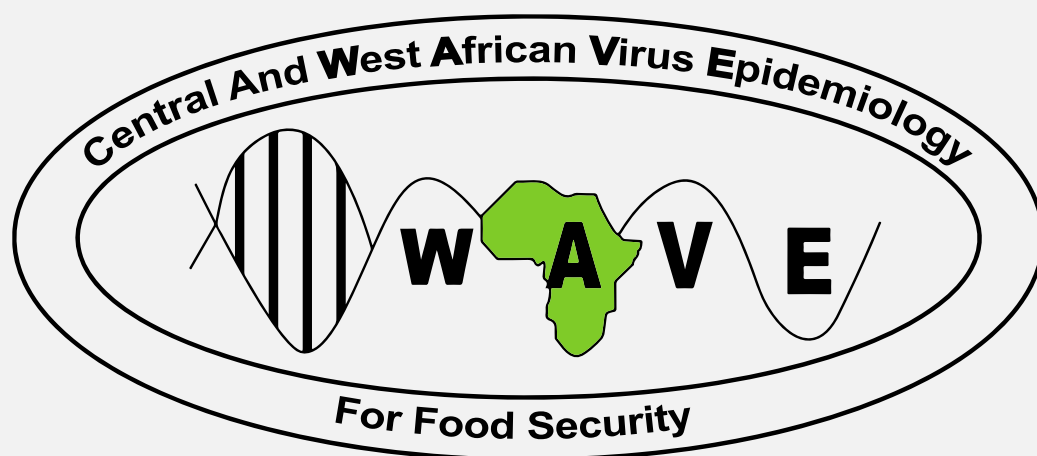


PROGRAMME CENTRAL AND WEST AFRICAN VIRUS EPIDEMIOLOGY

(WAVE)



**WAVE PROTOCOL
FOR PARTICIPATORY SURVEILLANCE OF
CASSAVA VIRAL DISEASES
IN WEST AND CENTRAL AFRICA**

BACKGROUND

Cassava is the staple food for about 800 million people worldwide, including nearly 500 million Africans. Although Africa is the world's largest cassava producer with 169 million tones (61% of global production), the average yield is paradoxically the lowest at 9 tones/ha compared to Asia with a yield of 21.5 t/ha (FAOSTAT, 2019). This low yield can be explained by several factors including the unavailability of good quality planting materials (cuttings), inadequate knowledge and failure to follow the technical procedures, especially poor management of viral diseases.

Indeed, cassava production is constrained by two main viral diseases: Cassava mosaic disease (CMD) and Cassava brown streak disease (CBSD). African cassava mosaic disease is caused by a diversity of nine (9) species of geminiviruses including African Cassava Mosaic Virus (ACMV) and East African Cassava Mosaic Virus (EACMV). Diseases caused by these two viruses are the primary constraints to cassava cultivation in sub-Saharan Africa. In addition, CBSD, caused by the potyvirus Cassava Brown Streak Virus (CBSV), is prevalent in Eastern and Central Africa, causing yield losses of up to 90 to 100%.

Awareness raising and training of cutting multipliers and cassava producers in the use of healthy planting material is the best alternative for disease leaching and can lead to significant production improvements. To this end, the Central and West African Virus Epidemiology (WAVE) program will undertake a participatory surveillance in collaboration with PlantVillage of Pennsylvania State University (USA) through regular cassava disease diagnostics based on the use of an intelligent application called *Nuru*.

This application will enable extension agents, agricultural specialists, plant material suppliers and cassava growers to be more efficient and self-reliant in identifying diseases and other damage in cassava fields. Thus, it offers a promising future for disease detection by cassava stakeholders in the field autonomously. It will thus make it possible to avoid using already diseased cassava stems for the establishment of new cassava fields in order to curb the spread of diseases. Where the application is not able to identify the symptom properly or when alerts received, WAVE researchers will collect samples in the field for further diagnosis in the laboratory.

OBJECTIVES OF THE PARTICIPATORY SURVEILLANCE

General objective

To contribute to the improvement of cassava productivity in West and Central Africa in a sustainable manner, by monitoring and protecting the cassava crop against viral diseases.

Specific Objectives (SO)

SO1- Conduct a baseline study of the main actors of the cassava value chain and the extension systems.

