

Preemptive management of the virulent
cassava mosaic disease through
an integrated cassava development
approach for enhanced rural sector
economy in the south-south and south-
east zones of Nigeria

Multiple investor development project
document

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Acronyms and abbreviations

ACDI/VOCA	Agricultural Cooperative Development International/Volunteers in Overseas Cooperative Assistance
ACMV	African cassava mosaic virus
ADB	African Development Bank
ADP	Agricultural Development Project
AEZ	agroecological zone
AIDU	Agroindustrial Development Unit
ANAP	Assessment of Nigeria's Agricultural Policy
ARCEDEM	African Regional Center for Engineering Design and Manufacturing
ARTS	African root and tuber scale
AU	African Union
CAD	cassava anthracnose disease
CAYS	Cassava area yield survey
CBO	community-based organization
CBB	cassava bacterial blight
CBSD	cassava brown streak disease
CDRC	Cassava Development and Resource Centers
CGM	cassava green mite
CMB	cassava mealy bug
CMD	cassava mosaic disease
CMP	Cassava Multiplication Project
DAIMINA	Developing Agricultural Input Markets in Nigeria
DANIDA	Danish International Development Agency
DFID	Department for International Development (UK)
EACMV	East African cassava mosaic virus
EACMV-Ug	East African cassava mosaic virus–Ugandan variant
EARRNET	East Africa Root Crop Research Network
ECOWAS	Economic Community of West African States
EEC	European Economic Community
ESARC	East and Southern Africa Regional Center
FAMEG	Federal Agroprocessing and Market Expansion Group
FAO	Food and Agriculture Organization of the United Nations
FGN	Federal Government of Nigeria
FIIRO	Federal Institute of Industrial Research, Oshodi
FMANR	Federal Ministry of Agriculture and Natural Resources
FMARD	Federal Ministry of Agriculture and Rural Development
FoodNet	Food Network of East Africa

FOS	Federal Office of Statistics
ICS	Information Communication Support for Agricultural Growth in Nigeria Project
IEHA	Initiative to End Hunger in Africa
IFAD	International Fund for Agricultural Development
IFDC	International Fertilizer Development Center
IPM	integrated pest management
IPPM	integrated plant and pest management
MIS	Market Information System
NACCIMA	Nigerian Chambers of Commerce, Industry, Mines, and Agriculture
NACRDB	National Agricultural Cooperative and Rural Development Bank
NAERLS	National Agricultural Research and Extension Liaison Services
NAFDAC	National Agency for Food and Drug Administration and Control
NARO	National Agricultural Research Organization
NASME	National Agency for Small and Medium-scale Enterprises
NCAM	National Center for Agricultural Mechanization
NDDC	Niger Delta Development Commission
NNPC	Nigerian National Petroleum Corporation
NPV	Net Present Value
NRCRI	National Root Crops Research Institute
NSPRI	National Stored Products Research Institute
OAU	Organization of African Unity
PL480	United States Public Law 480 programs
PRODA	Project Development Agency
RMRDC	Raw Material Research and Development Council
RTEP	Root and Tuber Expansion Program
RUSEP	Rural Sector Enhancement Program
SAMEG	State Agroprocessing and Market Expansion Group
SARRNET	Southern Africa Root Crop Research Network
SG	state government
SME	Small- and medium-scale enterprise
SON	Standards Organization of Nigeria
TMS	Tropical <i>Manihot</i> Selection
TTC	Technology Transfer Center
UNIDO	United Nations Industrial Development Organization
UNSD	United Nations Statistics Division
USAID	United States Agency for International Development

Executive summary

Nigeria is the world's largest producer of cassava, which is grown by over 30 million farmers in the country. The southern states account for 64% of the total cassava production. Cassava, predominantly grown by smallholder farmers, plays a vital role in the food security of the rural economy because of its capacity to yield under marginal soil conditions and its tolerance of drought. Both rural and urban communities use cassava mainly as food in both fresh and processed forms. Cassava-based meals are the most frequently eaten meals in the rural areas in Nigeria. Eighty percent of Nigerians in the rural areas eat a cassava meal at least once weekly. The per capita consumption of cassava of 88 kg/person/year between 1961 and 1965 increased to 120 kg/person/year between 1994 and 1998. A recent study* of the assessment of Nigeria's Agricultural Policy (ANAP) conducted by a consortium of scientists from the International Institute of Tropical Agriculture (IITA), the University of Ibadan, and the International Food Policy Research Institute (IFPRI), identified cassava as a commodity with high priority for investment in four out of the six geopolitical zones of Nigeria (south-south, south-east, south-west, and north-central zones). The study estimated a gross return of US\$570 million per year over a period of 17 years from 1999 to 2015. It also identified cassava as a commodity with a comparative economic advantage in the domestic, regional, or world market in the same four geopolitical zones.

IITA and its collaborating research partners reported the emergence of a new virus challenge to cassava. An unusually severe CMD outbreak of a dynamic and devastating nature has been spreading from Uganda, through East Africa and westwards into Central Africa. The virus causing the pandemic has been identified as a novel type and a recombinant hybrid of the East African cassava mosaic virus (EACMV) and African cassava mosaic virus (ACMV), designated as the Ugandan variant (EACMV-Ug). This hybrid of two yield-reducing viruses caused a devastating cassava mosaic epidemic in Uganda, characterized by zero yields and total crop failure. The outbreak of this severe form of CMD led to the loss of 60 billion Ugandan shillings (US\$60 million) every year, as well as several thousands of famine-related deaths. Fortunately, scientists at IITA had already successfully bred cassava cultivars with durable resistance to the new form of the disease and their deployment in Uganda was a huge success. Nevertheless, the disease has continued to spread into other countries and Nigeria is now threatened.

The two viruses (ACMV, EACMV) and their variants have already been detected in mixed infections on cassava in the major cassava growing agroecologies of the cassava belt of Nigeria. These viruses, when found in mixed infections and occurring on the same plants, recombine to form a more dangerous virus strain. Even when there is no recombination

* IITA, University of Ibadan, IFPRI. 2003. Assessment of the Nigerian agricultural policy: mitigating constraints to commercialization and investments in Nigeria's agriculture (draft).

of the two viruses, ACMV and EACMV act synergistically in mixed infections to cause symptoms of increased severity. A recent diagnostic survey to monitor the changes and spread of CMD showed that the mixed infections of the two viruses are now widespread in the south-south and south-east zones of Nigeria and have increased in incidence from 18% in 1998 to 48% in 2003, implying that there is an increase in the chances of getting a recombinant hybrid strain that may be as virulent as the Ugandan strain. The survey showed that virulent strains of ACMV and EACMV inducing severe symptoms are already present in the surveyed zones. In addition, a small population of unidentified, seemingly virulent strains/species of cassava mosaic viruses was also found in the surveyed zones.

The occurrence of ACMV, EACMV, and their variants in mixed infections in Nigeria, the severe symptoms that characterize such mixed infections, and the possible spread of the virulent Ugandan variant (EACMV-Ug) to Nigeria, threaten to devastate Nigeria's cassava production and create in its wake, a food crisis of monumental proportions in the world's largest cassava producing nation if immediate preventive measures are not taken. Any reduction in cassava production could have incalculable effects on the Nigerian economy and on the lives of the millions of Nigerians for whom cassava is the major starchy staple food. Such an outbreak could also lead to food shortages in the cassava belt of West Africa.

The most vulnerable areas are the south-south and south-east states of Nigeria, including the Niger Delta region where the population (more than 29 million people) depends predominantly on cassava for subsistence, and where chronic food shortages and widespread poverty and unemployment are recurrent causes of social disturbances. CMD, if unchecked, could result in a potential food security crisis with major social impacts throughout the region. It would also undermine the potential to develop markets for cassava in livestock feed, ethanol, starch, and other products. It is therefore imperative that the CMD threat be contained in Nigeria and does not spread throughout West Africa.

This prompted IITA to take immediate action to prevent a repetition of the devastation that occurred in Uganda in the 1990s. To address the critical threat of an outbreak of this disease in Nigeria, the Federal Government of Nigeria, 11 state governments of the south-south and south-east zones, the Niger Delta Development Commission (NDDC), the Nigerian National Petroleum Corporation (NNPC), and its joint venture partners endorsed an action plan of US\$16.5 million in a four-year project proposal and committed funding for the preemptive management of the virulent cassava mosaic disease through an integrated cassava development approach in the south-south and south-east zones of 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). The Federal Government would provide 15% (US\$2.475 million), NDDC 20% (US\$3.3 million), NNPC and its joint venture partners, 20% (US\$3.3 million). The shortfall 5% (US\$830 000) should be sourced from other development investors by IITA.

In a recent stakeholders forum of over 200 participants (23–25 June) in Port Harcourt, Rivers State, the stakeholders unanimously admitted Ondo State of the south-west zone as one of the states benefiting from the CMD project. With the addition of Ondo State, the government would be required to contribute its share of the matching funds of US\$600 000,

as with the other benefiting states, bringing the total funding required to implement the project to US\$17.1 million. The Federal Government has paid its share in full, while NDDC has paid 50% of its commitment. The commitments of the state governments and oil companies are at various stages of approval and disbursement.

The overall objectives of the proposed project are as follows.

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

To achieve these objectives, 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 the public and private sector institutions—relevant government institutions such as the International Fund for Agricultural Development-Root and Tuber Expansion Project (RTEP), National Root Crops Research Institute (NRCRI), Agricultural Development Projects (ADP), strategic private industries, nongovernmental organizations (NGO), and individuals.

IITA and its partners will provide local communities with the means to address in a sustainable way and guard against present and future CMD-associated production collapse of cassava by producing millions of high quality cassava planting materials of the new and durable CMD-resistant cultivars and deliver them to Nigerian farmers. The improved cultivars will not only resist the disease but will also slow its spread to nonresistant cultivars, acting as a barrier to the advance of the disease. Since IITA-bred cultivars also produce more cassava per plant, their distribution to farmers will lead to increase in total Nigerian production. Higher cassava production will also be promoted by developing efficient markets, by linking producers/processors and others to agri-input and service delivery systems and financial institutions for credit, and by promoting value adding postharvest processing and storage technologies for competitive and viable commercial enterprises. Through this integrated commodity and market led-approach, there is a significant potential to improve food security, raise rural incomes, and increase productivity of this critical crop.

The project being proposed is a precursor of the Presidential Initiative on Cassava Production and Export, and should be regarded as complementary to the national

program on cassava development in Nigeria. IITA is confident that the productive potential of this key African food staple will be assured in Nigeria by adopting the same approach for the management of CMD as it did in East Africa, based on meticulous research for development, stakeholder network development, and rapid and targeted implementation of control tactics. Combined with the release of the huge, untapped commercial opportunities that the crop offers through microenterprise and market development, value-chain addition and development of supply-chain structures and management, the potential to generate producers' income, create employment, and contribute to economic growth will be fully exploited in the targeted states. The involvement of multiple stakeholders at community level with a clear manifestation of ownership will also ensure the sustainability of the project's impact.

Preemptive management of the virulent cassava mosaic disease through an integrated development approach to the cassava subsector for enhanced rural sector economy in the south-south and south-east zones of Nigeria

Background and justification

Nigeria has substantial economic potential in its agricultural sector. However, despite the importance of agriculture in terms of employment creation, its potential for contributing to economic growth is far from being fully exploited. The sector's importance has fluctuated with the rise and fall in oil revenue. Over the past 10 years, the Nigerian agricultural sector has remained stagnant while the contribution of the manufacturing sector to the GDP has declined over the same period. Inappropriate macroeconomic and sector policies perpetuated by the 15 years of military rule and mismanagement have had a negative impact not only on agriculture, but also on the entire economy. Consequently, per capita incomes have declined from approximately US\$1200 in the 1980s to about US\$300 in 1999 (World Bank 2000). In addition, Nigeria's social indicators have fallen well below the average for all developing countries. For instance, 70% of the population is below the US\$1/day poverty line (World Bank 2000). Life expectancy is only 53 years (ADB 1999), and infant mortality rate is as high as 74 per 1000 live births, with adult literacy also low at only 43% (ADB 1999).

Following the democratic elections in 1999, major investment opportunities have been identified and various presidential initiatives¹ to bolster the development of the agricultural sector have been put in place. In addition, the present government has pledged to accord the agricultural sector the highest importance during the next four years (Obasanjo 29 May 2003). However, as a result of the considerable depth of poverty in the country, particularly in the rural areas, this has raised expectations for quick improvements in the livelihoods of the general populace. Data from the Federal Office of Statistics (FOS 1999) indicate that poverty levels in the country have been on the increase since 1986. Detailed analysis of the poverty situation in Nigeria revealed that most of the poor people work in the agricultural sector and most of them reside in the rural areas. Studies in Nigeria (D'Situ and Bysmouth 1994) and elsewhere (World Bank 2000) have traced an evident linkage between poverty and agricultural sector performance. Therefore, improvements in performance of the agricultural sector can have far-reaching and beneficial implications for food security, income generation, as well as poverty reduction.

¹The following major presidential initiatives to boost the agricultural sectors contribution to economic growth have been proclaimed: cassava, rice, vegetable oils, livestock, and tree crops.

Although efforts at the political level have been intensified to increase the agricultural sector's contribution to economic growth, there has been no significant impact on employment creation, or improvement in rural incomes. This is because growth in agriculture has been incapacitated by a lack of adequate agroindustries to spur demand for agricultural raw materials. While various programs have been designed to achieve sustainable agricultural growth, they have mainly focused largely on increasing farm productivity through the maximization of agronomic efficiency. Through the efforts by various agricultural research institutes, technologies for transforming smallholder agriculture have been developed for production through postharvest, but adoption of these remains low. Also, efforts to promote commercialization and agroenterprise development have not received adequate attention.

In general, the types of agricultural system, (crop or livestock production) as well as the level of intensification are influenced by the agroecological zone (AEZ) in which agricultural activities are carried out. According to classifications provided by IITA, Nigeria has six major AEZ that run transversely from west to east. In a south-north axis, these zones are the humid forest (mainly in the south), the derived/coastal savanna (part of the south), the southern Guinea savanna (the entire Middle Belt), and the northern Guinea savanna, the midaltitude savanna, and the dry Sudan/Sahel savanna, all in the northern parts of the country. The Guinea savanna AEZ are noted for producing livestock (cattle, sheep, goats, and chickens), and the following major crops: cotton, groundnut, maize, millet, sorghum, soybean, yam, cassava and vegetables (tomato, carrot, lettuce, onion, and pepper). The humid forest and the derived/coastal AEZ is noted for producing tree-crops (cocoa, oil palm, rubber, and timber), and food crops (cassava, yam, maize, pineapple, banana, plantain, papaya, mango, orange, yam beans, and vegetables (fluted pumpkin, okra, tomato, and pepper). Livestock production (small ruminants and poultry keeping) is also practised in the southern AEZ. Among the crops grown in the south, cassava is the most widely cultivated, both as a food and a cash crop.

Cassava in the Nigerian economy

Nigeria is the largest producer of cassava in the world. Its production is currently put at about 33.8 million tonnes a year (FAO 2002). Total area harvested of the crop in 2001 was 3.1 million ha with an average yield of about 11 t/ha. Cassava plays a vital role in the food security of the rural economy because of its capacity to yield under marginal soil conditions and its tolerance to drought. It is the most widely cultivated crop in the country; it is predominantly grown by smallholder farmers and dependent on seasonal rainfall. Rural and urban communities use cassava mainly as food in both fresh and processed forms. The meals most frequently eaten in the rural areas are cassava-based.

Data from the Collaborative Study of Cassava in Africa (COSCA) showed that 80% of Nigerians in the rural areas eat a cassava meal at least once weekly (Nweke et al. 2002). Per capita consumption of cassava of 88 kg/person/year between 1961 and 1965 increased to 120 kg/person/year between 1994 and 1998 (Nweke et al. 2002).

The contribution of cassava production by geopolitical zones in Nigeria is presented in Figure 1. In total, the southern states account for 64% of the cassava produced in Nigeria, but the crop has also increased in importance in the Middle Belt (north-central zone) in recent years and is expanding into the dry savannas bordering the Sahel. It provides the livelihood for over 30 million farmers and countless processors and traders.

Nweke et al. (2002) maintained that cassava performs five main roles: famine reserve crop, rural food staple, cash crop for urban consumption, industrial raw material, and foreign exchange earner, also that Nigeria is the most advanced of the African countries poised to diversify the use of cassava as a primary industrial raw material and livestock feed. Two factors provide Nigeria with this comparative advantage in Africa: the rapid adoption of improved cassava varieties and the development of small-scale processing technologies including the cassava grater.

Among the crops widely cultivated in southern Nigeria, research efforts have made the greatest impact on cassava. Production has increased substantially in the country over the last 20 years principally owing to an increase in the area cultivated and improvements in production efficiency through the introduction of high-yielding, disease- and pest-resistant cultivars (Fig. 2).

