

**Ministry of Agriculture and Animal Resources  
The Republic of Rwanda**

**SMALLHOLDER  
MARKET-ORIENTED  
AGRICULTURE PROJECT  
IN  
THE REPUBLIC OF RWANDA**

**FINAL REPORT  
NUTRITION IMPROVEMENT**

**July 2021**

**JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)**

**SANYU CONSULTANTS INC.  
NIPPON KOEI Co., LTD.**

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## **ACRONYMS AND ABBREVIATIONS**

AAP	District Annual Action Plan
ANRU	Agriculture and Natural Resource Unit, District
BFC	Bio-fortified Crop
CHWs	Community Health Workers
CNF	National Women's Council
CIP	Crop Intensification Program
DDP	District Development Plan
DDS	District Development Strategy
DPEM	District Plans to Eliminate Malnutrition
DRC	Democratic Republic of the Congo
DT-F	Demonstration and Training Farm
ECD	Early Childhood Development
FBF	Fortified Blended Foods
FFSFs	Farmer Field School Facilitators
FPs	Farmer Promoters
GIRINKA	One Cow per Poor Family Program
HU	District Health Unit
IFNA	Initiative for Nutrition and Food Security in Africa, JICA
JICA	Japan International Cooperation Agency
MAEP	Market oriented Agriculture Extension Package
MIGEPROF	Ministry of Gender and Family Promotion
MINALOC	Ministry of Local Government
MINAGRI	Ministry of Agriculture and Animal Resources
MINECOFIN	Ministry of Finance and Economic Planning
MOU	Memorandum of Understanding
NAEB	National Agricultural Export Development Board
NCDA	National Child Development Agency
NDC/ NDF	Nutrition Dense Crop (Food)
NECDP	National Early Childhood Development Program
PSTA4	Strategic Plan for Agricultural Transformation Phase 4, 2018-2024
RAB	Rwanda Agriculture and Animal Resources Development Board
RBC	Rwanda Biomedical Center
RHCC	Rwanda Health Communication Center
SAP	Single Action Plan
SAIP	Sustainable Agricultural Intensification and Food Security Project (with support from World Bank)
SEDO	Social and Economic Development Officer
SMAP	Smallholder Market-oriented Agriculture Project
SNV	Netherlands Development Organization
SPRP	Stunting Prevention and Reduction Project (with support from World Bank)
TMC	Quarterly Technical Monitoring Committee
UNICEF	United Nations Children's Fund
USAID	United States Agency for International Development

### **UNIT CONVERSATION**

1 meter (m)	=	3.28 feet
1 are	=	10 m x 10 m=100 m <sup>2</sup>
1 kilometer (km)	=	0.62 miles
1 hectare (ha)	=	2.47 acres
1 acre	=	0.405 ha
1 inch (in.)	=	2.54 cm
1 foot (ft.)	=	12 inches (30.48 cm)
1 ac-ft	=	1233.4 cum

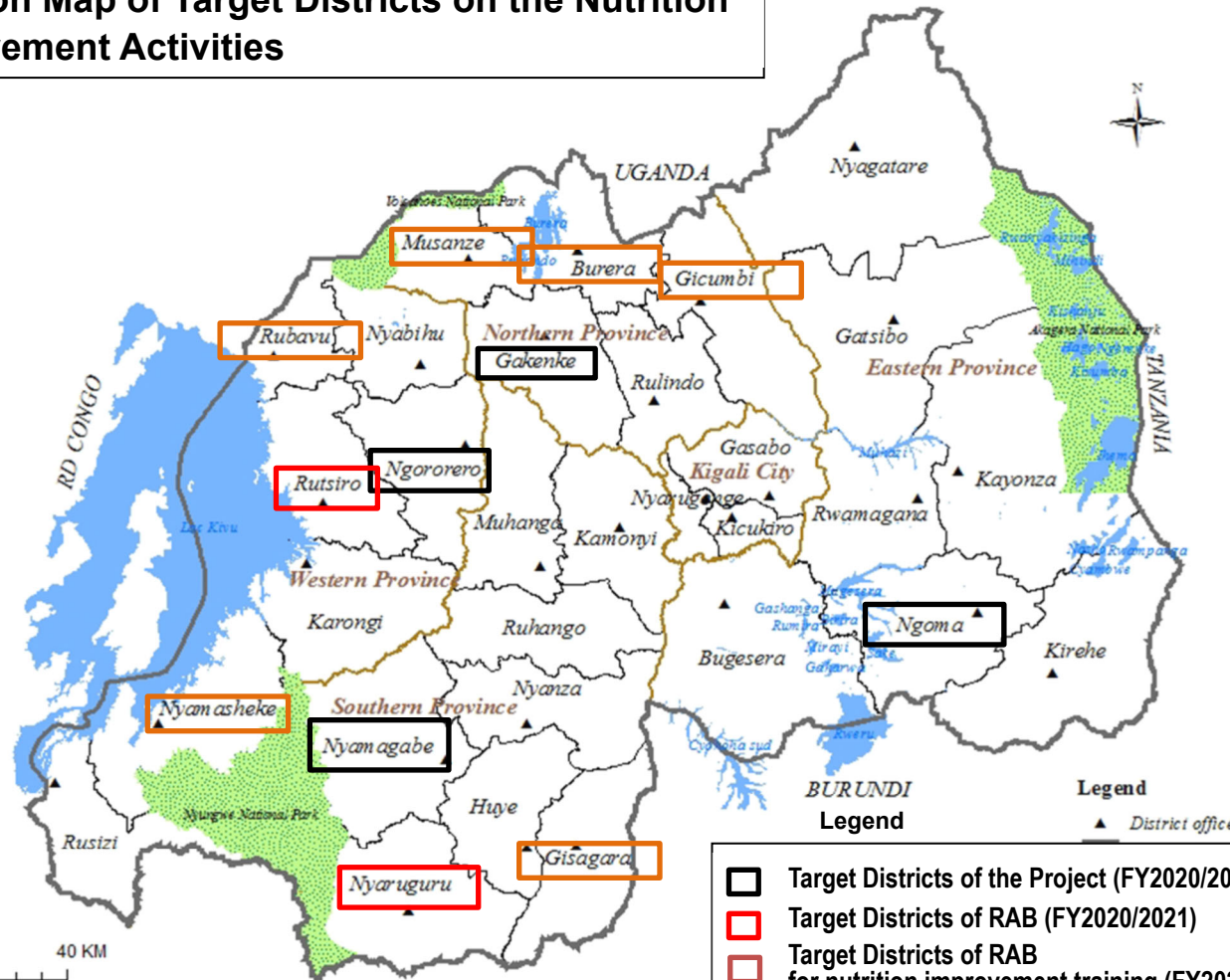
### **CURRENCY EQUIVALENTS (AS OF MAY 2021, JICA EXCHANGE RATE)**

US\$ 1.00	=	108.842 Japanese Yen
RWF 1.00	=	0.11163 Japanese Yen

### **RWANDA FINANCIAL YEAR**

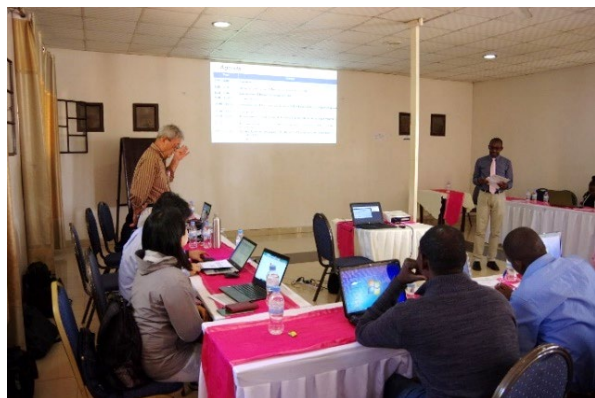
July 1 to June 30

## Location Map of Target Districts on the Nutrition Improvement Activities





## PHOTO ALBUM



**Explanation of support activities from the JICA Project Team at the Kick-off Workshop. (Rwamagana District, 1<sup>st</sup> Oct. 2019)**



**Greeting from the Head of Crop Research & Technology Transfer Department. (Rwamagana District, 1<sup>st</sup> Oct. 2019)**



**Dr. Margueritte, representative of C/P explained nutrition improvement using Nutrition Dense Crops. (Rwamagana District, 1<sup>st</sup> Oct. 2019)**



**Greeting from Manager of Postharvest Management & Biotechnology Division. (Rwamagana District, 1<sup>st</sup> Oct. 2019)**



**Introduction Meeting at Ngoma District with Mayor & Director of Agriculture. (Ngoma District, 8<sup>th</sup> Oct. 2019)**



**Introduction Meeting of Nutrition Improvement Activities. (Nyaruguru District, 9<sup>th</sup> Oct. 2019)**



**Introduction Meeting of Nutrition Improvement Activities with representatives of Rutsiro District. (Rutsiro District, 10<sup>th</sup> Oct. 2019)**



**Introduction Meeting with Mayor, Heads of HU and Agriculture. (Gakenke District, 14<sup>th</sup> Oct. 2019)**



**Elaboration of Training Module by Irish Potato Group, RAB. (Rwamagana District, 20<sup>th</sup> to 21<sup>st</sup> Jan. 2020)**



**Elaboration of training Module by Soybeans & Iron Beans Groups, RAB. (Rwamagana District, 20<sup>th</sup> to 21<sup>st</sup> Jan. 2020)**



**Elaboration of training Module by Yellow Cassava Group, RAB. (Rwamagana District, 20<sup>th</sup> to 21<sup>st</sup> Jan. 2020)**



**Elaboration of training Module by Vegetables & Fruits Group, RAB. (Rwamagana District, 20<sup>th</sup> to 21<sup>st</sup> Jan. 2020)**



**Elaboration of training Module by Orange Sweet Potatoes Group, RAB. (Rwamagana District, 20<sup>th</sup> to 21<sup>st</sup> Jan. 2020)**



**Review of Training Module by Food Quality & Nutrition Program. (Rwamagana District, 20<sup>th</sup> to 21<sup>st</sup> Jan. 2020)**



**The price of vegetables, not vary greatly between the rural areas and the urban areas. (Huye Market)**



**Grain Crops prices do not fluctuate significantly both in rural and Urban areas. (Muhanga Market)**



**The most distributed Kidny beans in Rwanda were used for the cultivation technical training. Crossbreeding is progressing, and beans of different colors and shapes are mixed. (Muhanga Market)**



**A grocery store that sells oil and seasonings. Prices of oil and seasonings are almost the same in urban and rural areas. (Muhanga Market)**



**Participants were asked to answer the questionnaire before and after the training. (Ngororero District, 12<sup>th</sup> Feb. 2020)**



**A lecture on basic information of nutrition was given before the demonstration. (Gakenke District, 6<sup>th</sup> Feb. 2020)**



**Health volunteers were washing orange sweet potatoes. (Gakenke District, 6<sup>th</sup> Feb. 2020)**



**Health volunteers were preparing green onions for the cooking demonstration. (Rutsiro District, 12<sup>th</sup> Feb. 2020)**



**For each training, the Cell staff and Caregivers procured water for cooking demonstration. (Rutsiro District, 12<sup>th</sup> Feb. 2020)**



**Health volunteers were preparing vegetables such as pumpkin leaves, etc. (Gakenke District, 6<sup>th</sup> Feb. 2020)**



**[Tofu Making]** Soybeans were soaked in the water overnight and grinded by a cassava leaf grinder at the local market near the training venue. Grinded soybeans were boiled and filtered to the soymilk. (Nyaruguru District)



**[Tofu Making]** Separate the protein from the soymilk with brewed vinegar, put it in a mold and apply pressure from above to compact it. (Nyamagabe District)

**[Tofu Making]** Cut the tofu and simmer in tomato sauce. (Ngoma District)



Rehydrate the dried small fish with hot water, crush it with a mortar, and knead it with orange sweet potatoes to make baby food. (Rutsiro District)

Two types of donuts were made, one with cassava and another with orange sweet potatoes. (Ngororero District)



**Tofu with Tomato Sauce. (Ngororero District)**



**Beans fried with onion & garlic. (Ngororero District)**



**Okara fried with vegetables. (Ngororero District)**



**Irish potatoes, pumpkin leaves with beans. (Ngororero District)**



**Soybeans with carrots and French beans. (Rutsiro District)**



**Donut making was the most liked by the training participants. (Ngoma District)**



**Children diagnosed with malnutrition were tasting Orange Sweet Potatoes. (Ngoma District)**



**Malnourished girl who participated the training with her mother. (Rutsiro District)**



**Malnourished children who are fed fortified foods until they are ready to cook. (Rutsiro District)**



**Mother of a malnourished child was answering a questionnaire. (Rutsiro District)**



**Mothers of malnourished children who helped cook at first but sat down during the way. (Rutsiro District)**



**Kitchen Garden in the Home Based ECD Center. (Rutsiro District)**



Lecture on cultivation techniques by RAB staff. She was explaining the cultivation training with training materials. (Nyamagabe District, 17<sup>th</sup> Feb. 2020)



After the lecture, practice with cultivation techniques was conducted in the field. Compost is applied to the vegetable nursery. (Nyamagabe District, 17<sup>th</sup> Feb. 2020)



Lecture by RAB staff at target coop's warehouse due to rainfall. (Nyamagabe District, 18<sup>th</sup> Feb. 2020)



RAB staff explained the condition of healthy seedlings. (Nyamagabe District, 18<sup>th</sup> Feb. 2020)



Lecture in a conference room of the Sector office due to rainfall. (Nyamagabe District 19<sup>th</sup> Feb. 2020)



Planting of potato seed, after applying the fertilizer. (Nyamagabe District 19<sup>th</sup> Feb. 2020)





**Lecture by RAB staff. Many farmers participated the training. (Nyaruguru District, 20<sup>th</sup> Feb. 2020)**



**Demonstration of fertilizer application by RAB staff. Participants were interested in using the fertilization method and amount. (Nyaruguru District, 20<sup>th</sup> Feb. 2020)**



**Farmer-prepared compost was not mature, so RAB staff detailed the condition. (Nyaruguru District, 20<sup>th</sup> Feb. 2020)**



**Many farmers brought back orange sweet potato vines to grow in their own fields. (Nyaruguru District, 20<sup>th</sup> Feb. 2020)**



**School teachers beside the DT-F participated the training. Some of the tools and fruit tree seedlings were provided to this school. (Rutsiro District, 20<sup>th</sup> Feb. 2020)**



**Four varieties of potatoes were planted in the training. They were cultivated in the same area, and farmers planned to compare their growth and yield. (Rutsiro District, 20<sup>th</sup> Feb.**



Farmers learned the sowing method from RAB staff. Their instructions became more accurate, and training could be carried out efficiently. (Rutsiro District, 26<sup>th</sup> Feb. 2020)



Farmers sang with joy and gratitude because of acquiring new techniques and varieties. Sector Agro. also said that this training was very educational. (Rutsiro District, 26<sup>th</sup> Feb. 2020)



Greetings from the District Agronomist. Due to the high proportion of malnourished households, he strongly recommended the cultivation of nutritionally improved crops. (Ngororero District, 27<sup>th</sup> Feb. 2020)



Planting of cassava stems. Since they should be planted at equal intervals, participants planted them at the same time using a string. (Ngororero District, 27<sup>th</sup> Feb. 2020)



Potato planting with four types of seed potatoes. Since the plants are planted at equal intervals, the intervals are measured using tree branches. (Ngororero District, 10<sup>th</sup> Mar. 2020)



