

REPUBLIC OF GHANA



FREEDOM-JUSTICE



MINISTRY OF FOOD AND AGRICULTURE

**ACTION PLAN TO MITIGATE CASSAVA VIRAL
DISEASES IN GHANA**

WEST AFRICAN VIRUS EPIDEMIOLOGY FOR FOOD SECURITY (WAVE)



DECEMBER 2018

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LIST OF ABBREVIATIONS

FAO :	Food and Agricultural Organization
IFAD:	International Fund for Agricultural Development
IITA:	International Institute of Tropical Agriculture
AGRA:	Alliance for Green Revolution for Africa
PFJ:	Planting for Food and Jobs
BMGF:	Bill and Melinda Gates Foundation
UKAID :	United Kingdom Aid
CMD:	Cassava Mosaic Disease
CBSD:	Cassava Brown Streak Disease
Ha:	Hectare
USD:	United State Dollar
EOC:	Emergency Operation Centre
NGO:	Non- Governmental Organization
PPRSD:	Plant Protection and Regulatory Services Directorate
NADMO:	National Disaster Management Organization
CSIR:	Council for Scientific and Industrial Research
CRI:	Crops Research Institute
MESTI:	Ministry of Environment, Science, Technology and Innovation
MoFA :	Ministry of Food and Agriculture
USAID:	United State Agency for International Development
EU:	European Union
CABI:	Centre for Agriculture and Bioscience International
BNARI:	Biotechnology and Nuclear Agriculture Research Institute
FBO:	Farmer Based Organization
CBO:	Community Based Organization

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FOREWORD BY THE MINISTER OF AGRICULTURE

Cassava is an important source of carbohydrates for human consumption and is a strategic crop to our nation. It is a staple food for nearly 25 million Ghanaians and it is also an important subsistence and cash crop for farmers and is widely used in industries. The resilient nature of cassava has made it a strategic crop for food security and poverty reduction.

Despite cassava's significant nutrition, health and economic importance, its cultivation is threatened by viral diseases especially, the African cassava mosaic virus disease (CMD) which is already endemic in the country and the more damaging cassava brown streak disease (CBSD), yet to be detected in the country. However, the recent spread of CBSD from East Africa into Central Africa, poses a threat to West Africa and more specifically to Ghana.

To combat the threat and contain spread of cassava viral diseases, an Emergency Operation Centre (EOC) will be launched under the flagship of the Ministry of Food and Agriculture. The EOC must coordinate detection and response activities through strong leadership and a shared vision of all operations. Its implementation will take a concerted and multisectoral approach.

The following principles have guided the strategic plan of the EOC

- Capacity development: the EOC will identify the capacity and infrastructural needs of cassava viral disease emergency management system
- Integration of the EOC into international efforts, particularly, regarding regional and continental initiatives aimed at sharing lessons and good practices of the plant viral disease management to strengthen the entire international system and
- Creation of agile, autonomous and visionary institution with access to new resources, research results and equipped with appropriate techniques and technology meaning that the EOC will be at the service of the entire plant viral disease management system in Ghana.

The Ministry will continue to cooperate and partner efforts with technical institutional and NGOs to strengthen technical and operational capacity that improve the effectiveness of programs that manage cassava viral diseases in the country.

Signed:

Honourable Minister of Food and Agriculture, Republic of Ghana

EXECUTIVE SUMMARY

Cassava is an important source of carbohydrates which is a requirement for human survival and wellbeing. It is a staple food for nearly 25 million Ghanaians. It is also an important subsistence and cash crop for farmers as well as industrial raw material. Indeed, the resilient nature of cassava has made it a strategic crop for food security and poverty reduction.

Despite cassava's significant nutrition, health and economic importance, its cultivation is impeded by several constraints. Among them, African Cassava Mosaic Disease (CMD) and Cassava Brown Streak Disease (CBSD) are the most damaging.

The threat posed by these diseases particularly, CBSD which is currently not detected in Ghana requires every effort must be made to impede its spread into the Country. The disease has caused enormous food shortages in endemic countries in East Africa and its spread westwards makes it a greater concern to governments and all stakeholders in the cassava value chain.

To impede the spread of CBSD and other viral diseases into the country this action plan has been designed with the vision to establish an emergency response centre which will combat the threat and contain spread of cassava viral diseases for enhanced food security in Ghana by 2023. The plan has as its strategic objectives;

- 1) to have a well-trained human resource, financial and infrastructural capacity to respond to any viral disease outbreak
- 2) to establish an Emergency Operation Center (EOC) in response to outbreak of viral diseases
- 3) to have in place a regular disease monitoring and surveillance system for early detection
- 4) to map out key institutions and stakeholders who can effectively contribute to any outbreak to contain spread

Several activities have been elaborated in the plan that will guide the realization of the strategic objectives and the vision of the plan.

This response plan has been segmented into five sections. Section I provides a background on the status of the national cassava production and threats of viral diseases, key stakeholders across the entire value chain, identification of risk and control measures in preventing cassava viral diseases, current management process and evaluation of current internal response plan for emerging cassava diseases versus the ideal/best practices (gaps assessment).

Section II addresses the vision and the strategic objectives of the national response plan. Section III elaborates on the structure of the Emergency Operations Centre (EOC). This section identifies the institution where the EOC will be anchored and goes on to indicate how it will be governed, its organizational structure, human resource requirements and partnerships that needed to be formed to ensure successful operationalization. To this end the Crops Research Institute (CRI) of the Council for Scientific and Industrial Research (CSIR) under the Ministry of Environment, Science, Technology and Innovation (MESTI) has been identified as the organization that will anchor the EOC. CRI is the Regional Centre of Excellence for Root and Tuber Research within the West African Sub-region. Section IV also gives comprehensive

emergency response plan that deals with actions to be taken before viral disease outbreak, during disease outbreak and phytosanitary measures which explain laws and regulations on biosecurity, seed systems, vector control and communication among others. Section V is about operational strategy; that is the implementation plan of the strategy. This section indicates the road map, resource mobilization plan, implementation risk management and monitoring and evaluation processes. The action plan also has a budget estimates which is expected to support its operationalization by 2023.

I. CONTEXT

Current national situation on Cassava Viral Threats

Economic and social importance of cassava in the country

Cassava is an important source of carbohydrates which is a requirement for human survival and wellbeing. It is a staple food for nearly 25 million Ghanaians. It is also an important subsistence and cash crop for farmers as well as industrial raw material. Indeed, the resilient nature of cassava has made it a strategic crop for food security and poverty reduction.

The multiple derived products of cassava in Ghana includes gari, tapioca, fermented dough, attiéké, flour, starch and chips which also contribute to sub-regional trade. Yields are generally low (12 tons/Ha) compared to world averages. However, there is the potential to exceed 40t/Ha if available germplasm are fully exploited compared to the current yields of around 12 tons/ha. It is estimated that by 2050, given population growth and increasing urbanization, cassava yields will have to exceed 25t/Ha to meet both consumption and industrial needs.

Despite cassava's significant nutrition, health and economic importance, its cultivation is impeded by several constraints. Among them, African Cassava Mosaic Disease (CMD) and Cassava Brown Streak Disease (CBSD) are the most damaging.

