes
- cassava strips/titbits

Facilitation of the development of agri-input and service delivery systems (fertilizer, agrochemicals, tractor services, machine fabricating, processing, etc.) to support cassava commercialization

MA, EO, CE, RO, PI, JL, FO in collaboration with Syngenta, Candel, CEFAN, ARCEDEM, PRODA

The compilation of the inventory on agrochemical dealers, tractor service providers, agricultural machine dealers, and credit institutions on a state-by-state basis will commence in the last quarter of the year. The project has distributed CMD-resistant cassava cuttings to all cassava producing states in Nigeria. Of particular interest are the CMD states where there are more than 115 farms growing 40 genotypes distributed by the project. Over 110 farmers participated in the exercise in 2003/04 and it expected that this number would triple this year.

The project is in active discussion with the Ministry of Commerce on fertilizer procurement and distribution to farmers. It is in good contact with Syngenta and also carrying out an evaluation trial with crystallizer fertilizer. In collaboration with CEFAN/ARCEDEM, the project is coming up with equipment standards and training modules that meet farmers' and processors' needs. Arrangements are in top gear to link farmer groups with bigger firms, government parastatals, or groups of individuals that can lend input services like tractors to them.

Development of an active market information acquisition and dissemination and intelligence system for use by stakeholders (producers, processors, researchers, input dealers, product marketers, and end-users) in the cassava commodity chain to make informed decisions

CE, RO, LS, MA, AD, EO, JL, FO in collaboration with RTEP, NIFST, Agroindustries, LCCI, AIDU, NTA, Radio stations, Print media, ADPs, NGOs

Introduction

The missing link in cassava market development is the absence of a market information service (MIS) that will guide investments in the subsector in Nigeria. Presently, there are no readily available disaggregated data that would allow comparisons of volumes, prices,

seasonality of supply, and evaluations of opportunities in the domestic and export markets. Existing databases are weak and are either too old or too limited in content. While MIS is an expensive venture it is vital for agroindustrial development. Several lessons were learnt from the pilot national MIS set up by the USAID funded RUSEP project in Nigeria beginning 2002. It is possible to provide an active and transparent national MIS with available telecom technology (email, computers, mobile phones, Vsat). Second, a donor-driven market information system for Nigeria is not sustainable. Third, the private sector appears willing to contribute to the cost of an effective MIS in Nigeria provided the agency vested in the execution of the service is a trusted, committed, and transparent NGO. This implies that, in the long run, a national MIS has to be a private activity. Finally, the information provided has to be accurate, timely, and appropriate to the needs of the end users especially the private sector.

Objectives

- Generate information and interest in the development of the cassava business.
- Improve transparency in the cassava business and increase investments in the subsector.
- Facilitate the organization of the cassava market and stakeholders.

Methodology

The national cassava MIS will cover about 30 states since markets have no boundaries and there is no further need to do pilot studies. Market information will be collected from Abia, Akwa Ibom, Anambra, Bayelsa, Benue, Cross River, Delta, Ebonyi, Edo, Ekiti, Enugu, FCT, Imo, Kaduna, Kano, Kebbi, Kogi, Kwara, Lagos, Nassarawa, Niger, Ogun, Ondo, Osun, Oyo, Plateau, Rivers, and Taraba states.

Information on market prices will be collected and disseminated on a weekly basis for the following commodities: cassava fresh tuber, *gari*, local *fufu*, packaged *fufu*, *lafun/elubo*, *abacha*, tapioca, and local (edible) starch. Information on prices will also be collected for noncassava-based commodities such as maize, sorghum, soybean, rice, yam, and beans. These commodities complement or substitute cassava and cassava-based products at different times of the year and are therefore important in explaining price changes for cassava in Nigeria.

Information on prices will also be collected for the following commodities at the factory gate on a fortnightly basis. The commodities include HQCF, cassava chips, cassava chunks, native starch (flour), crude ethanol, extra-neutral alcohol, corn starch, and wheat flour.

Information will also be provided on a monthly basis for inputs such as fertilizer, agrochemicals, farm machinery, cassava stems, and farm labor wage rate by location.

Transportation (haulage) costs from the state capitals and major commercial cities to export points namely Calabar, Port Harcourt (Onne), and Apapa (Lagos) will also appear on a fortnightly basis on the national cassava MIS.

The data collection points will be at two levels: namely, the major commodity markets in urban and rural areas and from the factory gate of cassava industries and end-user industries. Information will be collected by trained ADP staff working under the RTEP SAMEG

program and by industry staff. The data collection will be monitored by the CMD zonal managers and by the NIFST especially in the Lagos area.

Information will flow from the state enumerators to IITA Ibadan. Enumerators will transcribe data by email and mobile phones to the central point at IITA Ibadan stations within a stipulated day in the week. Data will be input into a computer within 48 hours and transmitted back to enumerators by email at the state level for broadcast in their respective state radio stations. The state enumerators are expected to record the information on cassettes within 24 hours for broadcast on state radio stations. The factory gate informants are also expected to transmit prices by mobile phone to Ibadan following the same procedure.

The data collected will be processed at IITA Ibadan and disseminated through radio stations, newspapers, national television, and on the website. The radio stations and language of broadcast may include Radio Nigeria Kaduna (Hausa), Delta FM (Pidgin English), PH FM 93.7 or 106.5 FM (Pidgin English), Ogun FM (Yoruba), Eastern Heartland Imo (Igbo), Abia FM (Igbo) Enugu FM (Igbo), Ray Power 100.5 Lagos (English), Abuja FM (English), Edo FM (Pidgin), Akwa Ibom FM (Ibibio), Ondo FM (Yoruba), and Kano FM (Hausa). In the long run it is expected that this coordinating role by IITA will be transferred to the private sector or an NGO.

The newspapers will include *The Guardian*, *Businessday*, and other interested newspapers. Broadcasts on prices will also be made on NTA Business News and published on the website (www.cassabiz.org). Several pages in the website will also be used to provide other information such as price forecasts, cassava agroenterprise development and services for potential investors, and links to international market prices for cassava-based products.

Ownership and sustainability issues

The sustainability of the national cassava market information can only be guaranteed if it is in private sector hands. IITA will set up and test run the national cassava market information system for a period of two to three years. The service will be transferred to a coalition of interested private sector operators. The private sector operators will be identified from the first year of operation of the cassava MIS and will be carried along throughout the process of development of the MIS. A second MIS meeting will be held at the launching of the national website consisting mainly of private sector operators in the cassava industry to discuss modalities for private sector ownership, operation, and maintenance of the MIS initiative.

Geospatial analysis of cassava product markets in Nigeria

CE, RO, CL, AD in collaboration with Universities, ADPs

Introduction

Conventional market studies have been able to provide information on the basic structure, conduct, and performance of the traditional cassava food markets in Nigeria. Very little has

been done to map the movement of these traditional cassava food products from rural to urban markets on a national level using geographic information system (GIS) tools. The scientific basis of this activity is therefore driven by the need to update the GIS available at IITA and elsewhere in Nigeria. Such information will also help to understand the behavior of agents in the marketing of cassava and cassava-based products in Nigeria.