Planting Orange Sweet Potato vines. Since the training participants were belong to the Farmer Promoter's cooperative, they were able to practice efficiently without wasting time. (Ngororero District, 10<sup>th</sup> Mar. 2020)



Practical training on vegetable cultivation by RAB staff. After preparing the nursery, the sowing method was explained in detail. (Ngororero District, 10<sup>th</sup> Mar. 2020)



Closing remarks by the District Director of Agriculture. He participated in the training enthusiastically since he is very interested in improving nutrition. (Ngororero District, 10<sup>th</sup> Mar. 2020)



Lecture in cultivation technique training. The project staff explained the need for fortified crops, and the RAB staff explained Soybean cultivation techniques. (Ngoma District, 3<sup>rd</sup> Mar. 2020)



Making soybean sowing grooves. Compost and chemical fertilizer (DAP) are applied here as the main fertilizer. (Ngoma District, 3<sup>rd</sup> Mar. 2020)



Parents and children who are malnourished and invited to the training. It seems they are not interested in the contents of the training. (Gakenke District, 5<sup>th</sup> Mar. 2020)



Making a nursery for vegetable cultivation. After making the nursery, make a sowing groove using a wooden stick. (Gakenke District, 5<sup>th</sup> Mar. 2020)



**Mr. Firmin, RAB officers, conducted the classroom training on cultivation of nutrition dense crops. (Rubavu district, 27<sup>th</sup> Apr. 2021)**



**Ms. Agnes, RAB officers, lectured the cultivation of nutrition dense crops. (Rubavu district, 27<sup>th</sup> Apr. 2021)**



**Ms. Lea, RAB officers, conducted cooking demonstration. (Musanze District, 28<sup>th</sup> Apr. 2021)**



**Director of Agriculture & Natural Resource of Burera District conducted opening remarks to the participants before training starts. (Burera District, 29<sup>th</sup> Apr. 2021)**



**The trainees in Gisagara District were active and committed to include balanced diet in their dairy meal. (Gisagara District, 6<sup>th</sup> May 2021)**



**Cooking demonstration. (Nyamasheke District, 11<sup>th</sup> May 2021)**

## CHAPTER 1: SUMMARY OF PROJECT ACTIVITIES FOR NUTRITION IMPROVEMENT

This report is a compilation of the additional work of the “Rwanda Smallholder Market Oriented Agricultural Project (SMAP)” carried out from October 2014 to October 2019 as a work completion report (nutrition improvement edition). In the additional work, the JICA Project Team provided support for dissemination activities and dissemination systems related to nutrition improvement to RAB and target districts. The additional work for RAB Nutrition Improvement Activities was started in October 2019. Due to the impact of the COVID-19 epidemic from early 2020, the Project activities were postponed for about a year and ended at the end of July 2021.

### 1.1 Background and Objectives

In Rwanda, the improvement of “Stunting” issues, which the President of the Country has set as an urgent task, is an urgent development issue<sup>1</sup>. In response to this, JICA has started to implement a "Sector Policy Loan for Nutrition Improvement through Agricultural Transformation" (hereinafter referred to as "Nutrition Loan Project"). The SMAP aimed market-oriented agriculture for small-scale farmers in Rwanda, and the achievement of the SMAP activities was expected to contribute to the purpose of the above the Nutrition Loan Project.

At the same time, success of the Nutrition Loan Project was considered to help strengthen the dissemination work of the counterpart agency (RAB). For this reason, as additional activities of the JICA Project Team as follows were carried out, so that RAB could become to implement the activities for Nutrition Loan Project (hereinafter referred to “Nutrition Improvement Activities”) independently and smoothly from FY2020/2021.

The additional activities of the JICA Project Team were i) support for the creation of training materials related to the mainstreaming of nutrition improvement, which was focusing on the agricultural field, ii) support for the establishment of a dissemination system for RAB Nutrition Improvement Activities, and iii) support for the implementation of training for farmer groups in target districts. The additional activities were started in October 2019 and were postponed for about one year due to COVID-19, which spread from March 2020 in the world, however the Project activities eventually ended in June 2021. The detail activities are as follows:

- 1) Support for formulating action plans of RAB Nutrition Improvement Activities (FY2020/2021);
- 2) Budget application support for RAB Nutrition Improvement Activities (FY2020/2021);
- 3) Implementation of TOT for RAB officials of 4 programs;
- 4) Support for nutrition improvement enlightenment and dissemination activities by RAB officials for the districts to be supported (4 districts);
- 5) Management of nutrition improvement enlightenment and dissemination activities carried out by RAB officials for the districts to be supported (2 districts);
- 6) Support for creating nutrition improvement training materials;

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<sup>1</sup> 1) ‘Kagame tasks leaders to urgently eradicate persistent stunting among children’, The Inspirer, 10<sup>th</sup> August 2018, (<https://rwandainspirer.com/2018/08/10/kagame-tasks-leaders-to-urgently-address-persistent-stunting-burden/>), ‘Rwanda Economic Update’, World Bank Group, (<https://openknowledge.worldbank.org/handle/10986/29908>), June 2018 (accessed in June 2021)

- 7) Support for RAB's training and dissemination activities for nutrition improvement in 2021 in the Nutrition Loan Project.

The final seminar which was scheduled after the completion of additional activities by the JICA Project Team, with RAB officials was canceled due to COVID-19. Therefore, the JICA Project Team prepared a video use for guiding users of the developed training manual.

## **1.2 Target Districts of Project Activities**

The JICA Project Team supported RAB during the limited Project period to carry out the Nutrition Improvement Activities independently and efficiently. At the kick-off workshop, among of 12 districts which was selected by the Nutrition Loan Project, activities in 6 districts were decided to be supported by the JICA Project Team (refer to the Target District Location Map at the beginning).

Moreover, after the suspension of the Project activities due to COVID-19, the JICA Project Team restarted the support for RAB to implement the Nutrition Improvement Activities in remaining 6 districts among of 12 districts targeted by Nutrition Loan Project.

### **(1) Target districts covered by the JICA Project Team in collaboration with RAB**

The following four districts were decided as target districts for which the JICA Project Team was to support nutrition improvement enlightenment and dissemination activities through RAB officials.

- Ngoma District (Eastern Province): Medium-sized dam constructed by RAB with support of JICA and its irrigation water user cooperatives support under way;
- Gakenke District (Northern Province): Ranked among the top five where malnutrition is a serious problem, District was interested in the Project activities, positive response of District and cooperatives supported by RAB-SMAP activities;
- Ngororero District (Western Province): Target district of JICA's Preliminary Survey on Nutrition Improvement, and aggressive cooperatives to RAB-SMAP activities;
- Nyamagabe District (Southern Province): The district and RAB were exchanging MoU for cultivation technology training of RAB-SMAP, and an active attitude to the Project activities.

### **(2) Target districts covered by RAB with the JICA Project Team support**

The following two districts were decided as the target districts for which the JICA Project Team supported nutrition improvement enlightenment and dissemination activities carried out by RAB officials.

- Nyaruguru District (Southern Province): Good response of the district and supportive cooperatives towards RAB-SMAP activities;
- Rutsiro District (Western Province): Target districts of JICA's Preliminary Survey on Nutrition Improvement.

### **(3) Target districts for RAB nutrition improvement and dissemination training in 2021**

The JICA Project Team provided support for nutritional improvement awareness and dissemination activities carried out by RAB in the following six districts in 2021.

- Gisagara, Rubavu, Burera, Nyamasheke, Musanze, Gicumbi Districts

### **1.3 Establishment of the Implementation Arrangements**

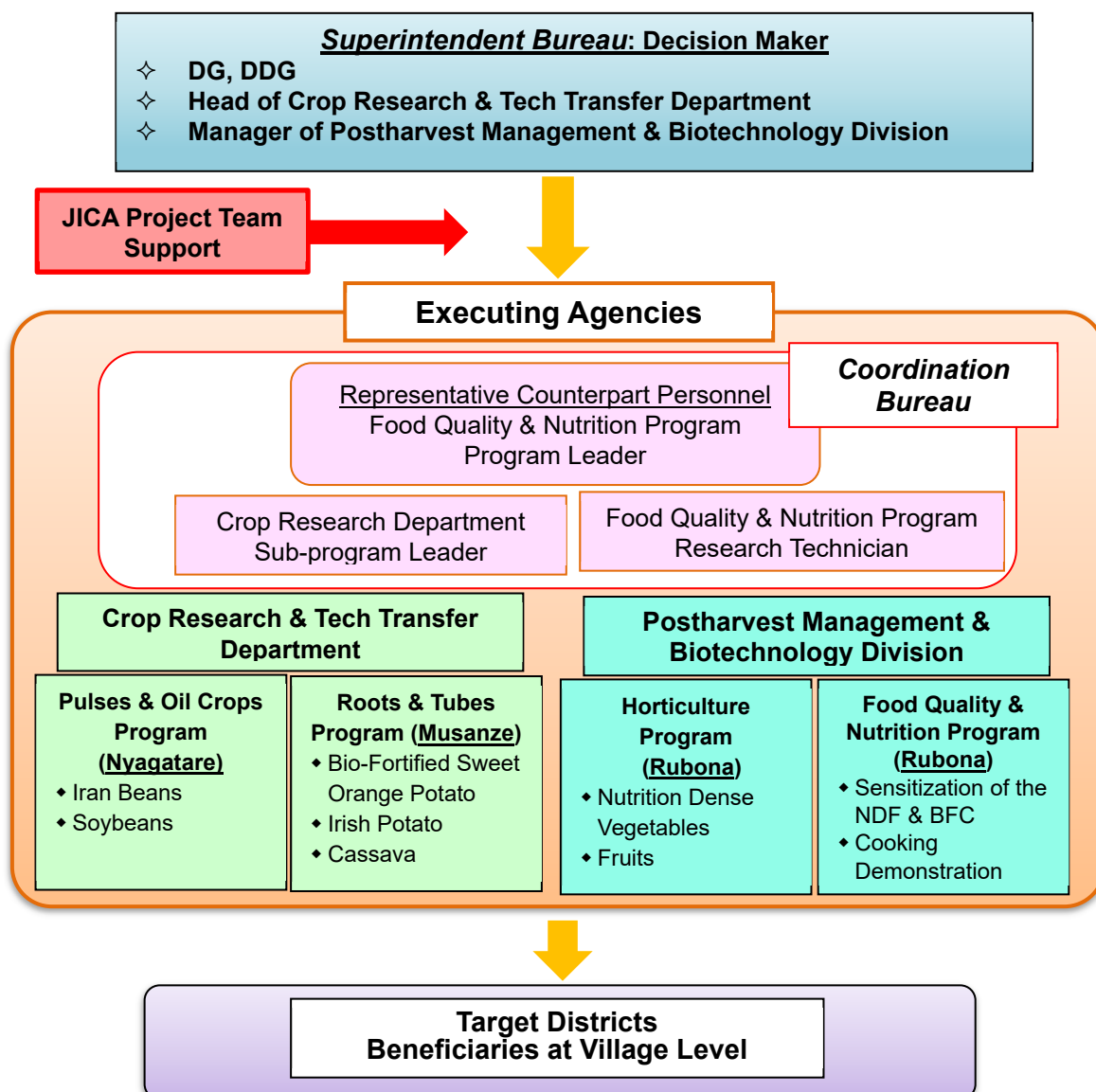
#### **1.3.1 Kick-off Workshop**

A kick-off workshop was held in Rwamagana District on October 1, 2019, and the RAB officials related to the implementation of Nutrition Improvement Activities were convened to share information on the purpose and contents of this additional work of the JICA Project Team. In addition, RAB and the JICA Project Team identified target crops for nutrition improvement and dissemination, confirmed the implementation programs for these dissemination activities, and finalized the implementation structure for the Nutrition Improvement Activities.

#### **1.3.2 Establishment of the Extension Service Arrangements**

The implementation structure for the Project activities and the Nutrition Improvement Activities is shown in the following figure. Four programs of RAB were decided as counterpart organizations (implementation organizations), namely Pulses & Oil Crop Program, Roots & Tubers Program, Horticulture Program and Food Quality & Nutrition Program.

In addition, a “Coordination Bureau” was newly established to coordinate the holding of workshops between these programs and the implementation of training in target districts. This was the first attempt within RAB to carry out a cross-sectional activity through the collaboration of four programs RAB officials.



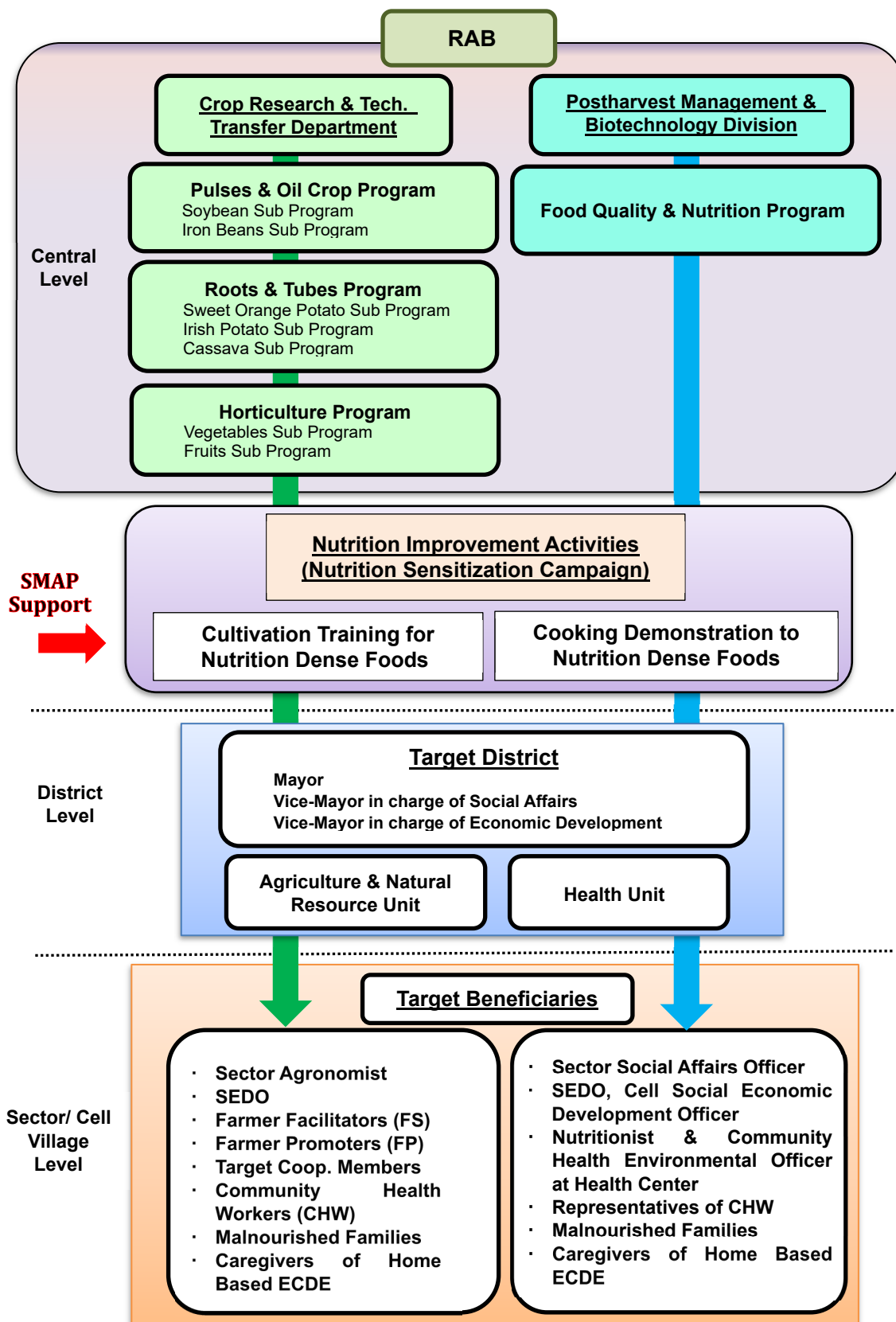
Source: JICA Project Team (2019)

Note: NDF: Nutrition Dense Food; NDV: Nutrition Dense Vegetables; BFC: Bio-Fortified Crops

**Figure 1.3.1 Implementation Structure of JICA Project activities and RAB Nutrition Improvement Activities**



The implementation structure between RAB and target districts is shown in the following figure.