Due to its geographical distribution, CMD, caused by the Geminivirus, constitutes the most eminent constraint to cassava production in Ghana. The disease can lead to 40-70% yield loss which is estimated around 5 million tonnes of annual production. The recent spread of CBSD from East Africa into Central Africa, and the threat this poses to Ghana is an additional cause for concern. CBSD can lead to cassava yield losses of up to 90% or more. These two viral diseases are transmitted by white flies (*Bemisia tabaci*), which are abundant in our country. The diseases can also be disseminated by humans through the exchange and use of infected cassava cuttings.

Developing a national response plan for controlling cassava viral diseases and, to halt the progression of Cassava Brown Streak Disease to West Africa including Ghana and prevent its spread in the sub-region is in sync with the Government of Ghana's agenda of eradicating pest and disease constraints to Ghana's agricultural productivity for improved food security and poverty reduction for sustainable development. This agenda includes development of virus resistant cassava varieties by National Research Institutes and enforcement of plant quarantine rules and regulations within the country and its borders by the Plant Protection Regulatory Services Directorate (PPRSD). To this end, several enactments have been promulgated in the form of the Plant and Fertilizer Act (Act 803) which guides the movement of plant material in and out of the country.

The importance of cassava as a food security crop in Ghana is demonstrated by its inclusion in government's flagship "Planting for food and jobs" (PFJ) programme through which thousands of Ghanaians are being provided with jobs whilst at the same time addressing the challenge of food insecurity in the country. This flagship programme instituted by the current government is intended to raise productivity of farmers through the provision of healthy planting material,

supply of fertilizer and other inputs, to make available raw materials to feed industry for wealth creation and improvements of livelihoods.

Summary of current situation on the threats to cassava and current mitigation actions

With the low adoption (41%) of improved cassava varieties, CMD still remains a threat since farmers are cultivating susceptible local varieties which results in low yields.

Although CBSD is currently not found in Ghana, its spread westward from East Africa toward West Africa makes it a potential threat to cassava production due to the movement of germplasm through un-approved routes into the country without undergoing proper quarantine procedures.

Actions to mitigate cassava viral diseases are elaborated below:

At the Government level:

- National Research Institutes have developed cassava varieties resistant to CMD virus and education is on-going to encourage farmers to adopt improved cassava varieties
- Disease surveys have been conducted through the country to map out areas of cold spots and hot spots to support the breeding and multiplication of resistant varieties to farmers
- National Research Institutes have conducted joint surveys to ascertain the distribution of CMD and the incidence of any other viruses to support Breeders develop cassava resistant varieties for Ghana and other countries in the sub-region
- Collaboration between Ghana and endemic countries is ongoing to identify CBSD resistant genotypes that be deployed should there be any outbreak of the disease
- Enforcement of Plant and fertilizer Act 2010 (Act 803) is intended to halt the entry of unknown viruses into the country

International Organization:

International organizations are supporting the National Agricultural Research Systems (NARS) with financial and technical resources to develop expertise and infrastructure for the development of improved cassava varieties.

NGO:

Both local and international NGOs such as Catholic Relief Services (CRS), Adventist Relief Agency (ADRA) among others continue to build capacity of cassava value chain actors to ensure product availability and improve yield and income.

Mapping of key stakeholders

Along cassava value chain

Table 1: Key stakeholders across cassava value chain

Inputs	Production	Storage and Transport	Transformation	Marketing and Promotion
Research centers	Farmers, Farmer Based Organization	Research station driver, Government Ministries, departments and agencies drivers	Millers, Processors, Buffer stocks companies	Government Ministries, Departments and agencies (Commodity exchange, Food and Drugs Authority, Ghana Standards Authority, Ministry of Trade)
Agricultural station	Farmers, Farmer Based Organization, seed growers	Wholesalers	Miller	Retailers
Agro-dealers	Farmers, Farmer Based Organization	Transporters Porters/ Loaders	Processors	Government Ministries, Departments and agencies
Cooperatives	Cooperatives	Cooperatives wholesalers, aggregators	Cooperatives	Cooperatives
Contract farmers	Seed growers	Transporters, Porters/ Loaders	Millers, Processors, Buffer stocks companies	Retailers
Seed growers	Farmers, Farmer Based Organization, NGO	Transporters Loaders/ porters, wholesalers, aggregators, farmers	Millers, Processors, Buffer stocks companies	Retailers, Trade Associations, wholesalers, cooperatives, unions

Other relevant actors

Table 2: Other relevant actions

Government actors	Private sector	Civil society organizations/NGOs	Bilateral and multilateral partners
Government of Ghana (MoFA, MESTI, Ministry of Education: Public Universities)	Private organizations such as NGOs, FBOs	FAO, IFAD, IITA, AGRA	BMGF, DFID, World Bank, USAID, IFC

Risk Assessment

Table 3: Current risk to cassava production in Ghana

Names of the main threats	Level of risk (Low/Moderate / High)	Current consequences on crops	Probability of outbreak (Low / Moderate / High)	Further consequences if nothing is done
Fungal threats				
Anthracnose	Low	Not severe	Low	Poor crop establishment from infected planting material resulting in low yields
Bacterial threats				
Cassava Bacterial Blight	Moderate	Limited to some ecologies in farmers' fields	Low	Total loss (Can wipe the whole field)
Viral threats				
Cassava Mosaic Disease	High	Reduces production 30-40%	Moderate	Severe yield loss
Cassava brown streak virus disease	High	Can lead to over 90% percent yield loss	Quite high if stringent mechanisms are not put in place to prevent incidence in the country	Total yield loss can occur
Other threats (Insects)				
Mealy bugs	Low	Reduces yield significantly during outbreaks (over 70%)	Low	Loss of fields
Whiteflies	High	Transmit viral diseases (ACMD, CSBD) which reduce yield	Moderate	Depending on diseases they transmit
Mites	Low	Feed on crops and reduces it photosynthetic ability and assist in spreading other diseases	Low	Moderate losses

Current risk management process

Actions currently taken

Table 4: Actions currently taken to mitigate cassava viral threats

Type of risk	Prevention, Mitigation, and Preparedness	Detection and Response	Monitoring and Evaluation
Bacteria	Promotion of clean and healthy planting materials	Surveillance and destruction of infected fields	<p>Disease symptoms, incidence and severity</p> <p>Information is collected through field surveillance</p> <p>Information is shared: Before: Awareness creation and education on the diseases</p> <p>During: Public education, workshops, farmer fora</p> <p>After crises: Education using information vans, routine monitoring to track how the education went</p>
Viral	<p>Use of resistant materials</p> <p>Pre-emptive breeding</p>	Detection and Destruction of the vector	<p>Disease symptoms, incidence and severity</p> <p>Information is collected through field surveillance</p> <p>Information is shared: Before: Awareness creation and education on the diseases</p> <p>During: Public education, workshops, farmer fora</p> <p>After crises: Education using information vans, routine monitoring to track how the education went</p>
Whiteflies	Use of insecticides	Visual detection and spray with insecticides	<p>Information collected on population density</p> <p>Information is shared: Before: Awareness creation and education on the insects</p> <p>During: Public education, workshops, farmer fora</p> <p>After crises: Education using information vans, routine monitoring to track how the education went</p>

Gap Assessment

Strengths

The strengths of the National cassava disease management are evidenced by:

1. The availability of about thirty (30) improved cassava varieties developed and released by various national research institutes and public universities for use by farmers.
2. The existence of laws that regulate the movement of cassava plant materials in and out of the country to prevent the entry and spread of cassava viral diseases.
3. The availability of highly skilled human resource and infrastructure for the detection of viruses and the development of cassava resistant varieties.
4. Development of country-wide disease maps to support breeding for cassava virus resistant varieties.