Despite this development, the demand for cassava is mainly for food; and opportunities for commercial development remain largely undeveloped, in contrast to the other major regions of cassava cultivation in Asia and South America. The absence of agroindustrial markets remains the major constraint to further development of the crop. Cassava production exhibits high levels of variability and cyclical gluts, due mainly to the inability of markets to absorb supplies. As a result, prices of storage roots decline sharply and production levels are reduced in succeeding years before picking up again. Such factors cause price instability over the years, which significantly increases the income risk to producers. Insufficient processing options for the storage roots, inadequate marketing channels, and a lack of linkages between producers and the end-users are major factors preventing greater profitability for producers and processors. There is a potential to generate from one crop multiple economic benefits through improved postharvest handling and processing of fresh storage roots.

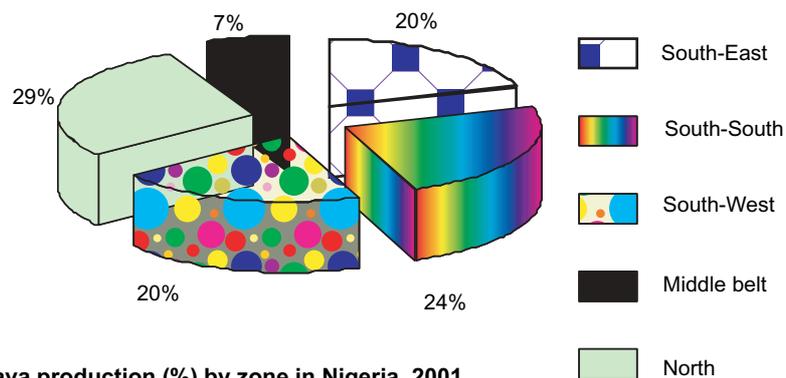


Figure 1. Cassava production (%) by zone in Nigeria, 2001 (Based on CAYS data from FMARD, 2002).

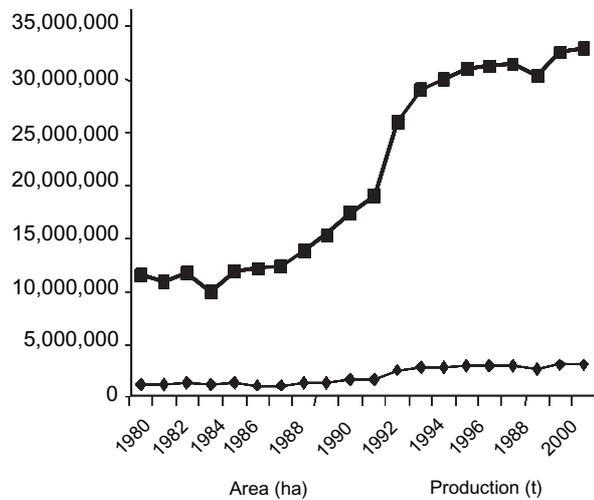


Figure 2. Cassava production and area trend in Nigeria.

Cassava as food security crop

Cassava has long been used as a famine reserve and food security crop produced mainly through smallholder subsistence farming systems. Low input use, rudimentary technology, large postharvest losses, and minimal processing characterize these farmers. Small-scale cassava producers (cultivating < 2 ha) constitute about 95%, while those with more than 5 ha constitute about 5% of the total.

Although cassava is widely consumed in Nigeria, prospects for expanding demand as food will come only from population increase. Income elasticity estimates based on a household food consumption and expenditure survey showed that there is less possibility of expanding demand among urban households, particularly for its main consumed forms, *gari* and *fufu*, (Kormawa and Chianu 2003). Thus, taking price and nonprice factors into consideration, the prospects for expanding the domestic cassava market for food in the form of fresh cassava or *gari* are limited. These results suggest that efforts to expand the domestic market for cassava should not focus on fresh cassava, *gari*, or similar products, but rather on the development of new products. Unless new products that are more acceptable to consumers are developed, future efforts to expand the cassava market should look outside the traditional food sector.

Gender and cassava

Cassava provides different opportunities for both men and women farmers and processors. A study by Nweke et al. (2002) identified five important gender relevant issues related to cassava. For instance, first, men and women make significant contributions of their labor to the cassava industry, with each specializing in different tasks; men work predominantly on land clearing, plowing, and planting, while women specialize in weeding, harvesting, transporting, and processing. Secondly, men and women play strategic but changing roles in the cassava transformation process. Thirdly, as cassava becomes a cash crop, men increase

their labor contribution to each of the production and processing tasks. The introduction of laborsaving technologies in cassava production and processing has led to a redefinition of gender roles in the cassava food systems. Finally, women who want to plant cassava are usually constrained by the lack of access to new cassava production technologies and other resources. A recent study on gender and cassava commercialization in Nigeria showed that as cassava is commercialized, households in cassava producing areas invest more on the education of their children (Kormawa and Asumugha 2003).

While the sexes are equally represented in trading, women, and to a lesser extent children, dominate in processing. As opportunities for commercialization increase (arising from favorable market opportunities for cassava and its products), the number of women involved in processing increases. Growth in cassava production is therefore likely to provide increased employment opportunities for women. However, there is a tendency, as mechanized processing equipment (such as graters and mills) are acquired, for men's involvement in cassava processing to increase, as they often control and operate these machines (Spencer and Associates 1997). Women may therefore lose some of the benefits of increased employment, as they lose control of some of the income. Steps need to be taken to ensure that this does not happen, e.g., by assisting women to get organized into groups that can effectively carry out the commercialization of the commodity, increasing the access of such organized women's groups to credit for the acquisition of postharvest machinery, and training them to operate the equipment properly, and enhance their postharvest and microenterprise skills. This means that the needs of women should be kept in mind even at the project design and implementation stages to prevent any possible negative impacts of increased commercialization in the sector, e.g., the equipment design and dissemination stages.

Return to investment on cassava in Nigeria

A recent study, an assessment of Nigeria's agricultural policy (ANAP) (IITA et al. 2003) conducted by a consortium of scientists from IITA, the University of Ibadan, and IFPRI, identified cassava as a commodity with a comparative economic advantage in the domestic, regional, or world market in four out of the six geopolitical zones of Nigeria (IITA et al. 2003). Stakeholders (exporters, processors, farmers' associations, policymakers) involved in this ANAP study ranked cassava very highly as a priority commodity in the south-south, south-east, south-west, and north-central zones of Nigeria. Cassava also showed good promise in the drier areas of the country, as varieties adapted to these ecologies are being made available to the farm communities.

An ex-ante evaluation of the returns to investments (using a partial equilibrium model) for 26 priority commodities identified in Nigeria, given the current level of the technology portfolio available for each commodity, identified cassava as the first commodity to invest on (an estimated gross return of US\$570 million per year over a period of 17 years from 1999 to 2015).

Key constraints to cassava production and commercialization: challenges and opportunities

The ANAP study classified major constraints in the agricultural sector of Nigeria as technical, resource, socioeconomic, and organizational. These constraints function along the entire chain from production to consumption, with the marketing of farm products usually cited by farmers as a major constraint to commercialization.

Pests and diseases

In sub-Saharan Africa, diseases and arthropod pests causing economic losses continue to take their toll on the cassava crop, occasionally in epidemic proportions in both traditional and new areas of production. The most important diseases and pests are the cassava mosaic virus disease (CMD), transmitted by the ubiquitous whitefly (*Bemisia tabaci*), cassava brown streak virus disease (CBSVD), cassava bacterial blight (CBB), cassava mealybug (CMB), green spider mite (CGM), African root and tuber scale (ARTS), and the larger grain borer, which attacks dry chips of cassava in storage. Others are termites, anthracnose (CAD), root rots, rodents, and stem girdlers. These diseases and pests as well as adverse agronomic conditions combine to reduce storage root yields by about 50% (Herren and Bennett 1984). CMD, for example, routinely reduces cassava production by 15–25% for most of the time, but losses as high as 90% could be obtained with susceptible genotypes. Cassava mealybug and CGM have been largely controlled through Africa-wide biological control efforts of IITA and its partners. White ants (termites) destroy stems that are planted before they sprout. Some areas appear to be very prone to this problem. Various chemical control measures are recommended, but the need for safe use and high costs restrict their use among many small farmers who practice mixed cropping. Termite control focuses on the manipulation of planting dates and different land preparation methods. The menace of rodents is also a regular occurrence in the field.

Cassava is very susceptible to weed competition during its first three to four months of growth. Crop losses due to weeds can be as high as 50–70% depending on the type of weed and duration of competition. Weeding alone may require 30 to 45 person-hours per hectare (Muma 2000). Opportunities for minimizing cassava losses due to weeds include chemical control, an appropriate cassava population, the practice of mixed cropping, and the use of cover crops (Chikoye et al. 2002).

The cassava mosaic disease pandemic

Although CMD has been singled out as the most important economic constraint to the production of cassava in sub-Saharan Africa, and the most important vector-borne disease of any African food crop, routinely reducing cassava production continent-wide by 15–25% for most of the time, scientists did not really get alarmed about its potential impact until the late 1980s when the first news began to trickle in of a devastating epidemic of the disease in north-central Uganda. By 1999, a pandemic of an unusually severe form of CMD had expanded to cover more than 750 000 km² (square kilometers) of East and Central Africa. These areas include virtually all of the cassava growing regions of Uganda, much of

western Kenya, and significant areas of northwestern Tanzania, as well as southern Sudan. The effects of the pandemic have been devastating with up to 100% yield loss in terms both of the storage roots and leaves, resulting in farmers typically abandoning cassava production (Harrison et al. 1997; Otim-Nape et al. 1997). In Uganda alone, an estimated production loss of 600 000 tonnes amounting to US\$60 million annually, triggered large-scale famine and the death of 3000 people. Region-wide losses in East Africa have been estimated to be in excess of US\$100 million annually. The virus causing the pandemic has been identified as a novel type and a recombinant form of the East African cassava mosaic virus (EACMV) and African cassava mosaic virus (ACMV), designated as a variant of EACMV in Uganda (EACMV-Ug) (Harrison et al. 1997).

Expansion of the CMD pandemic

As the pandemic continues to expand from Uganda (Fig. 3), neighboring countries (Tanzania, Kenya, and southern Sudan) have been affected. Burundi and Rwanda have also been affected. More recently, the Democratic Republic of Congo, and the Republic of Congo (Brazzaville) have been affected. There are also reports of increasing severity of CMD in Central Africa Republic, Cameroon, and Equatorial Guinea. This CMD pandemic

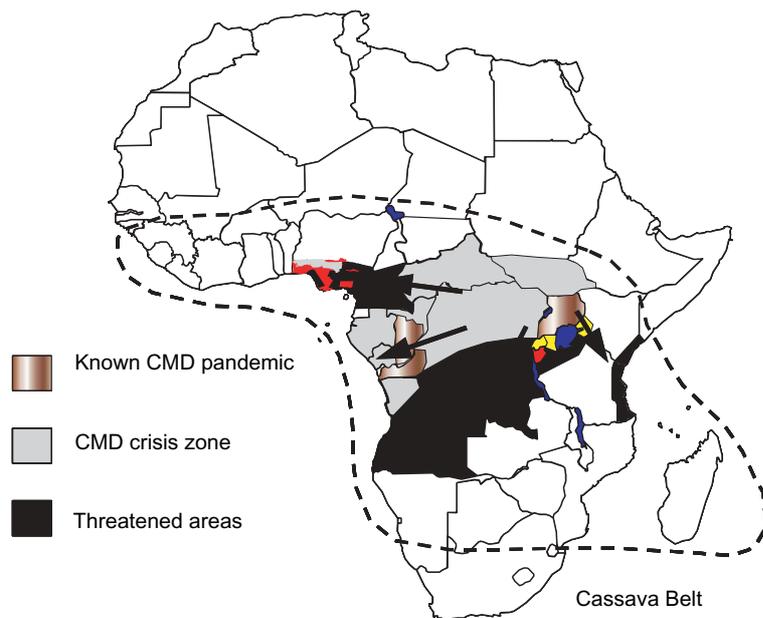


Figure 3. Continental spread of virulent Ugandan variant of East African cassava mosaic virus.

represents a major threat to regional food security. Recently, mixed infections of ACMV and EACMV, the two viruses that gave rise to EACMV-Ug, have been reported in Cameroon, Ghana, Nigeria, and Togo (Fondong et al. 1998; 2000; Offei et al. 1999; Ogbe et al. 1999; Ogbe 2001; Ogbe et al. 2003).

CMD threat to cassava production in Nigeria

By 1998, root yield losses due to cassava mosaic disease were as high as 70% on susceptible genotypes in Nigeria. The production loss due to CMD in Nigeria has been more realistically estimated at 6.78–9.69 million t in 1998 when the total harvest for the country was 33.56 million t (Echendu et al. 2003). This translates to a direct loss to the Nigerian economy of nearly US\$65 million. If indirect losses were considered, the damage to the economy would be even greater. The two yield-reducing viruses (ACMV, EACMV) and their variants, which gave rise to the unusually severe and devastating CMD in Uganda, have already been detected in mixed infections on cassava in the major cassava growing agroecologies of the cassava belt of Nigeria (Ogbe 2001; Fig. 4). Severe symptoms characterize such mixed infections. Even when there is no recombination, the two viruses (ACMV and EACMV) act synergistically in mixed infections to cause severe symptoms.

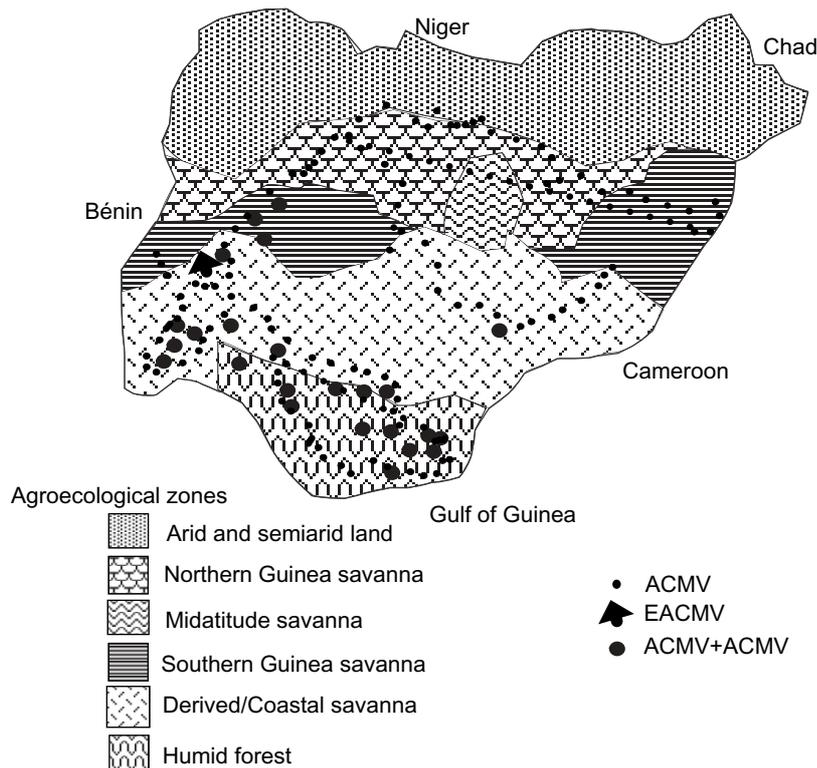


Figure 4. Occurrence of East African cassava mosaic virus and African cassava mosaic virus and their distribution in Nigeria: the two viruses that gave rise to the severe form of cassava mosaic disease (1997–1998). Source: Plant Disease 87: 229–232 (March 2003).

A recent diagnostic survey to monitor changes and spread of CMD showed that the mixed infections of the two viruses are now widespread in the south-south and south-east zones of Nigeria (Fig. 5) and have increased in incidence from 18% in 1998 to 48% in 2003, implying that there is an increase in the chances of getting a recombinant hybrid strain that may be as virulent as the Ugandan strain. The survey showed that virulent strains of ACMV and EACMV inducing very severe symptoms are already present in the surveyed zones. In addition, a small population of unidentified, seemingly virulent strains/species of cassava mosaic viruses was also found in the surveyed zones. The complex situation of cassava mosaic *begomoviruses* in the survey area suggests the possible occurrence of a Nigerian strain that may deserve attention equal to that needed by the Ugandan strain.

The occurrence of ACMV, EACMV, and their variants in mixed infections in Nigeria, the severe symptoms that characterize such mixed infections, and the possible spread of the virulent Ugandan variant (EACMV-Ug) to Nigeria threaten to devastate Nigeria's cassava production and create in its wake, a food crisis of monumental proportions in the world's largest cassava producing nation if immediate preventive measures are not taken. Any reduction in cassava production could have incalculable effects on the Nigerian economy and on the lives of the millions of Nigerians for whom cassava is the major starchy staple food. Such an outbreak could also lead to food shortages throughout the cassava belt of West Africa.