Source: JICA Project Team (2019)

**Figure 1.3.2 Implementation Structure of RAB Nutrition Improvement Activities with Target Districts**

## 1.4 Summary of Project Activities

Table 1.4.1 below shows the outline of activities from October 2019 to July 2021. During the period from March 2020 to March 2021, the Project activities were suspended due to the spread of COVID-19. Those activities resumed in April 2021. The main activities are shown in Table 1.4.1 and Table 1.4.2.

**Table 1.4.1 Summary of Project Activities**

Main Activity/Year/Month	2019				2020					2021			
	9	10	11	12	1	2	3	4	5	4	5	6	7
1. Kick-off Workshop	■												
2. Explanation of the Project to 6 Target Districts		■											
3. Formulation of the 2020/2021 Nutrition Improvement Action Plan with its Budget			■	■									
3.1 Holding the Workshop		■	■										
3.2 Submission to RAB DG			▲										
4. Field Survey in 6 Target Districts			■	■									
5. Formulation of the training materials and implementation schedule			■	■	■	■	■	■					
6. Nutrition Improvement Campaign & Cooking Demonstration						■	■	■					
7. Implementation of FFS for Nutrition Dense Crops						■	■	■	■				
8. Support of RAB Nutrition Improvement Training at Target Districts										■	■	■	
9. Delivery of Training Material and Pamphlets										■	■	■	■
10. Submission of Reporting													▲

Source: JICA Project Team (2021)

**Table 1.4.2 Main Project Activities**

Date	Main Activity	Content of Activity
1 <sup>st</sup> Oct. 2019	Kick-off WS Venue: Rwamagana District Participants: 17 RAB officials	<ul style="list-style-type: none"> <li>Explanation of the Project activity and decision of Target Districts</li> <li>Target District supported by the JICA Project Team in collaboration with RAB: 4 districts (Ngoma, Gakenke, Ngororero, Nyamagabe)</li> <li>Implemented by RAB supported by the JICA Project Team: 2 districts (Rutsiro, Nyaruguru)</li> <li>Identification of Nutrition Dense Crops (NDC) &amp; Bio-fortified Crops BFCs: iron beans, yellow cassava, orange sweet potato, Irish potato NDCs: soybean, vegetables, fruits trees</li> <li>Confirmation of Project Implementation Arrangement</li> <li>Discussion of training material contents at each Program</li> </ul>
8 <sup>th</sup> to 14 <sup>th</sup> Oct. 2019	Explanation on Project implementation to 6 Target Districts	Explanation & discussion of the Project activities, implementation arrangement to District Mayor, and staff involved in the nutrition improvement activity in collaboration with RAB officials
23 <sup>rd</sup> to 25 <sup>th</sup> Oct. 2019	Formulation of Action Plan with its budget Elaboration of training materials Venue: Rwamagana Participants: 13 RAB officials	<ul style="list-style-type: none"> <li>Formulation of Implementation Plan (FY2020/2021) and its budget for Nutrition Improvement Activity by RAB</li> <li>Formulation of Training Material for dissemination of nutrition improvement: iron beans, sweet orange potato, bio-fortified Irish potato, soybean, vegetables, fruits (avocado, tree tomato, passion fruit, papaya) and sensitization on the priority of Nutrition Dense Food (NDF)</li> </ul>
5 <sup>th</sup> to 7 <sup>th</sup> Nov. 2019	Same as above Venue: Kigali Participant: 6 RAB officials	<ul style="list-style-type: none"> <li>Formulation of the Implementation Plan (FY2020/2021) for Nutrition Improvement Activity by RAB</li> <li>Formulation of Budget of Implementation Plan (FY 2020/2021) for Nutrition Improvement Activity by RAB</li> <li>Formulation of Training Material for dissemination of nutrition improvement: yellow cassava</li> </ul>

Date	Main Activity	Content of Activity
18 <sup>th</sup> Nov. to 13 <sup>th</sup> Dec. 2019	Site investigation in 6 Target Districts	<ul style="list-style-type: none"> <li>• Decision on NDCs and BFCs at each Target District</li> <li>• Decision of candidate trainees</li> <li>• Decision on cultivation DT-Farm and cooking demonstration places</li> </ul>
20 <sup>th</sup> to 21 <sup>st</sup> Jan. 2020	WS for formulation of training material Venue: Rwamagana Participants: 25 RAB officials	<ul style="list-style-type: none"> <li>• Formulation of Training Materials for dissemination of nutrition improvement: ⇒ 1st edition of Training Module, Kinyarwanda, 8 training materials were finalized.</li> </ul>
4 <sup>th</sup> to 21 <sup>st</sup> Feb. 2020	1st cycle cooking demonstration	6 Target Districts x 1 site =6 sites
10 <sup>th</sup> to 13 <sup>th</sup> Mar. 2020	2 <sup>nd</sup> cycle cooking demonstration	Ngororero and Rutsiro Districts, 2 sites. Due to COVID-19 influence, remaining 4 districts were canceled.
18 <sup>th</sup> Feb. to 6 <sup>th</sup> Mar. 2020	Cultivation Training FFS1	FFS1 was implemented at 13 DT-Farms (6 Target Districts)
19 <sup>th</sup> Mar. 2020	Temporary return	Due to COVID-19 influence, Japanese Experts returned Japan temporarily.
Mar. to Apr. 2020	Finalizing of Training Material	<ul style="list-style-type: none"> <li>• Reflecting the results and lessons learned from the cultivation technique training and cooking training; the contents of each training material were reviewed and finalized by exchanging emails with related RAB officials.</li> </ul>
Apr. 2020 to Mar. 2021	Project interruption	Project activities suspended due to the spread of COVID-19 epidemic
2 <sup>nd</sup> to 21 <sup>st</sup> Apr. 2021	Resumption of project activities	<ul style="list-style-type: none"> <li>• Site inspection in 6 Target Districts by local staff</li> <li>• Courtesy and meetings with related organizations, formulation of future activity plans</li> </ul>
27 <sup>th</sup> Apr. to 11 <sup>th</sup> May 2021	Supporting of RAB nutrition improvement activity	Training of nutrition improvement at Rubavu, Musanze, Burera, Gicumbi, Gisagara and Nyamasheke Districts
Apr. to Jun, 2012	Approval of Training Material as official Printing and delivery of training materials to Target Districts, etc.	<ul style="list-style-type: none"> <li>• As a result of discussions with MINAGRI PS and RAB DDG, it was approved to be used as an official teaching material.</li> <li>• Printing and delivery of Nutrition Improvement Pamphlet.</li> <li>• Preparation of video to introduce training material.</li> <li>• Web posting of nutrition improvement material data.</li> </ul>
July 2021	Submission of report	Submission of Completion Report (Nutrition Improvement Edit)

Source: JICA Project Team (2021)

The assignment schedule of Japanese experts engaged in the additional Project activities for nutrition improvement is shown in Annex 1.

## **CHAPTER 2 SUPPORT FOR THE PLANNING AND BUDGETING OF RAB NUTRITION IMPROVEMENT ACTIVITIES IN FY2020/2021**

### **2.1 Planning and Budgeting Workshop**

From the end of October to the beginning of November 2019, a workshop was held to support the implementation plan and budget formulation for RAB Nutrition Improvement Activities under the Nutrition Loan Project implemented in FY2020/2021 and FY2021/2022.

Participants were representatives of RAB four programs, namely Pulses & Oil Crop Program, Roots & Tubes Program, Horticulture Program and Food Quality & Nutrition Program (Annex 7 “Participants List for Nutrient Training Materials”). At the workshop, the following items were discussed and decided.

#### **(1) Objective of the workshop**

In order to improve nutritional inhibition of Rwanda, it is necessary to promote and increase the production of nutritious agricultural products and increase their consumption. For this reason, the purpose of the workshop organized by the JICA Project Team was to support RAB to formulate the action plan (FY2020/2021) and its budget related to the Nutrition Improvement Activities.

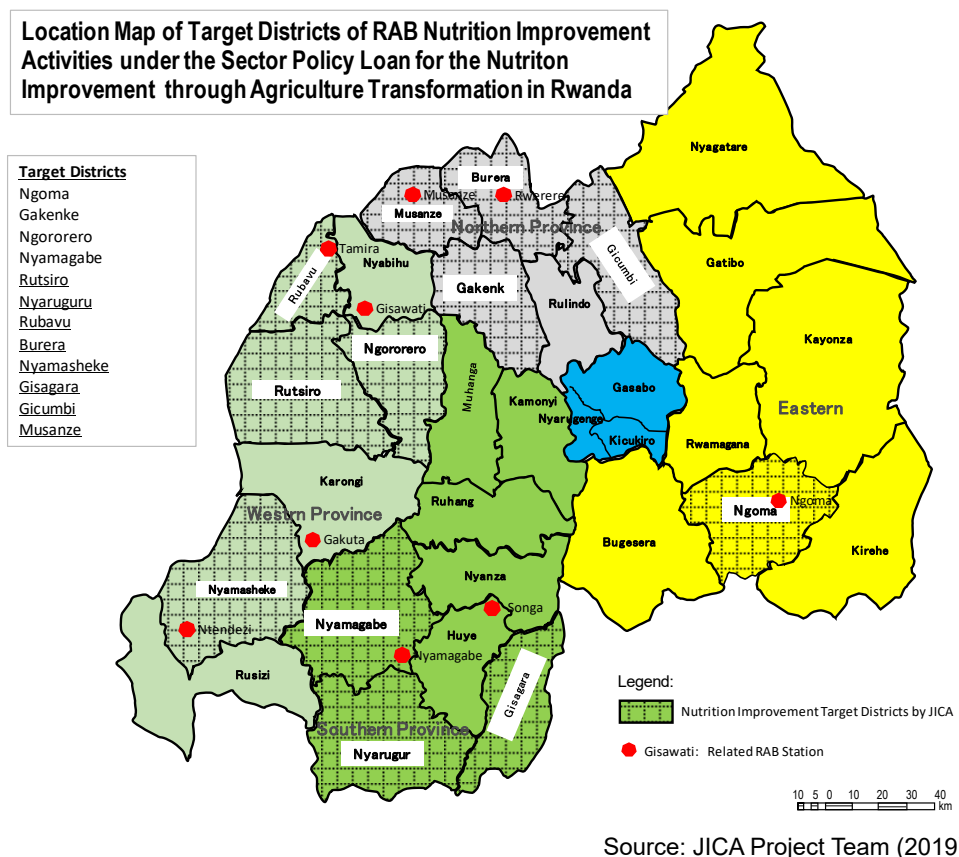
#### **(2) Target districts of RAB Nutrition Improvement Activities under the Nutrition Loan Project**

Out of the 30 districts, as target areas of Nutrition Improvement Activities which was the part of Nutrition Loan Project, Government of Rwanda and JICA selected the following 12 districts with high stunting rates<sup>1</sup> and other than World Bank Project’s target districts. The following figure shows the locations of 12 target districts.

- ◆ Eastern Province : Ngoma District
- ◆ Southern Province : Nyaruguru, Nyamagabe and Gisagara (3 districts)
- ◆ Western Province : Rubavu, Rutsiro, Ngororero and Nyamasheke (4 districts)
- ◆ Northern Province : Musanze, Gicumbi, Burera and Gakenke (4 districts)

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<sup>1</sup> Stunting rate is calculated by the proportion of children under the age of 5 who are short stature, disproportionate to their age.



**Figure 2.1.1 Location of Supported Target Districts by the RAB Nutrition Improvement Activities**

### (3) Target beneficiaries of the training on RAB Nutrition Improvement Activities

As a result of discussions with RAB and target district officials, target persons of the training on cultivation techniques for Nutrition Dense Crops (NDC) and on cooking demonstration were decided as follows. In principle, the maximum number of participants in each training was decided as 45.

#### a) Target Persons for Training on Cultivation Techniques (FFS)

- District Agriculture and Natural Resource Unit;
- Sector Agronomist Officer of Target Sector per site;
- Social Economic Development Officers (SEDO) of Cells in Sector where the training site is located;
- Farmer Facilitators of target crops in target Sectors;
- Farmer Promoters of villages in the Cell where the training site is located;
- Representative of coop member where the Demonstration and Training-Farm (DT-Farm) is located;
- Malnourished family identify in Sector where the training site is located;
- Community Health Workers (CHWs) in charge of nutrition in villages of cell where the training site is located.