SO2- Raise awareness on the existence of cassava diseases and use the intelligent application *NURU* for their diagnosis in a participatory approach.

SO3- Train extension agents, producer associations, seed inspectors and cassava planting materials multipliers on the use of *NURU* application for the diagnosis of cassava diseases and the need to use healthy plant materials for planting

SO4- Using the *NURU* application in real-life setting

SO5- Molecular characterization of pathogens responsible for suspicious symptoms or symptoms not recognized by the *NURU* application.

SO6- Assess the impact of the participatory surveillance initiated by *WAVE*

EXPECTED RESULTS

- Cassava stakeholders and the entity in charge of extension in each country identified and informed of the participatory surveillance initiated by *WAVE*.
- Cassava stakeholders and the entity in charge of extension in each country sensitized on the existence, recognition and control of cassava diseases.
- At least 30 cassava-producer associations and 100 cutting multipliers in the 13 hubs of 10 countries in Central and West Africa where *WAVE* is implemented trained to use the *NURU* application for disease recognition. .
- At least 160 cutting multipliers trained in the use of healthy cassava planting material in the 13 hubs of the 10 Central and West African countries where the *WAVE* program is implemented.
- Training materials (leaflets and audiovisuals) published for sensitization and training on cassava diseases and the use of the *NURU* application.
- The *NURU* application used by the beneficiaries and the data stored in the database for further use.
- Suspicious samples characterized at the molecular level and an alert sent to the Emergency Operations Center (EOC) of the National Response Unit if necessary.
- The use of intelligent applications and healthy plant materials adopted, thereby improving production and income of beneficiaries.

BENEFICIARIES

Cassava-producer associations, cutting multipliers including women producers especially, are the target groups and direct beneficiaries of the participatory surveillance initiated by *WAVE*. This initiative is also an attractive job creation opportunity for rural and urban youth who will provide services to operators in the cassava value chain. It will contribute to increasing the professional experience of agricultural extension and development agents by strengthening their technical capacities in the prevention and control of cassava diseases.

The project will also benefit the scientific community by providing a modern tool for the diagnosis of plant diseases and for the participatory phytosanitary surveillance of crops, in collaboration with producers and other stakeholders of the cassava value chain.

In addition, participatory surveillance will be a key link in the implementation of the National Response Plan developed (by each of the 10 countries implementing WAVE) against viral diseases in cassava.

ACTIVITES PER SPECIFIC OBJECTIVE

The following Participatory surveillance activities will be carried out:

SO1- Conduct a baseline study of the main actors of the cassava value chain and the extension systems.

- Identification and contact with the Entity in Charge of Extension (ECE) in each country
- Identification and contact with stakeholders in the cassava value chain who will benefit from the project
- Identification of suitable locations for training and establishment of demonstration plots

SO2- Raise awareness on the existence of cassava diseases and the use of the intelligent application *NURU* for their diagnosis in a participatory approach

- Initiative kick-off workshop
- Raising awareness on the existence, recognition and control of cassava diseases

SO3- Train extension agents, producer associations, seed inspectors and cutting multipliers in the diagnosis of cassava diseases through the *NURU* application and the use of healthy planting materials

- Training on the use of the *NURU* application
- Training on the need to use of healthy plant materials

SO4- Using the *NURU* application in real-life setting

- implementing monitoring - diagnosis of cassava diseases and enrichment of the WAVE database
- Management and use of data sent by extension agents, seed multipliers and producers

SO5- Molecular characterization of pathogens responsible for suspicious symptoms or symptoms not recognized by the application.

- Collection of suspicious samples

- Molecular diagnosis of suspicious samples and identification of the culprit pathogen(s)

S06- Assessing the impact of the participatory surveillance initiated by WAVE

- Socio-economic study on the use of the intelligent applications for diagnostics
- Monitoring and evaluation of the participatory surveillance initiated by WAVE
- WAVE participatory surveillance initiative closing Workshop

The activities to be carried out have been grouped into components as follows:

COMPONENT I/ AWARENESS AND TRAINING

- Activity 1: Identification and establishment of contact with the Entity in Charge of Extension (ECE) in each country
- Activity 2: Identification and establishment of contact with stakeholders in the cassava value chain who will benefit from the project
- Activity 3: Identification of suitable locations for training and establishment of demonstration plots
- Activity 4: kick-off workshop
- Activity 5: Raising awareness on the existence, recognition and control of cassava diseases
- Activity 6: Training on the use of the *NURU* application
- Activity 7: Training on the use of healthy plant materials for planting

Activity 1: Identification and establishment of contact with the Entity in Charge of Extension (ECE) in each country

Each Country/Zone Director will identify and contact the Extension Entity in their country or zone for partnership in this initiative. A Memorandum of Understanding (MoU), detailing the objectives of the WAVE program, the objectives of Participatory Surveillance (its approach and issues) will be drafted and signed between the stakeholders.

