



ACTION PLAN ON CASSAVA VIRAL DISEASES IN BENIN

WEST AFRICAN VIRUS EPIDEMIOLOGY FOR FOOD SECURITY (WAVE)

November 2018

CONTENTS

FOREWORD BY THE MINISTER FOR AGRICULTURE, LIVESTOCK, AND FISHERIES	I-4
SUMMARY	I-6
I. CONTEXT	I-7
Current national situation on cassava viral diseases	I-7
Mapping of key stakeholders	I-8
Risk assessment	I-9
Current risk management process	I-10
Gap assessment	I-13
II. STRATEGIC OBJECTIVES AND VISION OF THE NATIONAL ACTION PLAN	II-15
Vision	II-15
Strategic objectives.....	II-15
III. STRUCTURE OF THE EMERGENCY OPERATIONS CENTER (EOC)	III-17
Institutional anchoring	III-17
Governance.....	III-17
Organizational structure.....	III-18
Human resources	III-20
Financial and material resources	III-23
IV. EMERGENCY RESPONSE PLAN	IV-25
Actions to be taken before an outbreak	IV-26
Actions to be taken in case of an outbreak.....	IV-28
Phytosanitary measures	IV-31
V. OPERATIONAL STRATEGY	IV-34
Strategy implementation plan	IV-34
Monitoring and evaluation plan for the strategy.....	IV-38

LIST OF ABBREVIATIONS

ABENOR: Agence Béninoise de Normalisation (Benin Agency for Standardization)

ABSSA: Agence Béninoise de la Sécurité Sanitaire des Aliments (Benin Food Safety Agency)

AfDB: African Development Bank

ATDA: Agence Territoriale du Développement Agricole (Local Agricultural Development Agency)

AWPB: Annual work plan and budget

BMGF: Bill & Melinda Gates Foundation

CBRSI: Centre Béninois de la Recherche Scientifique et des Innovations (Benin Center for Scientific Research and Innovation)

CBSD: Cassava brown streak disease

CIRAD: French Agricultural Research Center for International Development

CMD: Cassava mosaic disease

COOPDICPA: Coopérative de Distribution et de Commercialisation des Produits Agricoles (Cooperative for Distributing and Marketing Agricultural Products)

DANA: Direction de l'Alimentation et de la Nutrition Appliquée (Directorate for Food and Applied Nutrition)

DAAEP: Direction Départementale de l'Agriculture, de l'Élevage et de la Pêche (Departmental Directorate of Agriculture, Livestock, and Fisheries)

DFID: Department for International Development

DPV: Direction de la Production Végétale (Directorate for Plant Production)

DQIFE: Direction de la Qualité des Innovations, de la Formation Entrepreneuriale (Directorate for Innovation Quality and Entrepreneurial Training)

EACMV-UG: East African cassava mosaic virus-Uganda

ECOWAS: Economic Community of West African States

EOC: Emergency Operations Center

FAO: Food and Agriculture Organization of the United Nations

FAST: Faculty of Science and Technology, University of Abomey-Calavi

FNPS: Fédération Nationale des Producteurs de Semences (National Federation of Seed Growers)

FSA: Faculty of Agronomic Science, University of Abomey-Calavi

FUPRO: Fédération des Unions des Producteurs du Bénin (Benin Federation of Farmers' Unions)

GIZ: Deutsche Gesellschaft für Internationale Zusammenarbeit

IEC: Information, education, and communication

IFAD: International Fund for Agricultural Development

IITA: International Institute for Tropical Agriculture

INRAB: Institut National des Recherches Agricoles du Bénin (Benin National Agricultural Research Institute)

IPPC: International Plant Protection Convention

IRD: Institut de recherche pour le développement (French Research Institute for Development)

IsDB: Islamic Development Bank

LCBVAP: Laboratoire Central des Biotechnologies Végétales et d'Amélioration des Plantes (Central Laboratory for Plant Biotechnology and Plant Breeding)

LCSSA: Laboratoire Central Sécurité Sanitaire des Aliments (Central Food Safety Laboratory)

MAEP: Ministry of Agriculture, Livestock, and Fisheries

MESRS: Ministry of Higher Education and Scientific Research

NGO: Non-governmental organization

NPPO: National plant protection organization

PASCIb: Plateforme des Acteurs de la Société Civile au Bénin (Platform for Civil Society Actors in Benin)

PNOPPA: Plateforme Nationale des Organisations Paysannes et de Producteurs Agricoles (National Platform for Farmers' and Agricultural Producers' Organizations)

PSDSA: Strategic Plan for Agricultural Sector Development

ProCAD: Programme Cadre d'Appui à la Diversification Agricole (Agricultural Diversification Support Program)

PTAA: Programme de Technologie Agricole et Alimentaire (Agriculture and Food Technology Program)

SPS: Sanitary and phytosanitary

SPV: Service de la Protection des Végétaux (Plant Protection Department)

SOP: Standard operating procedure

UAC: University of Abomey-Calavi

UNA: National University of Agriculture

UP: University of Parakou

USAID: United States Agency for International Development

WAEMU: West African Economic and Monetary Union

WAVE: West African Virus Epidemiology

WTO: World Trade Organization

FOREWORD BY THE MINISTER FOR AGRICULTURE, LIVESTOCK, AND FISHERIES

Cassava is the third largest source of carbohydrates for human food and makes an ideal subsistence and cash crop for farmers. Hardy and resilient, it has emerged as a strategic crop for food security and poverty reduction. It is an inescapable staple food for almost 800 million people in the world, including almost 500 million Africans. In Benin, cassava is eaten by more than 75% of the population. Although highly productive varieties are available in Africa, with a potential exceeding 40 metric tons/ha, and our continent is the largest producer of the crop worldwide at 57%, the average yield in the continent is just 10 t/ha, less than Asia at 21.34 t/ha, according to 2016 estimates.

The low cassava yield in African countries is caused by biotic and abiotic constraints that negatively impact production. The most serious constraint is currently viral diseases, which must be tackled urgently.

Cassava mosaic disease (CMD) is the most prevalent in terms of its geographical distribution in Africa. Surveys carried out by WAVE Benin between 2015 and 2017 confirmed that cassava mosaic disease has a very high incidence in Benin. Laboratory analyses undertaken by WAVE in Benin, Burkina Faso, and the UK found that the Ugandan variant of mosaic disease (the most virulent form) is present in Tchikandou in the commune of Nikki. These tests also detected the Cameroon form of the virus in the commune of Abomey-Calavi. Almost all traditional varieties of cassava in the African continent are susceptible to the disease, which causes yield loss of 40–70%. Meanwhile, **cassava brown streak disease (CBSD)** can cause losses of up to 90% or even 100%. Both these viral diseases are a serious threat to cassava production.