#### b) Target Persons for Cooking Demonstration

- District Health Unit;
- Sector Social Affairs of target Sector per site;
- Social Economic Development Officers (SEDO) of Cells in the target Sector;

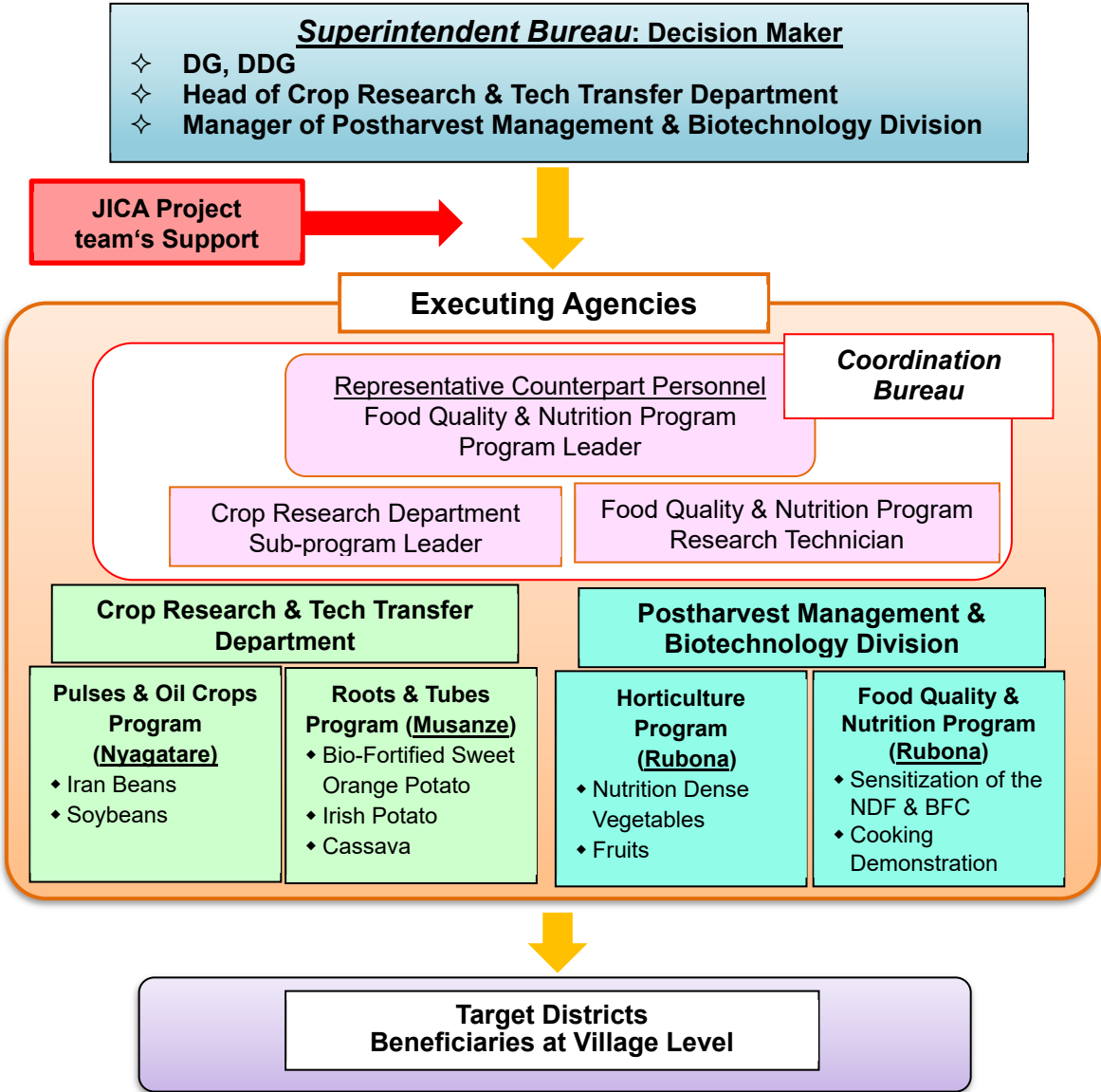
- Nutritionist and Community Health Environmental Officer at Health Centre;
- Representative of CHWs at Cell Level where the Cooking Demonstration Site is located;
- CHWs in charge of nutrition at village of cell where the Cooking Demonstration Site is located;
- Caregiver representatives at each village in Cell where the Cooking Demonstration Site is located;
- Malnourished families;
- Farmer Promoter in Village where the Cooking Demonstration Site is located.

#### **(4) Implementation structure of RAB Nutrition Improvement Activities**

Four Programs within RAB, namely Pulses & Oil Crop Program, Roots & Tubers Program, Horticulture Program and Food Quality & Nutrition Program, were decided as the implementing agencies. Moreover, a new Coordination Bureau has been established to supervise the overall of programs, negotiate with target districts, prepare the reports, etc. In addition, these Programs carried out the activities in collaboration with the Agriculture and Natural Resources Unit (ANRU) and the Health Unit in target districts. The overall implementation structure is shown in Figure 2.1.2.

#### **(5) Implementation period of RAB Nutrition Improvement Activities**

The implementation period of RAB Nutrition Improvement Activities was one year, from July 2020 to June 2021.



Source: JICA Project Team (2019)

**Figure 2.1.2 Implementation Structure of RAB Nutrition Improvement Activities**

**2.2 Support for the Planning and Budgeting Processes**

**2.2.1 Overview**

In October and November 2019, RAB officials were convened to hold a workshop to formulate an action plan and budget for RAB Nutrition Improvement Activities in 2020/2021. The action plan for each program and its budget are shown in Annex 2. The formulated action plan was submitted to and approved by RAB DG in November 2019. After that, it was submitted from RAB to MINECOFIN, and the budget was finalized. However, due to the impact of the spread of COVID-19 infection, the budget was not distributed from MINECOFIN to RAB in FY2020/2021.

## 2.2.2 Support for the Planning Process

### (1) Decision on nutrition improvement crops at target districts

Considering the natural conditions (elevation, temperature, soil, etc.) of each target district, as a result of discussions with the RAB officials of relevant programs of Nutrition Improvement Activities, the nutrition improvement crops to be introduced in each district were decided as follows.

**Table 2.2.1 Nutrition Improvement Crops introduced in each District**

Target District/ Introduction Crops	Nutrition Dense Crop/ Fruits/ Bio-Fortified Crop						
	Soybean	Iron beans	Vegetables	Yellow cassava	Sweet orange potato	Bio-fortified Irish potato	Fruits (Avocado, tree tomato, etc.)
Ngoma *1)	Y	Y	Y	Y	Y	N	Y
Gakenke*1)	Y	Y	Y	Y	Y	Y	Y
Ngororero*1)	Y	Y	Y	Y	Y	Y	Y
Nyamagabe*1)	N	Y	Y	Y	Y	Y	Y
Rutsiro*1)	Y	Y	Y	Y	Y	Y	Y
Nyaruguru*1)	Y	Y	Y	Y	Y	Y	Y
Rubavu	Y	Y	Y	N	Y	Y	Y
Nyamashoke	Y	Y	Y	Y	Y	N	Y
Burera	N	Y	Y	N	Y	Y	Y
Gisagara	Y	Y	Y	Y	Y	N	Y
Musanze	N	Y	Y	N	Y	Y	Y
Gicumbi	N	Y	Y	N	Y	Y	Y
Total	8	12	12	8	12	9	12

Y: It was targeted., N: It was not targeted.

Source : JICA Project Team (2019)

\*1) Districts supported by JICA Project team in 2019.

### (2) Decision on number of DT-Farm and cooking demonstration in each target district

In consultation with the district staff who are the target of nutrition improvement activities, locations of Demonstration and Training Farm (hereinafter referred to as “DT-Farm”) and cooking classes were decided as shown in the following table.

**Table 2.2.2 Number of DT-Farm and Cooking Class in each Target District**

Particular	Target Districts	Number of DT- Farm/ Cooking Class	Cultivation Area (ha)	Remarks
<b>Cultivation Technical Training</b>				
Soybean	8	16	0.25	2 sites/district
Iron beans	12	12	0.25	2 sites/district
Irish potato	9	27	0.1	3 sites/district
Vegetable	12	12	0.5	1 site/district
Fruit trees*1)	12	12	0.4	1 site/district
Yellow cassava*2)	8	16	0.25	2 sites/district
Sweet orange potato	12	24	0.25	2 sites/district
<b>Cooking Class</b>	12	24	-	2 sites/district

Source : JICA Project Team (2019)

\* 1) Passion fruits and tree tomato were planted in the DT-Farms, but other fruit trees was planned to be distributed to the participants.

\* 2) It takes more than one year to plant yellow cassava.



### (3) Action plan for RAB Nutrition Improvement Activities in 2020/2021

The action plan for the Nutrition Improvement Activities in 2020/2021 was formulated as shown in the following table.

**Table 2.2.3 Summary of RAB Nutrition Improvement Activities (2020/2021)**

Activity	2020						2021					
	7	8	9	10	11	12	1	2	3	4	5	6
Information Discussion to the 12 Target Districts	Kick-off WS											
Selection of Target Groups/ Cooperatives 2 sites/ District, total 24 sites												
Visit to Target Groups/ Coops./ Kitchen Cells Confirmation of participants of training. Collection of basic information to Kitchen Cells												
Procurement of Seed/ Seedling for Bio-Fortified Crops, etc. and ingredients and office supplies												
Conduct 24 training sessions at 12 Districts												
1. Horticulture Program (Vegetables & Fruits)				■	■	■	■	■	■	■	■	■
2. Pulses & Oil Crops Program (Iron Beans and Soybean)				■	■	■	■	■	■	■	■	■
3. Roots & Tubers Program (Sweet Orange Potato, Irish Potato, Cassava)				■	■	■	■	■	■	■	■	■
4. Food Quality & Nutrition Program (cooking demonstration)				■	■	■	■	■	■	■	■	■
Monitoring of Trainees				■	■	■	■	■	■	■	■	■
Quarterly Evaluation at each District				■	■	■	■	■	■	■	■	■
Preparation/ Submission of RAB-Nutrition Improvement Action Plan with Budget				Submission to RAB DG		▲	Submission to MINECOFIN			▲	Approval by MINECOFIN	
Quarterly Reporting and Submission to RAB DG/DDG			▲			▲			▲			▲

Source: JICA Project Team (2019)

### 2.2.3 Support for the Budgeting Process

#### (1) Confirmation of prerequisites

In formulating the budget for Nutrition Improvement Activities in each program, participants of the workshop confirmed and agreed on the unit price for each item shown in the table below as a prerequisite.

**Table 2.2.4 Confirmation of Basic Unit Prices**

Item	Unit Price / Day (Rwf)	Remarks
Mission allowance for RAB officials	54,000	Lodging (47,000 Rwf) + Daily allowance (7,000 Rwf)
Daily allowance for Local Officers	6,000	District and Sector Officers
Transportation & Lunch for Local Officers and farmers	15,000	Transportation fee (10,000 Rwf) + Lunch fee (5,000 Rwf)
Car rental fee	84,000	
Conference Hall rental fee	100,000	

Source: JICA Project Team (2019)

## (2) Budget of implementation

The following table shows the budget for each program in Nutrition Improvement Activities. The total cost was about RWF 2.12 billion. Since the Coordination Bureau was to negotiate with target districts, adjust the training schedule, and prepare the report, an amount of about RWF 130 million was added to this budget (details are shown on Annex 2).

**Table 2.2.5 Implementation Cost at each Program**

Program	Role/ Target Crop	Cost (Rwf)
Project Implementation Coordination Bureau	To manage and monitor the overall activities	129,624,000
Food Security & Nutrition	Sensitization of Nutrition Dense Food (NDF)	252,358,480
Sub-total		<b>381,982,480</b>
Pulses & Oil Crop	Soybean	297,880,000
	Iron beans	280,350,400
Sub-total		<b>578,230,400</b>
Roots & Tubes	Sweet orange potato	293,729,220
	Irish potato	256,825,000
	Yellow cassava	120,388,460
Sub-total		<b>670,942,680</b>
Horticulture	Vegetables (NDF) Including SMAP concept	253,074,000
	Fruit	231,776,000
Sub-total		<b>484,850,000</b>
<b>Total</b>		<b>2,116,005,560</b>

Source: JICA Project Team (2019)

## CHAPTER 3: SUPPORT IN THE IMPLEMENTATION OF TRAINING IN TARGET DISTRICTS

### 3.1 Preparation for the Training

#### (1) Site investigation

The JICA Project Team, in collaboration with RAB officials, conducted a field survey in 6 target districts on the following schedule. The outline of training implementation was explained to the district representatives, then request for cooperation, location of DT-Farm, location of nutrition improvement enlightenment and cooking demonstration (hereinafter referred to as “cooking demonstration”), number of participants in the training, etc. were discussed.

**Table 3.1.1 Schedule of the Field Survey in 6 Target Districts**

Target District	Period of Survey	Remarks
Ngoma	18-19 Nov., 2019	Eastern Province
Nyaruguru	20-21 Nov., 2019	Southern Province
Nyamagabe	21-22 Nov., 2019	Idem
Rutsiro	28-29 Nov., 2019	Western Province
Ngororero	5-6 Dec., 2019	Idem
Gakenke	12-13 Dec., 2019	Northern Province

Source: JICA Project Team (2019)

#### (2) Decision of target vegetative crops and their cultivation area in target districts

The following table shows the cultivated areas of the introduced vegetative crops in 6 target districts. The total area of the DT-Farm was 7,600 m<sup>2</sup> in 6 districts. Regarding fruit trees, the villages with good access were selected as the DT-Farms to distribute the fruit tree seeds and seedlings to farmers free of charge so that the project effects can be easily monitored in the future. As a general rule, the cooperative farmlands were used for the DT-Farms, however, in areas where some crops such as cassava were cultivated individually, individual farmlands were selected as the DT-Farms.

**Table 3.1.2 Proposed Vegetative Crops and their Cultivation Area**

Target District/ Proposed Crops	NDCs/Vegetables/BFCs						
	Soybean	Iron beans	Vegetables	Yellow cassava	Sweet orange potato	Bio-fortified Irish potato	Fruits (passion fruit and tree tomato, etc.)
Ngoma	10 x 10	10 x 10	20 x 20	10 x 10	10 x 10	-	20 x 20
Gakenke	10 x 10	10 x 10	20 x 20	10 x 10	10 x 10	10 x 10	20 x 20
Ngororero	10 x 10	10 x 10	20 x 20	10 x 10	10 x 10	10 x 10	20 x 20
Nyamagabe	-	10 x 10	20 x 20	10 x 10	10 x 10	10 x 10	20 x 20
Rutsiro	10 x 10	10 x 10	20 x 20	10 x 10	10 x 10	10 x 10	20 x 20
Nyaruguru	10 x 10	10 x 10	20 x 20	10 x 10	10 x 10	10 x 10	20 x 20
Total	500m <sup>2</sup>	600m <sup>2</sup>	2,400m <sup>2</sup>	600m <sup>2</sup>	600m <sup>2</sup>	500m <sup>2</sup>	2,400m <sup>2</sup>

Source: JICA Project Team (2019)

#### (3) Determination on DT-Farms and cooking demonstration venue

For the selection of training sites, the ease of access was given top priority, and the DT-Farms for each target crop and cooking demonstration venue were decided in consultation with the relevant parties in

the target districts (see Table 3.1.3 and Table 3.1.4). As a general rule, two locations were selected as DT-Farms in each district. In Nyamagabe District, Irish potatoes are generally cultivated in highlands, therefore it was necessary to set up the DT-Farm for Irish potatoes in a place different from other crops, so three sites were selected for the DT-Farm. Details are shown in Annex 3.1.

### 1) DT-Farms and their cultivated areas for target crops

The following table shows the place of DT-Farms and their cultivated areas by target crop in each district. As a result of discussions with each district, 13 sites were decided, and the total cultivated area was 7,600 m<sup>2</sup>.

**Table 3.1.3 Target Vegetative Crops at each DT-Farm**

Target District	DT-Farm 1	DT-Farm 2	DT-Farm 3
Ngoma	Coop. KOTURI, Rukira Sector, Nyaruvumu Cell	CCT Urumuri, Rukumberi Sector, Gituza Cell	
Target crops	Soybean, Iron beans	Vegetables, Fruits, Yellow cassava, Sweet orange potato	
Cultivation Area	200m <sup>2</sup>	1,000m <sup>2</sup>	
Nyaruguru	KOABI Coop., Rusenge Sector, Gikunzi Cell	Jyambere Muhinzi, Kibeho Sector, Mubuga Cell	
Target crops	Vegetable, Iron beans, Soybeans, Yellow cassava	Irish potato, Fruit, Sweet orange potato,	
Cultivation Area	700m <sup>2</sup>	600m <sup>2</sup>	
Nyamagabe	KOIKWI Coop. Cyanika Sector, Ngoma Cell	KOTUBAKA Coop. Kaduha Sector, Nyabizindu Cell	Gatara Sector, Rwamakara Cell
Target crops	Vegetable, Sweet orange potato	Yellow cassava, Iron beans, Fruits	Irish Potato,
Cultivation Area	500m <sup>2</sup>	600m <sup>2</sup>	100m <sup>2</sup>
Rutsiro	Manihira Sector, Haniro Cell	Boneza Sector, Nkira Cell	
Target crops	Irish potato, Fruits	Vegetable, Iron beans, Soybean, Yellow cassava, Sweet orange potato	
Cultivation Area	500m <sup>2</sup>	800m <sup>2</sup>	
Ngororero	Coop. Zamuka Muhinzi, Ngororero Sector, Nyange Cell	Nyange Sector, Gaseke Cell	
Target crops	Soybeans, Iron beans, Sweet orange potato, Vegetables, Irish potato	Yellow cassava, Fruits	
Cultivation Area	800m <sup>2</sup>	500m <sup>2</sup>	
Gakenke	Coko Sector, Mubirima Cell	Mukinga Coop. Kiburuga Sector, Rugimbu Cell	
Target crops	Yellow cassava, Orange sweet potato, Fruits, Irish potato	Soybeans, Iron beans, Vegetables	
Cultivation Area	700m <sup>2</sup>	600m <sup>2</sup>	
Total	6 sites, 3,400m <sup>2</sup>	6 sites, 4,100m <sup>2</sup>	1 site, 100m <sup>2</sup>

Source: JICA Project Team (2019)

### 2) Cooking demonstration venue in each target district

For the cooking demonstration, 2 sites were selected in each target district, then cooking demonstration was held at a total of 12 sites. As a general rule, the number of trainees at each site was 45.