Sources of verification

- Meeting reports complete with attendance lists and photos
- MoU document

Activity 2: Identification and establishment of contact with stakeholders in the cassava value chain who will benefit from the project

Sub-activity 2.1. Identifying and contacting extension agents

- Identify the agents who will receive the training
- Agree on the training dates
- Determine jointly with these agents, which producer and multiplier associations should be integrated into the initiative as well as the potential training sites

Sub-activity 2.2. Identification and contact with producer associations and cutting multipliers

Ideally, this contact should be made immediately after the establishment of contact with extension agents. This should be done by:

- Travel to the sites/regions;
- contact the administrative and traditional authorities to explain the objectives of the initiative in order to obtain their support and endorsement;
- contacting producer and multiplier associations (formal and informal organizations);

- explain to the future trainees the objectives and expectations of the training.

Sources of Verification:

- Attendance list
- Photos
- Meeting reports

The WAVE Phase 2 Monitoring and Evaluation document indicates 30 producer associations and 100 multipliers to be trained in all 13 hubs. Their distribution is given in Table 1.

TABLE 1 : Expected repartition of the actors

COUNTRY	CI	BFA	GH	TG	BN	NIG			GAB	SL	RDC		CAM	
HUB	UFHB	INERA	CRI	UL	UAC	CU	NRCRI	KSUSTA	IRAF	NARC	IFA	INERA	IRAD	Total
Number of multipliers	7	5	8	5	7	10	10	10	7	5	10	10	6	100
Number of producer associations	2	2	2	2	2	3	3	3	2	2	3	2	2	30

CI: Côte d'Ivoire ; BF : Burkina Faso ; GH :Ghana ; TG :Togo ;BN :Benin ; NIG :Nigeria ;
GAB: Gabon ; SL :Sierra-Leone ;RDC : Republic Democratic of Congo ; CAM :Cameroon

Activity 3: Identification of suitable locations for training and establishment of demonstration plots

To carry out this activity, the beneficiaries of a region will be grouped by zones and a central town in each zone will be identified as a training location. The central town, training location, should have adequate meeting spaces and other equipment necessary to conduct the training. Its geographical location should minimize the cost of travel for training participants.

To be identified as a potential demonstration plot, a field will be pre-selected based on:

- the susceptibility of the cultivars (present in the field) to the disease to be in question;
- the presence of susceptible and potentially resistant cassava cultivars;
- the diversity of diseases in the field;
- the age of the field: from 3 to 6 months maximum for viral diseases;
- the willingness of the field owner to cooperate;
- the accessibility of the field.

The pre-selection of fields can be done by the extension agents. However, the evaluation and validation of the selection will be done by the WAVE research team. Selected fields will be georeferenced and marked with identification signs bearing the WAVE and donor logos.

Sources of verification:

- Photos
- Signs with logos
- Selection reports

Activity 4 : Initiative kick-off workshop

The kick-off workshop provides an opportunity to pass information to the general public, administrative, political and customary/traditional authorities, and to gain their support.

This workshop should:

- highlight the WAVE program;
- highlight the participatory surveillance initiated by WAVE;
- highlight the objectives and expectations of the participatory surveillance;
- encourage the various stakeholders to be involved in the participatory surveillance.

This kick-off workshop will bring together stakeholders involved in the participatory surveillance (local authorities, stakeholders from the cassava sector, VCA and the relevant WAVE hub).

The stakeholders of the cassava value chain will be made up of:

- representatives of cassava producers' organizations,
- seed multipliers,
- cassava processors.

The local authorities will be the:

- Traditional rulers (kings and/or chiefs)
- administrative authorities and political decision-makers (example in Francophone countries: the Sub-Prefects, Deputy and Mayor, etc.).