The most vulnerable areas are the south-south and south-east states of Nigeria including the Niger Delta region where the population of more than 29 million people (2002 projection) depend predominantly on cassava for subsistence, and where chronic food shortages

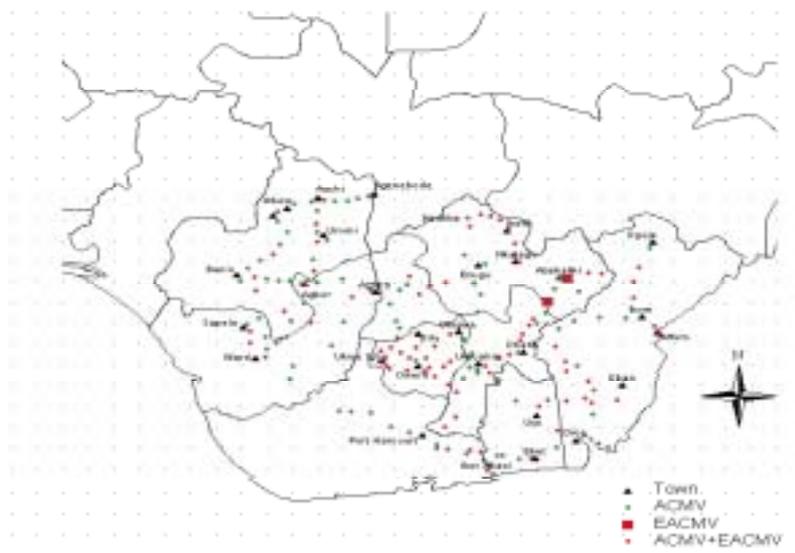


Figure 5. African cassava mosaic virus (ACMV) and East African cassava mosaic virus (EACMV) distribution in the survey areas: south-south and south-east states of Nigeria (2002/2003).

and widespread poverty and unemployment are recurrent causes of social disturbances. CMD, if unchecked, could result in a potential food security crisis with major social impacts throughout the region. It will also undermine the potential to develop markets for cassava in livestock feed, ethanol, starch, and other commodities. In addition, in this area of the country more arable land can hardly be found to increase acreages except by inducing degradation of forest resources, which will have catastrophic consequences. Not only would increased acreages fail to restore food supply if high yielding and resistant varieties are not used, but also, the resulting terminal destruction of the environment would threaten livelihoods, with potential spill-over effects on the whole country and beyond. It is therefore imperative that the CMD threat be contained in Nigeria and not spread throughout West Africa.

In view of the current importance of cassava in Nigeria, coupled with its potential to serve as an engine for future agricultural development, threats to production must be considered very seriously. It is within this framework that the current threat to cassava production posed by CMD must be considered. In fact, the National Chair of Nigeria's ruling Peoples Democratic Party referred to CMD as one of the greatest threats to the country's democracy³.

Without preemptive measures to contain the virulent form of the CMD, the estimated loss to the cassava industry in Nigeria would amount to ₦36 billion at 2001 production levels (RUSEP 2003). The collapse of the cassava industry would also lead to loss of jobs in the rural areas, and the processing and machine fabrication industry, and a sharp decline in urban and rural food security. This may eventually lead to food unrest, loss of confidence in government, and pressure on government to import food. If CMD is not controlled in Nigeria, it will spread throughout West Africa.

Tackling the cassava mosaic disease pandemic

The first successes in tackling this problem in Uganda were based on gathering baseline information to establish which areas were most affected, how fast the disease was spreading, and which areas were immediately threatened. This was followed by the development, multiplication, and distribution of diverse CMD-resistant varieties to farmers, in close collaboration with the Ugandan national research system and other partners, including IITA, and development investors. As part of this emergency effort, the pandemic was also monitored in East and Central Africa, and CMD-resistant variety multiplication centers were established at strategic locations and in the most recently affected areas for distribution of planting material to farmers. A massive boost in germplasm diversity was also provided through innovative germplasm exchange mechanisms, and agricultural workers and farmers were trained in a wide range of cassava cultivation skills.

In addressing what had become a "pandemic" in East and Central Africa, IITA took the initiative to set up a regional program at its East and Southern Africa Regional Center

³Speech presented by the National Chair of Nigeria's ruling Peoples Democratic Part (Chief Audu Ogbe), representing the President and Commander-in-Chief of the Federal Republic of Nigeria, Chief Olusegun Obasanjo, at a one-day senior executive briefing meeting on the "Preemptive management of cassava mosaic disease" attended by a wide range of key cassava stakeholders at the High Rainfall Onne Station, Rivers State, 10 October 2002.

(ESARC), Uganda, for the management of the disease outbreak in East Africa. With support from USAID, Danish International Development Agency (DANIDA), the Department for International Development of the United Kingdom (DFID), the Gatsby Charitable Foundation, and the Rockefeller Foundation, together with the regional research networks, East Africa Root Crop Research Network (EARRNET) and Southern Africa Root Crop Research Network (SARRNET), a network of partners was established and a multifaceted emergency program was launched. Key components in this sustainable approach included the deployment of elite germplasm, phytosanitation, biological control, cultural practices, and soil fertility management. These were integrated and tested with farmers using participatory methods in strategically located technology transfer centers (TTCs). The capacity of farmers to optimally manage pest, disease, and soil fertility constraints in their cassava fields was strengthened through in situ field-based training activities. In order to tie sustainable production increases to enhanced income generation opportunities, links were proactively developed among TTCs and identified markets for a range of fresh and processed products to enable stakeholders to capitalize on the developments in processing and marketing technologies.

Impact of the cassava mosaic disease management

The total benefits, using the Dynamic Research Evaluation for Management (DREAM) impact model version 3.0 of the International Food Policy Research Institute, for one of Uganda's CMD-resistant cassava multiplication projects (ACDI/VOCA, Public Law 480 programs (PL480), a partnership project between the National Agricultural Research Organization (NARO, Uganda) and IITA, to combat the CMD pandemic in six districts of Uganda were approximately US\$36 million over four years (1998–2001) for an initial investment of US\$0.8 million. In another study (Bua 1998), the economic returns to investments for the widespread diffusion and adoption of improved varieties in improving household food security in a number of districts in Uganda through the participatory research and development efforts to control CMD in the country were assessed. The internal rate of return (1990–1996) to the participatory interventions was estimated at 121%, suggesting that the investments have been profitable. A favorable benefit–cost ratio of c.7.2 with a net present value (NPV) showing a net surplus by 1994 was attained. This high profitability to investment was attributed to the massive responses to the CMD effects, testing, and dissemination of improved varieties in collaboration with complementary organizations.

Due to the success of the efforts in Uganda, other projects on mitigating the effects of CMD on cassava in sub-Saharan Africa (SSA) were developed and funded in the following countries:

1. Uganda, Kenya, Tanzania, Rwanda, DRC, Congo Republic, and Mozambique: funded by USAID.
2. Southern Africa Root Crops Research Network (SARRNET) member countries (Southern Africa): funded by USAID.
3. East African Root Crops Research Network (EARRNET) member countries (East Africa): funded by USAID.
4. Cameroon, DRC, Mozambique, and Tanzania: funded by IFAD.

5. Western Kenya: Funded by the Gatsby Charitable Foundation and Rockefeller Foundation.
6. Uganda: funded by Natural Resource International.

Newly developed CMD-resistant varieties

While control efforts for the CMD pandemic were based mainly on the deployment of host plant resistance, a major breakthrough in IITA's breeding program was made as new sources of CMD resistance, identified in diverse landraces collected in West Africa, were combined through pyramiding with the resistance genes of the earlier Tropical *Manihot* Selection (TMS) varieties. Germplasm with multiple resistance to pest and diseases was developed for a wide range of ecologies including the humid forest, moist and dry savannas, wet inland valleys, and midaltitudes, as well as different cropping systems in SSA. These varieties passed what had been an apparent yield plateau in cassava improvement and, in many cases, combined virtual immunity to CMD with improved postharvest qualities and excellent levels of acceptance by farmers. The pyramiding of multiple sources of resistant genes in these varieties is especially important for imparting to varieties durable CMD resistance that would prove difficult for various strains/species of the virus to overcome. The characteristics of the new genotypes also reflect the vision of an expanded future role for cassava in SSA as a major source of income from industrial use and in the animal feed sector as well as many nontraditional food uses. These improved genotypes have been virus-tested at Ibadan, and are available to any national programs that request them.

In the case of Nigeria, 46 diverse CMD-resistant varieties have been selected from this stock for widespread deployment. In order to get these materials into farmers' fields as quickly as possible, a novel fast-track varietal testing approach is used. New clones are rapidly multiplied on-station, then taken straight for simultaneous multilocational evaluation on-station and participatory evaluation in farmers' fields, followed by large-scale multiplication and distribution to farmers.

Agronomic challenges

Lack of a well-organized planting material multiplication and distribution system for improved cassava varieties

Despite the development of high yielding and pest- and disease-resistant varieties in Nigeria, many recommended varieties are yet to be released, and many released varieties are yet to be multiplied on a large scale and made available to farmers. Shortage of planting materials is also compounded by farmers' inability to preserve planting materials. The lack of a well-organized planting material multiplication and distribution system is one of the major constraints to the adoption of improved cassava varieties. The system of multiplication and distribution is often inefficient either because strategically located national seed production schemes do not exist or because cassava is given a lower priority. The very low multiplication rate, bulkiness, and high perishability of cassava planting materials make their multiplication and distribution more expensive than conventional (grain-based) seed services. The private sector has not participated in the multiplication and supply of cassava for these reasons. Making high quality planting material of the improved varieties available

to farmers in a well-organized planting material multiplication and distribution system is one of the potential means of ensuring widespread adoption of the released cassava varieties. This is essential if cassava productivity is to be increased.

Lack of access to improved cassava planting materials, appropriate crop and soil management practices

Although improved varieties with a potential yield of more than 40 t/ha have been developed for cultivation in Nigeria (FMARD 2003), the national average on-farm yields are estimated to be 11 t/ha. The low yields are attributed to poor agronomic practices, low soil fertility, and poor input delivery mechanisms (FMANR 2000). Cassava root yields are poor because of the low usage of modern inputs, (e.g., improved varieties, fertilizer, and lime), labor shortages that force farmers to plant late, and a lack of improved crop husbandry practices, (e.g., optimum planting densities, appropriate crop mixtures for sustained soil fertility management, etc).

Cassava production is dependent on a supply of vegetative planting materials (stem cuttings). Using conventional field techniques, the multiplication ratio is very low compared with that of seed crops (plantable units 200:1 for maize compared to 10:1 for cassava). This low multiplication ratio can, however, be improved using new techniques, known as rapid multiplication techniques. The bulkiness of cassava planting materials is a disadvantage in respect of ease of handling and associated labor and transportation costs compared with conventional (grain-based) seed services. The main problem is that in any one delivery, far fewer farmers will be supplied than if the delivery was of seed for grain crops. This has obvious implications for the time that is required for distribution of materials and the associated cost. To cut and collect cassava stems from the field, and transport stem cuttings require efforts that substantially exceed that for seed crops. Cassava stems easily lose germination ability and vigor due to drying out within a few days after harvest and suffer mechanical damage during pruning, carrying, packing, and transporting. The establishment of strategically located production schemes of planting materials will reduce these problems.

The yield stability and environmental development of cassava are highly dependent on the quality of planting materials, and there is evidence that the initial use of healthy cuttings is a very important factor in the subsequent attainment of good yields. Conversely, cuttings with low vigor and infested/infected by pests and diseases often limit cassava production. However, research has over the years produced technical solutions and means of minimizing the problems. For example, cutting sanitation methods for producing healthy planting materials are available.

Low soil fertility in most cassava growing areas is a major problem, as fallow periods have become shorter due to pressure on arable land resulting from increasing population. For example, the soils in the humid zone of the southern Nigeria are nutrient deficient because of high acidity and very low reserves of primary minerals. Commercialization of cassava production will certainly target the cultivation of higher yielding varieties. This will consequently have a negative effect on the fertility of the soil unless soil amendments are available. For example, to obtain a root yield of over 30 t/ha, 164 kg of nitrogen, 31 kg

of phosphorus, 200 kg of potassium, 80 kg of calcium, 31 kg of magnesium are removed from the soil at harvest (Asher et al. 1980). Applying soil amendments such as inorganic and organic fertilizers can solve the problem of low soil fertility. These fertilizers could be made available through the private sector. However, these are hardly available in affordable quantities to farmers as a result of inefficient input marketing arrangements. Low cost methods, such as intercropping with legumes and the use of manure or organic matter, are other opportunities for enhancing soil fertility.

While integrated pest management (IPM) in cassava has witnessed remarkable achievements over recent years, for instance in the management of CMD, CMB, and CGM, it is important to avoid the establishment of new pest or disease epidemics. Furthermore, as cropping intensification occurs, with more continued cropping of cassava on the same areas of land, the likelihood of new pests and diseases appearing in relation to cropping practice becomes more credible. An integrated plant and pest management (IPPM) strategy should focus on the development, testing, and implementation of effective, commercially viable, and environmentally safe cassava plant protection technologies, which reduce the losses incurred from pest and diseases and enhance productivity. The most important components of this holistic approach for IPPM of cassava are biological control (particularly for CMB and CGM), host plant resistance (with high priority for CMD, CBB, and root rots), and cultural methods within a cropping system perspective.

Processing and storage and product quality

Lack of improved postharvest processing, storage, and utilization technologies

Freshly harvested cassava roots are bulky and the shelf life rarely exceeds 2 days after harvesting due to enzymatic reactions. Cassava also contains varying amounts of cyanogenic glucosides which break down to hydrocyanic acid, a toxic compound. The bulkiness and high perishability of harvested roots and the presence of cyanogenic glucosides call for immediate processing of the storage roots. Simple processing—pounding, grating or chipping—is essential for detoxifying the tuberous roots, and allowing farmers/processors to convert the highly perishable cassava roots into dry, stable, and safer products. Processing also adds value to cassava and extends the shelf life by converting freshly harvested roots into a freely traded commodity.

The present cassava processing methods are highly labor-intensive and expensive. For example, manual processing requires a minimum of 4 person-days to peel and wash, and 23 person-days to chip one tonne of fresh cassava roots which translates to approximately US\$65/t of flour (Kormawa and Akoroda 2003 in preparation) because appropriate processing technologies, machines, and tools are not easily affordable and sometimes unavailable at the farm level. In contrast, the cost of processing cassava into flour is approximately US\$16/t in other cassava producing countries, such as Colombia (B. Ospina⁴, personal communication) under mechanized processing.

⁴B. Ospina, International Center for Tropical Agriculture (CIAT), Cali, Colombia.

Among other principal constraints to cassava processing are the absence of efficient dryers, peeling machines and pelletizers. Almost all the processes of cassava transformation require the roots to be peeled at one stage or another.

Perhaps the greatest constraint to cassava processing is drying which takes up to four days to complete. Drying is a key process for making virtually all cassava products. This is because the major cassava producing zones are also the zone with relatively more rain and have a longer period of rain fall. Solar radiation is relatively low, justifying the need to use dryers extensively for cassava commercialization in southern Nigeria. Although dryers using kerosene, charcoal, and electricity exist, they are not used. Their economic advantages have not been widely demonstrated at farm levels. Also they are expensive and not energy-use efficient. Flash dryers are the most appropriate machines for drying cassava in powdered form. There are a number of locally made flash dryers that can be used by small to medium-scale enterprises. However, they are also expensive. The development and promotion of efficient pelletizing machines for poultry, ruminant, or fish feed, and for export are engineering challenges as more Nigerians are becoming increasingly aware of the production of pellets for animal feeds. Thus, to make cassava competitive, both for the domestic and export markets, investments in cassava processing machines among others must be a prerequisite.

Improved storage and packaging technologies to extend shelf life will contribute to increasing cassava root availability and reliability, stabilizing prices, and facilitating export.

Diversifying the use of cassava

Although there is a wide range of cassava products in Nigeria, these are mostly for direct human consumption. This is because the emphasis on the promotion of cassava has been focused in the past for its use as a food. The greatest constraint to cassava development in Nigeria is inability to diversify the use of the crop as a basic raw material for industrial purposes. With the focus changing from food to market diversification, such as the use of cassava in livestock feed, textile, pharmaceuticals, alcohol and other beverages, there is a need to explore these opportunities to diversify cassava markets. This requires private–public partnerships, with the private sector investing in market development and procuring machinery, while the public sector provides the needed policy environment and physical infrastructure. Market diversification will also require the presently weak link between industrial processors and producers of cassava products to be strengthened.