Weaknesses

The weaknesses of the National cassava disease management are evidenced by:

1. Poor enforcement of quarantine procedures thus allowing entry of diseased plant materials into the country.
2. Lack of knowledge by farmers on viral identification and few institutions have knowledge/expertise and facilities that can detect viruses.
3. Inadequate resources to conduct monitoring and evaluation, viral detection and research in the country.

Key takeaways

The key takeaways are:

1. To build the capacity of immigration officers, customs officers and NADMO staff to complement the efforts of PPRSD quarantine staff to detect and prevent entry of cassava viral infected plant material into the country.
2. The importance of cassava as food security crop and industrial raw material for livelihood enhancement requires that plans are put in place to manage any crisis that can affect the production and utilization of the crop.

II. STRATEGIC OBJECTIVES AND VISION OF THE NATIONAL RESPONSE PLAN

Vision

To enhance food security and improved income in Ghana through the management of cassava viral disease threats.

Strategic Objectives

Strategic Objective 1

To mobilize requisite human resource to respond to cassava viral disease threats

Activities to achieve objective

1. Identify needed expertise required to respond to any outbreak
2. Conduct training needs assessments
3. Organize regular training and refresher courses

Strategic Objective 2

To establish an Emergency Operation Center (EOC) in response to outbreak of viral diseases

Activities to achieve objective

1. Acquisition of needed material resources for the establishment of the EOC
2. Development of SOP (Standard Operations Procedure) for monitoring, prevention, detection and mitigation, before, during and after crisis
3. Establishment of data collation and processing unit
4. Mobilization of funds from multiple sources for the operation of EOC
5. Develop infrastructure (offices and laboratories) for use by the EOC

Strategic Objective 3

To create awareness and sensitize the public on the threats of cassava viral diseases

Activities to achieve objective

1. Map out key institutions and stakeholders with requisite expertise to respond effectively to any cassava viral disease outbreak
2. Organise training workshops, seminars and farmer field days
3. Create platforms, identify respective roles of stakeholders for shared learning in response to cassava viral disease outbreak

4. Develop and distribute factsheets, handbills, flyers etc.
5. Educate the general public on cassava viral diseases through mass media outlets

Strategic Objective 4

Create a cassava disease monitoring and surveillance system for early detection

Activities to achieve objective

1. Develop protocols for field surveys and monitoring
2. Identify tools for rapid field diagnosis of virus infected cassava plants
3. Develop protocols for rapid laboratory diagnosis
4. Train technical experts in disease modelling and surveillance

Strategic Objective 5

Develop rapid planting material multiplication systems in response to cassava viral disease threats

Activities to achieve objective

1. Rapid multiplication of virus resistant cassava varieties at low disease pressure sites for distribution
2. Production of clean planting materials through tissues culture
3. Production of clean planting materials through Semi-autotrophic hydroponics (SAH)

Strategic Objective 6

Institute pre-emptive breeding activities for the development of CBSD resistant cassava varieties

Activities to achieve objective

1. Country wide germplasm collection
2. Molecular characterization of germplasm to remove duplicates and create core collections
3. Collaborate with CBSD hotspot countries for screening to identify resistant cassava genotypes
4. Collaborate with Cassava Breeders from hotspot countries to introgress CBSD resistance into Ghanaian cassava varieties

III. STRUCTURE OF THE EMERGENCY OPERATION CENTER(EOC)

Institutional anchoring

The Emergency Operation Center (EOC) will be anchored at Ministry of Environment Science Technology and Innovation (MESTI) which will be housed at Crops Research Institute (CRI) under the Council for Scientific and Industrial Research (CSIR).

The CSIR-CRI is the Centre of Excellence for Agricultural Research, Innovation and Capacity building for development. In the West Africa sub-region, CSIR-CRI is the regional center of excellence for root and tuber research.

The institute is mandated to work on all food and industrial crops; to develop and disseminate demand-driven technologies and build capacity for sustainable food and industrial crops productivity to enhance livelihoods.

CSIR-CRI has the relevant human resource and expertise in virus detection and viral disease surveillance and monitoring, nematology, entomology, mycology, weed science, biocontrol, molecular biology, tissue culture, breeding, socio-economics, biometry, biochemistry and communication.

The institute has functional molecular and virology laboratory, tissue culture lab, insectary, screen houses and research fields (on-station and out-station). It has over the years developed and release cassava varieties with adequate resistance to CMD for cultivation in Ghana and in the West African sub-region.

Governance

Mandate

CSIR-CRI is governed under the CSIR Act 1996 (Act 521) with the mandate to work on all food and industrial crops; to develop and disseminate demand-driven technologies and build capacity for sustainable food and industrial crops productivity to enhance livelihoods. Because the EOC is anchored at CSIR-CRI, the EOC will be governed by the CSIR Act 1996 (Act 521).

The mission of the EOC will be to:

1. Coordinate and formulate policies and facilitate programmes responsive to viral diseases
2. Collaborate with other relevant agencies/institutions
3. Resource Mobilization and allocation (funding, human capacity, infrastructural)
4. Supervise and train regulatory staff
5. Create public awareness on viral diseases through sensitization, stakeholder workshops and media engagement

6. Publish information materials
7. Enhance the capacity of relevant stakeholders
8. Responsible for data management and records keeping

There will be an MOU signed between the institute and relevant partners. This MOU is to provide guidelines between the anchored Institution and other stakeholders involved in running the EOC.

Organizational Oversight

The EOC will have a Consultative Group with representatives each from:

1. Ministry of Food and Agriculture (Directorate of crop services): will play advisory role because of their national responsibility for ensuring cassava improvement.
2. Ministry of Food and Agriculture (Plant Protection and Regulatory Services Directorate (PPRSD)): They are the agents responsible for issuing phytosanitary and import permits. Their role is to advise on phytosanitary matters
3. Ministry of Food and Agriculture (Extension services): They are government agent responsible for education and knowledge transfer to farmers. They will advise the EOC on best ways to transfer knowledge to farmers
4. CSIR-CRI (Deputy Director in charge of research): The deputy Director of CRI is responsible for research activities and is therefore required to know what the EOC is doing in terms of research direction.
5. EOC Coordinator: As the coordinator of the EOC he must be part of any decision-making activity to ensure smooth operation of the EOC
6. NGO: A representative from non-governmental organization with interest in cassava productivity to contribute ideas towards efficient running of the EOC
7. Farmer Based Organization: A representative of a cassava-based farmer organization to serve as a liaison between the EOC and cassava farmers.