According to the Food and Agriculture Organization of the United Nations (FAO), CBSD originating in East Africa has been identified in Central Africa and is advancing freely towards West Africa. Reviewing the situation, it is undeniable that CBSD, which is sometimes described – without exaggeration – as *“Ebola for cassava”*, **is headed for West Africa and if nothing is done about it, it will end up attacking all the countries in this subregion, including ours**. For this reason, we must throw ourselves into the management and prevention strategies needed to combat these emerging and re-emerging viral diseases such as CBSD. When this crisis of chaos – which we do not want – reaches our feet and our doors, will we be ready to face it? We must answer this specific question as clearly as possible.

That means drawing up a national action plan in response to cassava viral diseases and producing a road map for its effective implementation. The national action plan will be implemented by setting up an **Emergency Operations Center (EOC)** to tackle these diseases. We look forward to each other’s contributions. The objective of the plan is to contribute to the survival of millions of people

in our country and around us, namely those populations who rely, in their everyday lives, on the protection that we must guarantee for cassava here and now and on its production.

We are urged to accept more responsibility and mobilize our resources to put up a better fight against this vital challenge for our national and regional community. We shall not forget that Benin does not exist in a vacuum and that viral diseases on the move do not acknowledge the borders between countries. We are convinced that WAVE Benin is an opportunity we must not miss, especially bearing in mind that the other countries in this program are already working to put in place strategic plans that may allow them to contain this scourge. We will therefore have no excuse if we fail to meet our target of equipping ourselves with a concrete action plan on cassava viral diseases, now that we have the opportunity.

I would like to take this opportunity to offer my very sincere thanks to our technical and financial partners, including the most prominent for these activities, which is the Bill & Melinda Gates Foundation. This cause extends beyond our borders and we have a pressing duty to get to work for the wellbeing of our populations, particularly those in the most deprived areas.

Gaston C. Dossouhoui
Minister for Agriculture,
Livestock, and Fisheries

SUMMARY

Cassava is a staple food for the Beninese and is grown in almost all the country's agroecological zones. Its yield is falling day by day because of threats from many diseases that affect its productivity. Among these diseases, two viruses are a serious menace to cassava production. These are cassava mosaic disease (CMD), found in all production zones, and cassava brown streak disease (CBSD), which is threatening to reach Benin. These two viral diseases cause yield losses of up to 100%.

This document sets out a draft national action plan on cassava viral diseases and is divided into five sections. Section 1 covers the background on cassava viral diseases in the country and the key players involved in the cassava value chain. It also describes the levels of risk from diseases and the current procedure for managing outbreaks, with its strengths and weaknesses. Section 2 sets out a vision for the national action plan with four strategic objectives for tackling viral diseases in Benin. Section 3 describes the structure of the Emergency Operations Center (EOC), its institutional anchoring, and how it will be governed. This section also set out the human, financial, and material resources required to manage the EOC. Section 4 examines the actions to be taken before an outbreak and if one occurs, along with phytosanitary measures. It covers the risk analysis method, definitions of risk level, plans, surveillance, prevention, engagement, and partnerships to be developed before an outbreak; methods for detection, identification and confirmation, intervention, containment, quarantine, and elimination; how the system is activated and operates; and evaluation of the response. Finally, section 5 is a plan for carrying out the strategy, including a road map, system for mobilizing resources, management of risks related to implementing the action plan, and monitoring and evaluation plan.

I. CONTEXT

Current national situation on cassava viral diseases

Economic and social importance

Cassava is a staple food and the most commonly consumed crop in many African countries, including Benin. It has been identified by the Benin government as a priority crop in the Strategic Plan for Agricultural Sector Development (PSDSA). Previously used in times of cereal shortages, this crop is playing an increasingly significant role in the population's diet. In 2016, Benin produced 4,317,642 metric tons of cassava, according to figures from the Ministry of Agriculture (MAEP), and it is the second most common crop in terms of areas sown (Nekeyan, 2018). It is the most common root and tuber crop, accounting for 54% of surface area and 59% of total production. The area under cassava cultivation in the country rose from 209,812 ha in 2011 to 275,558 ha in 2016. Production has followed the same trend, increasing from 3,645,924 metric tons in 2011 to 4,317,642 metric tons in 2014. However, estimated mean yield per hectare was 13.05 metric tons in 2004, 17.37 t in 2011 and 15.66 t in 2016 (FAOSTAT, 2018), well below its potential of 40 tons per hectare.

This low yield compared with potential is caused by several constraints, of which the most dangerous are viral diseases. CMD and CBSD cause yield losses of up to 100% in susceptible cultivars. In Africa, losses from mosaic disease alone account for 2.3 billion USD. The disease is increasingly undermining food security in developing countries, including Benin. Plant damage from the virus is not directly observed by growers, and the harm caused by this disease is increasing every day in all the country's cassava production zones.

Summary of current situation

Cassava mosaic disease is present in almost all cassava fields in Benin. Recent studies have shown that the prevalence of this disease in the country has reached 97% (WAVE Benin survey, 2016). In addition, the most virulent form (EACMV-UG) was recently identified in Tchikandou, Nikki, not far from the Nigerian border (WAVE Benin). Investigations have also shown that methods to tackle the disease are not used and farmers have poor knowledge of how the virus is transmitted. They use cuttings from neighboring fields, which may already be infected, to sow new areas (Houngue et al., 2018). This is a significant factor in the rapid spread of the disease, and the consequences are rising daily.

Mapping of key stakeholders

Cassava value chain

	Research	Inputs	Production	Storage and transport	Processing	Marketing and promotion
Public	<ul style="list-style-type: none"> - INRAB - University of Abomey-Calavi - University of Parakou - National University of Agriculture - CBRSI 	<ul style="list-style-type: none"> - FNPS - COOPDICPA - INRAB - DPV - Universities - DDAEPs - Projects and programs 	<ul style="list-style-type: none"> - ATDAs - DPV 		<ul style="list-style-type: none"> - INRAB/PTAA - Universities - DANA - LCSSA - ABSSA - ABENOR 	<ul style="list-style-type: none"> - ABENOR - ATDAs - Public press
Private	<ul style="list-style-type: none"> - Universities - IITA Benin 	<ul style="list-style-type: none"> - Input distributors - NGOs - Farmers' organizations - Projects and programs - Seed companies 	<ul style="list-style-type: none"> - PNOPPA - Growers (smallholders) - NGOs - FUPRO 	<ul style="list-style-type: none"> - Transporters - Wholesalers - Growers - COOPDICPA 	<ul style="list-style-type: none"> - Processors - Packaging manufacturers - Transporters 	<ul style="list-style-type: none"> - Retailers - Private press - Consumer association - NGOs

Other relevant actors

Government	Private sector	Civil society, NGOs, foundations	Bilateral and multilateral partners	Other
<ul style="list-style-type: none"> - Ministry of Agriculture - MESRS - Ministry of Planning - Ministry of Interior - Ministry of Decentralization - Ministry of Finance - Public universities 	<ul style="list-style-type: none"> - IITA - Private universities 	<ul style="list-style-type: none"> - Friedrich-Ebert-Stiftung - BMGF - Alliance for a Green Revolution 	<ul style="list-style-type: none"> - DFID - USAID - GIZ - AfDB - World Bank (e.g. ProCAD) - FAO - IFAD - IsDB 	<ul style="list-style-type: none"> - Local councils / locally elected officials - Communications units / media - Religious actors