Labor shortage due to migration to urban centers and poor health

Shortage of labor is a major impediment to agricultural growth and the problem is mainly attributed to high levels of urbanization in the country. The quality of labor available is low because it is mainly provided by old people and children. Diseases which are most prevalent during the rainy season, when demand for labor is high, affect the quality of labor. Malaria and the HIV/AIDS epidemic exacerbate the existing labor constraints in agriculture.

Postharvest processing of cassava is laborious and a source of drudgery for women and children. New laborsaving and quality improving technologies exist, but they are mostly located in urban and peri-urban areas. More efficient hand tools and animal drawn/mechanical implements may increase labor productivity in cassava production while improved postharvest machines and hammer-mills would reduce the drudgery in postharvesting handling.

Inadequate market information

Poor linkages between producers and buyers exist because of poor access to market information. Sustainable and timely dissemination of national market information for cassava is essential to enable the producers, processors, distributors, etc., to take advantage of new or high value market opportunities. Currently, there is no well-established market information system for cassava in the country. Although the Rural Sector Enhancement Program (RUSEP) pilot project funded by USAID/Nigeria and executed by IITA has initiated an agricultural Marketing Information System (MIS), it is still far from adequate. For cassava, the collection of data is restricted to only one state, and the MIS is basically historical at the present time. Hence, an effective market information system is needed to ensure that operators within the cassava industry have access to relevant information with ease. The system should capture information on product standardization (chips, flour, starch, etc.), price and pricing, inventory levels, product range, utilization possibilities, alternative markets for cassava products, and price profiles, etc.

Poor access to inputs and financial services

Farmers are unable to access essential inputs (fertilizer) and financial services (credit), and are therefore unable to improve the productivity of their land. Operators (farmers, processors) within the cassava industry generally lack adequate capital for both upstream and downstream production activities. Personal savings are low; disposable incomes are grossly inadequate to finance farm activities, while the majority of the farmers lack access to formal credit links. Most small-scale farmers do not borrow from commercial banks because of very high interest rates as well as their own lack of collateral. The private sector provides credit in form of inputs only for export crops such as cotton and cocoa. Financial agencies should provide short and medium-term credit to target beneficiaries. Effective and long lasting links are needed between the financial agencies and farmers and processors through group formation, savings mobilization, the development of profitable on-farm and off-farm activities, and assistance in supervising credits.

Poor access to markets

Marketing can be a problem for poor farmers especially those living in villages with poor feeder roads who may not have resources to transport their commodities to the market. Typically, farmers transport cassava as head loads, on bicycles, or in lorries. With poor market access, marketing cassava can be particularly problematic because of its bulky nature, especially as unprocessed roots. Poor access also makes the movement of goods and

people difficult; particularly during the rainy season. The roads linking the major towns are usually quite good. Though the market access road network is better in Nigeria than in other West African countries, the rural feeder road networks are poorly developed or absent in some places. This has significant implications for marketing, cost of inputs, access to health facilities and other social services, and has adverse effects on production and the rural standard of living.

There are also problems of unreliable supply, uneven quality of products, low producer prices, and costly marketing structure which affect its use for agricultural transformation. However, cassava has unique characteristics and great potential as a raw material for different end uses and product markets.

The extent to which the potential market for cassava may be expanded depends largely on the degree to which the quality of various processed products can be improved to make them attractive to various markets, local and foreign, without significant increases in processing costs.

Market opportunities

A potential market for cassava is in the livestock feed industry. However, only about 5% of amount produced is used as feed, indicating that the industry is underdeveloped. The current demand for maize in the Nigerian livestock industry is put at 4.3 million t/year. Cassava is unlikely to completely replace maize as the basic energy source in livestock feed. Cassava storage roots are cheaper than maize in both rural and urban markets but the additional processing to chips and pellets is prohibitive due to high processing costs (Fig. 6). Secondly, Nigeria has no comparative advantage in the export of cassava chips and pellets because of stiff competition from Thailand (which dominates the export market at the moment), and

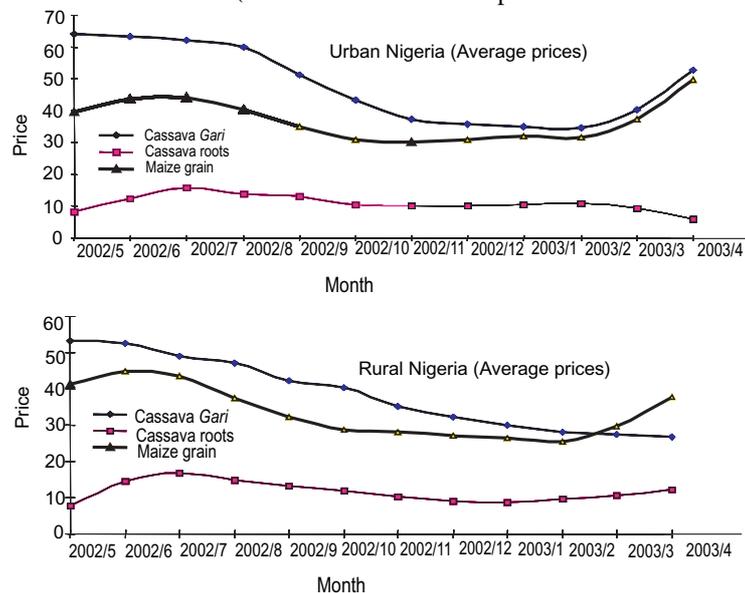


Figure 6. Cassava products and maize prices in urban and rural areas.

the underdeveloped structures for commercialization (Ezedinma et al. 2002; Nweke et al. 2002). The favorable domestic prices for maize grain do not encourage the use of cassava chips and pellets in livestock feed in the country.

The enterprises in which cassava is likely to make an impact are processing cassava flour for bread and confectionery, processing sweeteners such as fructose and glucose for foods and beverages, producing starch and adhesives (dextrin) for the paper, textile, wood and crude oil production, producing crude ethanol for hospitals, distilleries, and pharmaceutical industries, and developing multiplication centers for healthy planting materials to satisfy the demand for improved high yielding varieties.

The ethanol industry has the most potential for providing a rapid market for cassava. Cassava is a very productive source for ethanol. Cassava produces much more alcohol/t (150 liters/t of fresh roots) than sugarcane (48 liters/t) but has been used as a source of a raw material without much success in Nigeria (Bamikole 2002; 2003). A distillery using cassava to produce alcohol can operate all year round because cassava is always available. Nigeria currently imports about 90 million liters of alcohol annually and 80 million liters is used by the liquor industry alone. Replacing 80 million liters of imports with local cassava would require 500,000 t of dried cassava roots (or 2 million t of fresh roots) valued at (today's prices) roughly US\$62 million.

Figure 7 shows the value of alcohol and starch imports to Nigeria between 1996 and 2000. Development of these two industries as a market for cassava in Nigeria would contribute significantly to rural economic growth. Interest in investments in the Nigerian ethanol industry is growing but emphasis on small-scale cassava-based production units using cassava as raw material will provide a rapid alternative market for the commodity. This will definitely increase employment and income for farmers, processors, and agroindustries along the value chain, thus diversifying the rural economy.

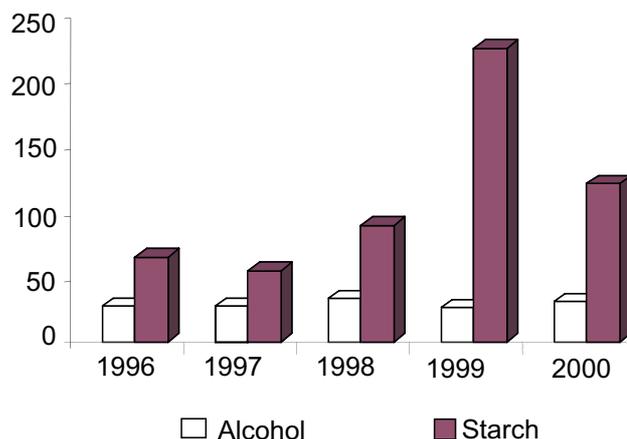


Figure 7. Value (million US\$) of alcohol and starch imports to Nigeria, 1996–2000.

Source: Computed from UNSD-Comtrade, Website accessed June 2003.

The use of cassava starch as an industrial raw material in Nigeria is low and the market structures are also underdeveloped. In the early 1990s, only about 700 t/year of cassava starch was produced because Nigerian cassava starch is considered to be of low quality by industries and none is exported (Nweke et al. 2002). Maize starch rather than cassava was preferred, especially by the textile and confectionery industry. The harsh economic climate during the military era also led to the near collapse of the textile industry in Nigeria and so reduced the potential market for cassava starch. The positive steps taken by the present democratically elected government to revive the textile industry will provide an incentive to develop the starch industry.

The soft drinks industry imports all its syrup concentrate because cassava starch derivatives (hydrolysates, e.g., glucose, sucrose, fructose, maltose, and syrup) are not currently developed in Nigeria. The current annual use of starch hydrolysates in the pharmaceutical industry is 1523 t but 80% of the raw materials used by the pharmaceutical industry in Nigeria are imported because (for now) it is easier, less risky, and much less complicated to import than to manufacture locally (RMRDC 1997). Again in the 1990s, 58,000 t of adhesives, a major derivative of starch (dextrin), were used in the wood, cable, paper and printing, packaging, and footwear industries in Nigeria. Unfortunately, these were imported, either as adhesives or as dextrin. Developing the starch industry for use as adhesives for these industries would put 60,000 t of cassava into use for this industry alone in Nigeria (Nweke et al. 2002).

Policy

There is no separate policy articulation for the development of the agribusiness sector or for the cassava subsector in Nigeria. Reference to agribusiness development in Nigerian agricultural policy is stated in Section 4.6 of the 1988 document for agricultural commodity processing. The objectives of that section of the agricultural policy are as follows:

1. Widen the demand base for agricultural commodities and, hence, accelerate the rate of growth of the agricultural sector.
2. Preserve perishable agricultural commodities, thereby reducing their level of waste and degree of seasonal price fluctuations.
3. Diversify employment opportunities in the rural areas through the establishment of rural-based, small-scale agricultural commodity processing industries.

Other than these broad statements, there is no specific articulated national policy except for the Presidential Initiative on Cassava that focuses on the development of cassava as an important subsector—especially in the areas of agricultural commodity quality standardization, storage, processing, packaging, packing, and marketing.

Poor extension delivery system to farmers

The present extension delivery system in Nigeria is ineffective. The ADPs are responsible for extension delivery at state levels. For most of the ADPs, the target ratio of extension agents (EAs) 1: 1000 farmers could not be realized due to myriad problems, ranging from underfunding to the unavailability of adequate and appropriate trained human capacity.

This has had a negative impact on the effectiveness and coverage of the various cells/circles in a given locality. Another fundamental problem with extension strategy is the irrelevant nature of some of the recommendations (FMANR 2000). Quite often, the technological options offered by extension do not fit into the farming system and the socioeconomic conditions under which the rural people are operating. A broader range of new varieties that match different ecologies and end-user requirements should be developed and released to farmers. Several different models are possible to address this weakness. These include the secondment of a limited number of ADP staff to assist in the implementation of the activity, linkage with NGOs including Sasakawa Global 2000 which is implementing a very successful crop technology activity in northern Nigeria and is prepared to expand its operations, and engaging the private sector, including agro-input dealers through the USAID-funded project—Developing Agricultural Input Markets in Nigeria (DAIMINA)—executed by the International Fertilizer Development Center (IFDC) to facilitate the extension of appropriate technical information. In addition, the activity will benefit from the ongoing operations of a Farm Service Information Center located in Abia State, funded under a USAID/IITA activity to promote market information to the region through various media, including regular radio programs.

Relationship between the preemptive management of the virulent CMD project and the presidential initiative on cassava production and export in Nigeria

The President of the Federal Republic of Nigeria, Chief Olusegun Obasanjo, launched (July 2002), an initiative to promote cassava as a foreign exchange earner (US\$5 billion/year in value added cassava exports within the following 3 years) in Nigeria, in addition, to satisfying the national demand.

The cultivation of multiple pest- and disease-resistant and productive varieties is central to increasing the production of cassava varieties and enhancing the competitiveness of cassava in Nigeria. Cassava production in Nigeria suffered a severe setback in the 1970s and early 1980s due to epidemics of CMD, CBB, CMB, and CGM (FMANR 2000). The Federal Government of Nigeria put in place programs to combat these diseases and pests through the introduction of new resistant and high yielding varieties, as well as biocontrol measures developed by IITA in collaboration with the National Root Crop Research Institute (NRCRI), Umudike, Abia State. Through the Cassava Multiplication Program (CMP) (1986–1996), Nigeria's production of cassava increased from 12.4 million t in 1986 to 33 million t in 1996, an increase of more than 300%. This attests to the favorable conditions and almost limitless elasticity of production in the Nigerian cassava sector. By the end of CMP in 1996, and thereafter, production reached a plateau at the level of 33 to 36 million t/year which represents the limit of human food demand. (FMARD 2003), as a cyclic glut has been occurring every 3 years since then.

Targets have been set for achieving the production of cassava in the country required to meet the presidential initiative on cassava production and export by 2006 (FMARD 2003) as follows:

Table 1. Cassava production and planting material (seeds) needed for achieving a target of 150 million t of fresh cassava storage roots and 37.5 million t of dry cassava products, such as chips and pellets.

Target	Year			
	2003	2004	2005	2006
Hectarage required (million ha)	3.1	3.6	4.5	5.0
Production of fresh roots (t)	77.5	90.0	112.5	150.0
Breeders seeds (million bundles ⁺)	1.4	3.97	6.53	9.2
Foundation seeds (million bundles)	10.9	31.8	52.3	73.2
Certified seeds (million bundles)	155.0	180.0	225.0	250.0

Source: FMARD 2003 (Draft).⁺ One bundle = 50 stems of 1 m length.

1. A production of 150 million t of cassava is expected by the end of 2006.
2. At 25% extraction rate, the total output will be 37.5 million t dry cassava products such as chips, pellets, and other premium products which are expected to be produced by 2006.

With 2003 as the base year, the incremental production in terms of the hectarage and production of fresh cassava storage roots, as well as the quantity of different classes of planting materials (seeds) that would be required is shown in Table 1. The current average yields in farmers' fields are about 11 t/ha and the total productive hectarage was 3.1 million ha in 2003. It is evident, therefore, that the aims will not be achieved in 2006 unless vigorous action is taken in the following areas: widespread cultivation and distribution of productive and multiple pest- and disease-resistant varieties, with high levels of durable resistance to CMD, more efficient field production in terms of better returns per unit of land, labor, and other inputs as well as better services in terms of better quality planting materials (variety and health status). In recognition of the imminent disaster from the outbreak of the severe form of CMD in Nigeria, and the consequences on the country's cassava production, food security, and the new presidential initiative on cassava, the preemptive management of the disease has been proposed and should be vigorously pursued as a matter of urgent priority to forestall any disaster. Action should begin with the most vulnerable south-south and south-east states (Phase 1), followed by the north-central and south-west states (Phase 2).

In addition, the most serious factor inhibiting cassava production is the limited industrial application of cassava, which is traceable to the absence of primary processing. Therefore, the first step towards diversification of cassava utilization has to be the establishment of primary processing to handle any projected surplus over and above the human consumption demand. The proposed project follows a commodity chain approach (Fig. 8) and is based on lessons learned from various development investors and IITA activities and through the implementation of various projects within Nigeria and elsewhere in Africa⁵. In particular, the focus on the preemptive management of CMD is based on experiences in Uganda, where the disease could be managed, but commercialization of the crop was undermined because

⁵A commodity chain encompasses a comprehensive set of activities required to bring a product from a concept stage to marketing and consumption of end products (Geretti 1999).

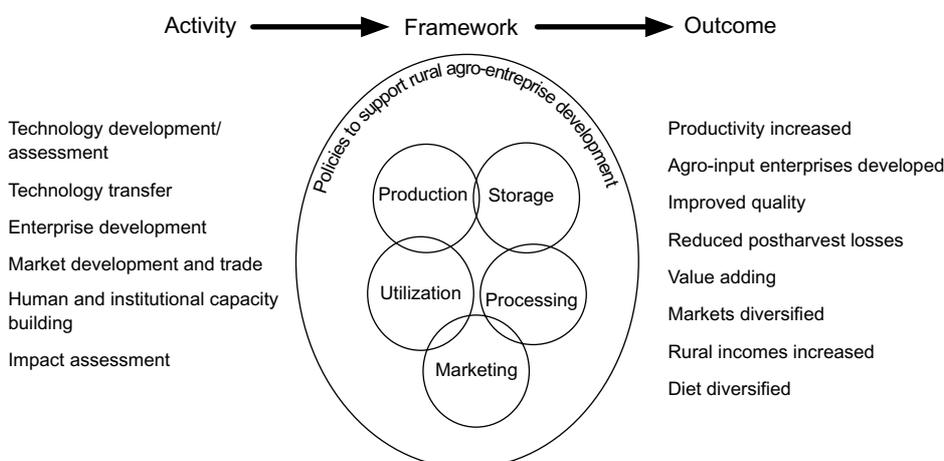


Figure 8. Conceptual framework of the cassava commodity chain showing major activities and outcomes.

marketing opportunities were not integrated into the disease management interventions at the same time. Lessons learned from the RUSEP project show that promoting market and commercialization must be an essential component of production-based activities. More importantly, access to inputs remains a critical constraint to improving productivity. Within the production to consumption chain, the promotion of value added processing and storage improves rural incomes and investment in production and related activities. An important challenge to stimulating growth in the cassava subsector is financial constraint. However, experience with RUSEP in Nigeria shows that partnership with private financial institutions to provide credit to project beneficiaries is possible if the project is thoroughly thought through and well implemented. IITA has been working closely with the private sector to explore the processing and marketing potential for cassava through these activities.