Objectives

- To provide information on the geospatial movement of traditional cassava products from rural to urban markets in Nigeria.
- Determine the break-even distances and relative volumes of traded cassava products in Nigerian markets.
- Ascertain the optimal location of rural markets to urban markets based on identical cassava products.

Methodology

The survey will be in two phases. The first phase will involve a listing of all markets in the city/urban market using a questionnaire. The GPS reading of all the markets will be recorded in each city. The relative volumes of cassava products that come into the market will be ascertained through key informants. A list of the rural markets from where the cassava products are sourced will be compiled. The major source markets by volume for each cassava product will be obtained again using key informants. Information obtained at this stage will be transmitted to IITA for a recompilation of the major rural markets.

The second phase of the survey will involve a visit to all the rural markets listed during the urban market survey. The GPS location of the rural markets will be recorded in the questionnaire. The destination (urban) market of all the identified cassava products by relative volume from the source (rural) market will be recorded. Where the rural market is in session, the number of persons selling different cassava-based products should also be documented. The frequency of the rural market sitting (i.e., once every four days or once every eight days, etc.) should also be documented.

The cassava products of importance are cassava tuber, *gari*, *elubollafun*, (i.e., cassava fermented flour), cassava chips/chunks, prepared *fufu*, and *fufu* paste.

The country is divided into five zones and the major cities of importance (above two-million inhabitants) are:

Southeast: Port Harcourt, Aba, Owerri, Onitsha, Enugu, Calabar

Southwest: Benin City, Warri, Lagos, Abeokuta, Ibadan, Ilorin

Central: Markurdi, Lokoja, Abuja, Jos, Kaduna, Lafia

Northeast: Yola, Bauchi, Maiduguri

Northwest: Zaria, Kano, Katsina, Sokoto, Birnin Kebbi, Minna.

The survey will commence in August and end in September 2004. Data from the survey will be fed into a GIS database at IITA Ibadan. The distances between rural and urban markets will be estimated from the GIS database and used to ascertain the optimal location of markets using the GAMS MINOS program.

Promotion and linkage of small-and medium-scale enterprises to financial institutions for credit, and to appropriate domestic and export markets

CE, MA, LS, RO, JL, FO, AD, EO in collaboration with Banks, ADPs, NCGA

Linkages with private sector

The project had open linkages with some international institutions from Brazil (Halotek), Denmark, Holland, and Thailand on information regarding markets for cassava flour business in Nigeria.

Technical assistance for large-scale cassava production by the private sector has also been provided to a number of investors (Table 8). Some private investors have continued to interact with IITA on medium- to large-scale cassava processing in Akwa Ibom, Delta, Edo, and Rivers states and they are at different stages of procuring the required capital and equipment. They have also been encouraged to finance medium- to large-scale processing of cassava into quality foods and industrial raw materials.

Technical assistance was given to the Cassava Growers Association as well as medium- and large-scale producers of cassava in the southwest on group organization to supply chips at 140 t/day to an ethanol factory (Allied Atlantic, at Sango Otta, Ogun State) as from 2005. Technical assistance is also being given to farmers in the southeast to organize and supply fresh roots at 300 t/day to the Nigerian Starch Mills, Ihiala from June 2004. Also, farmers in Ubiaja in Edo State and Ibadan in Oyo State have already been organized and mobilized to supply healthy planting materials to large farms including the Nigeria Starch

Table 8. Linkages established with some targeted and potential investors for cassava processing, marketing and export.

Name	State	Product	Contact person
Nigeria Starch Mills**	Anambra and Imo	Native and modified starches	Dr Chris Okeke
De Ladder Establishment Limited**	Edo	Adhesives	Dr R. Ehigiamusoe
ALCONI Nig. Ltd.**	Lagos	Ethanol	Edwin Ibude
Hephzibah Integrated farms*	Edo	Multiple cassava product	Esiomeme Ebaide or Igbiginun Patience
Ekha Farms*	Delta	Native and modified starches	Mr Yomi Ige
Tandy Associated Investment*	Rivers	Multiple cassava products	Mr Taiwo Olowu
Fresh and Green *	Akwa Ibom	Multiple cassava products	Capt. M. Okon or Matilda Okon
PEMO Farms limited*	Kogi	Multiple cassava products	Mr P.E Momodou

** Functional

*About to become operational

Mill farm site at Egbema in Imo State, Ekha Farms in Benin, Edo State, Dewo Foods in Niger State, and Hill View Farms in Kaduna State.

Technical assistance was given to a Brazilian Company and her Nigerian partners who are conducting a feasibility study for the establishment of a modified starch plant with a capacity of 400 tonnes of fresh root per day in Nigeria.

Linkages with credit institutions

IITA/CMD is in discussion with credit institutions in Nigeria (Union Bank & NACRDB) and some from abroad but based in Nigeria about how the farmers' group will secure credit.

Output 4. Human and institutional capacity to promote private sector investment in the cassava industry enhanced

Establishment and maintenance of cassava development and resource centers for zonal technology transfer and training

LS, RO, MA, JL, FO, CE, EO, AD in collaboration with ADPs, NRCRI

The project is currently developing materials through ADPs and some research institutes that will be utilized in resource centers in each state. Computers have been acquired that will facilitate this process. The design of two model processing centers for the zonal hubs are complete. Construction work has started in the SS hub center.

Development and strengthening of the capacity of cassava producers and processors for sustainable production, processing, and utilization technologies

LS, CE, AD, MA, RO, JL, FO, in collaboration with NCGA, ARCEDEM, NCAM, AIDU, PRODA

The project is working closely with the Nigeria Cassava Growers Association to improve and strengthen the organization. The project has developed cluster farming models and farmer groups so that they can benefit from economies of large scale input procurement and marketing benefits.



Cleared site for CMD postharvest model plant at IITA Onne.

It also assisted in the formation of the Cassava Processors Association of Nigeria (CAPAN) with Mr Humprey Nwosu of Abia State, the Protem President and Dr Ehigiamusoe of Edo State, the Protem Secretary. Registration of the association is in progress.

IITA has further facilitated the recognition of the various organizations. CAPAN attend Prisms stakeholders meeting at Sheraton Hotel Abuja while NCGA, CAPAN, and CEFAN attended the cassava stakeholder's forum at the Presidential Villa, Abuja.

The project is developing public–private linkages between government institutions and private entrepreneurs.