The Consultative Group will have oversight/advisory role on the operations of the EOC.

Organizational structure

Departments and governing organs

Table 5 : Departments and governing actors of the EOC

Division	Roles
Research	Participatory breeding for virus resistant cassava varieties, Production of clean planting material, marker assisted breeding, Baseline and impact studies
Surveillance	Conduct country-wide viral disease survey to scout for virus infected plants.

Diagnostics	Identification of unknown viral strains
Data processing and management	Data collation, analysis and information management
Extension and Communication	Farmer and public education and information delivery
Administration, human resource and finance (Office of director, Human resource, registry, transport, accounts, audit	Liaison between stakeholders and development partners Policy direction for the project Project management Internal controls and disbursement of funds
Monitoring and evaluation	Develop monitoring and evaluation framework Routine monitoring and evaluation

The EOC will be governed under the CSIR Act 1996 (Act 521) and will be accountable to the Director of CSIR-CRI in consultation with the Consultative group.

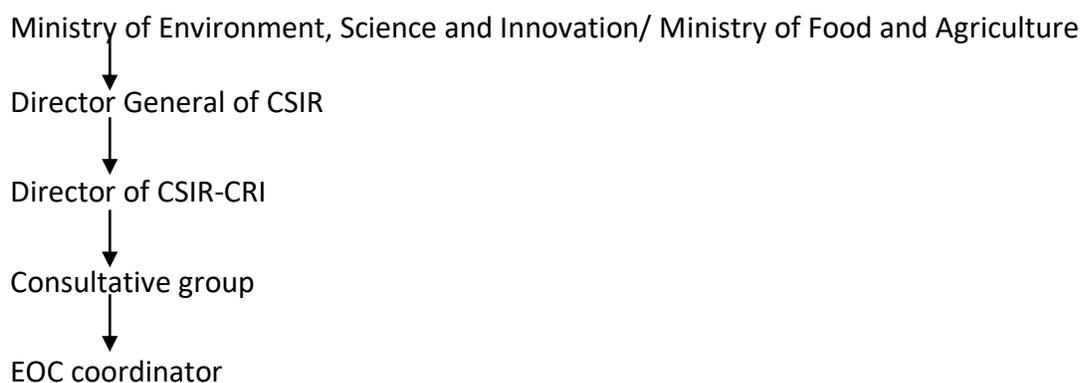
The EOC coordinator will be responsible for the day to day running of the EOC assisted by the deputy coordinator and heads of divisions.

Reporting and decision-making structure

The divisional heads would submit quarterly report on project activities to the EOC coordinator who will forward it to the Director of CRI whilst informing the Consultative Group for advice. The Consultative Group will then report the outcome to the CSIR-CRI director who will then report to higher authorities (Director General and the Minister).

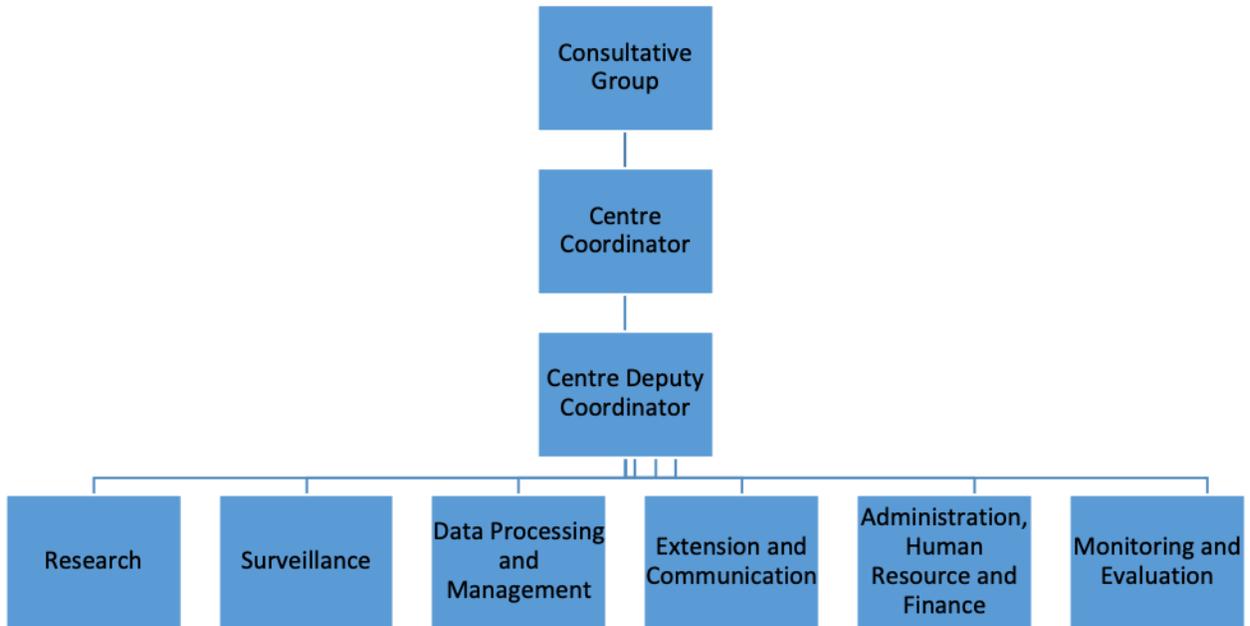
The decision will be taken at the Ministerial level (MESTI and MoFA) and will pass on to the Director General of CSIR to the director of CSIR-CRI through the consultative group to the EOC coordinator for implementation.

Decision making Structure



Organizational tree

Figure 1: Organizational tree of the EOC



Human Resources

Core Competencies

Various competencies will be needed for the successful running of the EOC. These include skills in:

1. Virus disease identification and detection
2. Effective communication
3. Field data capturing entry, analysis and interpretation
4. Cassava field establishment and husbandry practices
5. Virus disease prediction and modelling
6. Cassava variety development
7. Disease impact measurement
8. Planting material production and dissemination
9. Monitoring and evaluation
10. Alternate host identification

All the skills enumerated above will be needed at each stage (Prevention, Mitigation, Preparedness, Detection and response, Monitoring and evaluation) of the crises.