**Table 3.1.4 List of Cooking Demonstration Venue in each Target District**

Target District	1 <sup>st</sup> cycle	2 <sup>nd</sup> cycle
Ngoma	Kibungo HC, Kibungo Sector, Cyasemakamba Cell, Amarembo Village	Zaza HC, Zaza Sector, Ruhembe Cell, Kabeza Village
Nyaruguru	KOABI Coop, Agatobwe Marshland, Rusenge Sector, Gikunzi Cell, Rwabujagi Village	Jyambere Muhinzi, Kibeho Sector, Mubuga Cell, Rwoganyoni Marshland
Nyamagabe	KOIKWI Coop/CYOGO Marshland, CYANIKA Sector, Ngoma Cell, Murama Village	Home Based ECD at Kaduha Sector, Kavumu Cell, Bamba Village
Rutsiro	Home Based ECD at Manihira Sector, Haniro Cell, Gisunzu Village	Home Based ECD at Boneza Sector, Bushaka Cell, Kinunu Village
Ngororero	Home Based ECD Ngororero Sector, Nyange Cell, Gatara Village	Home Based ECD at Nyange Sector, Gaseke Cell, Gaseke Village
Gakenke	Home Based ECD Minazi Sector, Murambi Cell, Kabuga Village	Home Based ECD Kivuruga Sector, Gasiza Cell, Nturo Village
Total	6 sites	6 sites

Source: JICA Project Team (2019)

#### (4) Participants of the training

In consultation with RAB and the officials of six target districts, the candidates for the cultivation technique training and cooking demonstration were decided as follows.

##### 1) Participants of cultivation technical training (FFS: Farmer Field School)

- District Agriculture Unit
- Sector Agronomist Officer of Target Sector per site
- Social Economic Development Officers (SEDO) of Cells in Sector where identify training site
- Farmer Facilitators of Target Crops per site located to the Target Sectors at each site
- Farmer Promoters of Villages in the Cell where located training site
- Representative of coop member where located DT-Farm
- Malnourished family identify in Sector where located training site
- CHW in charge of Nutrition at village of cell where located training site
- Caregiver of Home Based ECDE in the Village located DT-Farm

##### 2) Participants of cooking demonstration

- District Health Unit
- Sector Social Affairs of Target Sector per site
- Social Economic Development Officers (SEDO) of Cells in Core Sector
- Nutritionist and Community Health Environmental Officer at Health Centre
- Representative of CHWs at Cell Level where located Cooking Demonstration site
- CHW in charge of Nutrition at village of cell where located training site
- Caregivers representative at each Village in Cell where located cooking site
- Malnourished Families
- Farmer Promotor at Village where located Cooking Demonstration site

##### (5) Number of participants

Participants who are closely living to the training place were selected as much as possible due to restrictions such as budget for the transportation costs, the space of the training venue, and to hold WS on time.

In principle, the maximum number of participants in the cultivation technical training and cooking demonstration was decided as 45 in consultation with the district officials, referring to the training target in the previous section (4). The planned number of participants in the training was estimated to be 1,005 in total of 6 districts.

**Table 3.1.5 Number of Scheduled Participants for the Training at each Target District**

Target District	Cultivation Technical Training/FFS			Cooking Demonstration Venue		Total
	Site 1	Site 2	Site 3	Site 1	Site 2	
Ngoma	40	35	-	41	45	161
Nyaruguru	35	39	-	40	38	152
Nyamagabe	39	40	34	46	54	213
Rutsiro	40	35	-	41	45	161
Ngororero	46	30	-	50	32	158
Gakenke	38	43	-	38	41	160
Total	238	222	34	256	255	1,005

Source: JICA Project Team (2019)

## 3.2 Awareness Raising in Nutritional Improvement and Cooking Demonstration

### 3.2.1 Preparation for the Cooking Demonstration

The program of cooking demonstration consisted of a lecture in nutrition improvement and the cooking demonstration on the ground with a variety of menus.

The JICA Project Team together with RAB and the beneficiary 6 districts officers decided the dates, target participants as well as the necessary tools, utensils and ingredients for the implementation of cooking demonstrations. In addition, it was agreed to conduct the cooking demonstration in a total of 12 cooking sites by selecting 2 cooking sites from each district. The cooking demonstrations were planned to be conducted by dividing the 12 sites into 2 groups. The 1<sup>st</sup> group consisting of one site from each of the 6 districts was to be covered in the 1<sup>st</sup> cycle of cooking demonstration between February 3<sup>rd</sup> and 21<sup>st</sup>, 2021. This would be followed by the 2<sup>nd</sup> cycle corresponding from March 9<sup>th</sup> to 27<sup>th</sup>, 2021. The 2<sup>nd</sup> cycle was to cover the 2<sup>nd</sup> group consisting of the other site of the 6 districts.

The 1st cycle of cooking demonstration was successfully conducted as planned, however the 2<sup>nd</sup> cycle had to be suspended due to the countrywide lockdown instituted by the Rwandan government against the pandemic of COVID-19, after the cooking demonstrations in Ngororero District on March 11<sup>th</sup>, 2020 and in Rutsiro District on March 13<sup>th</sup>, 2020. The details of the dates of the cooking demonstrations in the beneficiary 6 districts are shown in Annex 3.2 and Annex 3.3.

#### (1) Appointment of instructors by RAB

As listed in Table 3.2.1 below, 4 officers from the Food Quality and Nutrition Program and 1 RAB intern student were appointed by RAB as instructors of the cooking demonstrations.

**Table 3.2.1 Cooking Demonstration Instructors Appointed by RAB**

	Name	Position	Program
1	Dr. Marguerite NIYIBITURONSA	Program Leader	Food Quality and Nutrition Program, RAB
2	Mr. Jean Bosco SHINGIRO	Researcher	
3	Ms. Lea NDILU	Research Technician	
4	Ms. Gérardine NYIRAHANGANYAMUNSI	Research Technician	
5	Ms. Sabine MUGWANEZA	Intern Student of RAB	

Source: JICA Project Team (2019)

**(2) Provision of the cooking utensils and ingredients**

After each cooking demonstration, the 23 types of cooking utensils used in the same event, such as frying pans, plates, cutlery, and so forth, and the remaining ingredients were handed over to the cell office or the health centers where the cooking demonstrations were taken place. The details of cooking utensils and ingredients are shown in Annex 3.4 and Annex 3.5, while their value per event amounted to RWF 172,450 as shown in table below.

**Table 3.2.2 Value of the Cooking Utensils and Ingredients Provided**

Item	Total value provided (Rwf)	The value provide/ site (Rwf)
Cooking Utensils	1,473,600	RWF 122,800
Ingredients	595,800	RWF 49,650
<b>Total</b>	<b>10,930,900</b>	<b>RWF 172,450</b>

Source: JICA Project Team (2020)

**3.2.2 Collaboration with JOCVs**

Some Japan Overseas Cooperation Volunteers (JOCVs) who were engaged in nutrition improvement activities in their assigned locations requested the JICA Project Team to allow them to participate in the cooking demonstration so that they can draw lessons from the experience for their own activities. As a result of consultations with the JICA Rwanda Office, 6 JOCVs participated and supported the activities.

**(1) Support activities by JOCVs**

Prior to the actual participation, the following activities to be supported by JOCVs were agreed between the JOCVs, JICA Rwanda office and the JICA Project Team.

- ◆ Support to illiterate participants in the filling of the pre and post tests;
- ◆ Support in the preparation and implementation of cooking demonstrations and in the cleaning up of the venue after implementation;
- ◆ Support in filming and taking pictures;
- ◆ Sharing findings and suggestions for future demonstrations with JICA Project Team through the submission of a brief report.

**(2) JOCVs' participation**

The following 6 JOCVs participated the cooking demonstrations.

**Table 3.2.3 Participation of JOCVs**

Name/ Speciality	Assigned location	Cooking demonstration	
		Date	Venue
Ms. NODA E. / Community Development (Water Sanitation)	Ngoma, Rukira	Feb. 5 <sup>th</sup> , 2020	Kibungo Health Centre, Kibungo Sector, Ngoma
Ms. Tagawa J. / Community Development (Water Sanitation)	Ngoma, Kibungo	Feb. 5 <sup>th</sup> , 2020	Kibungo Health Centre, Kibungo Sector, Ngoma
Mr. Ota N. / Community Development (Agriculture)	Rulindo, Bushoki	Feb. 6 <sup>th</sup> , 2020	Cell Office Kivuruga Sector, Gakenke
Ms. Sato H. / Vegetable Growing	Rulindo, Shorongi	Feb. 6 <sup>th</sup> , 2020	Cell Office Kivuruga Sector, Gakenke
Ms. Ota K. / Vegetable Growing	Bugesera, Nyamata	Feb. 12 <sup>th</sup> , 2020	Nyange Cell Office, Ngororero Sector, Ngororero
Ms. Kuma A. / Vegetable Growing	Huye, Ngoma	Feb. 21 <sup>st</sup> , 2020	Cyanika Health Post Cyanika Sector, Nyamagabe

Source: JICA Project Team (2020)

### 3.2.3 The 1<sup>st</sup> Cycle of Cooking Demonstration

The 1<sup>st</sup> cycle of cooking demonstration was conducted from February 5<sup>th</sup> to 21<sup>st</sup>, 2020 at each district. The venue was shown in Table 3.1.4.

#### (1) Participants

Table 3.2.4 below illustrates the number of participants of each cooking demonstration during the 1<sup>st</sup> cycle. All the demonstrations could achieve the expected participants, then average number of participants was 46.5 per site. However, it was turned out that the number of planned participants was too many for the limited space. Due to the time constraints, only some public officers were allowed to do some practice of cooking, in addition, not all the participants could actually observe how to cook the meals due to the crowdedness. The detail of participants of the 1<sup>st</sup> cycle of cooking demonstration is shown in Annex 3.6.

**Table 3.2.4 Participants of the 1<sup>st</sup> Cycle of Cooking Demonstration**

Participants Name/ Date	Ngoma District			Gakenke District			Ngororero			Rutsiro District			Nyaruguru			Nyamagabe			Total		
	5th Feb. 2020			7th Feb 2020			12th Feb 2020			14th Feb 2020			19th Feb 2020			21st Feb 2020			M	F	Total
	M	F	Total	M	F	Total	M	F	Total	M	F	Total	M	F	Total	M	F	Total			
Health Workers including Community Health Workers and Care Giver	3	10	13	8	11	19	10	8	18	9	14	23	2	7	9	6	19	25	38	69	107
Local Government Office and Health Center Officer	13	11	24	11	7	18	8	16	24	14	10	24	22	7	29	12	12	24	80	63	143
Family with Malnutrition, etc.	0	3	3	2	8	10	0	5	5	0	5	5	0	2	2	0	4	4	2	27	29
RAB	0	4	4	0	4	4	1	4	5	1	4	5	1	4	5	1	4	5	4	24	28
<b>Sub Total</b>	<b>16</b>	<b>28</b>	<b>44</b>	<b>21</b>	<b>30</b>	<b>51</b>	<b>19</b>	<b>33</b>	<b>52</b>	<b>24</b>	<b>33</b>	<b>57</b>	<b>20</b>	<b>45</b>	<b>19</b>	<b>39</b>	<b>58</b>	<b>124</b>	<b>183</b>	<b>307</b>	
Project Team & Volunteer	0	2	2	1	1	2	2	1	3	0	0	0	0	0	0	0	0	0	3	4	7
SMAP Local Staff	0	2	2	3	2	5	0	2	2	0	2	2	0	2	2	0	2	2	3	12	15
<b>Total</b>	<b>16</b>	<b>32</b>	<b>48</b>	<b>25</b>	<b>33</b>	<b>58</b>	<b>21</b>	<b>36</b>	<b>57</b>	<b>24</b>	<b>35</b>	<b>59</b>	<b>25</b>	<b>22</b>	<b>47</b>	<b>19</b>	<b>41</b>	<b>60</b>	<b>130</b>	<b>199</b>	<b>329</b>

Source: JICA Project Team (2020)

#### (2) Contents of the 1<sup>st</sup> cycle of cooking demonstration

The agenda of the cooking demonstration in the 1<sup>st</sup> cycle is illustrated in Table 3.2.5 below. At the beginning of the program, a lecture was provided to raise awareness of the participants in the current situation of Rwanda with undernutrition of children and pregnant women and in the importance of nutrition improvement. It was followed by the presentation of nutrient-dense crops. Only after such a lecture, the actual cooking demonstration was implemented.

**Table 3.2.5 Agenda of the Cooking Demonstration in the 1<sup>st</sup> Cycle**

Contents	Time required
Need for nutrition improvement, need for high nutrition crop intake Pre-test implementation, post-test questionnaire distribution	20 minutes
Importance of soybean, bean, sweet potato, Irish potato and vegetables	
Preparation of all ingredients with participants	
Soybean processing to make soybean milk	3.5 hours
Tofu making	
Okara and vegetables	
Beans, potatoes, and pumpkin leaves	
Irish potatoes with mushrooms	
Tofu in sauce	
Soybean flour and sweet potatoes/Irish potatoes puree with small fish	
Soybean/cassava/OFSP with wheat flour doughnuts	
Exchange of opinions (comments, suggestions, etc. from participants)	

Source: JICA Project Team (2020)



### 3.2.4 Reflection Workshop

After the completion of the 1<sup>st</sup> cycle cooking demonstration, a workshop to reflect the entire cycle was held with the participation of the JICA Project Team and RAB instructors on 27<sup>th</sup> February 2020. In the workshop, suggestions made by the workshop participants shown below and measures to be taken were discussed. As a result, participants agreed to the reduction of the numbers of participants and menus of each cooking demonstration in the 2<sup>nd</sup> cycle. Suggestion made by workshop participants was shown as follows.