Development of the capacity of entrepreneurs in market identification, product development, storage, and enterprise development

CE, LS, RO, MA, JL, FO, EO, AD, PI in collaboration with MD, AO, ADPs, NCGA, Universities

The project staff has developed two-page flyers on investment requirements for small-scale cassava enterprises for, cassava *fufu* flour, high quality cassava flour, adhesives, *gari*, and cassava starch. These documents are in draft form and are expected to aid capacity development in cassava product and enterprise development. The project has strongly encouraged private sector leadership. Entrepreneurs are encouraged to own cassava farms cropped with CMD-resistant varieties. CMD also encourage these entrepreneurs to carry along the farmers in their community, own farm gate processing equipment, and use their farms as models. The various product-training programs also incorporate enterprise development. Such trainings include cassava flour, ethanol production, *fufu* production, and several others. The MIS will help in market identification.



Training of enumerators for cassava baseline survey at IITA Onne

Postharvest needs assessment meeting at IITA Onne

Enhancement of entrepreneurial capacity to adopt cassava product standards and grades for local industrial and export markets

LS, RO, CE, MA, PI, JL, FO in collaboration with SON

The project will commence this activity after the publications of various standards in conjunction with Standards Organization of Nigeria and NAFDAC.

Training of farmers and processor groups in credit management, group organization and management, and microenterprise development

CE, MA, LS, RO, JL, FO, PI in collaboration with ADPs

The project is planning a training activity for farmers and processor groups in credit management and microenterprise development.

Training of fabricators for fabrication and servicing of postharvest and processing machines for widespread dissemination on a sustainable basis

LS, MA, PI, RO, JL, FO, CE in collaboration with ARCEDEM, NCAM, PRODA, Universities, FIIRO, Private fabricators

The project assisted in the formation of the Cassava Equipment Fabrication Association of Nigeria (CEFAN). The Protem President is Engineer Ayo Olubori and the Protem Secretary is Unaegbu John. Registration of the association is in progress.

The project had started linkages with ARCEDEM, PRODA, NCAM/AIDU, FIIRO, and some private fabricators in Nigeria. Arrangements are in top gear to mount a training workshop on fabrication of equipment to meet SMEs in the SS and SE using reputable fabricating centers.



CMD agronomist (in brown shirt) training students from Rivers State College of Education, Ndele, at IITA Onne. **CMD postharvest specialist (standing) training students from Federal University of Technology, Owerri, at IITA Onne.**

The project is planning to train operators from each ADP and Ministry of Agriculture in CMD states on the use of power tillers just acquired for CMD work from Hong Kong/China.

Development, production, and dissemination of training and extension support materials

RO, LS, CE, MA, PI, AD, JL, FO, EO in collaboration with NRCRI, ADPs

The following documents are in various levels of editorial review: Project flyer, trials monitoring report, cassava statistical handbook, postharvest equipment inventory, processing of cassava products, benefits from the CMD project activities, agronomic practices, proceedings of the postharvest workshop held in Port Harcourt, and the project document. To capture major tips on production, processing and marketing, a newsletter is in progress.

Output 5. Cassava stakeholders network and coordination strengthened and impact of project activities monitored and evaluated

Organization of annual stakeholders consultative forum for project sensitization and focus

AD, EO, CE, LS, MA, RO, JL, FO

Work planning meeting with implementing partners for the 2003 cropping season on production component

In facilitating the simultaneous conduct in 2003 of the participatory on-station varietal evaluation of cassava, adaptive on-farm trials, demonstration, expanded multiplication of the new and diverse CMD-resistant cassava varieties, and capitalizing on the current growing season in order not to lose a whole year of the project, a work planning meeting with implementing partners on germplasm activities was held from 5 to 7 May 2003 at the High Rainfall Station of IITA, Onne, Port Harcourt, Rivers State for the immediate take-off of the participatory multilocational on-station evaluations, on-farm trials with active farmers' participation, community-based demonstration plots of cassava varieties, and rapid multiplication of planting materials of diverse CMD-resistant varieties for distribution to farmers, as well as training of technicians and farmers on rapid multiplication, including field days. Work plans and budgets were developed for the cropping season, and roles and responsibilities were assigned to various implementation agencies.

Stakeholders consultative forum and work planning workshop on postharvest processing and marketing component

A stakeholder's consultative forum and work planning workshop on market development and commercialization was held from 22 to 25 June 2003 at the Integrated Cultural Center, Port Harcourt, Rivers State. Over 200 stakeholders from various areas of the cassava subsector attended. The purpose was to discuss with a broad-based stakeholdership, the preemptive management of the virulent CMD in Nigeria and give a status report of its implementation; discuss aspects of implementation for expanding the utilization and commercialization options for cassava in the SS and SE zones of Nigeria; plan and adopt strategies for future implementation of postharvest processing and market development activities that will enable entrepreneurs to take advantage of new market opportunities in the domestic and export markets; and propose and discuss an outline of project implementation and coordination structures.

Verification meeting of the multidonor preemptive management project

A small team of stakeholders also met on from 15 to 17 July 2003 and reviewed the multidonor project document after the recent consultative stakeholders forum in Port Harcourt.

This was to ensure that the project interventions as spelt out in the document have the desired effect on food security, agroindustrial development, and poverty alleviation of the target beneficiaries. The team verified the following:

- Key objectives of the project to ensure it is a precursor and complimentary to the Presidential Initiative on cassava production and export.
- Key objectives and outputs are attainable within a short time frame of four years.
- Implementation strategy and list of partners of the project are updated.
- Indicators for monitoring progress and measuring impact are succinct and clear to ensure that project interventions have the desired effect at the producer', processor', traders/marketer,' and end-users/consumer' levels.
- Project serves as a key model using the commodity-chain approach for other projects to emulate in Nigeria and in the subregion.

Definition of target communities and partners, and their involvement in project implementation design

EO, LS, CE, MA, PI, JL, FO, RO, AD in collaboration with ADPs, Universities, NRCRI, NSPRI, SON

Target communities identified are the ones IITA is using for multilocal, on-farm, and demonstration trials for cassava farming.

After the needs assessments survey, various communities would be selected for the establishment of processing centers in each senatorial districts of the state.

We are in partnership with NRCRI, state ADPs, universities, NSPRI, RIAT, NGOs, NCAM, AIDU, FIIRO, the Nigerian Export Promotion Council, NGOs, and SON.

We intend to extend our collaboration with NAFDAC and other stakeholders in the near future.

Establishment of a national project advisory committee for administrative and technical oversight

EO, AD in collaboration with stakeholders

The composition of the national project advisory committee is in progress.

Collation and updating, where necessary, of detailed baseline information and development of performance and monitoring indicators

CE, RO, FN, MA, LS, JL, FO in collaboration with NRCRI, ADPs, Universities, FIIRO, LCCI

Authoritative baseline data on cassava in Nigeria was collected by the COSCA study about 10 to 15 years ago. The survey covered about 65 villages in Nigeria because it had a continental

Table 9. Summary table of selected survey villages, Nigeria.