Roles and Responsibilities

Permanent staff and their roles and responsibilities for on-going operations of the EOC

Table 6: Roles and responsibilities of the EOC staff

Job title	Role/ responsibilities
Socioeconomics	Conduct baseline surveys to assess farmers knowledge and disease impact assessment
Extensionists	Information and knowledge transfer to farmers
Virologist	Conduct disease survey, detection of disease pathogens and develop management measures
Pathologists	Conduct disease survey, detection of disease pathogens and develop management measures
Entomologist	Detection and management of disease vector
Tissue culturist	Production of clean planting materials and invitro conservation of genetic material
Molecular Biologist	Detection of known and unknown viruses, marker assisted selection for identification of traits of interest
Cassava Breeders	Development of virus resistant cassava varieties
Agronomist	Development of improved cassava cropping systems
Communication experts	Production of factsheets on the developed strategies and sensitization of farmers and the general public on the available control measures, reporting of project activities
Seed inspectors	Seed inspection and certification
Monitoring and evaluation officer	Monitoring and evaluation of all project activities, and utilization of project resources
Project Finance Officers	Disbursement of project funds, internal control of project funds expenditure and accounting

Temporary roles and responsibilities during emergency response

Table 7: Roles and responsibilities during emergency response

Job title	Role/ responsibilities
PPRSD experts (Quarantine inspectors)	Monitoring, sensitization and education of farmers and the general public Enforcement of the quarantine laws
Immigration and customs officials, NADMO, Security agencies	Enforcement of the quarantine laws
Secretarial staff	Communications, day-to-day secretarial duties
Drivers	Drive project vehicles for regular monitoring and surveillance
Data entry clerks	Data entry, screening and management

Epidemiologist	Assess the incidence and severity of the disease and the vector (over a period of time on the distribution and pattern of spread of the disease). Development of disease management and control models
Seed inspectors	Certification of planting materials (seed) ear-marked for dissemination
Private transport services	Transportation of deployed resistant varieties
District agricultural extension agents	Deployment of improved resistant
Casual labourers	Destruction of infected fields

Mechanisms for assigning roles

The mechanisms for assigning roles are based on the following criteria:

- Academic Qualification such as PhD, MSc., BSc
- Competencies in a field of specialization
- Experiences in the area of work and the period of serving as a specialist

Recruitment Strategy

The strategy for recruitment of staff will be done through the following means:

- **General recruitment:** Positions requiring specified academic qualifications will be advertised in both the electronic and print media for interested persons to apply.
Qualified persons will be interviewed and deployed. Positions to be filled via general recruitment will include Receptionist, Data Manager, Data Entry Clerks, Drivers, Security, Cleaners, Laboratory technicians, Administrator
- **Head hunting:** This approach will be used to fill highly skilled and specialized positions that cannot be easily sourced through general recruitment, such as epidemiology skills.
- **Secondment:** Persons from relevant institutions with the needed competence and experience could be posted to support the operations of the EOC. Positions for the general recruitment will include EOC Coordinator, Deputy EOC Coordinator, Administrative Assistants, Virologist, Mycologist, Entomologists, Weed Scientist, Cassava Breeder, Tissue Culturist, Molecular Biologist, Socio -economist, Communication Experts, Monitoring and Evaluation Officer, Soil Scientist, Finance Officers, Screenhouse Manager, Biocontrol Specialist, Agronomist, Biometrician, Seed Specialist, Laboratory and Field Technicians.

Training

To identify gaps, training needs assessment will be conducted. Furthermore, there will be trainings on how to operate an effective and efficient EOC.

New hires:

New hires will be trained in the following identified areas based on their needs

Table 8: Training areas for new staff

Job Title	Training Required
All recruited staff	Project Implementation Workshop/Monitoring and evaluation
Project Management and Technical Teams	Crisis Management
Virologist/Molecular Biologist/Laboratory Technicians	Diagnostic techniques
Biometrician/Data Manager/Data entry clerks	Data management and analysis
Tissue Culturists/Laboratory Technician/Screenhouse Manager/Cassava Breeder/Field Technician	Production and handling of tissue culture cassava planting materials
Tissue Culturists/Virologist/Molecular Biologist/Laboratory Technician/Screenhouse Manager	Transformation technique for the development of resistant cassava varieties
Tissue Culturists/Laboratory Technician/Screenhouse Manager/Cassava Breeder/Field Technician	Semi-Autotrophic Hydroponics system
Communication Experts	Effective communication on virus disease management
Seed Specialist/Cassava Breeder	Seed systems (Registration and certification)
Virologist/Mycologist/Entomologist	Phytosanitary practices

Existing staff:

Refresher courses will be conducted for existing staff across disciplines as and when necessary during project implementation. Some of the trainings that will be conducted for existing staff are as follows:

1. Monitoring and evaluation practices/procedures
2. Crisis management during viral outbreak
3. New diagnostic techniques
4. Data management and analysis
5. Production and handling of tissue culture cassava planting materials
6. Transformation technique for the development of resistant cassava varieties
7. Semi-Autotrophic Hydroponics system for the production of clean planting materials
8. Effective communication on virus disease management

9. Seed systems (Registration and certification)
10. Phytosanitary practices

Financial and material resources

Financial needs¹

Summary of the budget items for the EOC setup, EOC operating expenditure and contingency budget are shown below from FY2019 to FY 2023

Table 9: Five-year budget of the EOC

Budget Period:	FY2019	FY2020	FY2021	FY2022	FY2023	5YR TOTAL
<i>EOC SETUP COSTS</i>	2,334,900	441,750	363,000	319,250	296,000	3,754,900
<i>EOC OPERATING EXPENDITURE</i>	NO OPERATING EXPENSES INCURRED DURING THE EOC SETUP PERIOD		985,400	917,400	843,850	2,746,650
<i>CONTINGENCY BUDGET</i>			346,439	-	-	346,439
OVERALL TOTAL BUDGET	2,334,900	441,750	1,694,839	1,236,650	1,139,850	6,847,989

Materials needs

For the setup and for the operations:

The detailed quantities of the materials needed, and their prices have been presented in the budget for reference.

Regular operations

1. Office space (equipment, computers and accessories, sets of furniture, stationary)
2. Laboratory (laboratory equipment, chemicals, reagents and consumables, microscopes)
3. Vehicles and Trucks
4. Smart Phones
5. Training materials including LCD projectors, projector screen, Flip chart stands, flipcharts, posters, banners, stationary (notepads, pens, pencils, envelopes), lab-tops
6. Database management system
7. Field materials and equipment (GPS, Identification and preservation kits for alternative hosts)
8. Rapid Diagnostic kits (on-field virus detection tools/kits for rapid diagnosis)
9. Incinerators for efficient waste disposal system

¹See response plan budget for further details

During a Viral outbreak

In addition to materials needed in a regular operation, the EOC will require:

1. Portable Sequencer (quantity - 2) for rapid detection of unknown cassava viruses
2. Trucks for distribution of clean planting materials to affected farmers
3. Spraying machines to apply pesticides to manage disease vectors on infested farms

Resource management plan

Material Resources

The required material resources will be mobilized and distributed by the EOC coordinator and his team to various working groups. These materials will be distributed based on need requirement from the different actors.

Financial Resources

Normal operations

The required financial resources will be mobilized and distributed by the EOC coordinator and his team to various working groups. These resources will be disbursed based on budgeted allocations.

To ensure effective accounting for financial resources, the following conditions must be adhered:

1. Activities and action plan should align with the Project Development Objectives
2. Activities must have a work plan with budget, roles and responsibilities
3. Procurement should follow the national procurement procedures
4. Imprest retired within 14 – 21 days
5. Semi-annual or annual financial report submitted

During a viral outbreak

During a crisis the normal financial management disbursement process will be followed. However, the process will be fast-tracked, and necessary funding will be released within 2-days of an outbreak alert.