The promotion of cassava as an engine for economic growth in the rural areas in southern Nigeria would require interventions to address constraints from production to consumption. Thus, the commodity chain approach provides the best approach to implement this project with a view to sustaining technology transfer to and adoption by farmers and processors through linkages with markets as a driving force that would provide the necessary incentives to expanding cassava production and utilization.

The proposed project will, provide local farming communities with the means to address and resolve in a sustainable way an imminent outbreak of severe CMD in their area in the short term, with major emphasis on the south-south and south-east zones. It will also serve to develop the domestic market for primary raw materials in the livestock, starch, ethanol, and food industries. This will necessitate a market-oriented strategy with emphasis on value addition and productivity enhancement along the entire cassava value chain, as well as the development of supply chain structures and management involving the cooperation of processors of these commodities for identified markets and a coalition of private/public sector partnerships including farmers, processors, marketers, and other stakeholders. The development of the

domestic market will be emphasized to improve efficiency, standards, and scale economies with a view to positioning the country for the export market.

The proposed project is a precursor of the Presidential Initiative on Cassava Production and Export, and should be regarded as complementary to the national program on cassava development in Nigeria. IITA is confident that the productive potential of this key African food staple will be assured in Nigeria by adopting the same approach that was used for the management of CMD in East Africa, based on meticulous research for development, stakeholder network development, and rapid and targeted implementation of control tactics. Combined with the huge untapped commercial opportunities that the crop offers through microenterprise and market development, value-chain addition and development of supply chain structures and management, the income generating potential of the producers, employment creation from the crop, and its potential for contributing to economic growth will be fully exploited in the targeted states. The involvement of multiple stakeholders at community level with clear manifestation of ownership will also ensure sustainability of the project's impact.

Importance of Nigeria in relation to Africa and the international community

Nowhere in West Africa is stability more important to the continent and the international community such as the United States than in Nigeria, the continent's most populous nation (estimated population of 126 million in 2001 (World Fact Book 2001)).

Nigeria championed the formation of the Economic Community of West African States (ECOWAS) and is also the dominant partner to support the organization's objectives. Strengthening ECOWAS promoted Nigeria's national interests through encouraging development of the region's economy and its neighbors' intraregional reliance for military, political, and economic survival, thus serving such security interests as weakening colonial divisions within West Africa, ending border disputes, contributing to African unity, and strengthening West Africa's bargaining positions vis-à-vis the European Economic Commission (EEC). Nigeria is also a member of the African Development Bank and the Lake Chad Basin Commission. It also has cordial relations and bilateral agreements with all its neighbors as well as with other countries in the West African subregion. In the spirit of good neighborliness and friendship, it helped to resolve conflicts between Liberia and Sierra Leone, Burkina Faso and Mali, and Togo and Ghana. Nigeria also tried to make its neighbors "safe" friends, partly to reinforce boundary claims and protect the human rights of Nigerian citizens who were migrant workers and partly to stabilize relations among the immediate neighboring countries.

Nigeria has participated in peacekeeping operations of the United Nations (UN). It has also provided the majority of soldiers for the joint West African peacekeeping force in Liberia (since 1990) and Sierra Leone (from 1997 until 2000, when a UN peacekeeping force that included many Nigerian troops took over).

With regard to relations with the rest of Africa, Nigeria plays a big brother's role as a predominant African leader. Nigeria is a founding member of the Organization of African

Unity (OAU), now the African Union (AU), and often channels major policy initiatives through that organization. Although most of its relations with other African states took place outside the OAU framework, they were guided by OAU principles. The army has participated in peacekeeping forces, either alone or through the OAU, and has contributed personnel to the UN peacekeeping missions. In addition, Nigeria has given aid and technical assistance to several African states, often through the African Development Bank of which it is a major benefactor. A Technical Aid Corps, operating along the lines of the United States Peace Corps, was established in 1987 to enable young Nigerian professionals to serve in other African, Caribbean, and Pacific countries where their expertise is needed. Nigeria also provides scholarships and fellowships, training facilities, grants, equipment, and medical supplies to African countries. In the 1970s, Nigeria also provided subsidized oil under certain conditions to African countries, and offered concessionary prices to other African countries as the Middle East crises pushed oil prices upward.

The United States relies on Nigeria as a major source of oil (10% of US imports in 2000). Nigeria is also one of its most important regional allies, and one of the two (along with South Africa) focal points of its foreign policy in SSA.

Nigeria is therefore in a very important position and any threat to its national food supply must be taken very seriously and guarded against with urgency.

Current status of CMD mitigation efforts in Nigeria

The USAID Mission in Nigeria through a project “Cassava mosaic disease monitoring in Nigeria” provided funding (US\$300 000) for Year 1 (2002–2003) to start off the larger multiple donor project “Preemptive management of virulent cassava mosaic disease in Nigeria.”

As part of this preemptive management effort, baseline, monitoring, and diagnostic surveys for pests and diseases have been undertaken in Nigeria. Multiplication centers for CMD-resistant varieties were established in 2003 at strategic locations for the production of foundation seed stocks for participatory evaluation (on-station and in farmers’ fields) and for subsequent multiplication and distribution to areas vulnerable to CMD. A great increase in germplasm diversity and training of agricultural workers and farmers in cassava cultivation skills and management would also be provided.

As a matter of urgency, at a one-day briefing workshop attended by a wide range of key cassava stakeholders in Nigeria held at the High Rainfall Onne Station, Rivers State, 10 October 2002, IITA presented a comprehensive action plan including the additional financial resources required to effectively implement the proposed project throughout the 11 states in the south-south and south-east zones over a 4-year period. Senior executive representatives of the Federal Government and the 11 south-south and south-east states, representatives of the Nigerian National Petroleum Corporation (NNPC), major oil producing companies operating in the zones, and the Niger Delta Development Commission (NDDC) adopted the plan. They committed additional funding support to the tune of US\$15.675 million out of a total budget of US\$ 16.5 million required to implement the project in all the 11 south-south and south-east states of Nigeria as follows:

Niger Delta Development Commission	US\$3.3 million
The Federal Government of Nigeria	US\$2.475 million
The 11 state governments benefiting from the project	US\$6.6 million
NNPC and the major oil producing companies	US\$3.3 million
Total	US\$15.675 million

IITA is to source the shortfall of US\$0.83 million from other development investors.

Furthermore, in the communiqué adopted during the stakeholders' workshop on 10 October 2002, the Federal Government requested that the preemptive management of the disease should later cover the whole country.

In a recent stakeholders forum of over 200 participants (23–25 June) in Port Harcourt, Rivers State, the stakeholders unanimously admitted Ondo State from south-west zone as one of the states benefiting from the CMD project. With the addition of Ondo State, the government would also 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 and NNDC have paid their share in full while Ondo State has paid ₦10 million of its commitment. The commitments of the state governments and oil companies are at various stages of approval and disbursement.

Links to other donor-related projects and USAID strategic development framework in Nigeria

Close links are anticipated with ongoing related projects, and the Nigerian Presidential Initiative on Cassava Production and Export). Existing related donor-supported projects in Nigeria, which this project will complement include the following

1. Root and Tuber Expansion Program (RTEP) supported by the International Fund for Agricultural Development (IFAD) and the Federal Government of Nigeria (FGN).
2. Rural Sector Enhancement Program (RUSEP) funded by USAID Nigeria and FGN.
3. Information Communication Support for Agricultural Growth in Nigeria (ICS, in Nigeria) Project funded by USAID.
4. International Fertilizer Development Center (IFDC) DAIMINA Project funded by USAID.
5. Strategic Seed Reserve Project funded by USAID.
6. Community-based Resource Management Program funded by IFAD, NDDC and state governments (SG) of Nigeria in the Niger Delta region.

This proposed project also falls within the USAID Nigeria proposed Strategic Objective (SO) 12 "Rural sector economy diversified and strengthened in selected areas". Cassava provides a unique candidate commodity with high economic returns (IITA et al. 2003) to investment and the potential to contribute immensely to the USAID goal to encourage economic growth and agricultural development. The ANAP study indicated that estimated gross returns for cassava development exceed US\$500 million per year. Cassava is the most widely cultivated commodity in rural areas in Nigeria. Thus, the promotion of cassava, particularly in areas relating to production, processing and marketing, and utilization will

certainly contribute to enhancing and diversifying the rural economy. Cassava is also a major food for Nigerians, thus its promotion also support the US Presidential Initiative to End Hunger in Africa (IEHA), which is designed to increase agricultural productivity and trade in Africa. The IEHA targets will include improved productivity and an increase in rural income and food availability.

Preemptive management project

Project goal and objectives

Vision

This proposed 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.

Goal

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

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

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

Project outputs and activities

Output 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.
- 1.2 Participatory identification and evaluation of appropriate production technologies such as improved germplasm, soil amendments, integrated pest management options, and technologies.
- 1.3 Develop, evaluate, provide, and maintain diversified germplasm for the establishment of strategic stocks of CMD-resistant varieties for food, feed, and agroindustrial uses.
- 1.4 Facilitate the 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.

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

Activities

- 2.1 Assess postharvest and processing technology and product development needs and identify appropriate technologies for household and small to medium-scale businesses.
- 2.2 Introduce, demonstrate, adapt, and promote improved value adding postharvest technologies and products for expanded utilization, and income generation opportunities.
- 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.

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

Activities

- 3.1 Identify cassava market (domestic and export) and investment opportunities to promote production, processing, and trade.
- 3.2 Facilitate development and strengthening of effective agroindustrial and traders' associations.
- 3.3 Stimulate and promote advocacy (through participatory mechanisms) for strategic policies to enhance cassava commercialization and trade.
- 3.4 Facilitate the development of agri-input and service delivery systems (fertilizer, agrochemicals, tractor services, machine fabricating, processing, etc.) to support cassava commercialization.

- 3.5 Develop 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.
- 3.6 Promote and link small and medium-scale enterprises to financial institutions for credit and to appropriate domestic and export markets.

Output 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 for zonal technology transfer and training.
- 4.2 Develop and strengthen capacity of cassava producers and processors for sustainable production, processing, and utilization technologies.
- 4.3 Develop capacity of entrepreneurs in market identification, product development, storage, and enterprise development.
- 4.4 Enhance entrepreneurial capacity to adopt cassava product standards and grades for local industrial and export markets.
- 4.5 Train farmers and processor groups in credit management, group organization and management, and microenterprise development.
- 4.6 Train fabricators for fabrication and servicing of postharvest and processing machines for widespread dissemination on a sustainable basis.
- 4.7 Develop, produce, and disseminate training and extension support materials.

Output 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.
- 5.2 Define target communities and partners, and involve them in project implementation design.
- 5.3 Establish a national advisory committee for administrative and technical oversight.
- 5.4 Collate and update, where necessary, detailed baseline information and develop performance and monitoring indicators.
- 5.5 Organize work planning and review meetings for refinement of project activities.
- 5.6 Monitor project implementation and conduct midterm project evaluation.
- 5.7 Update studies to determine level and factors responsible for the adoption of cassava production, processing, and marketing technologies.
- 5.8 Organize biennial cassava trade show to foster cooperation among industry stakeholders around a common objective.
- 5.9 Evaluate impact of project activities on productivity, rural incomes, and employments.
- 5.10 Organize two zonal stakeholders' workshops to review achievements and lessons learned.

5.11 Organize a national stakeholders' end of project workshop to review achievements and lessons learned.

Major 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. South-east zone: Abia, Anambra, Enugu, Imo, Ebonyi States (NRCRI, Abia State, as zonal hub).

With regard to the establishment of the Cassava Development and Resource Centers for zonal technology transfer and training, the IITA High Rainfall Station at Onne, Rivers State, will serve as the zonal hub for the south-south zone, and NRCRI, Abia State as zonal hub for the south-east zone.

In view of the naturally slow multiplication of cassava planting materials, and the request of the Federal Government for CMD mitigation efforts to cover the whole country later (communiqué adopted during the stakeholders workshop on 10 October 2002), minimal activity in foundation seed multiplication will be undertaken in the Middle Belt/north central (Abuja, Makurdi) and south-west (Ikenne, Ibadan) zones to lay the foundation for a second phase of project intervention, which will focus on the Middle Belt/north central and south-western states.

Project implementation strategy

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

- 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.

Partner(s). IITA, NRCRI, Umudike.

The proposed project envisages a series of georeferenced annual surveys in the different states to monitor the health status of cassava. Records will be taken of all the major cassava pests and diseases, but with particular attention paid to CMD, the viruses that cause it and their whitefly vector, *Bemisia tabaci*. From these surveys, it will be possible to determine which areas are most severely affected by CMD and other major pest/disease constraints, whether the CMD is expanding as an epidemic, and if so, in which direction and at what speed. All these pieces of information will serve to enhance the control efforts, with greatest attention being directed towards managing the problem in the worst affected areas and areas likely to be threatened in the near future. The project will continue to monitor changes and spread of CMD, and identify the most severely affected zones to be targeted with control measures. As the management effort progresses, records collected through these surveys will also contribute to an indication of the impact of project activities at the farm level.

1.2 Participatory identification and evaluation of appropriate production technologies such as improved germplasm, soil amendments, IPM options, and technologies.

Partner(s). IITA, NRCRI, ADP, NGO/private sector, producer groups, Department of Agriculture—Land Resources Unit, oil companies, project staff.

Sustainable IPM and best-option production technologies will be tested and adapted to control the most important cassava plant protection and production problems under farmer-managed conditions. Key components to the sustainable approach to cassava production development will include the deployment of high yielding, disease-resistant varieties, phytosanitation, cultural practices, and sustainable soil fertility management. These will be integrated and tested with farmers using participatory methods.

The superior cassava varieties, resistant to multiple diseases will be promoted in large-scale demonstration plots in farmers' fields. The demonstrations will utilize farmer and consumer participatory approaches to supplement the information collected at research stations to identify truly superior varieties. The "mother-baby" demonstration approach will allow wider exposure of superior cultivars to farmers at low cost. This approach has been used to test and disseminate crop varieties and resource management technologies in southern Africa and involves complementary sets of demonstrations grown by researchers and farmers in farming communities. For each researcher-designed "mother" demonstration, there are 6–12 "baby" trials within walking or cycling distance. The "mother" trial evaluates a set of promising cassava cultivars under different management conditions. It is located in the center of a farming community and managed by an extension officer or a member of an NGO. These "mothers" will serve as component of the community-level technology transfer centers. "Baby" demonstrations contain four (or fewer) of the cultivars in the mother trial and are sown and managed by farmers.

1.3 Develop, evaluate, maintain, and provide diversified germplasm for the establishment of strategic stocks of CMD-resistant varieties for food, feed, and agroindustrial uses.

Partner(s). IITA, NRCRI, ADP, producer groups, NGOs, project staff.

This project will also maintain the flow of new CMD-resistant germplasm and facilitate the establishment of strategic stocks of CMD-resistant varieties in Nigeria. IITA and collaborating partners will conduct expanded on-farm testing of new varieties from IITA with end-user participation so as to make a diverse range of new CMD-resistant varieties available to farmers in the quickest possible time, in targeted communities. Assessments will be made of quality characteristics for specific end uses. These will include consideration of cyanogenic potential, starch yield and quality, dry-matter content, pasting properties, cooking characteristics, and the suitability of varieties for the dominant food and product preparations within the country. This should provide farmers with opportunities to access a wide diversity of germplasm combining multiple pest and disease resistance with preferred food, feed, and industrial quality characteristics in the shortest possible time. Primarily, the national research programs, NGOs, extension services, and farmer groups will undertake these activities.

1.4 Facilitate the establishment of a sustainable network of community-based private sector-driven cassava planting material production schemes of high yielding varieties resistant to CMD and other pests to supply high quality planting materials to farmers. Partner(s). ADP, RTEP, producers' groups, NGOs.