	COSCA	CMD	CEDP	LAGEMAN	Total
Climate humid—access poor	6	4			
Climate sub humid—access poor	15	11			
Climate humid—access good	11	11			
Climate sub humid—access good	29	18			
Others	4	2			
Total	65	46	21	3	135

focus. Presently, objective and representative information is required to provide a baseline for the assessment of the impact of donor investments in the cassava commercialization process in Nigeria. For instance, there is an urgent need to ascertain the level of productivity, employment, and income in the cassava farm enterprise today in southern Nigeria. Also, since the COSCA survey, it has been difficult to assess using scientific methods the level of adoption of improved (TMS and NR) cassava varieties in Nigeria.

Objectives

- Provide basic data for monitoring and performance of CMD project activities.
- Provide basic information for the evaluation of the impact of CMD activities on rural incomes and employment at the end of project life span.
- Re-assess changes in the cassava subsector since the COSCA surveys in Nigeria.
- Ascertain the level and factors responsible for the adoption of production (improved cassava varieties) and processing technologies.

Method of the survey

The baseline survey covers 60 villages and 180 households in the 12 CMD states. The CMD states are Abia, Akwa Ibom, Anambra, Bayelsa, Cross River, Delta, Ebonyi, Edo, Enugu, Imo, Ondo, and Rivers states. The survey states also include the eight CEDP states. The baseline survey therefore covers the express interests of the CMD and CEDP projects and to capture the status of cassava production and degree of change in southern Nigeria, the methodology also includes revisits to the COSCA (19) villages within the survey zone in Nigeria (Tables 9, 10, and 11).

The CMD villages were selected following the COSCA methodology. The sampling frame was derived from 12 km by 12 km grid map based on a climate, population density, and market access framework. The survey integrated both village and household level instruments and involves destructive sampling for cassava yield per household. The village level questionnaire focuses on the status of postharvest issues, namely processing and marketing. The household level questionnaires focus on household and farm production issues. GPS equipment were used to measure farmers' fields while weighing scales were used to measure yield of cassava from nine months of age in 40 m² plots. Soil samples were obtained from each sampled cassava field at a 40-cm depth using soil augur. The sampling units therefore covered 60 villages, 180 farm families, and about 450 farmers' fields.

Table 10. Distribution of selected villages by States.

	COSCA	CMD	CEDP	LAGEMAN	Total
*Abia	1	1	3	1	6
Abuja	1	0	0	0	1
Adamawa	4	1	0	0	5
*Akwa Ibom	1	1	3	0	5
*Anambra	1	2	0	0	3
*Bayelsa	0	1	3	0	4
Bauchi	1	0	0	0	1
Benue	2	5	0	0	7
*Cross River	4	2	0	0	6
*Delta	2	2	3	0	7
*Ebonyi	1	2	0	0	3
*Edo	3	3	3	0	9
Ekiti	1	3	0	0	4
*Enugu	2	3	0	0	5
*Imo	2	—	3	2	7
Kaduna	1	1	0	0	2
Kano	1	0	0	0	1
Kogi	6	0	0	0	6
Kwara	3	3	0	0	6
Nasarawa	5	1	0	0	6
Niger	1	2	0	0	3
Ogun	2	2	0	0	4
*Ondo	1	4	3	0	8
Osun	2	0	0	0	2
Oyo	5	0	0	0	5
Plateau	4	2	0	0	6
*Rivers	2	2	3	0	5
Taraba	4	3	0	0	7
Other	4	—	—	—	—
Total	65	46	21	3	135

* The 12 CMD and CEDP states account for 60 villages.

Table 11. Distribution of villages surveyed in the baseline study.

State	COSCA	CMD	CEDP	Total villages	No. of farmers	No. of fields
Abia	2	3	1	5	15	36
Akwa Ibom	1	2	1	4	12	30
Anambra	1	2	—	3	9	22
Bayelsa	0	1	3	4	12	30
Cross River	4	2	—	6	18	45
Delta	2	2	3	7	21	52
Ebonyi	1	2	—	3	9	22
Edo	3	1	—	4	12	36
Enugu	2	2	—	4	12	36
Imo	4	1	2	7	21	52
Ondo	1	3	—	4	12	36
Rivers	2	2	3	7	21	52
Total	19	20	13	60	180	450

The survey was done once over a period of two months using two teams of enumerators. The specific field activities in each village during the survey include group interviews, farmer interviews, field measurements, yield measurements, disease scoring, and soil sampling. Each team comprised four members (an economist, agronomist, soil scientist, and experienced field hand) and where necessary they used paid labor for intensive field activities such as yield sampling and slashing paths. The team leader in each of the two teams holds a PhD and all the enumerators were graduates in agriculture. The enumerators were trained (training and pretest) for the field activity between 27 and 30 January 2004. Production of questionnaires and survey preparation was concluded in February 2004.

Participants invited were from universities, the National Root Crops Research Institute, Umudike, state Ministries of Agriculture, and ADPs located within the SE and SS states of Nigeria. During the training, participants reviewed, improved, and pretested the survey instruments. They had hands-on experience of the use of GPS equipment, yield and soil sampling techniques, and the characterization of cassava varieties, pests, and diseases.

Data collection commenced in March 2004 and was concluded before the end of April 2004. The design of the database (in Microsoft Excel) and data entry also started simultaneously in March and has also been concluded. Data validation and drafting of a baseline report has commenced. The COSCA database will also complement the analysis and report for this survey. A workshop on the performance monitoring and evaluation of project activities is planned for September 2004.

Cassava industry baseline survey

Compilation of the directory of cassava industries and end users has been concluded. The questionnaire for the verification exercise has been drawn and the verification exercise has commenced.

Organization of work planning and review meetings for refinement of project activities

EO, AD, CE, MA, LS, RO, JL, FO in collaboration with Stakeholders

A stakeholder's consultative forum and work planning workshop on market development and commercialization was held from 22 to 25 June 2003 at the Integrated Cultural Center, Port Harcourt, Rivers State. Over 200 stakeholders from various areas of the cassava subsector attended. The purpose was to discuss with a broad-based stakeholdership the preemptive management of the virulent CMD in Nigeria and give a status report of its implementation; discuss aspects of implementation for expanding the utilization and commercialization options for cassava in the SS and SE zones of Nigeria; plan and adopt strategies for future implementation of postharvest processing and market development activities that will enable entrepreneurs to take advantage of new market opportunities in the domestic and export markets; and propose and discuss an outline of project implementation and coordination structures.



Members of the presidential Initiative ADP project managers meeting with sub-committee on production. CMD at IITA Onne.

Monitoring of project implementation and conducting midterm project evaluation

EO, AD, CE, MA, LS, RO, JL, FO in collaboration with Stakeholders

The PM–CMD project activities on the field in the 12 states covered by the project were monitored during 22–28 February 2004. Three teams drawn from FDA, RTEP NPQS, NDDC, SPDC, USAID, and IITA were formed and each team visited fields in four states. In each state, the team was guided by CMD partners with local knowledge of the field activities assisted by an IITA member of staff. Photographs of fields visited, videotapes of teams on the tour, and documentary reports by the teams were provided. A total of 152 field plots, randomly selected by the teams, were visited as shown in Table 12.