Mechanism for financial control and accounting

The mechanism for financial control and accounting for the EOC will be audited by both internal and external auditors. Internal audit is always conducted on all imprest requests and retirements. Statutory external auditing may be conducted by Government of Ghana auditor annually. Commissioned external auditors can audit project finances at the request of donors.

Partnerships

1. The financial institutions will include CABI, AGRA, FAO, GIZ, BMGF, CIAT, UKAid, EU, IITA and others
2. The technical institution PPRSD, Universities, BNARI, NGO, Private sector, FBO/ CBO, IITA, CIAT, CABI

IV. EMERGENCY RESPONSE PLAN

Actions to be taken before an outbreak

Table 10: Actions to be taken before an outbreak

	Risk analysis and definition of risk level	Planning	Surveillance	Mitigation	Community engagement	Partnership
Actions	<ul style="list-style-type: none"> -Pest risk initiation (to establish that the pest is there) -Risk assessment -Determine the level of risk; high, medium, low (based on disease distribution map). A disease with low risk has less likelihood of entry into the country. Materials with high risk need to be quarantined 	<ul style="list-style-type: none"> -Identify the requisite experts -Formation of technical team (key experts; virologist and the experts from the PPRSD, socioeconomist, Extensionists, biometrician -Assemble the relevant tools (compendium) -Setting up a secretariat -Building the capacity of the team on the disease with respect to the tools -Resources mobilization -Identify an operational area based on regional mapping (dividing the country into zones for easy and timely monitoring) 	<ul style="list-style-type: none"> -Look out for presence of the actual disease symptoms; leaves, stems and roots -Updated versions of disease compendium 	<ul style="list-style-type: none"> -Sensitization and education on the symptoms and effect of the disease (FBO's, AEA's) -The need for farmers to acquire planting materials from certified sources 	<ul style="list-style-type: none"> Awareness creation 	<ul style="list-style-type: none"> -Types partnerships; international partnerships (neighbouring countries), regional partnerships, inter-ministerial partnerships (MESTI, M etc.), academic research, partnership Donors

Responsibility	Plant quarantine division of the Plant Protection and Regulatory Services Division (PPRSD) and other relevant institutions (Research, Universities, research)	PPRSD and the technical committee of the team assembled	The technical team	All the relevant stakeholders (PPRSD, FBO's, AEA's, seed growers, Transporters	The traditional rulers, opinion leaders, FBO's, Religious leaders	All stakeholders
Process	<p>Collaboration between the importing and the exporting country.</p> <p>The importing country requests the pest list of the exporting country</p> <p>Using the CABI compendium list to search for the pest distribution</p>	<p>Organisation of periodic stakeholder meetings and consultations</p> <p>Through stakeholder workshops</p>	<p>-Early detection methods; Testing the whitefly for the presence of the virus (PCR, RT-PCR, ELISA, etc)</p> <p>-Testing the host plants for possible latent infection (molecular means)</p> <p>-Examination of roots for the symptoms</p> <p>-Quarantine materials from non-epidemic countries</p> <p>-Random testing of planting materials even from non-epidemic countries</p>	<p>Development of early warning systems</p> <p>Regular testing and certification of roots at multiplication sites</p> <p>Identify hotspots and quarantine the area to restrict movement of planting materials</p>	<p>Strong linkage between the traditional rulers, religious bodies and the technical experts</p> <p>Community stakeholder meeting</p> <p>Durbars</p> <p>The use of audio visuals</p> <p>Community information centres</p>	<p>Through provisions resources</p> <p>Interministerial collaboration (Immigration, NADMO, MESTI) to control the borders entry. And, response through NADMO in disease outbreaks</p> <p>Training of partners on disease symptoms</p>
Frequency	<p>Application for the import permit should be done at least 7 days before the importation</p> <p>PPRSD must acknowledge receipt within 3 days</p> <p>Response to application should be made within 30 WORKING days after acknowledgement (to allow for risk</p>	Regular routine testing of borders and various entry points for signs of the diseases or the vectors (this should be done in close collaboration with other bordering countries	Twice a year	Throughout the year	Once in a year in every community	Throughout year

	assessment)					
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Actions to be taken in case of an outbreak

Table 11: Actions to be taken in case of an outbreak

	Detection, Identification and Confirmation	Response, Containment, Quarantine and Elimination	Response system activation	Response system operation	Evaluation of the response to the outbreak
Actions	Presence of virus in the host plant and vector, symptoms in the roots and leaves	Restrict movement of planting materials between communities, districts and regions	The disease management strategy	The level of severity	Participatory monitoring
Responsibility	Technical experts	The technical experts Farmers	-The team of experts and other stakeholders -National security	-The team of experts and other stakeholders -National security	Technical experts and other relevant stakeholders
Process	- By molecular methods -Serological and visible symptoms	-Control the vectors to prevent further transmission -Prevent cross-border exchange of planting materials -Destruction of infested fields -Setting up a rapid response unit	-Swift communication to all members -Stakeholder meeting -Map up strategies on how to contain the disease	-Nationwide survey to assess the prevalence of the disease; varieties grown, regional distribution, how the fields got infested, how the farmer got the planting materials -Taking and testing of samples to confirm the disease -Proper diagnosis -Production of factsheets for distribution	Impact assessment

				-Produce jingles and audio visuals to educate farmers and AEA's on the disease Training of farmers on how to manage the disease	
Frequency	Immediately after an epidemic	Immediate Rapid response	Immediate	Immediate	Quarterly

Phytosanitary Measures

Laws and regulations on Biosecurity

Importation and exportation of plants and plant materials:

The movement of cuttings in and out of the country is governed by the Plants and Fertilizer Act 2010 (Act 803). This Act provides sufficient conduct of plant protection to prevent the introduction and spread of plant pest. Regulates the import and facilitate the export of plant and plant materials and provide for related matters.

Alerting mechanisms when border officers identify infected plant material

All imported cassava material must be accompanied by an import permit and phytosanitary certificate as prescribed by the Act. When imported cassava material is found to be infected, the alerting mechanisms followed by border officers is as follows:

- Quarantine the infected plants at a designated location and an authorized officer shall be present for the duration that the director considers necessary
- Remove the risk through chemical treatment (Any approved chemical depending on the risk)
- Re-exportation of the cassava cuttings back to the country of origin
- Destruction by burning or deep burying of the cassava at the port of entry

Seed system

The seed system in Ghana works based on the mechanisms listed below:

Mechanism for issuing certificates

- The seed importers, exporters, growers and cleaners must first apply through the Minister
- The application is accompanied by a fee determined by the Minister in consultation with Minister of Finance
- The application is either granted or refused based on technical or economic ground which is communicated to the applicant
- The Minister grants the registration subject to conditions specified in the certificate of registration

Best practice in handling cassava cuttings

- Cuttings are harvested from an inspected and approved seed multiplication sites
- 20-25cm fresh cuttings are bundled and labelled
- Cuttings are handled with care in order not to damage the buds

- To maintain genetic purity, care is taken to avoid genetic mixtures

Methods of transporting cuttings

The cassava cuttings must be freshly harvested from the field and transported in a well packaged in boxes and transported fresh by trucks and tractors to the destination.