- ◆ The cooking utensils, tools and ingredients used in the cooking demonstration were too expensive for the target populations.
- ◆ Cooking actions of instructors could not be observed by the participants due to crowdedness.
- ◆ The same cooking demonstration needs to be repeated so that the participants can fully acquire the recipes.
- ◆ A video of the cooking demonstration needs to be produced and distributed so that the participants can go through it repetitively.
- ◆ The cooking demonstrations need to be conducted in each sector.
- ◆ More cooking demonstrations need to be conducted.
- ◆ Cooking tools and utensils were not enough for all the participants to participate in/to practice.
- ◆ All the Early Childhood Development Centers need to be equipped with the cooking utensils.
- ◆ There was no time for questions and answers.
- ◆ The duration of the cooking demonstration was too long.
- ◆ The number of menus was too big for the time allotted.
- ◆ The instructors need to make sure that each of the participants fully understands the recipes.
- ◆ The menu with soybean, carrot and French beans was good (16 respondents out of a total of 20).

### 3.2.5 The 2<sup>nd</sup> Cycle of Cooking Demonstration

#### (1) Participants

RAB instructors and the JICA Project Team continued the cooking demonstrations, after the departure of JICA Experts from Rwanda due to the national lockdown against COVID-19. A total of 60 people participated, having 27 participants in Ngororero District and 33 participants in Rutsiro District, respectively. The number of participating officers from the District Offices and the Health Centers was smaller than expected due to the overlaps with other meetings and trainings. The number of menus was reduced to 6, as agreed in the reflection workshop of the 1<sup>st</sup> cycle. Both the cooking demonstrations were held at Cell Offices since their Health Centers were not equipped with cooking facilities.

**Table 3.2.6 Participants of the 2<sup>nd</sup> Cycle of Cooking Demonstration**

Category	Ngororero			Rutsiro			TOTAL		
	Male	Fema	Total	Male	Fema	Total	Male	Fema	Total
Health Workers including CHWs and Caregivers	7	4	11	3	13	16	10	17	27
Local Government Office and Health Centre Officer	3	4	7	5	1	6	8	5	13
Family with malnutrition, etc.	0	5	5	0	7	7	0	12	12
RAB	0	4	4	0	4	4	0	8	8
<b>SUB-TOTAL</b>	<b>10</b>	<b>17</b>	<b>27</b>	<b>8</b>	<b>25</b>	<b>33</b>	<b>18</b>	<b>42</b>	<b>60</b>
JICA Project Team & Volunteer	0	0	0	0	0	0	0	0	0
SMAP Local Staff	1	1	2	1	1	2	2	2	4
<b>TOTAL</b>	<b>11</b>	<b>18</b>	<b>29</b>	<b>9</b>	<b>26</b>	<b>35</b>	<b>20</b>	<b>44</b>	<b>64</b>

Source: JICA Project Team (2020)

## (2) Contents of the 2<sup>nd</sup> cycle of cooking demonstration

Comments made by participants were more favorable than those in the 1<sup>st</sup> cycle. Participants confirmed that they could understand and memorize the recipes. This could be attributed to the reduction of the number of menus from 8 to 6.

**Table.3.2.7 Agenda of the Cooking Demonstration in the 2<sup>nd</sup> Cycle**

Agenda	Time required
Concept of Malnutrition, Balanced meal and Nutrients dense foods	20 minutes
<ul style="list-style-type: none"> <li>◆ Importance of soybean, bean, sweet potato, Irish potato and vegetables</li> <li>◆ Pre-test implementation, post-test questionnaire distribution</li> </ul>	
Preparation of all ingredients with participants	2.5 hours
Soybean processing (preparation of soymilk, okara and tofu);	
Fresh beans	
Soybeans and carrots	
Sweet orange potato doughnut	
Soybean	
Sweet potatoes and fish (small) powder	
Exchange of opinions (comments, suggestions, etc. from participants)	30 minutes

Source: JICA Project Team (2020)

### 3.2.6 Pre-test and Post-test

The Pre-test and Post-test were conducted in every cooking demonstration to collect the following 5 kinds of information. Recommendations for future cooking demonstrations were formulated based on results of pre-tests and post-tests. The questionnaires of both the tests are shown in Annex 4.1 and Annex 4.2.

- ◆ The profile of participants;
- ◆ The living conditions of participants;
- ◆ The impact of the lecture part of the cooking demonstration;
- ◆ The relevance of menus;
- ◆ Challenges and points for improvement of the cooking demonstration.

#### (1) Profile of participants

The profile of participants (respondents of pre-test and post-test) in each demonstration of both the 1<sup>st</sup> and the 2<sup>nd</sup> cycle of cooking demonstration can be summarized as illustrated in Table 3.2.8 below. Gender balance was relatively good, because the proportion between female participants and male participants remained as 60:40.

On the other hand, the profile of participants for the 2<sup>nd</sup> cycle was different from that of the 1<sup>st</sup> cycle. In the 1<sup>st</sup> cycle, the proportion of Nutritionists and Community Health Environment Officers to all the participants was the largest; they were followed by Community Health Workers who ranked second. On the other hand, in the 2<sup>nd</sup> cycle, the proportion of care-takers of the Home Based Early Childhood Development Centre to all the participants was the largest, followed by the proportion of the residents and the Social and Economic Development Officers of the Cell Office.

In the second cycle, it was needed to reduce the number of participants as much as possible so that participants could see and learn about the cooking process, Therefore, Nutritionists, Community Health Environment Officers, Community Health Workers who do not cook on a daily basis were excluded

from the participants. As a result, it is thought that the number of caregivers at the ECD Center was the largest. "

**Table 3.2.8 Profile of the Participants of the 2<sup>nd</sup> Cycle of Cooking Demonstration**

		1 <sup>st</sup> cycle (Site-1)				2 <sup>nd</sup> Cycle (Site-2)			
		Pre-test		Post-test		Pre-test		Post-test	
Beneficiary Districts		Ngoma, Gakenke, Ngororero, Rutsiro, Nyaruguru, Nyamabage (6 Ditricts)				Ngororero, Rutsiro (2 Districts)			
Item		Numb	Proportion	Number	Proportion	Number	Proportion	Number	Proportion
Profile	TOTAL	238		212		50		66	
	Female	132	55.46%	N/A	N/A	30	60.00%	N/A	N/A
	Male	104	43.70%	N/A	N/A	20	40.00%	N/A	N/A
	Director of the District Health Department	4	1.68%	0	0.00%	0	0.00%	0	0.00%
	Officers of the District Health Department	3	1.26%	4	1.89%	0	0.00%	0	0.00%
	Social Affairs Officer of the Sector Office	28	11.76%	22	10.38%	2	4.00%	1	1.52%
	Nutritionist/Community Health Environment Officer of the Health Centre	39	16.39%	45	21.23%	0	0.00%	4	6.06%
	Social and Economic Development Officer of the Cell Office	33	13.87%	27	12.74%	9	18.00%	10	15.15%
	Community Health Workers (CHW)	38	15.97%	31	14.62%	8	16.00%	9	13.64%
	Residents	30	12.61%	24	11.32%	11	22.00%	10	15.15%
	CHW (in charge of Nutrition)	29	12.18%	24	11.32%	9	18.00%	7	10.61%
	Caretakers of Home Based ECD Centre	27	11.34%	31	14.62%	12	24.00%	15	22.73%
	Others	7	2.94%	4	1.89%	0	0.00%	10	15.15%

Source: JICA Project Team (2020)

Note: The highest proportion is highlighted with dark blue, while the second highest proportion is highlighted with light blue.

## (2) Living conditions of participants

Living conditions affect the nutritional status of residents. Therefore, the information on the living conditions of participants of the cooking demonstrations was collected through the pre-test.

### a) Basic conditions

Sources of cooking heat and drinking water, ways to treat drinking water at home, and access to the sanitation facility of the participant households were assessed. As a result, it was turned out that most of the participant households are using firewood for cooking, drinking water of a private well/borehole by boiling it at home, have a sanitation facility at home. Details of this analysis are illustrated in Annex 5.1.

**Table 3.2.9 Summary of the Living Conditions of Participants (respondents to the pre-test)**

Item		Sites 1+2 (All 6 Districts)	
		Number of all respondents : 288	
		Number	Proportion
Source of cooking heat	Firewood	211	73.26%
	Charcoal	182	63.19%
	Gas	50	17.36%
	Electricity	15	5.21%
	Others	3	1.04%
Source of drinking water	Rainwater	18	6.25%
	River/Pond/Spring water	17	5.90%
	Private well/borehole	125	43.40%
	Shared or Community	106	36.81%
	Public tap water	38	13.19%
	Private tap water	115	39.93%
	Others	7	2.43%
Means of Home treatment of drinking water	Boiling	217	75.35%
	Chlorine	74	25.69%
	Untreated	16	5.56%
	Others	14	4.86%
Access to sanitation facilities	Private latrine	262	90.97%
	Public latrine	18	6.25%
	No access	1	0.35%
	Others	3	1.04%

Source: JICA Project Team (2020)

#### b) Meal Frequency

As shown in Table 3.2.10 below, the number of the participant households eating meat, fish and dairy products (sources of animal proteins) between 1 and 10 times per month was the largest among the given options. The number of participants whose family eats soybean (source of plant proteins) between 1 and 10 times per months was the largest among the given options in the beneficiary Districts except Rutsiro. These findings show that participant households do not intake proteins at an appropriate frequency.

Participant households eat Irish potatoes more than any other staple food, although they also eat sweet potatoes and cassavas with less frequency. The frequency of having fruits and vegetables at the household level varied from one Cooking Site to another. A significant number of participant households do not have them every day. The promotion of nutrient-dense crops would help such households improve their nutritional status. The importance of self-consumption of nutrient-dense crops, in addition to their sales, should be reiterated in future Cultivation Training. Results of the analysis of participant households meal frequency are summarized in Annex 5.2.

**Table 3.2.10 Meal Frequency**

Meal Frequency		Sites 1+2		Meal Frequency	Sites 1+2		
		All 6 Districts			All 6 Districts		
		Total respondents : 288			Total respondents : 288		
		Number	Proportion		Number	Proportion	
Egg, beef, pork, chicken, fish, milk, dairy products	Every day, more than 30 times	9	3.13%	Irish potato	Every day, more than 30 times	22	7.64%
	21 to 30 times	33	11.46%		21 to 30 times	74	25.69%
	11 to 20 times	39	13.54%		11 to 20 times	90	31.25%
	1 to 10 times	178	61.81%		1 to 10 times	86	29.86%
	None	25	8.68%		None	10	3.47%
Soybeans	Every day, more than 30 times	19	6.60%	Cassava	Every day, more than 30 times	8	2.78%
	21 to 30 times	38	13.19%		21 to 30 times	32	11.11%
	11 to 20 times	48	16.67%		11 to 20 times	57	19.79%
	1 to 10 times	124	43.06%		1 to 10 times	162	56.25%
	None	52	18.06%		None	18	6.25%
Beans other than soybeans	Every day, more than 30 times	54	18.75%	Fruits	Every day, more than 30 times	22	7.64%
	21 to 30 times	90	31.25%		21 to 30 times	73	25.35%
	11 to 20 times	69	23.96%		11 to 20 times	79	27.43%
	1 to 10 times	63	21.88%		1 to 10 times	97	33.68%
	None	3	1.04%		None	10	3.47%
Sweet potato	Every day, more than 30 times	35	12.15%	Vegetables	Every day, more than 30 times	104	36.11%
	21 to 30 times	50	17.36%		21 to 30 times	91	31.60%
	11 to 20 times	68	23.61%		11 to 20 times	61	21.18%
	1 to 10 times	124	43.06%		1 to 10 times	31	10.76%
	None	4	1.39%		None	1	0.35%

Source: JICA Project Team (2020)

**(3) Impact of the lecture part of the cooking demonstration**

To confirm the impact of the lecture, the question to ask why nutrition is important was included in both the pre-test and the post-test. According to the analysis results of the 1<sup>st</sup> and the 2<sup>nd</sup> cycle pre-tests, most of the participants had already had the basic knowledge about nutrition prior to the lecture. After the lecture of the 1<sup>st</sup> cycle, the number of the participants who could tell the effect of nutrition increased while the number of participants who did not know why the nutrition is important decreased. Thus, positive impact of the lecture was confirmed in the 1<sup>st</sup> cycle. The same trend could confirm for the 2<sup>nd</sup> cycle, although the number of participants who believed that good nutrition could improve the immune system decreased for unknown reasons.

**Table 3.2.11 Difference in the Knowledge about Nutrition Before and After the Lecture**

Reasons why the nutrition is important (multiple answers)	Pre-test of the 1 <sup>st</sup> cycle (Respondents: 238)		Post-test of the 1 <sup>st</sup> cycle (Respondents: 212)		Difference in proportion	Pre-test of the 2 <sup>nd</sup> cycle (Respondents: 50)		Post-test of the 2 <sup>nd</sup> cycle (Respondents: 66)		Difference in proportion
	No.	%	No.	%		No.	%	No.	%	
Because it enhances children's growth	194	81.51%	200	94.34%	12.83%	36	72.00%	50	75.76%	3.76%
Because it protects me and my family from diseases	201	84.45%	198	93.40%	8.94%	40	80.00%	41	62.12%	-17.88%
Because it allows me and my family to work better and longer	170	71.43%	175	82.55%	11.12%	34	68.00%	47	71.21%	3.21%
I do not know	3	1.26%	0	0.00%	-1.26%	1	2.00%	1	1.52%	-0.48%

Source: JICA Project Team (2020)

#### (4) Relevance of menus

More than 80% of the respondents “liked” or “liked very much” all the menus addressed in the 1<sup>st</sup> cycle. The most favorite menu was “Beans, Potatoes, and Pumpkin Leaves” (92.92%), followed by “Soybean/Cassava/Orange Fleshed Sweet Potato with wheat flour doughnuts” (91.98%). On the other hand, the most disliked menus were “Tofu in sauce” and “Soybean flour and sweet potatoes/Irish potatoes puree with small fish” (for both the menus, the total proportion of “dislike” and “do not like so much” was 5.19%).

**Table 3.2.12 Evaluation of the Taste of Menus of the 1<sup>st</sup> Cycle**

Total respondents from 6 Districts : 212		1		2		3		4		5	
		Disliked		Did not like very much		So-so		Liked		Liked very much	
		No.	%	No.	%	No.	%	No.	%	No.	%
1	Soybean processing to make soybean milk	4	1.89%	3	1.42%	17	8.02%	47	22.17%	137	64.62%
2	Tofu making	4	1.89%	6	2.83%	30	14.15%	63	29.72%	110	51.89%
3	Okara and vegetables	3	1.42%	3	1.42%	20	9.43%	66	31.13%	113	53.30%
4	Beans, potatoes, and pumpkin	4	1.89%	0	0.00%	8	3.77%	49	23.11%	148	69.81%
5	Tofu in sauce	5	2.36%	6	2.83%	34	16.04%	63	29.72%	101	47.64%
6	Soybean flour and sweet potatoes/Irish potatoes puree with	3	1.42%	8	3.77%	23	10.85%	58	27.36%	115	54.25%
7	Soybean/cassava/OFSP with wheat flour doughnuts	4	1.89%	2	0.94%	6	2.83%	33	15.57%	162	76.42%

Source: JICA Project Team (2020)

Note: The most popular dish is highlighted in blue, and the next most popular dish is highlighted in light blue, which is a combination of "like" and "very like". The food with the largest number of participants (1st in the same ratio), which is a combination of "dislike" and "not like", is highlighted in pink.

In the 1<sup>st</sup> cycle, 66.04% of the participants thought that it was difficult to replicate tofu at home as illustrated in Table 3.2.13 below, and it posed challenges on the instructors in the promotion of tofu in rural areas. Meanwhile, 84.43% of the participants were willing to disseminate soybean milk production

to their neighbors. Thus, soybeans could be the potential food to improve the nutritional status of rural populations.