Table 12. Field plot visited by the various teams in different states.

State	On-farm trials	Community demonstration	Multiplication plots	Multilocational trials
Abia	8	1	1 = 1.2 ha	1
Anambra	10	3	1 = 2.0 ha	–
Ebonyi	6	2	1 = 3.3 ha	1
Enugu	6	1	1 = 1.15 ha	1
Rivers	–	–	2 = 1.0 ha	1
Imo	5	1	3 = ?	1
Akwa Ibom	9	2	2 = ?	1
Cross River	24	2	2 = ?	1
Ondo	8	3	1 = 3.0 ha	–
Edo	8	3	1 = 1.5 ha	1
Delta	10	3	1 = 0.7 ha	1
Bayelsa	8	3	1 = 0.6 ha	–
Total visited	102	24	17 = 34.45 ha	9
Total established	1320	108	93 ha	19

– : not visited; ? : not specified in the team's report.

Overall, the fields were planted and maintained, and the CMD resistant genotypes were generally growing well.

Variation in the level of execution was noticed among the states due largely to logistics at local level that need improvement as regards promptness of fund release and justifications, inputs, fertilizer, farm protection against rodents and goats/cattle, as well as the high cost and scarcity of labor.

Farmers are eager to see the best performing varieties among the sets being tested, even though *farmers have started to indicate* their preharvest preferences among the candidate cassava genotypes. One team sums their observations thus: ...a lot has been put into the project and credit should be given to the *executing agencies*...

Key suggestions from the teams on the field trials include the following:

- Plant trials plots early as farmers do in their locations.
- Label plots clearly for publicity and sensitization.
- Most soils on land made available by farmers are poor in fertility.
- Termite control is required to improve plant stand.
- Farmer to be encouraged to keep records of field activities.
- Farmers are poorly informed about the aims of the project.
- Identify farmers sites early before 2005 planting season.

The monitoring has provided us with a record of the progress made in the field by the project plantings since May 2003. All 12 states are participating and their fields have the CMD genotypes at four levels (on-farm tests, demonstrations, multilocational trials, and multiplication). All logistics and gaps have been identified for all partners to note for remedial action.

Updating studies to determine level and factors responsible for adoption of cassava production, processing, and marketing technologies

CE, RO, FN, MA, LS, JL, FO in collaboration with NRCRI, ADPs, Universities

The COSCA villages are included in the baseline survey. The report on the baseline is in progress and will be able to ascertain what has changed since COSCA in the 12 CMD states.

Organization of biennial cassava trade show to foster cooperation among industry stakeholders around a common objective

EO, RO, JL, FO, MA, LS, CE, PI, AD

Not yet done.

Evaluation of impact of project activities on productivity, rural incomes, and employment

CE, RO, MA, LS, JL, FO, AD

Not yet done but baseline studies that would provide indicators for the evaluation has been completed.

Organization of two zonal stakeholders' workshop to review achievements and lessons learned

JL, FO, RO, EO, MA, LS, CE, PI, AD

Not yet done.

Organization of a national stakeholders end of project workshop to review achievements and lessons learned

AD, EO, RO, JL, FO, MA, LS, CE, PI

Not yet done.

Procurement of capital equipment for project implementation and processing equipment for 12 CMD states

Some equipment has been procured to facilitate the project implementation at IITA-Onne, NRCRI-Umudike, and in the 12 CMD states (Table 13). These include vehicles, computers, power tillers, and postharvest equipment that have capacity for 2–3 t/day. Renovation of offices and houses at Onne is in progress. Construction of a training classroom for stakeholders in the Niger Delta region has been completed at IITA Onne. Construction of a model processing center at Onne and Umudike is in progress.

Table 13. Procurement of capital items for implementation of the project.

Computers and accessories	Requested	Delivered
Dell dimension 2400	20	20
Samsung TFT, 17" monitor	3	3
Dell flat monitor 14"	17	17
Color inkjet printer Hp 6122	8	8
Hp laser DeskJet 1300	12	12
Toshiba Protégé laptop + laptop bags	7	5
Tecra Toshiba laptop + laptop bags	2	1
Cannon multimedia projector+ bulb	3	3
Photocopying machine	1	1
Internal zip drives (250 MB)	5	5
250 MB external zip drives	2	2
Digital camera	4	2
Digital camera printer	1	
Microboards Bravo CD/DVD duplicator	1	
Scanners	3	3
Projectors	3	3
Epson aculaser c4000t	1	
Hp PSC 2110	2	2

Postharvest equipment

	Requested	Delivered
Gas/charcoal fired dryer	1	1
Pelletizer + Steam boiler with accessories	2	2
Sifters	12	12
Grating machine (2t/hr) with 8 hp Imex diesel engine + 7.5KVA alternator	12	12
Press (250 kg/batch) with 20-t hydraulic jack	72	72
Double screw press with 30-t hydraulic jack, 250 to 300 kg per batch	12	12
Industrial sealing machine (electricity powered up to 50 kg nylon bag)	12	12
Communal tray fryer (stainless steel)	72	72
Grating machine coupled with chipping machine with galvanized steel and driven by 5.2 hp diesel engine + extra grating sheet	12	12
Frying pot with chimney	12	12
Industrial sifter with 3 hp petrol engine	12	12
Dry milling machine with 6 hp diesel engine	3	
Combine chipper and grater & electric motor	2	2
Combine chipper and grater & diesel engine	12	12
Rotary dryer with base + accessories	8	4
Flash dryer	2	
Cabinet dryer (Electric/diesel operated & 120 trays)	1	
Troy Bit 10 hp chipper/shredder	6	

Vehicles and motorbikes

	Requested	Delivered
Ford Ranger	17	17
Hilux	5	5
Izuzu fts33 4 × 4 truck	2	2
Motorbikes	42	42

Production

	Requested	Delivered
GPS	63	58
Salter scale	31	15
VST Mitsubishi “Shakt” power tiller	26	26
Tail skid wheel	26	26
Reversible mold board plough	26	26
Wheel changer	26	26
5 Tynes cultivator	26	26
Ridger	26	26
Tipping trailers	26	26
Water pump	26	26
Cassava planter	1	
Cassava stem cutter	1	

Rehabilitation

Establishment of radio communication link—NRCRI, Umudike	Completed
Establishment of email communication facilities (VSAT)—Onne	Completed
Establishment of model processing center for SS (Onne) and SE (Umudike) states	In progress
Renovation of classroom blocks, staff offices, houses, and dormitories—Onne	In progress