Media coverage of the event will be made by local and national press organs.

Sources of verification

- Attendance list
- Photos
- Workshop Report
- Press publications

Activity 5: Raising awareness on the existence, recognition and control of cassava diseases

As many farmers and seed multipliers as possible will be sensitized on the threats of cassava diseases and will receive recommendations. Women (at least 30% of participants) should be strongly encouraged to take advantage of the awareness campaigns. To carry out this activity, the beneficiaries will be grouped together in the training locations.

Carrying out this activity will be useful for the selection of beneficiaries for training on the use of the application. The selection criteria are as follows: know how to read/write, be familiar with the use of a smartphone preferably Android, have a smartphone preferably Android, etc.

Activity 6: Training on visual recognition of virus symptoms and the use of the NURU application

The training should be done in two main steps. The first step will be to train the extension agents. The second training will target seed producers and seed multipliers.

Sub-activity 6.1. Training of the trainers

The future trainers are extension agents / agricultural specialists who will be trained on visual recognition of virus symptoms (using specially designed training materials), installation and use of the *NURU* application from their own smartphones. Practical tests will be organized at the end of the theoretical training on a selected farmer plot for the detection and recognition of cassava diseases.

At the end of the trainings, smartphones with the application will be given to selected trainees and future trainers.

Sources of verification

- Attendance list
- Trainees' evaluation forms for training
- Photos
- Training report
- Activities visible on PlantVillage platform

Sub-activity 6.2. Training of seed multipliers and cassava producers

The training will be done with the assistance of previously trained extension agents/ agricultural specialists.

- The training will include the same modules as that of the extension agents/agricultural specialists.
- The same training materials will be used.
- Learners will be shown how to install and use the *NURU* application.

- Trainees with smartphones will be selected (phones capable of running the *NURU* application). They will be specifically sensitized to support participatory surveillance initiative by using the application.
- Hands-on training will take place on plots of land identified with signs bearing the WAVE and donor logos.

Sources of verification

- Attendance list
- Trainee's evaluation forms for training
- Photos
- Training report

Activity 7: Training on the use of healthy plant material

Training on good practices for the production of healthy cuttings will especially be targeted to the seed multipliers. The seed multipliers must be from groups organized in formal or informal associations and leaders will be chosen for the monitoring and implementation of this activity. The leader is a member of a producer/multiplier association, respected by peers and able to motivate, coach and assist them in the use of the *NURU* application.

As a reminder,

- theoretical aspects of disease recognition and awareness on the use of healthy planting material will have been covered in previous training courses
- WAVE's monitoring and evaluation document stipulates two training courses (in 2021 and 2022) on the use of healthy cuttings, each of them for a total of 80 nurserymen (Table 2). Thus, activity 7 will be repeated in the two consecutive years 2021 and 2022. Representatives of producer associations may also be included.

TABLE 2 : Expected number of trainees

Countries	CI	BFA	GH	TG	BN	NIG			GAB	SL	RDC		CAM	
HUB	UFHB	INERA	CRI	UL	UAC	CU	NRCRI	KSUSTA	IRAF	NARC	IFA	INERA	IRAD	TT
Number of seed multipliers per training session	7	5	7	5	5	7	7	7	5	5	7	7	6	80

CI : Côte d'Ivoire ; BF : Burkina Faso ; GH :Ghana ; TG :Togo ;BN :Benin ; NIG :Nigeria ;
GAB : Gabon ; SL :Sierra-Leone ;RDC : Republic Democratic of Congo ; CAM :Cameroon

Taking into account the above-mentioned achievements, these two trainings could be organized into three sub-activities:

- Identification and setting up of demonstration plots
- Evaluation of the use of healthy planting material

- Learning the multiplication technique

Sub-activity 7.1. Identification and setting up demonstration plots

- Two types of demonstration plots will be set up. The first will be dedicated to the comparison of the effects of using diseased cuttings against using healthy cuttings. The second type will be dedicated to seed multiplication exercises for the production of healthy cuttings.
- The choice of the demonstration plot(s) will be made in mutual agreement with the associations of seed multipliers and cassava producers. They will have to be easily accessible to the trainees.
- These georeferenced demonstration plots will be set up during the rainy season. They will be identified by signs with the WAVE and donor logos.