**Table 3.2.13 Replicability of the 1<sup>st</sup> Cycle Menus**

Respondents: 212			No.	%
The menu which is difficult to replicate at home (Multiple answers)	1	Soybean processing to make soybean milk	77	36.32%
	2	Tofu making	140	66.04%
	3	Okara and vegetables	46	21.70%
	4	Beans, potatoes, and pumpkin leaves	32	15.09%
	5	Irish potatoes with mushrooms	26	12.26%
	6	Tofu in sauce	83	39.15%
	7	Soybean flour and sweet potatoes/Irish potatoes puree with small fish	37	17.45%
	8	Soybean/cassava/OFSP with wheat flour doughnuts	68	32.08%
	9	None of them	18	8.49%
The menu which you want to teach your neighbors (Multiple answers)	1	Soybean processing to make soybean milk	179	84.43%
	2	Tofu making	126	59.43%
	3	Okara and vegetables	122	57.55%
	4	Beans, potatoes, and pumpkin leaves	168	79.25%
	5	Irish potatoes with mushrooms	39	18.40%
	6	Tofu in sauce	105	49.53%
	7	Soybean flour and sweet potatoes/Irish potatoes puree with small fish	139	65.57%
	8	Soybean/cassava/OFSP with wheat flour doughnuts	123	58.02%

Source: JICA Project Team (2020)

Note: The highest proportion is highlighted with dark blue, while the second highest proportion is highlighted with light blue.

The menu of the 2<sup>nd</sup> cycle was not the same as that of the 1<sup>st</sup> cycle. The most favorite menu of the 2<sup>nd</sup> cycle was “soybeans, carrots and French beans” (77.27%) followed by “soybean flour and sweet potatoes/Irish potatoes puree with small fish” (72.73%). The most disliked menus were “tofu in sauce” and “soybean flour and sweet potatoes/Irish potatoes puree with small fish” (for both menus, the total proportion of “dislike” and “do not like so much” was 7.58%). The evaluation result on “soybean flour and sweet potatoes/Irish potatoes puree with small fish” varied from person to person.

**Table 3.2.14 Evaluation of the Taste of the Menus of the 2<sup>nd</sup> Cycle**

Total respondents from 6 Districts : 66		1		2		3		4		5	
		Disliked		Did not like very much		Soso		Liked		Liked very much	
		No.	%	No.	%	No.	%	No.	%	No.	%
1	Soybean processing to make soybean milk	0	0.00%	0	0.00%	9	13.64%	13	19.70%	31	46.97%
2	Tofu making	2	3.03%	1	1.52%	13	19.70%	11	16.67%	28	42.42%
3	Okara and vegetables	1	1.52%	2	3.03%	11	16.67%	11	16.67%	26	39.39%
4	Soybeans, Carrots and French beans	1	1.52%	0	0.00%	4	6.06%	13	19.70%	38	57.58%
5	Beans, onion and garlic	1	1.52%	3	4.55%	6	9.09%	12	18.18%	26	39.39%
6	Tofu in sauce	3	4.55%	2	3.03%	10	15.15%	17	25.76%	22	33.33%
7	Soybean flour and sweet potatoes/Irish potatoes puree with small fish	3	4.55%	2	3.03%	2	3.03%	11	16.67%	37	56.06%
8	OFSP with wheat flour doughnuts	2	3.03%	1	1.52%	9	13.64%	18	27.27%	26	39.39%

Source: JICA Project Team (2020)

Note: The most popular dish is highlighted in blue, and the next most popular dish is highlighted in light blue, which is a combination of "like" and "very like". The food with the largest number of participants (1st in the same ratio), which is a combination of "dislike" and "not like", is highlighted in pink.

In the 2<sup>nd</sup> cycle, 33.33% of the respondents still thought that it was difficult to replicate tofu at home, with a significant decrease in the proportion of participants, compared to the 1<sup>st</sup> cycle. This could be attributed to the downsizing of the squeezer. A smaller squeezer was made by a blacksmith in Kigali prior to the commencement of the 2<sup>nd</sup> cycle.

22.73% of the respondents thought that it was difficult to replicate “Soybean flour and sweet potatoes/Irish potatoes puree with small fish” at home, and the same proportion of participants also saw difficulties in the replication at home of “Orange fleshed sweet potato with wheat flour doughnuts”.

The result that Tofu was difficult to reproduce was the same as in the first cycle, but the percentage of participants who said it was difficult to reproduce was lower than in the first cycle. At the beginning of the second cycle, the equipment used to squeeze the water in the process of making Tofu was remodeled to a smaller one at a factory in Kigali city, but the miniaturization of this equipment made Tofu reproducible. It is presumed that it contributed to the reduction of the rate of concern.

On the other hand, 65.15% of participants were willing to disseminate the recipe of “Orange fleshed sweet potato with wheat flour doughnuts”, while 57.58% of participants were also willing to share the recipe of “Soybean flour and sweet potatoes/Irish potatoes puree with small fish” with their neighbors.

**Table 3.2.15 Replicability of the 2<sup>nd</sup> Cycle Menus**

Total number of respondents: 66)		No.	%	
The menu which is difficult to replicate at home (Multiple answers)	1	Soybean processing to make soybean milk	13	19.70%
	2	Tofu making	22	33.33%
	3	Okara and vegetables	10	15.15%
	4	Soybeans, carrots and French beans	8	12.12%
	5	Beans, onion and garlic	14	21.21%
	6	Tofu in sauce	12	18.18%
	7	Soybean flour and sweet potatoes/Irish potatoes puree	15	22.73%
	8	OFSP with wheat flour doughnuts	15	22.73%
	9	None	14	21.21%
The menu which you want to teach your neighbors (Multiple answers)	1	Soybean processing to make soybean milk	47	71.21%
	2	Tofu making	28	42.42%
	3	Okara and vegetables	34	51.52%
	4	Soybeans, carrots and French beans	34	51.52%
	5	Beans, Onion and garlic	21	31.82%
	6	Tofu in sauce	36	54.55%
	7	Soybean flour and sweet potatoes/Irish potatoes puree	38	57.58%
	8	OFSP with wheat flour doughnuts	43	65.15%

Source: JICA Project Team (2020)

Note: The highest proportion is highlighted with dark blue, while the second highest proportion is highlighted with light blue.

### (5) Challenges for replication and recommendations made by participants

88.68% of the 1<sup>st</sup> cycle participants and 65.15% of the 2<sup>nd</sup> cycle participants affirmed that it would be difficult for them and their beneficiaries to obtain necessary tools and cooking utensils for the menus, and this would be the largest obstructive factor for participants to replicate the cooking demonstration in their own places. For the 1<sup>st</sup> cycle participants, to obtain necessary ingredients was the 2<sup>nd</sup> largest obstructive factor (41.04%), while for the 2<sup>nd</sup> cycle participants, to duplicate the materials was the 2<sup>nd</sup> largest factor (30.30%). This indicates that there is a great need for necessary tools, utensils and ingredients for participants to replicate those menus.



At the same time, more than a half of participants affirmed that there was nothing to be improved in both the 1<sup>st</sup> and 2<sup>nd</sup> cycles of cooking demonstration (58.02% of the 1<sup>st</sup> cycle participants and 56.06% of the 2<sup>nd</sup> cycle participants). However, 56.60% of the 1<sup>st</sup> cycle participants and 50.00% of the 2<sup>nd</sup> cycle participants recommended appropriate time management so that all the participants could learn by actually watching how the instructors were doing. In future demonstrations, measures should be taken such as to reduce the total number of participants per demonstration/site or to rotate participants in order to prevent that some people stay in the front line throughout the event.

**Table 3.2.16 Challenges for the Replication and Recommendations Made by Participants**

Items		1 <sup>st</sup> cycle (Respondents: 212)		2 <sup>nd</sup> cycle (Respondents: 66)		
		No.	%	No.	%	
Challenges for replication (Multiple answers)	1	To find an appropriate venue with cooking facilities and provision of water	47	22.17%	10	15.15%
	2	To obtain necessary tools and cooking utensils	188	88.68%	43	65.15%
	3	To obtain necessary ingredients	87	41.04%	16	24.24%
	4	To obtain participants	26	12.26%	13	19.70%
	5	To duplicate the materials	57	26.89%	20	30.30%
	6	To obtain the instructors	57	26.89%	13	19.70%
Recommendations for Improvement (Multiple answers)	1	Nothing to improve	123	58.02%	37	56.06%
	2	To reduce the duration	17	8.02%	1	1.52%
	3	To increase the duration	98	46.23%	25	37.88%
	4	To explain better to enhance the understanding of participants	62	29.25%	10	15.15%
	5	To control the time so that all the participants can learn by watching	120	56.60%	33	50.00%
	6	To select the menus which could be prepared with only those tools, utensils and ingredients available and accessible in rural areas.	91	42.92%	27	40.91%
	7	I do not know.	1	0.47%	0	0.00%

Source: JICA Project Team (2020)

Note: The highest proportion is highlighted with dark blue, while the second highest proportion is highlighted with light blue.

### 3.2.7 Challenges, Countermeasures and Recommendations Based on Results of Pre- and Post-tests

The results of the pre- and post-tests show that both the 1<sup>st</sup> and the 2<sup>nd</sup> cycles obtained the targeted participants and the menus addressed were well received by participants. The lecture given in the demonstrations contributed to enhancing the participants' knowledge about nutrition, and, therefore, it should keep forming part of the cooking demonstrations. Table 3.2.17 below summarizes the challenges, countermeasures and recommendations identified through the analysis results of the pre- and the post-tests.

**Table 3.2.17 Challenges, Countermeasures and Recommendations Identified Based on the Analysis Results of the Pre- and Post-tests**

Challenges	Countermeasures/Recommendations
Clarification of the challenges to be addressed	<ul style="list-style-type: none"> <li>♦ It is important for RAB to clarify what challenges RAB wants to address through the Cooking Demonstrations, how Cooking Demonstrations could address such challenges, who are supposed to eat the menus to be addressed, and who are supposed to learn how to prepare the menus.</li> <li>♦ If the purpose of the Cooking Demonstrations is to enhance self-consumption of the nutrient-dense crops addressed in the Cultivation Training, target participants for both the Cultivation Training and the Cooking Demonstrations could be the same. In addition, Cooking Demonstrations could be planned in accordance with the cropping calendar, so that participants could have Cooking Demonstrations just before the harvest of concerned crops.</li> </ul>
Most of participant households use firewood for cooking heat.	<ul style="list-style-type: none"> <li>♦ Menus which can be easily prepared with firewood heat should be selected. It is important to select those menus which does not require subtle heat adjustment.</li> </ul>
Participants cannot afford tools, cooking utensils and ingredients used in Cooking Demonstrations.	<ul style="list-style-type: none"> <li>♦ Expensive ingredients such as pepper should not be used.</li> <li>♦ To enhance the consumption of soybeans; it is better to promote cooked soybeans rather than tofu. Most of the households in rural areas cannot afford those tools to crush soybeans and to squeeze tofu.</li> <li>♦ The use of mortar and heavy stones may not be welcome by most of target households, since they require more time and labor force.</li> </ul>
There were too many participants for the space.	<ul style="list-style-type: none"> <li>♦ The Cooking sites and participants should be strategically selected, so that the number of participants cannot exceed 30.</li> <li>♦ When the number of participants goes beyond 30, participants may be divided into smaller groups, so that they can rotate to give each of them an opportunity to learn by watching equally.</li> </ul>
The number of menus addressed in the Cooking Demonstration was too big for its duration.	<ul style="list-style-type: none"> <li>♦ The number of menus could be automatically narrowed down, when only those menus which most of the participants and their beneficiary households could replicate are selected.</li> </ul>
There was no opportunity for the Questions and Answers session.	<ul style="list-style-type: none"> <li>♦ The understanding of participants can be enhanced by having the questions and answers opportunities, as results of the reduction in the number of menus and participants.</li> </ul>
Participants might not understand the recipes enough to replicate them by themselves	<ul style="list-style-type: none"> <li>♦ RAB has a plan for the next fiscal year in which participants of the 1<sup>st</sup> and the 2<sup>nd</sup> cycles would play the role of instructors for new participants in Cooking Demonstrations. To make this happen, it would be important to go on simplifying the recipes and to use home-grown ingredients in future Cooking Demonstrations.</li> <li>♦ The implementation of the monitoring of Cooking Demonstrations to assess the degree of understanding of participants is required.</li> </ul>
There are no established opportunities for RAB and RBC to coordinate their Cooking Demonstration activities.	<ul style="list-style-type: none"> <li>♦ RBC is also implementing cooking demonstrations to residents by Community Health Volunteers at Health Centers and in villages.</li> <li>♦ The coordination mechanisms of the activities of RAB, RBC and District Offices are not yet fully functional at the district level.</li> <li>♦ The coordination mechanisms at the central level by NECDP among RAB, RBC and NECDP are not fully functional either.</li> <li>♦ The coordination capacity of NECDP and District Offices could be improved.</li> </ul>
The capacity of RAB officers needs to be strengthened to implement and manage the Cooking Demonstrations alone.	<ul style="list-style-type: none"> <li>♦ All the logistics and administration tasks entailed to the implementation of Cooking Demonstrations were carried out by the JICA Project Team.</li> <li>♦ The coordination mechanisms and the administrative capacity of RAB need to be strengthened enough to manage all the Training and Demonstration activities.</li> <li>♦ The Special Project Implementation Unit (SPIU) (Refer to Figure 1.3.1 RAB Organigram) is a unit which is directly answerable to the Deputy Director General (DDG), and it is supposed to be in charge of both the Cultivation Training and the Cooking Demonstration. However, this is a newly established unit in RAB, and it is not yet fully functional.</li> </ul>
Moral hazardous conducts by government officers were observed	<ul style="list-style-type: none"> <li>♦ Transportation allowances and per diem (lunch allowance) cannot be paid to those participants who do not go through the Cooking Demonstration from the beginning to the end.</li> <li>♦ Some of the instructors of RAB and participating local officers should be told not to eat first, before other participants eat.</li> <li>♦ The coordinator of the entire program should supervise the events to prevent any moral hazardous conducts.</li> </ul>

Source: JICA Project Team (2020)

### 3.3 Cultivation Training for Nutrition Dense Crops

#### 3.3.1 Pre-training Preparation

##### (1) Training schedule and selection of instructors from RAB

RAB has planned to dispatch 2 officials for each cultivation training for nutrition dense crops. The schedule of the training, name of the demonstration and training plot and the introduced nutrition dense crops, and name of RAB officials for the lecture are shown in the Table 3.3.1 below. Although the JICA Project Team together with RAB planned to support the target districts to implement both FFS-1 and FFS-2, only FFS-1 was supported due to the expansion of COVID-19. Trainings and follow-up activities after FFS-1 were carried out by the district officers with support by the JICA Project Team and RAB officials through phone call, e-mail and SNS.