Production equipment



Power tiller



Water pump



Power tiller trailers



Plough



Ridger

Postharvest equipment



Double screw press accessories



Combined grater/chipper



Double screw press



Double screw press accessories



Mechanical sifters



Tray fryers



Pelletizer for soft pellet



Pelletizer for both hard & soft types



8 hp engine



Rotary dryers

Vehicles, computers and building



Vehicle ford ranger



Vehicle (Hilux)



Motor bikes



Computer accessories

CMD logical framework

Country/region	Nigeria—West Africa		
Project title	Preemptive management of virulent CMD through an integrated development approach to the cassava subsector for enhanced rural sector economy in the SS and SE zones of Nigeria.	Requested contribution from multiple development investors	US\$17.1 million
Project management	IITA		
Narrative summary	Objectively verifiable indicators	Means of verification	Important assumptions
Overall goal	<ul style="list-style-type: none"> Contribute to the sustainable increase in food availability, reduction of rural poverty and unemployment, and enhancement of the agroindustrial and socioeconomic growth in Nigeria. 	<ul style="list-style-type: none"> Economic and social well-being of intended beneficiaries. Levels of rural incomes and employment rate among target beneficiaries. Levels of food security. 	<ul style="list-style-type: none"> Government statistics. FAO statistics. Annual project reports. Journal articles. Independent impact assessment report. End-of-project report. Population pressure continues to require greater agricultural intensification in southern Nigeria. Stability and security prevails in project states. Political security, and financial environment favorable to stakeholders.
Project purpose	<ul style="list-style-type: none"> Enhance sustainable and competitive cassava production, marketing, and agroenterprise development through preempting an imminent CMD-associated production crisis, promoting improved, value-added postharvest technologies, commercialization, agroindustrial development, and trade thereby ensuring food availability, providing increased economic opportunities, and reducing poverty in rural areas. 	<ul style="list-style-type: none"> Increased area, production, and yield of improved cassava varieties. Increased rates of adoption of improved technologies. Value and volume of cassava commodity traded/sold. Marketing of cassava products and processed products increased. Employment opportunities in the cassava sector significantly exceed preproject levels. More commercial producers. More commercial users. Competitive pricing. Lower transaction costs. Price reflects demand and supply conditions. 	<ul style="list-style-type: none"> Government statistics. Annual project reports. Workshop reports. Independent impact assessment. End-of-project report. Existence of demand for cassava produced by project beneficiaries. Linkages between partners sustained. All stakeholders remain committed to the project.

CMD logical framework (contd)

Narrative summary	Objectively verifiable indicators	Means of verification	Important assumptions
Results/outputs 1. Sustainable and competitive cassava production technologies generated, disseminated, and adopted.			
Activities			
1.1 Conduct diagnostic baseline survey of the cassava agroecosystems to determine the distribution, severity, and identity of various cassava biotic constraints and monitor the health status of cassava.	<ul style="list-style-type: none"> • Principal disease and pest constraints identified. • Distributions of severe CMD virus strain/species and whitefly status described and mapped. • Distribution maps of incidence and severity of other major plant health constraints produced. • Survey carried out once but monitored yearly. 	<ul style="list-style-type: none"> • Project reports. • IITA reports. • Severity and distribution maps. 	<ul style="list-style-type: none"> • Availability of adequate logistic support for uninterrupted operation.
1.2 Participatory identification and evaluation of appropriate production technologies such as improved multiple disease and pest-resistant germplasm, soil amendments, and integrated pest management options and technologies.	<ul style="list-style-type: none"> • An inventory on availability of production, IPM, and postharvest technologies. • Status of soil fertility status described and documented in production zone. • Number of technically feasible and economically profitable cassava production technologies identified and demonstrated. • Number and types of appropriate technologies disseminated and adopted. 	<ul style="list-style-type: none"> • Reports and other publications of project personnel. • Farmers growing or testing high yielding cassava varieties. 	<ul style="list-style-type: none"> • Farmers make land available for demonstrations.
1.3 Develop, evaluate, and maintain and provide diversified germplasm for the establishment of strategic stocks of CMD-resistant varieties for food, feed, and agroindustrial uses.	<ul style="list-style-type: none"> • At least five adapted, high yielding, and CMD-resistant cassava varieties elected for particular end uses per state readily available to farmers for use as planting materials. • Cassava germplasm identified meet the needs of end users' (food, feed, and industrial uses). • Extension booklets and other materials on characteristics of improved varieties and production practices available for use by extension workers, NGO, and farmers groups. 	<ul style="list-style-type: none"> • Stakeholder and project reports on numbers of stems and areas under CMD-resistant varieties. • Farmers using appropriate postharvest machines. 	<ul style="list-style-type: none"> • Logistic and conducive environment to conduct survey. • Effective system for technology transfer.
1.4 Facilitate the establishment of sustainable network of community-based private sector-driven cassava planting material production schemes of high yielding CMD-and other multiple pest-resistant varieties to supply quality planting materials to farmers.	<ul style="list-style-type: none"> • Quantity of high yielding disease-resistant varieties released and distributed to farmers. • Number of primary, secondary, and tertiary planting material sites established. • Number of public, private, and community-based organizations engaged in multiplication and distribution activities of improved planting materials. • Percentage increase in planted area and yield per unit of land area and time as a result of improved varieties. • Viable private sector and community-based centers established in the 12 project states. • Number of private sector agents involved with multiplication of planting materials. • Quantities of cassava planting material traded. • Number of community planting material production schemes fully functioning in the project area. 	<ul style="list-style-type: none"> • Follow-up reports of farmer surveys. • IITA reports. • Documented yield and production losses. • Project reports. • Soil status report for community plots/sites. • IITA reports. • Report of monitoring tours. 	<ul style="list-style-type: none"> • Profitable market for seed available.

CMD logical framework (contd)