Lack of a well-organized and sustainable network of planting material multiplication and distribution systems in Nigeria is one of the major constraints to the adoption of improved cassava varieties. Multiplication and distribution schemes are often inefficient, either due to nonexistence of a well organized and functional national seed production scheme or because the production of large amounts of high quality planting materials of vegetatively propagated crops, such as cassava, is a slow process. Distribution is a problem because stems are bulky and can deteriorate rapidly if not planted within one week after harvest. Bulkiness increases the handling and transport costs. The private sector, the key player in the cereal seed industry in the country, is not involved in providing quality cassava planting materials, partly because the cassava is viewed as a low priority crop. The plentiful supply of certified or high quality cassava planting material of improved varieties will be a key factor for achieving high storage root yields and increased production. The project will work in close collaboration with the institutions with a mandate for seed certification to facilitate the development of community-based schemes for the multiplication of planting material.

At least, five CMD-resistant varieties adapted to the specific agroecologies of each state and with specific end uses will be promoted through the decentralized and community-based multiplication and distribution centers. This project will build on existing initiatives established through the IFAD-RTEP Project, and will use the three-tier approach to the multiplication of planting materials that has been used so successfully in other parts of Africa. Initially, the project, in collaboration with the ADPs and NRCRI, would establish state-wide primary multiplication sites (station-based and typically > 10 ha) at strategic locations and supply the improved planting material from these sites to participating development organizations that will facilitate and coordinate extensive multiplication at secondary sites (local government-based and typically > 2 ha).

Nongovernmental and state extension agents will be responsible for distributing planting material and providing appropriate agronomic backstopping to representatives of community-level producer organizations at the tertiary multiplication sites (at the farm level and typically about 1 ha). Farmers groups, the private sector, and NGOs will manage tertiary sites. Rapid multiplication techniques will be practised at primary sites where irrigation is feasible. The more numerous local government-based secondary sites will use conventional multiplication methods if irrigation is not feasible and, like the primary sites, they will be managed by project partners. A private sector-driven approach to sustaining multiplication and distribution of planting materials of the improved cassava varieties will be encouraged at the community level. Partners will be encouraged and helped to evolve planting material schemes to ensure there is a continuous supply to farmers.

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

2.1 Assess postharvest and processing technology and product development needs:

identify appropriate technologies for household and small-medium scale businesses.

Partner(s): Project staff, AIDU (FAMEG/SAMEG), NRCRI, FIIRO, NSPRI.

Characterization of the cassava postharvest and processing systems will be carried out to document markets segmentation and to assess demand in terms of quantity and quality requirements within the food, feed, and industrial sectors. Market analysis of the most feasible and promising options within these sectors will be conducted to determine inefficiencies in the system, to identify niches and opportunities, and the policies and strategies required in improving access to producers and processors towards expanding cassava utilization in the country. Postharvest and processing needs at household level will be assessed in pilot communities.

2.2 Introduce, demonstrate, adapt, and promote improved value-adding postharvest technologies for expanded utilization, and income generation opportunities.

Partner(s): AIDU (FAMEG/SAMEG), project staff, NRCRI, RMRDC, FIIRO, UNIDO, NCAM, PRODA, ARCEDEM, NSPRI, NGOs, CBOs, private sector fabricators and processors.

Cassava roots can be used in different ways as a raw material for further processing. High quality cassava flour and chips can be produced and fed into rural- and urban-based industries for use by the confectionery, food processing, and livestock feed industries. Native starch can be used as a binder in petroleum exploration, sizing in the textile industry, and as a raw material input for the production of adhesives, ethanol, glucose, etc. Food-grade and pharmaceutical-grade starch can be used in the relevant industries. The foliage and other plant parts which are sources of protein, vitamins, and minerals could reduce the cost of animal feed and increase the access of consumers to animal protein.

Improved processing, storage, and packaging technologies and product promotion will contribute to increased cassava root availability, reliability and quality of product, price stability, and facilitate trade. They will catalyze increased cassava production, consumption, and industrial use as well as encouraging rural industrial development and raise the incomes of rural communities.

Processing using low-cost machinery and processes for producing high quality intermediate products under small-scale rural conditions would be encouraged on-farm or as near the farm as possible to reduce transportation costs. At the household level, laborsaving equipment and tools (graters, dewatering devices, sifters, stoves, chipping machines, and grinders) will be demonstrated and promoted to reduce the drudgery of processing by women and children while minimizing crop losses and improving the quality of processed products.

Storage and packaging technologies to extend products shelf life will be demonstrated and promoted. Particular attention will be paid to immediate processing of harvested storage roots into chips or flour to extend their shelf life. The flour/chips may be converted to

secondary products before sale, thus providing opportunity for farmers to retain a greater share of the value added to the commodity, or sold to middlemen for bulking and supply directly to factories at locations with established cassava-based industrial units.

This project will also demonstrate and promote a range of postharvest technologies at the community level to facilitate the development of cassava-based agroenterprises. Pilot processing centers at the community level will be established and these will open new market opportunities to the farmers if linked to a market. Linkages will be established with other research and development institutions to transfer suitable processing technologies.

Studies will be conducted to characterize food, feed, and industrial products to establish current use by humans and industries and the suitability of improved varieties for these uses. Recipes for household preparation will be developed, consumer acceptance of new products will be assessed, followed by widespread dissemination of recipes. In close partnerships with research institutes, development agencies, and the private sector (livestock feed manufacturers and livestock industries), the project will facilitate formulation and dissemination, promotion, and adoption of cassava-based rations for different categories of livestock through the processing of cassava roots, peel, leaves, and tender stems.

Smallholder farmers and/or farmer cooperatives at project locations will be given assistance through training in testing and adopting recommended technologies for primary processing and in product development in collaboration with partner development institutions. Models for bulking and grading would be established at the community level that can assure regular supply and consistent quality to potential large users in urban areas and reduce transport costs.

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.

Partner(s). AIDU (FAMEG/SAMEG), project staff, NRCRI, FIIRO, RMRDC, UNIDO, NCAM, PRODA, ARCEDEM, NSPRI, NGOs, CBOs, private sector fabricators and processors.

Sustainable best-bet technologies to enhance productivity for optimal management of the cropping environment and sustainable approaches to the management of cassava pests and diseases as well as simple market-oriented postharvest technologies to expand the market outlets and enhance income generation opportunities of cassava will be integrated and promoted with farming communities/groups using participatory approaches and training along the commodity chain in strategically located technology transfer centers (TTCs) in the target states. Improved varieties, management practices (phytosanitation, biological control, cultural practices, weed and soil fertility management) and processing technologies will be promoted as a total package. Links will be developed between TTCs and identified markets for a range of fresh and processed cassava products. The TTC approach will capitalize on the concentration of efforts by other organizations to enhance the collective gain from these efforts.

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

3.1 Identify cassava market (domestic and export) and investment opportunities to promote production, processing, and trade.

Partner(s): Project staff and consultants

The project will undertake a comprehensive analysis of the value chain in the cassava subsector. This will involve mapping the commodity from cultivation through processing and marketing to use as food and as raw material for industry. This will include a thorough costing of all inputs, investments, and sales.

A commodity subsector is understood to be a vertical slice in the commodity flow from input supply to consumption, showing all stages and agents. It shows the links between producers and consumers through the processes of buying, storing, transporting, processing, and selling the commodity. The project will assess the size of the different cassava markets, growth prospects, product flows, quality and standards, industrial and nonindustrial uses, and the characteristics of the target groups and beneficiaries, farmers, processors, small and medium-scale entrepreneurs, and agroindustries, also the investment climate.

Data collection will be conducted in three stages: first, wherever available, published data would be used to establish the structure, conduct, and performance of the cassava subsector. Secondly, a rapid appraisal survey would be conducted using focused group interviews and key informants to obtain information on trading patterns, transportation facilities, processing potential, and marketing systems in selected villages and urban areas. Interviews will cover all stakeholders, including farmers, village leaders, and community organizations such as women groups, extension agents, traders, processors, credit lenders, NGOs, marketing agents, and agrobusiness entrepreneurs.

The report from this survey will be mainly the description of the commodity value chain, the intervening agents, the major constraints, and opportunities in Nigeria (and the subregion). Results from this analysis will be used to pick out those links in the chain where an investment could achieve considerable financial gains for a large group of producers. It will also help to further refine the project implementation strategy for integrating the smallholder producers into the local/national market economy and possibly the subregional market.

3.2 Facilitate development and strengthening of effective agroindustrial and traders' associations

Partner(s): NGOs, project staff, NACCIMA, NASME.

The promotion and encouragement of viable associations of producers, processors, service providers, traders, and distributors is critical to the development of agricultural markets, agroenterprises, and rural nonfarm economies. Such organizations could address some of the constraints specific to agricultural production and marketing systems. They can serve as a political voice for the economic interests of farmers and other stakeholders who are normally too poor and too scattered to be heard, and provide a platform and a common voice for effective interactions with government. This project will facilitate development

and strengthen effective agroindustrial and traders' associations as the long-term success of the project will depend on its success in organizing the stakeholders of each cassava subsector in a way that would facilitate sustainable development and commercialization. The project may develop relationships with village farmer groups, cooperatives, individual smallholder farmers, associations of small entrepreneurs, or any other formal or informal organizations playing a significant role in the cassava subsector. Capacity building will extend to assisting small producers and agribusinesses to organize into relevant professional associations. Stakeholders will be identified at the initial stage of the subsector analysis. Various implementation meetings of stakeholders will be organized to identify additional participants and to discuss the organizational structures for the mobilization of farmers, processors, and end-users, and to secure their commitment to the project. The stakeholder meetings should establish the coordination structure for the local groups and organizations willing to be involved in the implementation of the project.

3.3 Stimulate and promote advocacy (through participatory mechanisms) for strategic policies to enhance cassava commercialization and trade.

Partner(s): Cassava commodity associations, organized private sector.

Lack of adequate policy and regulatory frameworks causes distortions in agricultural markets and serves as disincentives to producers. The promotion and encouragement of viable associations of producers, processors, service providers, traders, and distributors are critical to the development of agricultural markets, agroenterprises, and rural nonfarm economies. Such organizations could address some of the constraints specific to agricultural production and marketing systems. They can serve as a political voice to the economic interests of farmers and other stakeholders who are normally too poor and too scattered to be heard. This project will attempt to facilitate and promote the creation of lobbying groups (mixture of those with a stake in the commodity) to look after the interests of the crop, such that sectoral policies are designed for cassava to attract investments along the continuum from production to consumption.

3.4 Facilitate agri-input and service delivery systems (fertilizer, agrochemicals, tractor services, machine fabricating, processing, etc.) to support cassava commercialization.

Partners(s): National agri-input associations, State agri-input delivery companies (parastatals under State Ministry of Agriculture), cassava commodity associations, ADPs.

The project also recognizes the importance of facilitating the development of the private agri-input businesses to support the cassava production. Linking small-scale cassava farmers and processors to existing or new growth markets backed with an efficient input and service delivery system will strengthen the capacity to integrate research and development activities on cassava production, processing, and marketing to capture the market potential for the crop. This will enable cassava products to be developed as widely traded commodities that contribute to economic growth. The project will work closely with the private sector to drive this development.

3.5 Develop an active market information acquisition, 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 to serve and promote cassava commercialization.

Partner(s): State radio stations, Private media houses, Newspaper companies, IITA, project Staff, GSM companies.

Although market information is an important component in trading, this service is hardly functioning in Nigeria. Consequently, farmers and many traders are left with little information for negotiation. This leads to both parties taking risks in trading and the cost of this risk is often born most heavily by the producers who accept low prices and consumers who must pay high prices. This also serves as a disincentive to investment. This project will assess the information needs, data requirements, and existing market information system (MIS) for supporting cassava commercialization.

It will provide an information service and market intelligence on cassava and other agricultural commodities; and inputs nationwide for use by stakeholders (producers, processors, researchers, input dealers, product marketers, and end-users) in the cassava commodity chain to enable them to make informed decisions that will enhance cassava productivity, incomes, and trade. It will facilitate the formation of user groups (e.g., radio listeners groups) of the market information, and monitor feed back from clientele.

The cassava project will work with other national and regional agencies to develop an efficient MIS. This will involve the collecting of price and market data, and the processing and dissemination of information to domestic and international market clients. The cassava project will partner both domestic and regional MIS, where necessary, to strengthen capacity in the collection and delivery of basic MIS data from producers, traders, policymakers, and others associated with the cassava commodity chain.

3.6 Promote and link small and medium-scale enterprises to financial institutions for credit, and to appropriate domestic and export markets.

Partner(s): NACRDB, Union Bank, Bank of Industry, Agricultural Credit Guarantee Scheme, microfinance institutions, agricultural development projects of oil companies, NACCIMA.

IITA is cognizant of the need to improve access to financing for cassava producers, and processors, as well as agricultural input suppliers if this project is to have a rapid impact. This project will facilitate partnerships between producers/processors and private financial institutions to provide credit to project beneficiaries. IITA experience with the RUSEP project and similar projects in eastern Africa (FoodNet) suggests that it is more effective to work with existing financial institutions or input providers (as the case may be) and to build workable mechanisms, where possible. In linking small and medium-scale enterprises within the cassava project to financial institutions, we will identify local private sector partners, and NGOs for strengthening finance to project clients. This approach has worked perfectly with the Union Bank Plc., Nigeria, providing credit to RUSEP farmers in Nigeria.

Linkages between producers, processors, and markets are weak, yet such linkages are crucial in securing access to raw materials and outlet markets for the producers. Producers

lose tonnes of commodities and value because they lack information about markets for their products. Transaction costs are high, due to the absence of effective linkages, useful information, and other nontechnical barriers. In most cases, agroprocessors, traders, consolidators, transporters, packers, etc., spend an inordinate amount of resources in seeking and protecting information. IITA has resolved several such situations by linking producers and processors of the commodities to respective agribusinesses, profitable markets, and opportunities. As these linkages and markets improve, small-scale farmers and agroprocessors (entrepreneurs both) and consumers benefit in the long-term through improved trade, value adding activities, employment, and increased local investment in producing enterprises. Strategic research on emerging markets (national, regional, and international markets) would be conducted to increase economic growth of rural communities. The project will also link producers and processors to profitable markets and opportunities

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

4.1 Establish and maintain cassava development and resource centers for zonal technology transfer and training.

Partner(s): Project staff, NRCRI.

Institutional and human capacity building in this project will be accorded high priority. In providing a mechanism that would serve as a vehicle to achieving the goal of a commodity-based approach to cassava development and commercialization for the 12 target states, this project will establish and operationalize cassava development and resource centers (CDRCs) as a model agrobased technology development for demonstration and delivery, and as an information and training center to enhance the socioeconomic and nutritional well-being of the rural farm families through increased, profitable, and sustainable farm production as well as expanded utilization options and increased entrepreneurial skills. The CDRCs will also serve as a clearing house for cassava technologies and as a source for various kinds of information related to production, processing, and marketing as well as a drop-in center for stakeholders for professional advice. They will be training centers, and provide a multiple avenue for information dissemination print, radio, audiovisual, electronic, and internet.

The CDRCs will be situated at two zonal hubs for technology dissemination, input supply, and market linkages: Onne High Rainfall Station, Rivers State, to serve the needs of the south-south states and Ondo State, and National Root Crops Research Institute, Umudike, Abia State, to serve the needs for a commodity-based cassava commercialization and development center in the south-east states. These centers will encompass the strategic stocks of planting materials of productive varieties for large-scale multiplication and distribution, demonstration of best-bet production technologies; generation, adaptation, and dissemination of novel value-adding postharvest technologies and products, information and documentation for investors and training, and capacity building for researchers, extension workers, and the NGOs.

4.2 Develop and strengthen capacity of cassava producers and processors for sustainable production, processing, and utilization technologies.

Partner(s): RTEP, ADP, universities, NRCRI, IITA, project staff, private sector, NGOs.

Agricultural development encourages the growth of small and medium-scale enterprises as dynamic sources of job creation and diversification of production that are vital to the economic status of a country. Unfortunately, the poorly functioning markets and low levels of technology use constrain increased agricultural productivity. This project will implement a series of training activities from researcher to farmer's level to meet the human resource development needs and will engage technical providers to address constraints identified by the project in a manner that explicitly builds local capacity. In particular, preference will be given to technical providers—both private and public—in the project zone. Where necessary, these providers will be backed up with relevant institutions such as specialized market, trade, and processing companies, and centers providing relevant technology. In instances where technical backstopping is provided by a subcontractor from outside the country, the engagement arrangement will be done in such a way as to develop capacity and minimize dependency. For example, should some policy work be needed, a national university or institute could be engaged. If such a national institute will need help, IITA could engage the services of a more competent international organization to assist them. In such instances, the terms of reference of the international organization will be so defined that the capacity of the local institution will be enhanced.

4.3 Develop capacity of entrepreneurs in market identification, product development, storage and enterprise development.

Partner(s): Project staff, NSPRI, FIIRO.

In developing profitable agribusinesses based on the cassava commodity, the capacity of SMEs would be strengthened through training to develop business plans, do product costing and pricing, and source agricultural input and manage a regular supply to producers, processors groups/associations. Individual SMEs would also be enhanced in business management, while group management would be encouraged to develop into companies.