Risk assessment

Main threats	Level of risk (low / moderate / high)	Current consequences on crops	Probability of outbreak (low / moderate / high)	Consequences if nothing is done
Fungal threats				
Anthraxnose	Moderate	> 50% on susceptible varieties	Moderate	Yield loss and reduced production
<i>Cercospora</i> leaf spot	Moderate	Not evaluated (NE)	Moderate	Yield loss and reduced production
Soft rot and dry rot (several microorganisms)	Low	Not evaluated (NE)	Moderate (localized)	Yield loss and reduced production in humid areas
Bacterial threats				
Bacterial blight	High	> 50% on susceptible varieties	High	Yield loss and reduced production
Viral threats				
African mosaic	High	> 50% on susceptible varieties	High	Yield loss and reduced production
Brown streak	Moderate	Not evaluated	High	Yield loss and reduced production
Vein mosaic	Not evaluated	Not evaluated	Moderate	Yield loss and reduced production
Green mottle	Not evaluated	Not evaluated	Moderate	Yield loss and reduced production
Whitefly (<i>Bemisia tabaci</i>)	High	> 50%	High	Yield loss and reduced production
Other threats				
Abiotic risks/climate change	Not evaluated	Not evaluated	Not evaluated	Yield loss and reduced production

Mites	Not evaluated	Not evaluated	Not evaluated	Yield loss and reduced production
Nematodes	Not evaluated	Not evaluated	Not evaluated	Yield loss and reduced production
Mealybugs	Moderate	Not evaluated	Not evaluated	Yield loss and reduced production
<i>Zonocerus variegatus</i>	Moderate	Low	Not evaluated	Yield loss and reduced production
<i>Spodoptera</i> spp. (gnaws at young shoots)	Low	Not evaluated	Not evaluated	Yield loss and reduced production

Current risk management process

Actions currently taken (*)

Type of risk	Prevention, reduction, and strategic planning	Detection and intervention	Monitoring and evaluation
Bacterial threats	<ul style="list-style-type: none"> - Advocacy and awareness raising, training for stakeholders (growers, DDAEP inspectors, ATDAs, students, etc.) Scheduled treatments - Who: Ministry of Agriculture, DPV, INRAB, universities, WAVE, plant pathology, growers 	<ul style="list-style-type: none"> - Surveys, lab analysis, alerting after analysis, quarantining, training on actions to take after analysis, diagnosis of disease - Setting up / strengthening plant protection teams, building capacity for plant health controls at borders - Who: Ministry of Agriculture, INRAB, DPV, WAVE, researchers/plant pathology, lab technicians 	<ul style="list-style-type: none"> - Information on distribution, incidence, severity - Alerts (from growers and surveillance officers), surveys of people, surveys of crops, taking and analyzing samples - Raising awareness among the general public and through the media - Producing and distributing factsheets - Scientific publications - Who: Ministry of Agriculture, INRAB,

			DPV, WAVE, press, media
Viral threats	<ul style="list-style-type: none"> - Advocacy, awareness raising, training for stakeholders (growers, DDAEP inspectors, ATDAs, students, etc.) Scheduled treatments - Who: Ministry of Agriculture, DPV, virologists, growers, INRAB, universities, WAVE 	<ul style="list-style-type: none"> - Surveys, lab analysis, alerting after analysis, quarantining, training on actions to take after analysis, diagnosis of disease then replacement of planting material in area - Who: Ministry of Agriculture, INRAB, DPV, WAVE, researchers / virologists, lab technicians 	<ul style="list-style-type: none"> - Information collected on distribution, incidence, severity, and alternative host plants - Alerts (from growers and surveillance officers), surveys of people, surveys of crops, taking and analysing samples - Raising awareness among the general public and through the media - Producing and distributing factsheets - Scientific publications - Who: Ministry of Agriculture, DPV, WAVE, virologists, press, media
Fungal threats	<ul style="list-style-type: none"> - Advocacy, awareness raising, training for stakeholders (growers, DDAEP inspectors, ATDAs, students, etc.) Scheduled treatments - Who: Ministry of Agriculture, DPV, WAVE, plant pathology, growers, INRAB, universities 	<ul style="list-style-type: none"> - Surveys, lab analysis, alerting after analysis, quarantining, training on actions to take after analysis, diagnosis of disease - Setting up / strengthening plant protection teams, building capacity for plant health controls at borders - Who: Ministry of Agriculture, INRAB, DPV, WAVE, researchers/plant pathology, lab technicians 	<ul style="list-style-type: none"> - Information on distribution, incidence, severity - Alerts (from growers and surveillance officers), surveys of people, surveys of crops, taking and analyzing samples - Raising awareness among the general public and through the media - Producing and distributing factsheets - Scientific publications - Who:

			Ministry of Agriculture, DPV, WAVE, plant pathology, press, media
Nematode threats	<ul style="list-style-type: none"> - Advocacy, awareness raising, training for stakeholders (growers, DDAEP inspectors, ATDAs, students, etc.) Scheduled treatments - Who: Ministry of Agriculture, DPV, WAVE, entomologists, growers, INRAB, universities - 	<ul style="list-style-type: none"> - Surveys, lab analysis, alerting after analysis, quarantining, training on actions to take after analysis - Who: Ministry of Agriculture, INRAB, DPV, WAVE, researchers/plant pathology 	<ul style="list-style-type: none"> - Alerts (from growers and surveillance officers), surveys of people, surveys of crops, collecting and analysing samples - Raising awareness among the general public and through the media - Producing and distributing factsheets - Scientific publications - Who: Ministry of Agriculture, DPV, press, media, WAVE
Mite threats	<ul style="list-style-type: none"> - Advocacy, awareness raising, training for stakeholders (growers, DDAEP inspectors, ATDAs, students, etc.) Scheduled treatments - Who: Ministry of Agriculture, universities, WAVE, INRAB, DPV, entomologists, growers 	<ul style="list-style-type: none"> - Surveys, lab analysis, alerting after analysis, quarantining, training on actions to take after analysis - Who: Ministry of Agriculture, DPV, universities, entomologists, WAVE 	<ul style="list-style-type: none"> - Alerts (from growers and surveillance officers), surveys of people, surveys of crops, collecting and analysing samples - Raising awareness among the general public and through the media - Producing and distributing factsheets - Scientific publications - Who: Ministry of Agriculture, DPV, WAVE, entomologists, press, media

(*) For risks classed high or moderate above

Gap assessment

Strengths

- The plant pathologists/virologists and entomologists from the WAVE project, universities, INRAB, and the DPV have good knowledge of cassava viral, fungal, and bacterial diseases and their vectors. They are actively involved in training other stakeholders in recognizing the symptoms of cassava diseases and molecular detection.
- A national development plan for Benin's cassava sector is included in the government action plan, and the government is already taking steps to boost cassava production.
- The universities (UAC and UP), INRAB, and the DPV have labs that are involved in detecting pathogens and producing disease-free seeds (*in vitro* plants).
- Inspectors are present at border crossings for phytosanitary controls, and plant protection teams monitor cross-border trade in planting material and imports and exports of plants.
- Some CMD-resistant cultivars are available and recommended to growers in areas under high pressure from the virus.
- A national directorate responsible for plant protection, inspection, and certification of seeds and plants manages risk by supporting, advising, and educating growers.