Narrative summary	Objectively verifiable indicators	Means of verification	Important assumptions
Results/Outputs 2. Demand-driven cassava postharvest technologies generated, integrated with competitive production and IPM technologies, promoted, and adopted			
Activities:			
2.1 Assess postharvest and processing technologies and product development needs and identify appropriate technologies for household and small to medium-scale businesses.	<ul style="list-style-type: none"> • Postharvest and processing technology and product development needs assessment conducted. • Inventory of postharvest and processing technologies available nationally and regionally documented. 	<ul style="list-style-type: none"> • Project reports. • IITA reports. • Severity and distribution maps. 	<ul style="list-style-type: none"> • Logistic and conducive environment to conduct survey.
2.2 Introduce, demonstrate, adapt, and promote improved value adding postharvest technologies and products for expanded utilization and income generation opportunities.	<ul style="list-style-type: none"> • No. and type of appropriate postharvest and processing technologies for household and small to medium-scale businesses introduced and demonstrated in targeted communities. • No. of products for household and small to medium-scale businesses identified and demonstrated. • Demonstrable and viable postharvest and processing pilot centers operational in every state. • No. of awareness campaigns of the postharvest and processing technologies and pilot centers created. • Extension booklets and other materials on postharvest technologies available to households, producers/processing groups, and small to medium-scale businesses. • Reduced workload in processing farm produce by rural women; minimized crop losses; more product options in addition to traditional foods. • Increased production of good quality products with improved nutritional attributes. 	<ul style="list-style-type: none"> • Farmers using appropriate postharvest machines. • Follow-up reports of farmer surveys. • IITA reports. • Documented yield and production losses • Project reports, • Soil status report for community plots/sites. • IITA reports. • Report of monitoring tours. 	<ul style="list-style-type: none"> • Availability of adequate logistic support for uninterrupted operation. • Postharvest technologies available and affordable for groups/or individual male and female farmers to purchase.
2.3 Promote integrated value adding postharvest technologies, competitive “best-bet” cassava production, and integrated pest management strategies for viable commercial enterprise through decentralized community/village-oriented technology transfer centers.	<ul style="list-style-type: none"> • Number of technology transfer centers established and operational. • Number and type of postharvest technologies, IPM package, and “best bet” production technologies introduced, integrated, and promoted in targeted communities. • Number of fertility enhancement measures introduced, integrated, and promoted. • Number of processing and marketing technologies introduced, integrated, and promoted. • Number of farmers trained in TTCs in each in each community. • Increased productivity of cassava cultivation systems established. • Costs and returns to alternative systems of smallholder production and trade in selected market chains comparatively assessed with recommendations and guidelines formulated to increase profitability and institutional innovations that promote uptake of innovations. • Income per household that is derived from cassava and/or cassava products. 		<ul style="list-style-type: none"> • Farmers make land made available for demonstrations. • Effective system for technology transfer.

CMD logical framework (contd)

Narrative summary	Objectively verifiable indicators	Means of verification	Important assumptions
Results/Outputs 3. Viable private sector agribusinesses promoted, diversified cassava markets developed and access to credit institutions enhanced			
Activities.			
3.1 Identify cassava market and investment opportunities to promote production, processing, and trade.	<ul style="list-style-type: none"> • Private sector opportunities, needs, and constraints analyzed. • Strategic research on emerging markets at local and regional levels conducted. • Number of market opportunities identified and stakeholders informed. 	• Project and IITA reports.	• Available market data sufficient to conclude the review within the allocated budget.
3.2 Facilitate development and strengthening of effective agroindustrial and traders associations.	<ul style="list-style-type: none"> • Number of agroindustrial and traders' associations formed and operational. • Number of farmer–agribusiness market linkages. • Improved bargaining position of smallholders. • Increase in contract arrangements with input and output dealers. • Improved supply and quality of products. 	• Project and IITA reports.	• Active voluntary participation by local organizations in the project activities and statements by such organizations.
3.3 Stimulate and promote advocacy (through participatory mechanisms) for strategic policies to enhance cassava commercialization and trade.	<ul style="list-style-type: none"> • Knowledge of policy and institutions affecting sustainable cassava production and commercialization. • Number and type of intervention strategies (strategic policy and regulatory issues) developed for commercialization and trade expansion and taken for consideration by state and national policymaking bodies. • Policy and regulatory frameworks influencing market development and thereby commercialization in small-scale agriculture described, comparatively assessed, and recommendations and guidelines for framework improvement in pro-smallholder ways formulated. • Number of national cassava championship/coalition/lobby groups/associations groups strengthened to lead development of the cassava subsector. • Number of sensitization campaigns/lobbying sessions held for policy dialog on the potential of cassava for creating wealth. • Number of policy statements made by policymakers to favor cassava commercialization and trade per state. • Number of local examples/success stories of cassava that have economic impact (new employment, new businesses, income generating, and links to funds). • Number of advocacy sessions for rural radio systems. 	• Project and IITA reports.	<ul style="list-style-type: none"> • Collaborating NGOs and CBOs have adequate capacity and logistics to mobilize male and female farmers. • Costs of obtaining the policy data not prohibitive.
3.4 Facilitate agri-input and service delivery systems (fertilizer, agro-chemicals, tractor services, machine fabricating, processing, etc.) to support cassava commercialization.	<ul style="list-style-type: none"> • Inventory of service providers in each state (fertilizer, agrochemicals, tractor services, machine fabricating, processing, etc) available. • Number of critical market services in support of grades and quality standards, strategic market intelligence systems and food and industrial safety, access to input and financial markets facilitated. • Range of noncredit services available to producers, processors, fabricators, etc. • Increased use of inputs by producers and processors. 	• Project and IITA reports.	<ul style="list-style-type: none"> • Existence of a feasible market for products. • Producers not discriminating against product brokers on social/religious reasons.
3.5 Develop an active market information acquisition and dissemination system for use by stakeholders in the cassava commodity chain to make informed decisions.	<ul style="list-style-type: none"> • No. of people with increased access to market information and intelligence system. • Extent to which market information is disseminated/available, used leads to greater competition. • Access to market information system provides demand and supply of cassava. • Number of issues of MIS newsletters in local languages produced per state. • Number of state radio stations broadcasting MIS. • Market intelligence (current and forecasted information) available. 	• Project and IITA reports.	• Radio stations functional and costs of broadcast not prohibitive.
3.6 Promote and link small and medium-scale enterprises to financial institutions for credit, and to appropriate domestic and export markets.	<ul style="list-style-type: none"> • Number of credit institutions identified and evaluated. • Number of producers, processors etc., benefiting from credit institutions and with access to new forms of credit. • Volume of money available for credit-by-credit institutions. • Increased number of new market outlets. • Quantities of and revenue from cassava and cassava-based products traded nationally, regionally, and internationally. 	Project and IITA reports.	• Peace and stability to ensure uninterrupted implementation of project activities.

CMD logical framework (contd)