Vector control

Treatment of whiteflies:

The following activities may be used to manage whitefly vectors:

- Planting of cassava varieties resistant to both the vector and the virus
- Application of biological control methods like natural enemies (if available)
- Apply the "Push pull destroy approach" (plant alternative host that will attract the vector to be killed)

Handling of infected crops:

Infected crops will be handled in the following ways:

- Identify and destroy by burning infected cassava plants to remove any threat of disease spread to unaffected areas
- Identify alternative hosts of the vector and destroy to suppress their colonization and rapid population increase which will result in virus control

Distribution of disease resistant cassava varieties:

Research Institutions will develop virus resistant cassava varieties which will be disseminated through several avenues such as Ministry of Food and Agriculture, private sector seed growers or NGOs. These distribution centres will further multiply resistant cuttings for distribution to farmers and other stakeholders

Communication & Awareness

Community Engagement:

Groups/ Actors: The following actors along the cassava value chain will be engaged in all communication and awareness creation activities. The actors include traditional leaders, opinion leaders, religious leaders, farmers, seed growers, seed inspectors, quarantine officers, customs, immigration, extension agents, policy makers, processors, general public and NGOs.

Type of training and awareness campaigns will be in a form of durbars, farmer field days, audiovisuals, stakeholder consultations, fact sheets, hand bills, policy briefs, newspaper publications, use of mass media, information centres, workshops, conferences and seminars.

Channels of communication to different actors

Table 12: Channels of communication to different actors

Channel of communication	Actor	Frequency of engagement
Conferences, workshops, seminars, stakeholder consultations, policy briefs, newspaper publications,	Policy makers, seed inspectors, quarantine officers, customs, immigration, extension agents, seed inspectors, NGOs	As and when the need arises
Durbars, farmer field days, audiovisuals, fact sheets, hand bills, workshops, information centers, use of mass media	Farmers, opinion leaders, seed growers, traditional leaders, religious leaders, processors, public	As and when the need arises

V. OPERATIONAL STRATEGY

Implementation Plan

Roadmap

Table 13: Roadmap for the EOC

Strategic objectives	Activity	2019		2020		2021		2022		2023	
		S1	S2								
To mobilize requisite human resource to respond to cassava viral disease threats	Identify needed expertise required to respond to any outbreak	x	x	x	x	x	x	x	x		
	Conduct training needs assessments		x		x		x		x		
	Organize regular training and refresher courses				x		x		x		
Establish an emergency operations Centre (EOC) to manage the spread of cassava viral diseases	Acquisition of needed material resources for the establishment of the EOC	x	x	x	x						
	Development of SOP (Standard Operations Procedure) for monitoring, prevention, detection and mitigation, before, during and after crisis	x	x								
	Establishment of data collation and processing unit	x	x	x	x						
	Mobilization of funds from multiple sources for the operation of EOC	x		x		x		x			
	Develop infrastructure (offices and laboratories) for use by the EOC	x	x	x	x						
To create awareness and sensitize the public on the threats of cassava viral diseases	Map out key institutions and stakeholders with requisite expertise to respond effectively to any cassava viral disease outbreak	x	x								
	Organise training workshops, seminars and farmer field days		x		x		x		x		
	Create platforms, identify respective roles of stakeholders for shared learning in response to cassava viral disease outbreak										
	Develop and distribute factsheets, handbills, flyers etc.		x	x		x		x			
	Educate the general public on cassava viral diseases through mass media outlets			x	x	x	x				

Resource Mobilization Plan

The funds required for the EOC set up and operations over a 5-year period will be USD 6,847,989 as per the following breakdown:

Budget Period:	FY2019	FY2020	FY2021	FY2022	FY2023	5YR TOTAL
<i>EOC SETUP COSTS</i>	2,334,900	441,750	363,000	319,250	296,000	3,754,900
<i>EOC OPERATING EXPENDITURE</i>	NO OPERATING EXPENSES INCURRED DURING THE EOC SETUP PERIOD		985,400	917,400	843,850	2,746,650
<i>CONTINGENCY BUDGET</i>			346,439	-	-	346,439
OVERALL TOTAL BUDGET	2,334,900	441,750	1,694,839	1,236,650	1,139,850	6,847,989

Sources of funding:

The Government of Ghana can provide matching funds in the form of provision of lands for establishment of EOC, office space, payment of salaries to project staff on secondment. Development Partners may also provide funds for the establishment and operation of EOC before, during and after crisis. These players may be engaged to mobilize funds through round table discussions, proposal writing and stakeholder consultation.

Implementation Risk Management

Table 14: Implementation risk management plan

Risks	Risk Level	Mitigation strategies
Lack of funding	High	Identify multiple sources of funding
Untimely release of funds	High	Timely release of funds
Virement of allocated resources	Medium	Avoid virement by strictly following workplan and budget by project team. Sanctions such as refund will be applied to defaulters

Transfer of trained staff	High	Regular capacity building run regular recruitment drives in research centers, universities, advertise job opening in both electronic and print media
Lack of trained staff	Low	Regular capacity building run regular recruitment drives in research centers, universities, advertise job opening in both electronic and print media
Lack of buy in by stakeholders	High	Sensitization of stakeholders through seminars, workshops and conferences; directly engage with key influential opinion leaders

Monitoring and Evaluation Plan

Table 15: Monitoring and Evaluation plan

Intervention logic	Expected Results	Activities	Monitoring indicators	Monitoring frequency	Responsibility for monitoring	Audit sources	Assumptions	Evaluation frequency	Responsibility for evaluation
Mobilize requisite human resource to respond to cassava viral disease threats	Qualified human resources with strong technical capacity	Identified needed expertise required to respond to any outbreak	Number of people trained	Annual	Monitoring and Evaluation officer, EOC Coordinator	Reports	Availability of experts Funds released by donors	Annual	Monitoring and Evaluation officer, EOC Coordinator
		Conduct training needs assessments	Training needs ascertained	Bi-annual	Monitoring and Evaluation officer, EOC Coordinator	Reports	Availability of relevant training centers Funds released by donors	Bi-annual	Monitoring and Evaluation officer, EOC Coordinator

		Organize regular training and refresher courses	Number of refresher courses organized	Annual	Monitoring and Evaluation officer, EOC Coordinator	Reports	Availability of relevant training centers and qualified resource persons Funds released by donors	Annual	Monitoring and Evaluation officer, EOC Coordinator
2.0 Establish an Emergency Operation Centre (EOC) in response to outbreak of viral diseases	Operational EOC to coordinate and manage cassava viruses	Acquisition of needed resources for the establishment of the EOC	Quantities of resources acquired for the EOC set up	Bi-Annual	WAVE, Monitoring and Evaluation officer, EOC Coordinator	Reports	Availability of suitable supplies Fund released by donors	Bi-Annual	WAVE, Monitoring and Evaluation officer, EOC Coordinator
		Development of SOP (Standard Operations Procedure) for monitoring, prevention, detection and mitigation, before, during and after crisis	Standard Operations Procedure developed by 2019	Annual	WAVE, Monitoring and Evaluation officer, EOC Coordinator	Reports	Funds released by donors	Annual	WAVE, Monitoring and Evaluation officer, EOC Coordinator