Weaknesses

- Poor dissemination of information when diseases are detected, and lack of healthy seeds due to limited financial and material resources.
- No seed producers who must ensure that disease-free seeds are always available.
- Lack of decent equipment (detection kits, equipment for checking cuttings, and scanners) for phytosanitary control at borders.
- Lack of equipment in diagnostic laboratories at the universities, INRAB, and the DPV.
- No quarantine center for disease management.

Key takeaways

Strengthening institutions

- Equipment for university/WAVE, INRAB, and DPV labs involved in management
- Recruit staff for these labs

Capacity building among growers and producers of cuttings

- Raise growers' awareness of how to manage disease
- Recruit and train growers of cuttings in almost all communes

Capacity building among technicians/inspectors/plant protection teams

- Raise awareness and train technicians/inspectors/plant protection teams on steps to take to prevent or manage an outbreak
- Increase the number of technicians/inspectors/plant protection teams for better prevention or management of diseases
- Supply technicians/inspectors/plant protection teams with detection kits, equipment for checking cuttings, and scanners

Essential and urgent introduction of a response system

- Create an Emergency Operations Center for cassava viral diseases
- Draw up a management plan involving all stakeholders (universities, WAVE, DPV, INRAB, growers, NGOs, etc.)

II. STRATEGIC OBJECTIVES AND VISION OF THE NATIONAL ACTION PLAN

Vision

Ensure that viral diseases are prevented and eliminated in Benin and increase cassava production by 2023.

Strategic objectives

Strategic objective 1: Introduce a collective governance system to prevent outbreaks of cassava viruses

Activity 1: Set up a national committee on cassava viral disease management

Activity 2: Define lines of research on cassava viral diseases and their vectors for an efficient response

Activity 3: Set up an effective and rapid communication system among all key players in the alert and response system

Strategic objective 2: Introduce a rapid diagnosis system for viral diseases in Benin

Activity 1: Strengthen laboratories' diagnostic capacities

Activity 2: Strengthen the quarantine system for cassava viral diseases

Activity 3: Train stakeholders (ATDAs, phytosanitary technicians/inspectors, students, growers, etc.) in recognizing viral diseases

Activity 4: Develop rapid identification kits for viral diseases

Strategic objective 3: Develop effective methods of combating cassava viral diseases and their vectors

Activity 1: Conduct a literature review on cassava varieties

Activity 2: Conduct an agrosociological study to integrate growers' perceptions into the disease management approach

Activity 3: Select resistant varieties

Activity 4: Sanitize non-resistant elite varieties through *in vitro* culture of meristems

Activity 5: Ensure that propagating materials are produced and distributed (pre-basic, basic, and certified)

Activity 6: Develop strategies to combat cassava viral disease vectors.

Activity 7: Set up demonstration plots/pilot sites.

Activity 8: Arrange experience exchange visits and training for stakeholders.

Strategic objective 4: Set up an information and communications system for all cassava diseases, particularly viruses

Activity 1: Strengthen the communication system for viral diseases and associated factors.

Activity 2: Write, produce, and distribute informative texts (fact sheets, technical information documents, posters)

Activity 3: Organize awareness-raising sessions with the general public and through the media

III. STRUCTURE OF THE EMERGENCY OPERATIONS CENTER (EOC)

Institutional anchoring

The Ministry of Agriculture, Livestock, and Fisheries (MAEP) has been chosen as an anchor institution for setting up an Emergency Operations Center (EOC) in Benin. The Directorate for Plant Production (DPV), via its Plant Protection Department (SPV), will implement the scientific results of research carried out through the WAVE program. There is currently no response plan on cassava viral diseases.

Governance

Mandate

The EOC's mandate is to:

1. Identify the actors involved in managing cassava viral diseases;
2. Ensure the coordination of all actors and activities related to managing outbreaks, and define standard operating procedures (SOPs) for each priority risk category;
3. Develop epidemiological risk management strategies;
4. Mobilize the human, financial, and material resources needed to manage cassava viral diseases;
5. Collect, consolidate, and analyze data, both outside of outbreaks and if an outbreak occurs;
6. Communicate about epidemiological risks, preventive and reactive measures, and results;
7. Carry out the activities required by the SOPs, including prevention, mitigation, detection, and surveillance, before, during, and after an outbreak;
8. Coordinate all initiatives aimed at managing cassava viral diseases in Benin;
9. Anticipate any harmful organism that could affect cassava production in Benin.

The EOC will be created through an inter-ministerial decree.

Organizational oversight

Two committees will be set up to ensure the EOC fulfills its mission. The first committee will define strategic orientations and make strategic decisions. Its members will come from WAVE, the universities (UNA, UAC, FA/UP), INRAB, the DPV, FUPRO, the ATDAs, DQIFE, and the DDAEPs. A second committee will provide support and advice on coordinating the EOC. It will consist of representatives from the Ministry of Agriculture, Ministry of the Environment, Ministry of Finance, Ministry of Decentralization, Ministry of Public Security, and NGOs involved in this sector, as well as resource persons.

The representatives of these institutions and resource persons will have proven skills and already play an active role in the integrated management of plant diseases and the prevention of emergent diseases.

The members of the Steering Committee will have the following expertise-based roles:

Ministry of Agriculture (General Secretariat of the Ministry)	Provide governance of the steering committee
DPV	Coordinate EOC activities within the Ministry of Agriculture
WAVE	Pilot and execute all operational activities of the steering group
Umbrella organizations of growers (PNOPPA, PASCIB, FUPRO)	Identify problems and help to solve them
Ministry of the Environment	Ensure compliance with framework laws on biosecurity and signed agreements
INRAB	Support the coordination of EOC activities
ATDAs	
DQIFE	
DDAEPs	
Ministry of Finance	
Ministry of Public Security	
Universities	
Resource persons	
NGOs involved in the sector	Support awareness-raising and training for growers

Organizational structure

Departments and governing organs

The governing organs of the EOC are:

Technical and Scientific Committee

This committee's role will be to develop programs for delivery by the EOC and decide how they will be carried out. Committee members will come from WAVE, UNA, FSA, FAST, FA/UP, INRAB, the DPV, IITA, FUPRO, and NGOs. The Technical and Scientific Committee will meet four times a year.