4.4 Enhance entrepreneurial capacity to adopt cassava product standards and grades for local industrial and export markets.

Partner(s): SON, NAFDAC, universities, project staff, consultants.

Capacity building will extend to assisting producers and processors to adopt grades and standards that favor the utilization of existing products and the development of new products with added value.

4.5 Train farmers and processor groups in credit management, group organization and management, and microenterprise development.

Partner(s): Universities, project staff, training department of finance institutions, consultants.

Capacity building will also extend to assisting farmers and processors groups to develop business plans for credit and finance.

4.6 Identify and train fabricators for the fabrication and servicing of postharvest and processing machines for widespread dissemination on a sustainable basis.

Partner(s). Project staff, NCAM, PRODA, ARCEDEM, FIIRO.

Local manufacturers with capacity to adapt prototype laborsaving machines will be identified, and assisted to form a network that will facilitate the supply of the demand-driven equipment. Formal training courses on manufacture or adaptation as well as the servicing of proven postharvest and processing machines will be carried out to enhance the skills of fabricators in the project states. The participation of the private sector will be encouraged and strengthened to ensure a sustainable supply of machines for cassava commercialization.

4.7 Develop, produce, and disseminate training and extension support materials.

Partner(s): Project staff, universities, ADP, NAERLS, consultants.

In collaboration with various national research and extension institutions, pertinent IARCs and NGOs, the project will prepare training and extension support materials stressing the need to focus on growing a healthy cassava crop, and on the appropriate production and utilization of cassava as a viable business. Training and extension support materials will be designed to promote the understanding and application of cassava IPPM technologies and practices through postharvest marketing and consumption. The common materials will be the print materials, field guides, fact sheets, folders, posters, etc.

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

5.1 Organize annual stakeholders consultative forum for project sensitization and focus.

Partner(s): Project coordinator and staff.

Much of the success of emergency CMD management efforts in East Africa can be attributed to the establishment at the outset of a strong, committed, and broadly inclusive network of cassava stakeholders with interests in the affected zones. A practical feature of this network was the institution of regular regional stakeholder meetings and the setup of national advisory committees in each of the affected countries. In the Nigerian project, significant efforts have already been made to establish a network of cassava stakeholders. The project proposed here will strengthen this process of meeting regularly to review progress in the cassava work through contributing directly to the financing of stakeholder and advisory committee meetings and through providing technical guidance from IITA.

At the onset of the implementation of major components of the project, stakeholders encompassing key participants relating to the output (farmers groups, processors, end-users, national research and extension institutions, NGOs, industrialists, microfinance institutions, agroindustry policymakers) will be identified and invited for a meeting to discuss all aspects of the project, to obtain their commitment to the project. Similarly, coordination meetings of stakeholders will be organized annually or as frequently as required. As a sign of commitment to the project, stakeholders would participate in those meetings at their own cost. The purpose of the stakeholders meeting is to take stock of progress made, to identify constraints, and to strengthen the links between the various stakeholders.

This project will seek to leverage its efforts with those of other interested parties, the private sector, more established agribusiness firms, and other donor projects to explore synergies for expanded impact. Efforts will be made to facilitate the establishment of a public–private cassava research and development coalition in the zones.

5.2 Define target communities and partners and involve them in project implementation design.

Partner(s). Project staff, RTEP, ADP, and consultants.

Prior to project implementation, a team of key scientists in collaboration with other project partners will carry out a needs assessment in the target geopolitical zones to identify target communities (producers), processes, middlemen, fabricators, and other key stakeholders, using criteria set in the project focus (market access, supporting services, high probability of success, etc.). Once potential players have been identified, they will become an integral part of the project implementation process. Planning workshops will be convened to define administrative and technical roles of each partner, specify end-user needs, and agree on the contractual obligations of each partner.

The project will be implemented within a participatory and collaborative framework. To ensure success and guarantee impact on all beneficiaries, the project will continuously monitor and evaluate progress against targets and will use an incremental approach that ensures the proposed improvements are realistic and take into account the socioeconomic context and absolute needs for sustainability.

5.3 Establish a national advisory committee for administrative and technical oversight.

Partner(s). Project coordinator and staff.

The project will set up an advisory committee (AC). The objective of the AC will be to maintain the communication link between IITA and the broad range of project participants. Provisionally, the AC will have 13 official members. In essence, the AC will be the technical and administrative arm of the project, to include the monitoring and evaluation of project performance, and will normally meet once annually.

5.4 Organize work planning and review meetings for refinement of project activities.

Partner(s). Project coordinator and staff.

Experience gained in review and planning meetings through IITA-implemented CMD management efforts in East Africa will be used to strengthen the processes that will comprise the main activity of the work planning and review meetings of this project. In practical terms, meetings will review technical and financial reports and progress made towards attaining of the objectives of the projects.

5.5 Collate and update, where necessary, detailed baseline information and develop performance and monitoring indicators.

Partner(s). Project staff, RTEP, ADP, and consultants.

A needs assessment will be implemented to identify major constraints and opportunities for commercializing cassava in the targeted communities. Teams comprising an agronomist, agricultural economist, a food technologist, enterprise development specialist, and an

agricultural engineer will undertake a needs assessment of the cassava subsector in target zones (south-south and south-east) in the first 6 months of the project. Using formal questionnaires and informal interviews, the team will collect information on the vertical perspective of the cassava industry, domestic and international competitors, coordination between firms and linkages, points of leverage (e.g., credit availability, national policy, processing technology, and improved varieties), and stakeholder commitment especially local organizations and markets. The team will write and present a report of the field survey to project management team and stakeholders. The report will reflect the size of the different cassava markets, growth prospects, product flows, quality and standards, industrial and nonindustrial uses, and the characteristics of the target groups and beneficiaries, farmers, processors, small- and medium-scale entrepreneurs, agroindustries, and investment climate. Using information obtained from the needs assessment, performance and monitoring indicators will be developed which will be used later to evaluate the impact of the project on the intended beneficiaries and the rural economy.

5.6 Monitor project implementation and conduct midterm project evaluation.

Partner(s). Donor, AC, project coordinator and partners, consultants.

Participatory project evaluation and monitoring will be carried out annually (including midterm) by stakeholders to assess results against a given set of performance indicators (to be developed after needs assessment), introduce interim adjustments, and generate feedback for future planning. The project coordinating office in collaboration with the AC and key partners will participate in the project reviews. Monitoring and planning meetings will appraise technical reports and progress made towards attainment of project objectives. The general expected output of this activity will include reviewing achievements, identifying constraints, establishing priorities for future activities, evaluating human and financial resources available and those required to effectively carry out the planned activities, and identifying training needs.

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

Partner(s). Project staff, RTEP, ADP and consultants.

This activity will generate new knowledge on adoption pathways and critical events that promote or prevent the adoption of improved technologies. Studies will involve analysis of the current adoption status and document the history, trends, patterns, and prospects of technology adoption. Adoption studies will be also concerned with how far the introduction of an improved technology has been successful in meeting socioeconomic objectives and how well improved agricultural technologies have satisfied the needs and priorities of households and other units in the target population. These studies will be closely linked to impact studies.

5.8 Organize biennial cassava trade shows to foster cooperation among industry stakeholders with a common objective.

Partner(s). Project coordinator and staff.

The purpose of this activity is to encourage and support biennial cassava trade shows. The shows will attract producers, traders, processors, marketers, consumers, importers, and exporters to a central location to network, exchange ideas, techniques, and information, and form partnerships. Shows will consist of exhibits, discussions, demonstrations, and events to support the industry and encourage partnerships. With proper development, promotion, and advertising, these shows could attract buyers, wholesalers, and importers from domestic and international markets to the project target areas for years to come and serve as an example for other commodity-specific shows. As the cassava industry matures and develops, so too will the shows and exhibits, thus providing a measurable outcome from this activity.

5.9 Evaluate impact of project activities on productivity, rural incomes, and employments.
Partner(s). External consultants.

At the end of the project, an impact specialist (to be hired by the project) will conduct a detailed assessment to document the impact of the project on productivity and on all key players in the cassava subsector and on the rural economy. In addition to economic impact assessment, the social impact of the technology interventions involved in this project on the lives of people, their welfare, gender relations, and other social processes will be measured.

5.10 Organize two zonal workshops of stakeholders to review achievements and lessons learned.

Partner(s). Project coordinator and staff.

Two zonal stakeholders' workshops in the south-south and south-east zones, involving project partners, policymakers and all those interested in the cassava subsector will be held towards the final year of the project. The workshops will review all achievements in the respective zone and recommend scaling-up of success stories.

5.11 Organize a national stakeholders' end-of-project workshop to review achievements and lessons learned.

Partner(s). Project coordinator.

The final activity of this project will be a national stakeholders end-of-project workshop involving project partners, policymakers, and all those interested in the cassava subsector. The workshop will review all achievements and recommend scaling-up of success stories.

Expected benefits

1. A looming cassava crisis and national disaster posed by the outbreak of virulent CMD that could cause chaos, hardship, and economic turmoil averted.
2. Enhanced food security from the provision and adoption of safe and high quality improved CMD-resistant cassava varieties targeting the food, feed, and industrial uses, as well as stable volumes of cassava products in local markets for households and the general public.
3. A decentralized community-based, cost-effective, and sustainable system for the multiplication and distribution of plantable stems of cassava to farmers established in every state and operated by farming communities.

4. At least 200 000 resource-poor farm families in each of the south-south and south-east states, also in Ondo State, will benefit directly from the multiplication and distribution of planting materials of the best high yielding CMD-resistant varieties.
5. State-wide production increased due to greater and timely availability to farmers/ farmers' associations of healthy planting materials of several improved and diverse CMD-resistant varieties for specific end-uses, and cassava yield increased by at least one-third in farmers' fields.
6. Smallholder farmers' communities, small and medium-scale processors/entrepreneurs have access to simple market-oriented and competitive production, processing, and utilization technologies and products of cassava transferred from credible national and international institutions, allowing them to improve their food security and cash income capacity.
7. A functional and sustainable national system for the acquisition and dissemination of cassava market information accessible to target small-scale producers, processors, and retailers, and other entrepreneurs to enable them make timely decisions on trade and investment.
8. Supply-chain structure for primary and secondary cassava products better organized and strengthened, and agribusiness linkages between farmers' groups, agroprocessors/ entrepreneurs, credit institutions, input dealers, and markets strengthened to increase productivity and access profitable market outlets.
9. A large cadre of stakeholders (farmers' groups/associations, small and medium-scale processors/entrepreneurs, staff of national institutions and extension services, and nongovernmental and community organizations) acquired improved skills needed for the good functioning of commercially oriented agricultural operations (appropriate demand-driven production methods to maximize yields, and appropriate value-adding postharvest technologies, and agroenterprise development).
10. Increased income for producers, processors, marketers, and rural laborers from the resultant increase in employment opportunities, greater enterprise profitability and stability leading to substantial improvements in livelihoods. Family labor for the processing of cassava, especially for women who usually are in charge of these activities, would be translated into social benefits, such as a better infrastructure, health, and child care.
11. Significant savings in foreign exchange for the national economy from import-substitution and export of cassava-based products.
12. Networking, partnership, and cooperation among a wide range of stakeholders (policymakers, investors, entrepreneurs, credit institutions, input dealers, producers' associations, processors, nongovernmental and community organizations, research institutes, universities, extension services, and regional and international institutions) strengthened to enhance the cassava subsector.

Target beneficiaries

The project will benefit all stakeholders (producers, small and medium-scale processors, fabricators, commodity traders, consumers, national institutions and government, and private sector agribusiness entrepreneurs) involved in production, processing, handling, marketing, and consumption in the cassava subsector as a result of the 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 livelihood.

The primary beneficiaries of this project are the resource-poor smallholder farmers in the south-south, south-east, and north-central states, many of whom are women. They will benefit from improved access to a higher quantity of quality planting material of diverse high yielding cultivars, with multiple resistance.

Increased knowledge and capacity, as well as the adoption of integrated methods of competitive production, disease and pest management, and improved postharvest and processing of the perishable cassava roots to more shelf-stable and various high value products either for food or use in industry, will result in (1) better management of the cropping systems, (2) the reduction of disease and pest problems and losses both in the field and during storage, and (3) a higher quantity and quality of processed products. The resultant increase in on-farm yields of cassava per unit land area and time, labor, and cash expenditure, stabilization of productivity, and increase in the area of production, will be major contributions in improving the food supply situation in the whole country. The resource-poor smallholder farmers will also gain from improved productivity and the growing demand for the crop resulting from increased postharvest processing, and trade, employment, and higher output prices and income.

Processors, commodity traders, and consumers/small-scale industrial users who are secondary beneficiaries will benefit through increased cassava availability, demand, and commercialization. Processors of cassava to basic industrial raw materials will gain through increased commercialization of the crop resulting from improved demand for quality products and more efficient processes. Processors (including women) will be able to sell a range of improved, new, and value added products with lower production costs due to improved storage and processing efficiencies which will, in turn, raise price premiums and improve competitiveness. The opportunities for increased job creation in the rural areas will also reduce rural urban migration.

Commodity traders will benefit from the increase in market demand and take advantage of the situation to draw more effectively upon facilities and resources, including credit, to link producers with consumers to increase trade volume.

Consumers of cassava products, including low income consumers in rural and urban areas of Nigeria, will gain from the improved availability and reduced costs of food commodities as a result of economies of scale in processing and handling, as well as from competition in the marketplace. Industrial users of cassava-based raw materials will have the advantage of improved local availability of low cost and high quality raw material over similar, competing imported raw materials.

National institutions will acquire the capacity to identify needs, design and implement research, develop and extend programs that integrate cassava production and processing/ utilization and marketing in a way that leads to community-based economic growth, as well as to influence and guide national policies.

The government will benefit from domestically available raw materials for food, feed, and industry, by reducing current import requirements for basic commodities and/or by raising foreign exchange earnings through regional and international trading.

Staff of national and international organizations involved in the project will also benefit from the collaboration, training, and the exchange of information. The open flow of communication between scientists, extensionists, producers, and end-users is critical in the development of technologies that suit market needs and meet the research and development goals.

Other benefits of the project include the achievement of a sustainable increase in cassava production in fragile agricultural environments. The adoption of the ecologically sound techniques to control pests and diseases, manage soil fertility and cropping systems, as well as to add value to and expand the utilization of cassava will increase and stabilize productivity, foster a pesticide-free environment, enhance food security, and raise incomes in the project areas. As over-exploitation of natural resources and nonsustainable agricultural practices have their root causes in poverty, farmers will have an opportunity to prevent environmental degradation of both their fields and the surrounding vegetation, as well as to raise their incomes.

In the short term, the project would also have established minimum multiplication systems at Abuja and Makurdi in the north-central, and Ikenne and Ibadan in the south-west zones that can subsequently be used as seed stocks in the second phase of the project for providing planting materials of resistant varieties in the two zones.

Project management, monitoring, and evaluation plan

Project governance

The project governance structure is illustrated in Figure 9. IITA will be the project executing agency and a cassava specialist recruited by IITA will coordinate the project and be charged with the responsibilities of participating in and facilitating the implementation of the project activities in the country. The terms of reference of the project coordinator/manager will be set by IITA management, in liaison with partners in Nigeria, and will be at the level of an internationally recruited member of staff. Other project staff recruited in both the coordination office and the zonal and state offices will assist the project coordinator/manager.

Project advisory committee

At the onset of the project implementation, a broader stakeholders' meeting will be held and during this meeting, an advisory committee (AC) will be appointed from representatives of the Federal Ministry of Agriculture and Rural Development, state governments, national agricultural research system (NARS), IITA, producers' associations, the private

sector, and donor representatives. In essence, the AC will be the technical and administrative arm of the project, including the monitoring and evaluation of project performance, and will normally meet once annually. The official membership of the AC will normally not exceed 15 members nominated as follows:

States: AI = Akwa Ibom, CR = Cross River, RI = Rivers, BA = Bayelsa, DE = Delta, ED = Edo, AN = Anambra, AB = Abia, EB = Ebonyi, EN = Enugu, IM = Imo, ON = Ondo
RDC=Research-for-Development Council of IITA

FGN = Federal Government of Nigeria, SGN = 12 state governments of Nigeria, NNPC = National Nigerian Petroleum Corporation, Partners = major oil-producing companies in the Niger Delta, USAID = United States Agency for International Development.