		Establishment of data collation and processing unit	Data collection and processing unit demarcated within the EOC	Annual	WAVE, Monitoring and Evaluation officer, EOC Coordinator	Reports Data collection instruments Field pictures GPS Coordinates	Funds released by donors	Annual	WAVE, Monitoring and Evaluation officer, EOC Coordinator
		Mobilization of funds from multiple sources for the operation of EOC	Number of funding sources identified	Annual	WAVE, Monitoring and Evaluation officer, EOC Coordinator	Reports	Funds released by donors	Annual	WAVE, Monitoring and Evaluation officer, EOC Coordinator
		Develop infrastructure (offices and laboratories) for use by the EOC	The EOC complex constructed by 2020	Semi-annual	WAVE, Monitoring and Evaluation officer, EOC Coordinator	Reports and pictures	Funds released by donors Land earmarked and released by CRI Management	Annual	WAVE, Monitoring and Evaluation officer, EOC Coordinator, CRI Director
3.0 To create awareness and sensitize the public on the threats of cassava viral	Good agricultural practices for managing cassava viral diseases is communicated and is common	Map out key institutions and stakeholders with requisite expertise to respond effectively to any cassava	Number of relevant institutions and stakeholders identified	Annual	WAVE, Monitoring and Evaluation officer, EOC Coordinator	Reports	Availability of relevant institutions and stakeholders Funds released by donors	Annual	WAVE, Monitoring and Evaluation officer, EOC Coordinator

diseases	knowledge and	viral disease outbreak							
		Organize training workshops, seminars and farmer field days	Number of workshops, seminars and field days organized	Quarterly	WAVE, Monitoring and Evaluation officer, EOC Coordinator	Reports Pictures Participant s lists	Funds released by donors	Annual	WAVE, Monitoring and Evaluation officer, EOC Coordinator
		Create platforms, identify respective roles of stakeholders for shared learning in response to cassava viral disease outbreak	Number of platforms established across the country Lessons learnt (viral disease symptom identification and control measures) Benefits gained by stakeholders in participating on platform (networks created,	Quarterly Annual	WAVE, Monitoring and Evaluation officer, EOC Coordinator WAVE, Monitoring and Evaluation officer, EOC	Reports Field pictures List of platform participant s Reports	Cooperation from stakeholders Funds released by donors Cooperation from identified stakeholders	Annual Annual	WAVE, Monitoring and Evaluation officer, EOC Coordinator WAVE, Monitoring and Evaluation officer, EOC

			other issues addressed on platform) Defined roles/ responsibilities of identified stakeholders		Coordinator		Funds released by donors		Coordinator
		Develop and distribute factsheets, handbills, flyers etc.	Number developed and distributed	Semi-annual	WAVE, Monitoring and Evaluation officer, EOC Coordinator	Reports	Funds released by donors	Annual	WAVE, Monitoring and Evaluation officer, EOC Coordinator
		Educate the general public on cassava viral diseases through mass media outlets	Number of media engagements done	Semi-annual	WAVE, Monitoring and Evaluation officer, EOC Coordinator	Reports Print and electronic publications	Funds released by donors	Annual	WAVE, Monitoring and Evaluation officer, EOC Coordinator
4.0 Create a cassava disease monitoring and surveillance system for early detection	A rapid and responsive system	Develop protocols for field surveys and monitoring	Protocols developed for field surveys	Annual	WAVE, Monitoring and Evaluation officer, EOC Coordinator	Reports	Funds released by donors	Annual	WAVE, Monitoring and Evaluation officer, EOC Coordinator
		Develop protocols for rapid laboratory diagnosis	Protocols developed for laboratory diagnosis	Annual	WAVE, Monitoring and Evaluation officer, EOC Coordinator	Reports	Funds released by donors	Annual	WAVE, Monitoring and Evaluation officer, EOC Coordinator
		Identify tools for rapid field diagnosis of virus infected cassava plants	Tools identified for rapid field diagnosis	Annual	WAVE, Monitoring and Evaluation officer, EOC Coordinator	Reports	Funds released by donors	Annual	WAVE, Monitoring and Evaluation officer, EOC Coordinator

		Train technical experts in disease modelling and surveillance	Number of experts identified and trained	Annual	WAVE, Monitoring and Evaluation officer, EOC Coordinator	Reports Pictures List of experts trained	Funds released by donors	Annual	WAVE, Monitoring and Evaluation officer, EOC Coordinator
5.0 Develop rapid planting material multiplication systems in response to cassava viral disease threats	Production of healthy plant material is ensured	Rapid multiplication of virus resistant cassava varieties at low disease pressure sites for distribution	Quantity of resistant cassava varieties produced in low disease pressure sites	Annual	WAVE, Monitoring and Evaluation officer, EOC Coordinator	Reports	Funds released by donors Favorable weather conditions	Annual	WAVE, Monitoring and Evaluation officer, EOC Coordinator
		Production of clean planting materials through tissues culture	Quantity of clean cassava materials produced using tissue culture	Annual	WAVE, Monitoring and Evaluation officer, EOC Coordinator	Reports	Funds released by donors Favorable weather conditions Constant supply of electricity	Annual	WAVE, Monitoring and Evaluation officer, EOC Coordinator
		Production of clean planting materials through Semi-autotrophic hydroponics (SAH)	Quantity of clean cassava planting material produced in SAH	Annual	WAVE, Monitoring and Evaluation officer, EOC Coordinator	Reports	Funds released by donors Constant supply of electricity	Annual	WAVE, Monitoring and Evaluation officer, EOC Coordinator

6.0 Institute pre-emptive breeding activities for the development of CBSD resistant cassava varieties	Availability of CBSD resistant cassava varieties available countrywide	Country wide germplasm collection	Number of germplasm collections made	Annual	WAVE, Monitoring and Evaluation officer, EOC Coordinator	Reports	Funds released by donors	Annual	WAVE, Monitoring and Evaluation officer, EOC Coordinator
		Molecular characterization of germplasm to remove duplicates and create core collections	Number of germplasm characterized with markers	Annual	WAVE, Monitoring and Evaluation officer, EOC Coordinator	Reports	Funds released by donors	Annual	WAVE, Monitoring and Evaluation officer, EOC Coordinator
		Collaborate with CBSD hotspot countries for screening to identify resistant cassava genotypes	Number of CBSD resistant varieties identified in hot countries	Annual	WAVE, Monitoring and Evaluation officer, EOC Coordinator	Reports	Funds released by donors Custom officials permit entry of planting materials into hot spot countries	Annual	WAVE, Monitoring and Evaluation officer, EOC Coordinator
		Collaborate with Cassava Breeders from hotspot countries to introgress CBSD resistance into Ghanaian cassava	Number of genotypes introgressed with CBSD resistance	Annual	WAVE, Monitoring and Evaluation officer, EOC Coordinator	Reports	Funds released by donors	Annual	WAVE, Monitoring and Evaluation officer, EOC Coordinator

		varieties							
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