Management Unit

The Management Unit will be responsible for the following roles:

- Day-to-day management of the EOC
- Coordination of activities carried out

- Financial management
- Organizing and preparing for governance meetings
- Producing activity, technical, and financial reports
- Representing the EOC
- Monitoring and evaluating activities
- Arranging audits

The Management Unit will consist of the following individuals/bodies:

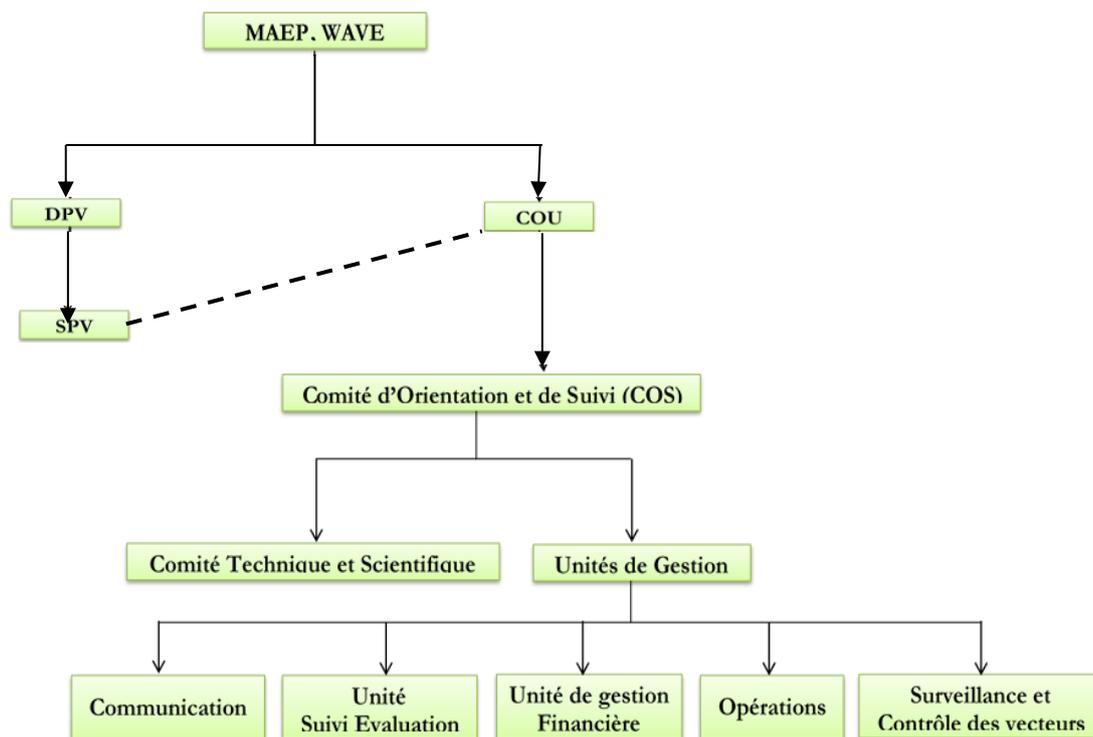
- Coordinator
- Financial Management Unit
- Operations Unit
- Surveillance and Vector Control Unit
- Communications Unit
- Monitoring & Evaluation Unit

The responsibilities and duties of each of these units will be described in specifications created by the EOC. Social and environmental considerations and a gender approach will be taken into account when setting up the EOC bodies.

Reporting and decision-making structure

The EOC will be located in the Directorate for Plant Production within the Ministry of Agriculture. At geographical *département* level, the EOC's activities will be coordinated by the Departmental Directorates responsible for agriculture (DDAEPs), working together with Regional Agricultural Development Agencies (ATDAs).

Organizational tree



Key: ——— Hierarchical relationship; - - - - Functional relationship

Figure 1: Organizational tree of the EOC

Human resources

Core competencies

Technical staff from the DPV, WAVE, INRAB, the ATDAs, and universities (plant pathologists/virologists, entomologists, phytosanitary inspectors, phytopharmacologists, weed scientists, nematologists, etc.) will provide the competencies required for prevention, mitigation and planning, detection and intervention, and monitoring and evaluation before and during an outbreak in terms of awareness-raising and stakeholder training, rapid disease diagnosis, and monitoring and evaluation of risks.

Specialists in seed production (seed inspectors), cassava agronomy, and plant genetics and biotechnology will play a key role in prevention, mitigation, detection, and intervention by providing resistant varieties and seeds. Lab technicians and students will be able to carry out biochemical and molecular virus detection.

Agro-sociologists will be involved in mitigation and intervention by incorporating farmers' perceptions into the disease management approach.

Permanent staff:

- Trainers
- Technical staff from the DPV, WAVE, INRAB, and the ATDAs (five, one per institution)
- Specialists in plant protection and decentralized structures (plant pathologists/virologists, entomologists, phytosanitary inspectors, phytopharmacologists, weed scientists, nematologists) (six, one per specialty)
- Ten specialists in seed production (seed inspectors)
- Two specialists in agronomy (cassava)
- Two specialists in plant genetics and biotechnology
- Two agroeconomists and agro-sociologists
- One anthropologist

Temporary staff:

- One outbreak supervisor
- Five lab technicians
- Four drivers
- Political/administrative officials (prefects, mayor, head of arrondissement, locally elected representatives such as traditional leaders, monarchy)
- Ten student volunteers

Roles and responsibilities**Technical staff from the DPV, WAVE, INRAB, ATDAs, and universities**

Sovereign control of the state, supporting the EOC in managing outbreaks.

Plant protection specialists

Inspecting/monitoring fields, indexing, diagnosis, taking part in awareness raising, producing technical documents, organizing training sessions, inspection at borders, quarantine management, proposing methods to tackle disease.

Seed production specialists

Organizing production of materials, taking part in seed plot inspections, taking part in awareness raising, organizing training for producers of propagative materials, certification of propagative materials, helping to make propagative materials available, mass production of *in vitro* plants (acclimatization).

Agronomy (cassava) specialists

Training on cassava crop protocols, taking part in producing technical documents, taking part in participative selection of resistant/tolerant varieties.

Plant genetics and biotechnology specialists

Developing resistant varieties, taking part in training and writing technical documents, taking part in participative selection of resistant/tolerant varieties, sanitation of sensitive elite varieties, mass production of *in vitro* plants

Agroeconomists and agro-sociologists

Cost assessments, taking part in training and writing technical documents, evaluating use of varieties developed, taking part in awareness raising among growers and distribution of varieties developed.

Outbreak supervisor

Coordinating disease management activities, leading and shaping activities to tackle the outbreak, ensuring that all response measures are taken.

Lab technicians

Detecting viral diseases, developing rapid virus detection protocols.

Drivers

Transporting samples, materials, and staff from institutions involved in disease management.

Locally elected representatives

Taking part in awareness raising, breaking down information for the populations concerned, exerting their influence to give instructions.

Biological science and agronomy students

Providing technical support, playing a role in awareness raising and training growers, carrying out research activities.

Farmer organizations, cooperatives, NGOs

Organizing awareness-raising and training sessions for growers, providing technical support, supplying seeds.