- Representative of FMARD (1)
- Representative of governments of south-south states (2)
- Representative of government of south-east states (2)
- Representative of major oil producing companies (1)
- Representative of USAID (1), Representative of NDDC (1)
- Representative of NRCRI (1), Representative of IITA (1)
- Representative of cassava growers' associations (1)
- Representative of cassava processors' association (1)
- Representative of cassava equipment manufacturers' association (1)
- Representative of private sector (2)

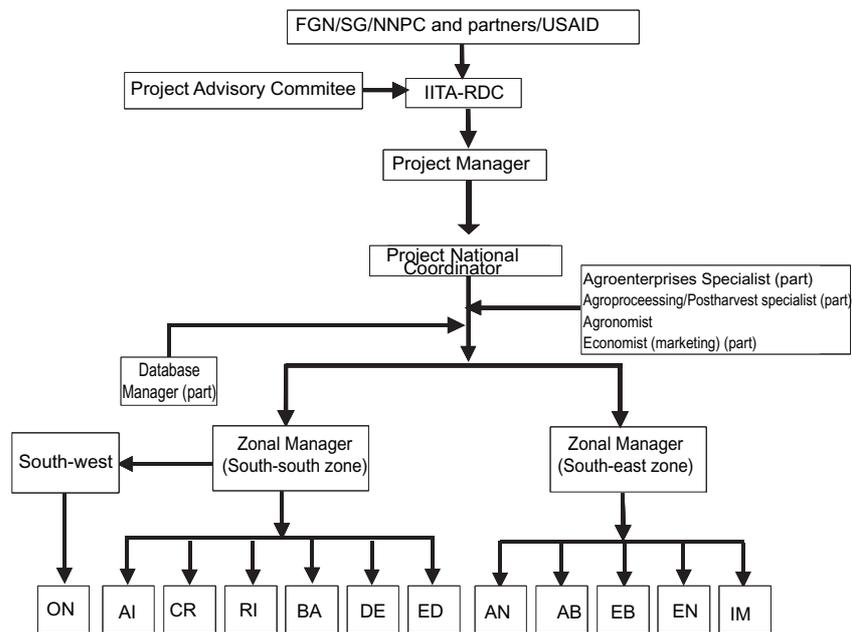


Figure 9. Project governance structure.

The chairperson of the AC will be elected yearly from among the members. The project manager will serve as secretary to the AC. Representatives of the governments of the south-south and south-east states will be appointed on a yearly and rotational basis. This is to ensure that during the project life, all states would have been represented in the AC. There will be two private sector members, one of whom must be a woman and the nominee must be directly involved with cassava production and processing. The Federal Ministry of Women Affairs would be requested to make this nomination.

Management of project funds

IITA will manage and account for project funds. The project coordinator/manager will be responsible for day-to-day management of operating and research funds. Funding in support of national activities will be disbursed directly to the participating-collaborating institutions and will be made according to the approved budget and in tranches following receipt of financial statements on expenses previously incurred. The preparation and submission of financial statements to the donors will be the responsibility of the IITA Budget and Finance staff. Reimbursement from donors will be requested in accordance with the Memorandum of Grant Conditions.

Project monitoring plan

Monitoring and evaluation will provide the means for assessing results against planned objectives, introducing interim adjustments, and generating feedback for future planning. The project will be monitored through the assessment of progress against targets and indicators provided. Assessments of progress will be made both on the basis of reports received from collaborators and from visits to sites of project activities made by IITA scientists and support staff as well as collaborating partners. At the end of each quarter of the project, a cumulative measurement of the project achievements will be set against the end of project target for each activity. This will provide a measure of the project progress in completing the activities which, when fully accomplished, will lead to the attainment of project objectives.

Annual program planning meetings will also be instituted to appraise technical and financial reports and progress made towards the attainment of project objectives.

Monitoring progress and measuring impact

Monitoring and evaluation will provide the means for assessing results against planned objectives, introduce interim adjustments and generate feedback for future planning. As the project starts, and during the first year, an ongoing baseline diagnostic survey of cassava agroecosystems as well as the subsector analysis will establish a true and most precise status of the distribution and severity of various cassava biotic, agronomic, and socioeconomic constraints including marketing needs and opportunities in the project areas. In addition, the knowledge of the structure and performance of the subsector will guide project interventions.

Assessing the impact of project interventions on trends of cassava production, processing, utilization, marketing, and trade is of paramount importance to the success of the project.

The potential impact of interventions measured by objectively verifiable indicators will be evaluated against baseline information. The draft set of indicators (see logical framework) should therefore assist in identifying key data sets required to provide the basis for the evaluation of the project. They have to address issues such as changes in productivity and income, adoption rate, and impact on resource base. Donors and IITA representatives, in conjunction with participating stakeholders, will assess project accomplishments by conducting a final evaluation.

The project will also employ the services of an external party, preferably an independent consultant, to assess the impact of the project in its final year, and the pre- and end-of-project surveys will demonstrate a positive impact on increased productivity, raised rural income, and improved food availability.

Project evaluation and audit

Development investors and IITA representatives, in conjunction with external resource persons, will conduct the project evaluation. The review will assess project accomplishments to the extent practicable and assess the impact of the project. Project financial audits will be conducted by IITA's Internal Auditor and/or as required by the development investors.

Reporting

The Project Manager (PM) through IITA will prepare biannual and comprehensive annual reports on technical matters for submission to the development investors. Sixty days before the completion of this project, the PM will prepare a draft of the final report incorporating a review of project achievements, problems encountered, and recommendations for future activities with regard to specifically stated objectives. The PM will also report through the Budget and Finance Department of IITA for financial matters, and through the Contracts and Grants Office of IITA for any other matter. These IITA units would then finalize the technical and financial reports for submission to the donor. IITA will submit to donors, on a quarterly basis, financial reports of its expenditure and accruals through its Budget and Finance Department. The format for this reporting will be in accordance with the donor's directive. All reports will be submitted by IITA to the donor supporting the project.

Budget requested from multiple development investors and duration

The total funding required is US\$17.1 million from various development investors over a period of 4 years (2003–2006 (FY3–Y6)). Through these contributed funds, IITA, in collaboration with a wide range of institutions and other stakeholders in Nigeria as mentioned earlier, will implement the overall project to attain its goal and objectives contained herein. The project will be projected to have a phase 1 (2003–April 2006) for the south-south and south-east zones, and a possible phase 2 (May 2007–April 2010) for the south-west and north-central zones.

Budget notes

Personnel (salary and benefits)

Provision has been made for a Project Manager/Coordinator (cassava specialist) and key core scientists at the coordination office. The Project Coordinator (cassava specialist) will be charged with the responsibilities of participating and facilitating the implementation of the project's activities in the country. Provision is also made for agroenterprise specialist, agroprocessing/postharvest specialist, agronomist, agricultural economist (marketing), and website and database manager to assist the coordinator in executing project activities. The budget for these members of staff is based on IITA terms and conditions of service. They include salary, health insurance, retirement benefits, initial/terminal travel, cost of living allowance, children and hardship allowances.

For effective implementation of the project, nationally recruited zonal managers (1 per zone = 2) will be hired to assist in the coordination of project activities at the zonal level. Provision is also made for hiring of technicians (production, agroprocessing, and marketing) in the zonal and state offices. In addition, administrative, biometric support, secretaries, accounting staff, and drivers will be hired to support the coordination, zonal, and state offices. The remuneration package will be in accordance with IITA standards.

Vehicles and operations

It is proposed to purchase four-wheel drive vehicles for scientists in the coordination office, and for each of the zonal and state offices, to enable effective implementation of project activities. This budget line item is to cover the cost of purchasing these vehicles.

There will also be frequent need to transport large quantities of heavy and bulky planting materials and equipment to various locations in the project area. Funds are allocated in this budget line item to cover the costs for purchasing two 7-tonne trucks for this purpose.

Provision is also made to buy motorcycles for the technicians (production, agroprocessing, and marketing) in each state to enable them to perform the research and development activities of the project. In addition, the vehicle and motorcycle insurance and operations (maintenance, fuel, and lubricants) are also provided for in this budget line item.

Equipment and supplies

Funds have been allocated for the procurement of postharvest processing and demonstration facilities including processing equipment and pilot/demonstration units, postharvest supplies (consumables), and propagation facilities/nurseries.

Funds have been also set aside under this line item to buy basic laboratory items (chemicals and glassware), and general and field supplies including field tools, herbicides, fertilizers, etc.

Provision has been made under this line item as well for acquiring basic office equipment and supplies. Part of the funds set aside is to pay for vital services such as communication (postage, courier, Internet link/website and email, etc.), among the coordination, zonal and state offices.

Support for collaborative interventions and activities

One of the major thrusts of the project is partnership with collaborating institutions and stakeholders. Funds have been set aside to support collaborative research activities and interventions. This budget line item will cover expenses related to accomplishing the activities related to the listed outputs.

Consultancy services

The project will require from time to time the services of short-term consultants to provide technical assistance and training expertise to the project which IITA cannot provide. These will be hired as required to assist the project coordinator in project implementation. The honoraria, per diem, travel, and lodging will be met from this budget line item.

Public awareness campaign

A public awareness campaign is an integral part of this project. Funds have been set aside in this budget line item to support publicity.

Travel

The coordinator and zonal project staff will travel extensively within the country to project sites to participate in collaborative research, technology validation, and technology transfer activities. Provision has been made to cover the expenses (accommodation, local travel, and per diem) of senior project staff and their technicians during project-related activities. Provision has also been made to cover economy class air tickets (where necessary), per diem, accommodation, and local travel per diem for technical backstopping from other international research centers.

IITA central services and overhead

IITA charges this fee for central services and overhead expenses incurred in managing the project and these costs are calculated at 22.8% in accordance with the current audited rate in effect for IITA.

In-kind contributions

IITA will:

1. Provide technical and administrative backstopping to the project.
2. Provide improved germplasm for varietal improvement and evaluation.
3. Allocate land and facilities (labs, lab equipment, library, publications, etc.) for cassava research and related developmental activities.
4. Provide office space.
5. Provide management support to the coordinator.
6. Contribute towards in-service training for the project.

National agricultural research and extension systems (national research institutes and agricultural development projects) will:

1. Allocate land and facilities for cassava research and related developmental activities.
2. Assign national scientists and extension staff for project research activities and pay their salaries and allowances.

3. Provide office and laboratory space.
4. Provide training at all levels approved by stakeholders.
5. Support consulting visits.

In addition, the staff and capacity of universities, national extension service (ADPs), media, and private sector operators in the country will be inventoried at the start of the project and during the stakeholders' meeting. As much as possible, their manifestations of direct and sustained collaboration, given their program commitment, will be assessed and solicited, but their budget allocations are difficult to pin down at present.

A number of international and local NGOs, and the private sector including producers and processors' groups would be expected to provide varying levels of support and contributions, mainly in kind and sometimes in supplementary budget outlays. They will also develop working relations with the rural communities and urban consumers to facilitate participatory implementation and project monitoring. They will be inventoried during the stakeholders' meeting as much as possible for manifestations of direct and sustained collaboration, given their program commitment, but their budget allocations are difficult to pin down at present.

Logical framework

Country/Region Nigeria-West Africa

Preemptive management of the virulent CMD through an integrated cassava development approach for enhanced rural sector economy in the south-south and south-east zones of Nigeria

Project management IITA Requested contribution from multiple development investors US\$17.1 million

Narrative summary Objectively verifiable indicators Means of verification Important assumptions

Overall goal

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| <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. | <ul style="list-style-type: none"> • 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. |
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Project purpose

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|---|---|---|---|
| <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 | <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 pre-project levels. | <ul style="list-style-type: none"> • Government statistics. • Annual project reports. • Workshop reports. • Independent impact assessment. • End-of- project report. | <ul style="list-style-type: none"> • Existence of demand for cassava produced by project beneficiaries. • Linkages between partners sustained. • All stakeholders remain committed to the project. |
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Narrative summary	Objectively verifiable indicators	Means of verification	Important assumptions
thereby ensuring food availability, providing increased economic opportunities, and reducing poverty in rural areas.	<ul style="list-style-type: none"> • More commercial producers. • More commercial users. • Competitive pricing. • Lower transaction costs. • Price reflects demand and supply conditions. 		

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, 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.

Narrative summary	Objectively verifiable indicators	Means of verification	Important assumptions
<p>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.</p>	<ul style="list-style-type: none"> • At least 5 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 post-harvest machines. • Follow-up reports of farmer surveys. • IITA reports. 	<ul style="list-style-type: none"> • Logistic and conducive environment to conduct survey. • Effective system for technology transfer.
<p>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.</p>	<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"> • 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.

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 post-harvest and processing technologies and product development needs and identify appropriate technologies for household and small/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"> • Number and type of appropriate postharvest and processing technologies for household and small to medium-scale businesses introduced and demonstrated in targeted communities. • Number 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. • Number of awareness campaigns of the postharvest and processing technologies and pilot centers created. • Extension booklets and other materials on postharvest technologies available to household, producers/processing groups, and small to medium-scale businesses. • Reduced workload in processing farm produce by rural women; minimized crop losses; more 	<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.

Narrative summary	Objectively verifiable indicators	Means of verification	Important assumptions
<p>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.</p>	<p>product options in addition to traditional foods.</p> <ul style="list-style-type: none"> • Increased production of good quality products with improved nutritional attributes. • 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. • Increased 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.

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	<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. 	<ul style="list-style-type: none"> • Project and IITA reports. 	<ul style="list-style-type: none"> • Available market data sufficient to conclude the review within the allocated budget.
3.1 Identify cassava market and investment opportunities to promote production, processing, and trade.	<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 	<ul style="list-style-type: none"> • Project and IITA reports. 	<ul style="list-style-type: none"> • Active voluntary participation by local organizations in the project activities and statements by such organizations.
3.2 Facilitate development and strengthening of effective agroindustrial and traders' associations.	<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. 	<ul style="list-style-type: none"> • 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.
3.3 Stimulate and promote advocacy (through participatory mechanisms) for strategic policies to enhance cassava commercialization and trade.			

Narrative summary	Objectively verifiable indicators	Means of verification	Important assumptions
	<ul style="list-style-type: none"> •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. 		
<p>3.4 Facilitate agri-input and service delivery systems (fertilizer, agrochemicals, tractor services, machine fabricating, processing, etc.) to support cassava commercialization.</p>	<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. 	<ul style="list-style-type: none"> •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.
<p>3.5 Develop an active market information acquisition and dissemination system for use by stakeholders in the cassava commodity chain to make</p>	<ul style="list-style-type: none"> •Number 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. 	<ul style="list-style-type: none"> •Project and IITA reports. 	<ul style="list-style-type: none"> •Radio stations functional and costs of broadcast not prohibitive.

Narrative summary	Objectively verifiable indicators	Means of verification	Important assumptions
informed decisions.	<ul style="list-style-type: none"> • Number of states, radio stations broadcasting MIS. • Market intelligence (current and forecasted information) available. 		
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. 	<ul style="list-style-type: none"> • Project and IITA reports. 	<ul style="list-style-type: none"> • Peace and stability to ensure uninterrupted implementation of project activities.

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 1. • 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 others (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 	<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.
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Narrative summary	Objectively verifiable indicators	Means of verification	Important assumptions
	<p>and farmers in the application and use of new technologies for land, crop, and livestock management.</p> <ul style="list-style-type: none"> • Number of new investments on cassava resulting from enhanced capacity of stakeholders. 		
<p>4.2 Develop and strengthen capacity of cassava producers and processors for sustainable production, processing, and utilization technologies.</p>	<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 training 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.

Narrative summary	Objectively verifiable indicators	Means of verification	Important assumptions
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"> • Farmers and other stakeholders willing to participate in training activities.
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 stateholders. • 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. 	
4.5 Train farmers and processors groups in credit management, group organization and management and microenterprise 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 	<ul style="list-style-type: none"> • Report on the number of active groups formed and registered with local authorities. • Project and IITA reports. 	<ul style="list-style-type: none"> • Male and female farmers ready and willing to be organized into groups.

Narrative summary	Objectively verifiable indicators	Means of verification	Important assumptions
	farmers' and processors' groups.		
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. 	<ul style="list-style-type: none"> • Project and IITA reports. 	
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. 	<ul style="list-style-type: none"> • Project and IITA reports. 	<ul style="list-style-type: none"> • Trained staff remain in their institutions.

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 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. 	<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.
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Narrative summary	Objectively verifiable indicators	Means of verification	Important assumptions
	<ul style="list-style-type: none"> • Evidence of complementary roles by different partners. • Number of joint programs implemented with selected partners. 		
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 socio economic 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 workplans and budget of project 	<ul style="list-style-type: none"> • Minutes/proceedings of meetings/workshops. 	

Narrative summary	Objectively verifiable indicators	Means of verification	Important assumptions
	activities established and outputs documented.		
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 shows 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 employments.	<ul style="list-style-type: none"> • Impact assessment conducted. • Positive 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. 	
5.10 Organize two zonal workshop 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 zonal workshop. 	

Narrative summary	Objectively verifiable indicators	Means of verification	Important assumptions
5.11 Organize a national stakeholders' end-of-project workshop to review achievements and lessons learned.	• National stakeholders' workshop held.	• Reports of end of project workshop.	

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