Sources of verification

- Updated list of multipliers
- Attendance list
- Photos
- Training reports
- Signs

Sub-activity 7.2. Evaluation of the use of healthy planting material

Demonstration plots will be set up with diseased and healthy cassava cuttings. Sources of the cutting (pretreated, symptomless plants, tissue culture derived), types (susceptible, resistant), varieties selected will depend on the context in each hub . The comparison of the phytosanitary status of the plants and the yield of each plot will be the parameters to be evaluated to encourage the use of healthy plant material. The phytosanitary status of the plants will be evaluated between three (3) and six (6) months after the establishment of the plot. As for the comparison of the yield, it will be done at harvest time. The *NURU* application can also be used for plant phytosanitary evaluation.

Postgraduate students will be able to collect epidemiological and other data on these different plots.

Sources of verification

- Attendance list
- Photos
- Training report
- Graduate Student Study Report

Sub-activity 7.3. Learning the multiplication technique

The training will be held on the plots provided for this purpose from seven (7) months of planting. The cutting back and/or the mini-cutting are the techniques envisaged for these trainings.

COMPONENT II/ APPLICATION AND MONITORING OF USE

- Activity 8: implementing monitoring - diagnosis of cassava diseases and enrichment of the WAVE database
- Activity 9: Management and exploitation of data sent by extension agents, seed multipliers and producers
- Activity 10: Collection of suspicious samples
- Activity 11: Molecular diagnosis of suspicious samples and identification of the pathogen

Activity 8: implementing monitoring - diagnosis of cassava diseases and enrichment of the WAVE database

This activity will be carried out after the training of cassava producers/growers by a team of students from each WAVE Hub and/or leading producers/growers with smartphones equipped with the *NURU* application. The follow-up activity will consist of:

- ensuring that beneficiaries contribute to the database in the WAVE cloud server;
- collecting in a form and transmitting to WAVE any problems encountered in the field while using the application.

Also, the beneficiaries of the telephones will be subject to a set of guidelines determining their collaboration with WAVE (in annex).

Activity 9: Management and exploitation of data sent by extension agents, seed multipliers and producers

This activity will mainly be conducted by the WAVE IT team in collaboration with the PlantVillage team of Pennsylvania State University. Photos taken using the *NURU* application will be systematically stored on WAVE's cloud server. Each hub will have a dedicated space accessible by a unique access right.

After curation by the scientists, the epidemiological data (identity and severity of the disease, geographical distribution, etc.) can be used as part of the National Response Plan against cassava viral diseases.

Activity 10: Collection of suspicious samples

As part of the monitoring and surveillance of emerging diseases, a WAVE team made up of a researcher and a technician will visit the georeferenced localities and will proceed with the collection of suspicious or unrecognized symptoms using the *NURU* application (after curation by the scientists).

Activity 11: Molecular diagnosis of suspicious samples and identification of the pathogen

Collected samples (suspicious or unrecognized) will be tested by appropriate molecular techniques to detect and characterize the causative agent of the symptoms.

COMPONENT III/ COORDINATION OF THE INITIATIVE

- Activity 12: Socio-economic study on the use of an intelligent application
- Activity 13: Monitoring and evaluation of the participatory surveillance initiated by WAVE
- Activity 14: WAVE participatory surveillance initiative closing Workshop

Activity 12: Socio-economic study on the use of an intelligent application

A survey of the agronomic, social and economic impact of the initiative will be conducted among users of the *NURU* application using a survey form. This form will record the date of the action, the ease of use of the application and the benefits generated for the beneficiaries.

This survey will be conducted by a student in socio-economics and supervised by an expert in collaboration with the WAVE research team.

Activity 13: Monitoring and evaluation of the participatory surveillance initiated by WAVE

The WAVE monitoring and evaluation officers (BMGF/FCDO financed portion) or a monitoring and evaluation team approved by CORAF (European Union financed portion) will ensure that the participatory surveillance is carried out in accordance with the implementation schedule and pre-established indicators.

Activity 14: WAVE participatory surveillance initiative closing Workshop

At the end of this initiative, a feedback workshop intended for the cassava stakeholders involved in the WAVE-initiated participatory surveillance, the administrative and traditional authorities and the policy makers will be organized in each hub/country. The media will be invited.

A film presenting the activities carried out within the framework of the initiative and testimonies of farmers involved will be shown.