Recruitment strategy

Recruitment process:

Candidates will be selected following tests or interviews based on the prerequisites below:

- Profile matches specialist role
- Good experience of cassava cultivation
- Benin national or immigrant from a West African country
- Aged eighteen or over

Recruitment plan:

- Periodic recruitment, strengthening the EOC team each time for the type of activity and intervention zone
- Recruits will take part in training programs and simulation exercises for outbreak management
- Competencies and qualifications of existing staff evaluated through tests or interviews

Training

New employees:

- Six months' training on managing an outbreak
- Take part in training programs and simulation exercises

Existing staff:

- Periodic refresher training on the key points of managing an outbreak
- Periodic self-appraisal

Financial and material resources

Financial needs

	FY2019	FY2020	FY2021	FY2022	FY2023
EOC SETUP COSTS	\$1,899,000	\$502,000	\$130,500.00	\$130,500.00	\$100,500.00
OPERATING EXPENDITURE	-	-	\$1,277,240.00	\$1,175,240.00	\$1,200,240.00
CONTINGENCY BUDGET	-	-	\$200,000.00	\$200,000.00	\$200,000.00
OVERALL TOTAL BUDGET	\$1,899,000	\$502,000	\$1,607,740.00	\$1,505,740.00	\$1,500,740.00

Material needs

The EOC requires the following material resources for its activities before, during, and after an outbreak:

- Meeting room with:
 - Furniture
 - Teaching aids
 - IT system and audiovisual equipment
 - Interpreting equipment (booth, headset, mixer, etc.)
 - Generator for relay
 - Wi-Fi
 - Flipcharts
 - Projector screen
- Laboratories with:
 - Virology (central and satellites)

- Entomology (central and satellites)
 - Molecular biology for developing resistant plant material
 - *In vitro* culture for rapid propagation of disease-free material
 - Kits, consumables, and reagents
 - Electron microscope
- Greenhouses
 - Quarantine centers with equipment
 - 4 pickup trucks (Hillux)
 - Specialist equipment and materials for storing samples (freezer blocks, etc.)

Resource management plan

The administrative, financial, and accounting management of the EOC must be autonomous, by decree of the Ministry of Agriculture, and the procedures for managing consultant recruitment, organizing validation workshops, writing manuals, and training stakeholders must be documented in a specific manual.

An overall plan of operations (covering the whole duration of the project) must be produced and implemented following this workshop, the regional workshops in preparation for the AWPB, and the national workshop on harmonization and consolidation.

The procedural manual must define and refer to the management of strategic partnerships (round tables and others) and resources during outbreaks.

IV. EMERGENCY RESPONSE PLAN

Actions to be taken before an outbreak

	Risk analysis and definition of risk level	Planning	Surveillance	Prevention	Community engagement	Partnerships
What	<ol style="list-style-type: none"> 1. Identify the main viral threats from surveys <ol style="list-style-type: none"> a. African cassava mosaic (high risk) b. Cassava brown streak (high risk) c. Vectors of viral diseases (humans, agricultural tools, infected cuttings, pest vectors such as <i>Bemisia tabaci</i>, etc.) (high risk) 	<ol style="list-style-type: none"> 1. Develop a monitoring program and action plan 	<ol style="list-style-type: none"> 1. Observe cassava leaves, stems, and roots as well as vectors 	<ol style="list-style-type: none"> 1. Main actions to take before an outbreak are: communication, awareness raising, training, etc. 	<ol style="list-style-type: none"> 1. Achieve recognition of how these viral diseases impact production and how to limit their spread 	<ol style="list-style-type: none"> 1. Encourage the inclusive participation of all stakeholders
Who	Universities, DPV, INRAB, and growers including seed growers	Universities, DPV, INRAB, ATDAs, and growers including seed growers	All stakeholders	Universities, DPV, INRAB, ATDAs, and growers including seed growers	Locally elected representatives, plant protection teams, cassava growers' organization	Local communities, universities, DPV, INRAB, ATDAs, DDAEPs, and growers including seed growers
How	<ol style="list-style-type: none"> 1. Surveys 2. Regular observations of fields 3. Laboratory analysis 	<ol style="list-style-type: none"> 1. Mobilize all stakeholders 2. Communication 3. Awareness raising 	<ol style="list-style-type: none"> 1. Set up an information and communication system involving all stakeholders 	<ol style="list-style-type: none"> 1. Information, education, and communication: raising general public awareness 	<ol style="list-style-type: none"> 1. IEC: Disseminate information through community 	<ol style="list-style-type: none"> 1. Support the introduction of high-yield, disease-free, resistant/tolerant

		4. Training for stakeholders	via the EOC communication system	via the media, developing and publishing factsheets and other information documents including flashcards	liaison, NGOs, and local radio 2. Get plant protection teams involved 3. Provide materials for awareness raising	material that meets the needs of growers including seed growers (DPV, WAVE, universities), processors, and consumers (cooperatives) 2. Structuring, awareness raising and training for stakeholders (WAVE, DPV, universities)
When	<ul style="list-style-type: none"> - Grower reports - Researcher observations - Alerts from technicians and field agents (DDAEPs, ATDAs) - Scheduled visits from researchers 	Always	Always	Always (and particularly before the emergence of whitefly – <i>B. tabaci</i>)	Always	Before starting the project

Actions to be taken in case of an outbreak

	Detection, identification, and confirmation	Response, containment, quarantine, and elimination	System activation	System operation	Evaluation of response
What	<ol style="list-style-type: none"> 1. Observation of symptoms in fields 2. Detection by serology 3. Molecular characterization 	<ol style="list-style-type: none"> 1. Identify zones concerned after DPV, EOC, WAVE visit 2. Inform and educate the population concerned on sanitary measures (ban on exchanging cuttings, systematic destruction of infected whole plants, observation of fallow period, etc.) via radio stations, TV channels, and the written press 3. Eliminate secondary host plants by regularly weeding fields 4. Tackle vectors using pheromone traps 	<ol style="list-style-type: none"> 1. Crisis meeting 2. Decision making 	<ol style="list-style-type: none"> 1. Core and additional staff will be mobilized on the DPV's instructions and deployed to outbreak areas, and communication will take place through the DPV communication system 	<ol style="list-style-type: none"> 1. Efficacy and efficiency of quarantine measures 2. Vector management 3. Efficacy and efficiency of outbreak management measures (communication, elimination, quarantine, containment, etc.) 4. Speed of intervention

		5. Replace plantations with healthy plants by distributing disease-free planting material			
Who	INRAB Partners: universities, WAVE, DPV, ATDAs, DDAEPs, farmers' organizations	DPV Partners: locally elected representatives, ATDAs, DDAEPs, farmers' organizations, INRAB, universities, WAVE, security force	DPV Rapid response team: WAVE, DPV, INRAB, locally elected representatives, ATDAs, DDAEPs, farmers' organizations, universities, security force	General operations: Ministry of Agriculture, WAVE	WAVE, INRAB
How	<ol style="list-style-type: none"> 1. Growers and surveillance officers report symptoms 2. Observation and sampling activities 3. Laboratory analysis for confirmation 4. Information circuit: growers/surveillance officers – research – Ministry 	<ol style="list-style-type: none"> 1. Organizations concerned summoned by authorities 2. Dialogue and decision making 	<ol style="list-style-type: none"> 1. After confirmation of the virus, INRAB sends a report to the Ministry, which instructs the DPV 2. The DPV summons and instructs the EOC via the communication system on how to manage the outbreak and organizes awareness raising and training of key stakeholders 	<ol style="list-style-type: none"> 1. Under the DPV's supervision, the EOC coordinates activities by organizing regular meetings between the different actors in the response system 	<ol style="list-style-type: none"> 1. Define performance indicators 2. Organize monitoring & evaluation activities in outbreak zones 3. Provide information on indicator levels achieved 4. Produce guidance on improving performance 5. Response system uses evaluation reports to implement