Narrative summary	Objectively verifiable indicators	Means of verification	Important assumptions
Results/Outputs 4. Human and institutional capacity to promote private sector investment in the cassava industry enhanced			
Activities.			
4.1 Establish and maintain cassava development and resource centers (CDRC) for zonal technology transfer and training.	<ul style="list-style-type: none"> • Number of functional resource centers established and operationalized by end of project year. • Number of new technologies (production, processing, and handling) developed/adapted and demonstrated. • Number (and type) of productivity enhancing and value-added technologies demonstrated. • Number (and type) of training given to stakeholders. • Number of NARS scientists and other (stakeholders) trained. • Number of visitors using CDRC facilities (MIS, internet, email, training, etc). • Extent to which new skills are used by male and female extension workers and farmers in the application and use of new technologies for land, crop, and livestock management. • Number of new investments on cassava resulting from enhanced capacity of stakeholders. 	<ul style="list-style-type: none"> • Project reports. • IITA reports. • NRCRI report. • Report on training and workshops held. • Report of monitoring visits. 	<ul style="list-style-type: none"> • The appropriate staff are in place.
4.2 Develop and strengthen capacity of cassava producers and processors for sustainable production, processing, and utilization technologies.	<ul style="list-style-type: none"> • Number of farmers' field days and training workshops conducted per year in each state. • Number of farmers/producer groups practising cutting sanitation in planting material production fields. • Number of farmers/producer groups actually using fertility enhancement measures. • Number of new cassava products developed by farmers/producer/processor groups and sold. • Increase in production area and yield of cassava resulting from enhanced capacity of producers. • Increased demand for cassava and its products resulting from enhanced capacity of stakeholders. • Number of bundles of planting materials produced and sold. • Revenue of farmers/producer/processor groups resulting from enhanced capacity knowledge of sustainable production, processing, and utilization technologies. 	<ul style="list-style-type: none"> • Project and IITA reports. • Report on trainings and workshops held. • Extension workers collecting data accurately and knowledgeable in PE methods. • Statistics on volume of quality planting materials produced and exchanged within and outside community. 	<ul style="list-style-type: none"> • Collaborating institutions remain functional with staff working with project. • Farmers and other stakeholders willing to participate in training activities.
4.3 Develop capacity of entrepreneurs in market identification, product development, storage, and enterprise development.	<ul style="list-style-type: none"> • Number of agri-input and output dealers trained in business skills and management. • Number and type of new products adopted. • Number and type of improved storage methods adopted. • Number of new investments on cassava resulting from enhanced capacity. • Number of small and medium-scale agroenterprises operational. 	<ul style="list-style-type: none"> • Project and IITA reports. • Report on the number of active groups formed and registered with local authorities. 	<ul style="list-style-type: none"> • Male and female farmers ready and willing to be organized into groups.
4.4 Enhance institutional capacity to support cassava standards and grades for industrial and export markets.	<ul style="list-style-type: none"> • Inventory of grades and standards of various national and international cassava products compiled and made available to stakeholders. • Number of producer groups trained to meet quality and contract requirements for identified markets. • Number (and type) of facilities improved to meet quality standards. • Quantity of improved and homogeneous product quality traded nationally and internationally. 	<ul style="list-style-type: none"> • Project and IITA reports. • Project and IITA reports. • Project and IITA reports. 	<ul style="list-style-type: none"> • Trained staff remain in their institutions.
4.5 Train farmers and processor groups in credit management, group organization and management and micro-enterprise development.	<ul style="list-style-type: none"> • Extent of improvement of stakeholder technical, business, and marketing capacity. • Number of new investments on cassava resulting from enhanced capacity. • Volume of financial and other resources available to farmers' and processors' groups. 	<ul style="list-style-type: none"> • Project and IITA reports. 	
4.6 Train fabricators for fabrication and servicing of postharvest and processing machines for widespread dissemination on a sustainable basis.	<ul style="list-style-type: none"> • Improved local entrepreneurship in fabrication, sales, and servicing of equipment. • Increased processing capacity and income. 		
4.7 Develop, produce, and disseminate training and extension support materials	<ul style="list-style-type: none"> • Quantity, quality, and type of relevant information/training materials produced, packaged, and disseminated. 		

CMD logical framework (contd)

Narrative summary	Objectively verifiable indicators	Means of verification	Important assumptions
Results/Outputs 5. Cassava stakeholders' network and coordination strengthened and impact of project activities monitored and evaluated.			
Activities.			
5.1 Organize annual stakeholders' consultative forum for project sensitization and focus.	<ul style="list-style-type: none"> • Network of stakeholders set up and operational. • Number of annual stakeholders meetings held. • Number of public and private sector stakeholders attending meetings/workshops and participating in project activities. • Number (and type) of clients and stakeholders involved in R4D process. • Evidence of complementary roles by different partners. • Number of joint programs implemented with selected partners. 	<ul style="list-style-type: none"> • Project and IITA reports. • Minutes of annual stakeholders' consultative forum. 	<ul style="list-style-type: none"> • All project partners remain committed to project activities. • Public and private stakeholders willing to participate in project.
5.2 Define target communities and partners and involve them in project design and implementation.	<ul style="list-style-type: none"> • Extent to which results of socioeconomic and livelihood survey are used in project activity planning. • Number and locations of key communities identified and involved in subsequent project planning activities. 	<ul style="list-style-type: none"> • Project reports and IITA reports. 	
5.3 Establish a national advisory committee (AC) and organize yearly AC meetings for administrative and technical oversight.	<ul style="list-style-type: none"> • Establishment of AC. • Yearly AC meetings organized to harmonize and integrate cassava R4D portfolio. • Leveraging of financial resources for cassava R4D. 	<ul style="list-style-type: none"> • AC meeting reports/minutes. 	
5.4 Collate and update where necessary, detailed baseline information and develop performance and monitoring indicators.	<ul style="list-style-type: none"> • Available information on soil fertility levels, land degradation, cropping systems, etc in project communities for use in activity planning. 	<ul style="list-style-type: none"> • Project reports and IITA reports. 	
5.5 Organize work planning and review meetings for refinement of project activities.	<ul style="list-style-type: none"> • Number (and type and quality) of planning and review meetings conducted for project activities. • Yearly goal-oriented work plans and budget of project activities established and outputs documented. 	<ul style="list-style-type: none"> • Minutes/proceedings of meetings/workshops. 	
5.6 Monitor annual project implementation and conduct midterm project evaluation.	<ul style="list-style-type: none"> • Annual project implementation monitored. • Midterm project evaluation conducted. 	<ul style="list-style-type: none"> • Project reports and IITA reports. • Annual and midterm project reports. 	
5.7 Update studies to determine level and factors responsible for adoption of cassava production, processing, and marketing technologies.	<ul style="list-style-type: none"> • Adoption studies conducted. 	<ul style="list-style-type: none"> • Reports of adoption studies available. 	
5.8 Organize biennial cassava trade shows to foster cooperation among industry stakeholders with a common objective.	<ul style="list-style-type: none"> • Number of cassava trade show held. • Heighten profile of the importance of and potential within the cassava industry 	<ul style="list-style-type: none"> • Project reports and IITA reports. • Media reports. 	
5.9 Monitor and evaluate impact of project activities on productivity, rural incomes, and employment.	<ul style="list-style-type: none"> • Impact assessment conducted. • Positive impact on impact on productivity, livelihood, income, and drudgery demonstrated. 	<ul style="list-style-type: none"> • Documentation on project impact on productivity, livelihood, income, and drudgery provided. • Reports of zonal workshop. 	
5.10 Organize two zonal workshops for stakeholders to review achievements and lessons learned.	<ul style="list-style-type: none"> • Number of workshops held. 	<ul style="list-style-type: none"> • Reports of end of project workshop. 	
5.11 Organize a national stakeholders end-of-project workshop to review achievements and lessons learned.	<ul style="list-style-type: none"> • National stakeholders' workshop held. 		