			3. Rapid response teams arrive on the field for containment, quarantine, and elimination		corrective measures successfully
When	- From confirmation of EACMV-UG or brown streak virus	- After evaluating the effectiveness of measures taken and confirming the absence of the disease in the field and in the lab	- From confirmation of the disease by the laboratory	- After the outbreak has been dealt with, the system is deactivated	- During and after the outbreak

Phytosanitary measures

Laws and regulations on biosecurity

Border control

The following regulations, agreements, and ratified conventions are in force in Benin governing the sanitary control of plants at borders, and must inform the EOC's activities:

- Law 91-004 of 11/02/1991 on phytosanitary regulation in the Republic of Benin
- Decree 92-258 of 18/09/1992 setting out the conditions for the application of Law 91-004
- Regulation C/REG. 21/11/10 harmonizing the structural framework and operational rules in regard to animal, plant and food safety within ECOWAS
- Regulation no. 007/2007/CM/UEMOA of 06/04/2007 on Sanitary Security of Plants, Animals and Foods in WAEMU
- International Plant Protection Convention (IPPC)
- WTO Agreement on the Application of Sanitary and Phytosanitary Measures (SPS Agreement)

Control of the movement of cuttings

Laws, orders, and decrees governing the movement of cuttings in force in Benin are listed below:

- Law 91-004 of 11 February 1991 on phytosanitary regulation in the Republic of Benin
- Decree 92-258 of 18/09/1992 setting out the conditions for the application of Law 91-004 of 11/02/1991
- 1995 Order No. 128/MDR/... of 05/05/1995 on the phytosanitary control of plants and plant products on import and export
- 2010 Order No. 173/MAEP/D-CAB/SGM/DRH/DPQC/SA of 07/06/2010 implementing the annexed technical regulation on the production, quality control, certification, and packaging of plant material from cassava plantations
- 2010 Order No. 176/MAEP/D-CAB/SGM/DRH/DPQC/SA of 07/06/2010 implementing the general technical regulation on the production, marketing, quality control, certification, and packaging of seeds and plants in the Republic of Benin
- 1995 Order No. 128/MDR of 05/05/1995 on the phytosanitary control of plants and plant products on import and export

Alerting mechanisms

The procedures for alerting or escalating information to higher authorities when infected cuttings are intercepted at borders are as follows:

- Interception report produced by phytosanitary inspector
- Report sent to DPV

- Notification form completed and sent to the NPPO in the country where the intercepted cuttings originated, the IPPC, and the WTO under the SPS Agreement
- DDAEP concerned summoned to take action

Seed systems

Certification / production and propagation of cassava cuttings:

The different steps for producing and certifying planting material (cuttings) are:

1. Cutting production processes
 - a. Production of pre-basic cuttings in research
 - b. Production of basic cuttings by the DPV (mother block)
 - c. Production of certified cuttings by seed producers
2. Cutting certification processes
 - a. Registration of seed grower (authorization obtained)
 - b. Approval for testing
 - c. Different types of inspection carried out by the DPV
 - d. Cuttings certified by the DPV

Distribution of cuttings: Prescribed mode of transport

Must avoid cuttings being wounded, contaminated, or drying out

Vector control

Treatment of whitefly

To combat whitefly:

- Use approved products containing lambda cyhalothrin (chemical control)
- Use pheromone traps
- Research alternative methods (such as biological control)

Management of infected plants

Infected cuttings must be systematically destroyed through incineration by inspectors or plant protection teams if they are circulating in the country or intercepted at borders.

Communication & awareness raising

Groups of stakeholders to train

For effective disease management, the EOC should organize periodic on-site training based on these approaches for researchers, technicians and all other field agents, inspectors at border crossings and within the country, producers of cuttings, and growers.

Types of educational campaign

Educational campaigns should consist of ‘train the trainer’ sessions, training for liaison workers, peer training, media campaigns, and general public and group awareness raising.

Channels of communication

The channels of communication are local and community radio, billboards, posters and factsheets, social media, town criers, and flashcards.

Frequency of community engagement

Community engagement should take place once every three months for researchers and once a month for field technicians.

V. OPERATIONAL STRATEGY

Strategy implementation plan

Roadmap

Strategic objective	Main steps necessary to achieve objective	2019		2020		2021	
		S1	S2	S1	S2	S1	S2
	Set up a national committee on cassava viral disease management	X	X				
	Define lines of research on cassava viral diseases and their vectors for an efficient response	X	X ^a		X ^a		X ^a
	Implement a fast and effective communication system between local, regional, state and federal government agencies, universities, and key industry professionals when response measures are necessary	X	X	X	X ^a	X ^a	X ^a
	Strengthen laboratories' diagnostic capacities	X	X	X ^a	X ^a	X ^a	X ^a
	Strengthen the quarantine system for cassava viral diseases	X	X	X			
	Train stakeholders (WAVE, ATDAs, phytosanitary technicians/inspectors, students, growers, etc.) in recognizing cassava viral diseases		X	X	X	X	
	Develop rapid identification kits for cassava viral diseases		X	X	X	X	X
	Provide rapid identification kits for cassava viral diseases to facilities responsible for control and research			X	X	X	X

	Conduct a literature review on cassava varieties	X		X		X	
	Conduct an agro-sociological and gender study and incorporate growers' perceptions into disease management		X		X		X
	Select resistant varieties			X	X	X	X
	Sanitize non-resistant elite varieties through <i>in vitro</i> culture of meristems	X	X	X	X	X	X
	Ensure that propagating materials are produced and distributed (pre-basic, basic, and certified)	X	X	X	X	X	
	Set up demonstration plots/pilot sites	X	X	X	X	X	X
	Arrange experience exchange visits and training for stakeholders			X	X	X	X
	Develop strategies to combat cassava viral disease vectors	X	X	X	X	X	X
	Strengthen the communication system for cassava viral diseases and associated factors	X	X	X ^a	X ^a	X ^a	X ^a
	Write, produce, and distribute informative texts (fact sheets, technical information documents, posters)	X	X	X	X	X	X
	Organize awareness-raising sessions with the general public and through the media	X	X	X	X	X	x

Notes:

X^a Activities to be updated and reoriented after annual meeting

X Permanent throughout duration of project

Resource mobilization plan

Financial resources required	Sources of funding	Fundraising strategy
<ul style="list-style-type: none"> - Long-term spending needs: quarantine center, meeting rooms, laboratories. - Short-term spending needs: greenhouses, vehicles, agent recruitment, training, detection kits. Making regulatory texts accessible, border control, production of <i>in vitro</i> plants, situation analysis (surveys), awareness raising, vigilance organizations, response measures (confinement, quarantine, and elimination), compensation for growers, working capital for the EOC. 	<ul style="list-style-type: none"> - Funders such as: Bill & Melinda Gates Foundation, DFID-UK, ECOWAS, IsDB, the World Bank, USAID, CIRAD, IRD, AfDB, FAO, and WAEMU are sought to contribute 60%. - The Benin State will contribute 30% of the budget via the national budget (DPV/Ministry of Agriculture) and compensation for cassava growers. - The private sector will be approached to contribute 10% of the budget. 	<ul style="list-style-type: none"> - Use WAVE's initial activities, which found the dangerous form of the mosaic virus in Benin - Get political decision-makers' attention via publications and radio/TV communications on the Ugandan form of EACMV found in a Beninese commune and on the serious threats in East Africa from CBSD, which is gradually moving towards West Africa - The action plan approved by the Ministry of Agriculture will be included in a West African network and center for the national and sub-regional fight against viral diseases - It will be submitted to funders for financial support, and to the government of each country for budget votes on an effective and sustainable response to these diseases

Implementation risk management

No.	Description of risk	Probability of occurrence	Mitigating actions
01	Weak engagement from government partners on producing a response plan	High	<ul style="list-style-type: none"> - Arrange regular appointments with government representatives - Hold individual meetings with each contributor group
03	Limited sources of funding	Moderate	<ul style="list-style-type: none"> - Use the WAVE network to access other sources of funding - Use other institutions such as FAO, CIRAD, IRD, etc.
04	Limited national capacity to implement the action plan	Moderate	<ul style="list-style-type: none"> - Focus on training and building the capacities of national stakeholders - Go on research trips/missions for transfer of knowledge
05	Little attention from media companies	Low	<ul style="list-style-type: none"> - No action / Deprioritize

06	Little engagement from growers, locally elected representatives, and sector advisers	Moderate	<ul style="list-style-type: none"> - Actively involve growers, locally elected representatives, and extension agents (cassava sector advisers for ATDA agricultural development areas) in recognition and strategies to combat cassava viral diseases in Benin
07	Low frequency of plot monitoring and visits to cassava growers by field agents from DDAEPs and ATDAs	Moderate	<ul style="list-style-type: none"> - Increase plot monitoring and visits to cassava growers by field agents from DDAEPs and ATDAs - Strengthen material resources, funding, and training for researchers

Monitoring and evaluation plan for the strategy

Intervention logic	Results	Activities	Monitoring indicators	Monitoring frequency	Responsibility for monitoring	Audit sources	Assumptions	Evaluation frequency	Responsibility for evaluation
SO1: Introduce a collective governance system for cassava virus outbreaks	A collective governance system for cassava virus outbreaks is introduced	Activity 1: Set up a national committee on cassava viral disease management	<ol style="list-style-type: none"> 1. Activities carried out on time 2. 10 meeting reports produced in 5 years 	Every 3 months	WAVE DPV, Ministry of Agriculture	Reports from EOC/Ministries	Favorable economic and social environment	Every 6 months	Independent experts
		Activity 2: Define lines of research on cassava viral diseases and their vectors for an efficient response	<ol style="list-style-type: none"> 1. 10 publications in 5 years 2. 12 dissertations in 5 years 	Every 6 months	EOC, WAVE, university, INRAB				
		Activity 3: Implement a fast and effective communication system between local, regional, state, and federal government agencies, universities, and key industry professionals when response measures are necessary	<ol style="list-style-type: none"> 1. PADs available (two per year) 2. Journal articles 3. Number of stakeholders informed 	Yearly	EOC, WAVE, DPV				
SO2: Introduce a rapid diagnosis system for viral diseases in Benin	A rapid diagnosis system is introduced for viral diseases in Benin	Activity 1: Strengthen laboratories' diagnostic capacities	<ol style="list-style-type: none"> 1. Number of procedural manuals produced 2. Technician performance to be evaluated 	Yearly	EOC, WAVE DPV	Reports from EOC/Ministries	Favorable economic and social environment	Per project	Independent experts
		Activity 2: Strengthen the quarantine system	<ol style="list-style-type: none"> 1. Quarantine center 	Yearly	DPV, Ministry of Agriculture				

		for cassava viral diseases	operational and equipped 2. Number of plant protection teams set up 3. Number of testing labs at borders 4. Number of phytosanitary inspectors recruited						
		Activity 3: Train stakeholders (ATDAs, phytosanitary technicians/inspectors, students, growers, etc.) in recognizing viral diseases	1. Symptoms of disease easily recognized 2. Number of training reports produced 3. Efficacy of pathogen detection	Every 6 months	DPV, WAVE, university, INRAB				
		Activity 4: Develop rapid identification kits for viral diseases	1. Catalog of specific kits available for growers 2. Rapid detection of viral outbreak areas	Yearly	Partners in UK				
SO3: Develop effective methods of combating cassava viral diseases and their vectors	Effective methods of combating cassava viral diseases and their vectors are developed	Activity 1: Conduct a literature review on the use of cassava varieties	1. List of cassava varieties available	Yearly	WAVE, universities, INRAB	Reports from EOC/Ministries	Favorable economic and social environment	Per project	Independent experts
		Activity 2: Conduct a socioeconomic study to integrate growers' perceptions into disease management	1. Number of meeting reports produced 2. Number of dissertations	At end of study	WAVE, universities, INRAB				

			or articles written						
		Activity 3: Select resistant varieties	1. Catalog of resistant cassava varieties available	At end of study	WAVE, universities, INRAB				
		Activity 4: Sanitize non-resistant elite varieties through <i>in vitro</i> culture of meristems	1. Disease-free cassava planting material available	At end of production	EOC, WAVE, INRAB				
		Activity 5: Ensure that propagating materials are produced and distributed (pre-basic, basic, and certified)	1. Number of growers with large plantations of disease-free cassava	Yearly	EOC, DPV, WAVE, INRAB				
		Activity 6: Develop strategies to combat cassava viral disease vectors	1. Significant regression of vectors	Yearly	EOC, WAVE, universities, INRAB				
		Activity 7: Set up demonstration plots/pilot sites	1. Demonstration plot visit	Seasonally					
		Activity 8: Arrange experience exchange visits and training for stakeholders	1. Level of stakeholder satisfaction	Occasionally					
SO4: Set up an information and communications system for all cassava diseases, particularly viruses	An information and communications system for all cassava diseases, particularly viruses, is set up	Activity 1: Strengthen the communication system for viral diseases and associated factors	1. Number of radio/TV programs broadcast and recorded 2. Availability of leaflets	Every 3 months	EOC, WAVE DPV	Reports from EOC/Ministries	Favorable economic and social environment	Every 6 months	Independent experts
		Activity 2: Write, produce, and distribute informative texts (fact sheets,	1. Factsheets and posters available	Every 6 months	EOC, WAVE, INRAB				

		technical information documents, posters)							
		Activity 3: Organize awareness-raising sessions with the general public through the media	1. Growers have good knowledge of the disease	Yearly	WAVE, DPV				