**Table 3.3.1 Schedule of Cultivation Training, Target Crops and the Name of Lectures**

Date	District	Location	Target Crops	RAB officials /Specialty
Monday, 17 <sup>th</sup> February 2020	Nyamagabe Site 1	KOIKWI Coop.	1. Vegetables	Umulisa Christine/Horticulture Program Murekeyimana Peruth/Horticulture Program
			2. Sweet orange potato	Kankundiye Lydie/Sweet Potato Sub Program Shumbusha Damien/Sweet Potato Sub Program
Tuesday, 18 <sup>th</sup> February 2020	Nyamagabe Site 2	KOTUBAKA Coop./Kaduha Sector	1. Yellow cassava	Gashaka Gervais/Cassava Program Mutumwinka Marie/Cassava Program
			2. High iron beans	Floride Mukamuhirwa/Bean Sub Program Ndayizeye Viateur/Bean Sub Program
			3. Fruits	(Same officials of Vegetable instructors)
Wednesday, 19 <sup>th</sup> February 2020	Nyamagabe Site 3	Gatare Sector	1. Irish potato	Musabyemungu Anastasie/Potato Sub Program Ndacyayisenga Theophile/Potato Sub Program
Thursday, 20 <sup>th</sup> February 2020	Nyaruguru Site 1	KOABI Coop. Rusenge Sector	1. Vegetables	Kagiraneza Boniface/Horticulture Program Murekeyisoni Peruth/Horticulture Program
			2. High iron beans	Mukamuhirwa Frolide/Beans Sub Program Ndayizeye Viateur/Beans Sub Program
			3. Yellow cassava	Ntivuguruzwa Serverien/Cassava Program Mukakanyana Cansilde/Cassava Program
			4. Soybeans	Rurangwa Edouard/Soybeans Sub Program Ayinkamiye Agnes/Soybeans Sub Program
Friday, 21 <sup>st</sup> February 2020	Nyaruguru Site 2	Jyamber Muhinzi wa Kibeho	1. Sweet orange sweet potato	Kankundiye Lydie/Sweet Potato Sub Program Shumbusha Damien/Sweet Potato Sub Program
			2. Irish potato	Musabyemungu Anastasie/Potato Sub Program Ndacyayisenga Theophile/Potato Sub Program
			3. Fruits	(Same officials of Vegetable instructors)
Tuesday, 25 <sup>th</sup> February 2020	Rutsiro Site 1	Individual Farmland Manihira Sector	1. Irish potato	Ntizo Senkesha/Potato Sub Program Nyirigira Sada/Potato Sub Program
			2. Fruits	Muhigirwa Chrisostome/Horticulture Program Ingabire Marie Aimé/Horticulture Program
Wednesday 26 <sup>th</sup> February 2020	Rutsiro Site 2	Individual Farmland	1. Vegetables	(Same officials of Vegetable instructors)
			2. High iron bean	Rumongi Alfred/Bean Sub Program Murwanashyaka Edouard/Bean Sub Program
		Boneza Sector	3. Soybeans	Kimenyi Martin/oybeans Sub Program Ayinkamiye Agnes/Soybeans Sub Program
			4. Yellow cassava	Kanyange Marie Claire/Cassava Program Mukakanyana Cansilde/Cassava Program
			5. Sweet orange potato	Ndirigwe Jean/Sweet Potato Sub Program Shumbusha Damien/Sweet Potato Sub Program
Tuesday, 10 <sup>th</sup> March 2020	Ngororero Site 1	Cooperative Zamuka Muhinzi wa Ngororero	1. Soybeans	Kimenyi Martin/Soybeans Sub Program Ayinkamiye Agnes/Soybeans Sub Program
			2. High iron beans	Murwanashyaka Edouard/Bean Sub Program Rumongi Alfred/Bean Sub Program
		Ngororero	3. Sweet orange potato	Ndirigwe Jean/Sweet Potato Sub Program Shumbusha Damien/Sweet Potato Sub Program

Date	District	Location	Target Crops	RAB officials /Specialty
		Sector	4. Vegetables	Filmin Uwizeye/Horticulture Program Esperanse Nyirahategekimana/Horticulture Program
			5. Irish potato	Ntizo Senkesha/Potato Sub Program Nyirigira Sada/Potato Sub Program
Thursday, 27th February 2020	Ngororero Site 2	Individual Farmland Nyange Sector	1. Yellow cassava	Kanyange Marie Claire/Cassava Program Mukakanyana Cansilde/Cassava Program
			2. Fruits	(Same officials of Vegetable instructors)
Tuesday, 3rd March 2020	Ngoma Site 1	KOTURU Coop. Rukira Sector	1. Iron beans	Gasigwa Evariste/Beans Sub Program Nibishaka Claudine/Beans Sub Program
			2. Soybeans	Uwizeyimana Mathilde/Soybeans Sub Program Mukampabuka Aurore/Soybeans Sub Program
Wednesday, 4th March 2020	Ngoma Site 2	CCT Urumuri Rukumberi Sector	1. Vegetables	Placidie Dusabimana/Horticulture Program
			2. Fruits	Busobozi Martin/Horticulture Program
			3. Yellow cassava	Gashaka Gervais/Cassava Program Mutumwinka Maria/Cassava Program
			4. Sweet orange potato	Shumbusha Damien/Sweet Potato Program Ndirigwe Jean/Sweet Potato Program
Thursday, 5th March 2020	Gakenke Site 2	Mukinga Cooperative, Kivuruga Sector	1. Soybeans	Kimenyi Martin/Soybeans Sub Program Ayinkamiye Agnes/Soybeans Sub Program
			2. Iron bean	Nzeyimana Martin/Bean Sub Program Nibishaka Claudine/Bean Sub Program
			3. Vegetables	Uzayisenga Christine/Horticulture Program Musabyisoni Aloys/Horticulture Program
Friday, 6th March 2020	Gakenke Site 1	Multiplier Farmland Coko Sector	1. Yellow cassava	Ntivuguruzwa Serverien/Cassava Program Mukakanyana Cansilde/Cassava Program

Source: JICA Project Team (2020)

## (2) Materials procurement for the cultivation training

Needed materials for the cultivation such as agricultural tools, chemical fertilizers, agricultural chemicals, and seeds/seedlings were procured by the JICA Project Team. The training was carried out only FFS-1 due to the restriction of the movement by COVID-19 in Rwanda. However, the JICA Project Team provided materials for other training to continue the activities. The total expenditure of one site for the necessary materials was approximately RWF 680,000.

**Table 3.3.2 The Cost for Necessary Materials**

Materials	Cost (RWF)	Others
Agricultural tools	4,860,000	13 Sites
Chemical fertilizers and agricultural chemicals	1,518,500	Idem
Seeds/seedlings of nutrition dense crops	2,463,000	Idem
Total	8,841,500	RWF 680,115/site

Source: JICA Project Team (2020)

**Table 3.3.3 List of Agricultural Tools for Cultivation Training**

Items	No. of Site	No. of Tools	Total No.	Unit Price	Total (RWF)	Others
Hoes	13	20	260	3,400	884,000	
Small hoes	13	10	130	2,000	260,000	
Trident	13	10	130	3,800	494,000	
Sticks	13	30	390	500	195,000	
<b>Sub-total</b>					<b>1,833,000</b>	
Watering cans	13	10	130	6,000	780,000	
Sprayers	13	2	26	60,000	1,560,000	
<b>Sub-total</b>					<b>2,340,000</b>	
Buckets	13	5	65	6,000	390,000	
String	13	1	20	1,900	38,000	
Measuring tape	13	2	26	9,000	234,000	
<b>Sub-total</b>					<b>272,000</b>	
Transportation					<b>25,000</b>	
<b>Total</b>					<b>4,860,000</b>	

Source: JICA Project Team (2020)

**Table 3.3.4 List of Chemical Fertilizers for Cultivation Training**

Items	Unit	Target Crops	Unit Price (RWF)	No. of Site	Amount	Total (RWF)
Ridomil	Pcg	Irish potato, fruits, vegetables	25,000	12	12	300,000
Safari zeb	Pcg	Irish potato, fruits, vegetables	1,500	12	24	36,000
Victory	Pcg	Irish potato, fruits, vegetables	2,500	12	12	30,000
Rocket	Pcg	Irish potato, fruits, vegetables, soybean, Iron beans	2,000	13	13	26,000
Copper oxychloride	Pcg	Irish potato, fruits, vegetables, soybean, iron beans	10,000	13	13	130,000
Thiovit	Pcg	Irish potato, fruits, vegetables, soybean, iron beans	12,000	13	13	156,000
Rhizobium	kg	Soybean, iron bean	2,000	13	1	2,000
Amonium sulfate	kg	Passion fruits, tree tomato	600	13	250	150,000
Kcl	kg	Passion fruits, tree tomato	850	13	500	425,000
Urea	kg	Passion fruits, tree tomato, iron beans	800	13	70	56,000
DAP	kg	Passion fruits, tree tomato, soybean, iron beans	850	13	150	127,500
NPK 17-17-17	kg	Vegetables, yellow cassava, sweet orange potato, bio-fortified Irish potato	800	13	100	80,000
			<b>Total (RWF)</b>			<b>1,518,500</b>

Source: JICA Project Team (2020)

**Table 3.3.5 List of Seeds/Seedlings for Nutrition Dense Crops for Cultivation Training**

Nutrition Dense Crops	Cultivation Area (are)	No. of Sites	Amount / Site	Total Amount	Supplier	Unit Price (RWF)	Total (RWF)
Soybean	1	5	500g	3,000	RAB/Rubona Station	Free of charge	
Iron beans	1	6	500g	5,000	RAB/Rubona Station		
Yellow cassava	1	6	150 cuttings	900	RAB/Rubona Station		
Bio-fortified Irish potato	1	5	40kg	200	RAB/Musanze Station	420	84,000
<b>Fruits</b>							
Passion fruits	4	6	200 trees	1,200	RAB/Karongi Station	600	720,000
Tree tomato			200 trees	1,200	RAB/Karongi Station	600	720,000
Avocado			30 trees	180	RAB/Rubona Station	1,300	234,000
Mango			30 trees	180	RAB/Kigali Station	1,300	234,000
Sweet orange potato	1	6	600 cuttings	3,600	Supplier	25	90,000
					Supplier	25	90,000
					Supplier	25	90,000
					Supplier	25	90,000
Vegetables	4	6	Zucchini	6 cans	Green farm, Ltd in Kigali	3,500	21,000
			Beetroots	6 cans		3,000	18,000
			Carrots	6 cans		3,000	18,000
			Cabbages	6 packages		6,000	36,000
			Dodo	6 Packages		2,000	12,000
	Watermelon	1 package	6,000	6,000			
					<b>Total (RWF)</b>		<b>2,463,000</b>

Source: JICA Project Team (2020)

Note: Vine of Sweet orange potato was multiplied by the Farmers Promoters who have a contract with RAB. They sell the vine to the Farmers.

### 3.3.2 Implementation of Cultivation Training

FFS-1 was carried out at 13 sites in 6 districts from 17 February 2020 to 10 March 2020. The dates, locations are shown in Table 3.3.1. However, after the FFS-1, Japanese experts went back to Japan due to the COVID-19 expansion; the movement of people was restricted and meetings were prohibited in Rwanda and, as a result, FFS-2 was canceled. Therefore, the JICA Project Team and RAB officials communicated with district officials and farmers in charge to support the Project activities via phone call, E-mail and SNS.

#### (1) Implementation of FFS-1

##### 1) Number of participants

The number of participants of each training is shown in the following table. The minimum number is 29 people, the maximum number is 64 people, and the average is 45 people per site.

**Table 3.3.6 Number of Participants of Cultivation Training at each Site**

Date	2020/2/17	2020/2/18	2020/2/19	2020/2/20	2020/2/21	2020/2/25	2020/2/26	2020/2/27	2020/3/3	2020/3/4	2020/3/5	2020/3/6	2020/3/10	
<b>District</b>	Nyamagabe	Nyamagabe	Nyamagabe	Nyaruguru	Nyaruguru	Rutsiro	Rutsiro	Ngororero	Ngoma	Ngoma	Gakenke	Gakenke	Ngororero	
<b>Sector</b>	Cyanika	Kaduha	Gatare	Rusenge	Kibeho	Manihira	Boneza	Nyange	Rukira	Rukumeri	Kivuruga	Coko	Ngororero	
<b>Location</b>	Cooperative	KOIKWI	KOTUBAKA	Individual Farm	KOABI	Jyambere Muhinzi wa Kibeho	Individual Farm	Individual Farm	Individual Farm	KOTWURU	CCP URUMURI	Association INGENZI	Individual Farm	Zamuka Muhinzi wa Ngororero
<b>Cell Level</b>	Farmers	10	9	2	20	31	4	12	13	11	16	20	12	3
	Malnourished Family	1	6	3	2	2	5	0	3	7	3	5	5	5
	Care Givers	1	7	5	4	6	8	7	7	0	2	4	5	8
	FP/FF	4	6	7	6	5	11	8	4	7	5	11	10	17
	SEDO	5	5	5	5	6	3	4	4	3	6	4	4	6
	Others	2	0	0	1	1	0	8	0	0	0	0	0	0
<b>Sector Level</b>	Agronomist	0	2	5	4	9	4	7	3	7	4	13	6	9
	Others	0	0	1	0	0	0	0	0	0	2	0	0	0
<b>District Level</b>	Agronomist	0	0	0	0	0	1	1	1	0	1	0	0	1
	Cash Crop	0	0	0	0	0	0	0	1	1	0	0	0	1
	Agriculture Inspector	0	0	0	0	0	1	1	0	0	0	1	0	0
	Others	1	0	0	0	0	0	0	0	0	0	0	0	1
<b>RAB</b>	RAB Officer	5	6	6	9	4	3	8	8	3	6	10	7	8
	Total	29	41	34	51	64	40	56	44	40	42	71	49	59
<b>Grand Total</b>														620

Source: JICA Project Team (2020)

## 2) Comments and suggestions from participants

Participants of the Cultivation Training gave us the following comments and suggestions:

- ◆ I understood the proper way of cassava planting. I did not make any soil ridge for cassava cultivation, before.
- ◆ I used to plant cassava with 20cm interval, but I understood the proper interval is 1m between plants.
- ◆ The planting distance between plants for sweet potato was new knowledge for me. I did not consider the distance between plants before.
- ◆ I have never used microbial materials to increase the mycorrhizal fungi for soybean cultivation. Also, I understood that we can get it by RAB.
- ◆ I have never used DAP for beans cultivation before. I have understood how to use it and where to get it.
- ◆ I understood the advantage of Nutrition Dense Crops, so I want to get these seed/seedlings for my farm.
- ◆ I understood that we have used not fermented manures before.
- ◆ I understood the proper amount of chemical fertilizer for each crop.
- ◆ I understood how to cultivate beetroot and zucchini which I never cultivated before.
- ◆ I did not apply water after cultivation, but I understood why to apply water immediately after planting.
- ◆ I did not apply basal fertilizer for fruit trees before, but I understood the method of basal fertilizer application and the appropriate amount of it.
- ◆ I would like to know the disease of fruit trees.
- ◆ I would like to know the cultivation method for other crops.

## (2) Monitoring activities after FFS-1

The local staff of JICA Project Team monitored all 13 sites in April 2020. Most of the cultivated crops were growing well. Farmers requested RAB and the JICA Project Team to continuously follow up the work being done at the sites so that RAB officials and the JICA Project Teams could keep in touch with the farmers, and they could communicate with RAB officials whenever necessary. For instance, for Irish

potato cultivation, RAB officials suggested to the farmers to apply the fungicide to control the diseases. The result of the monitoring is shown in Annex 6.

### **3.3.3 Result of the Cultivation Training, Challenges and Countermeasures**

#### **(1) Criteria of Trainees**

The JICA Project Team invited farmers who were engaged in cultivation technique dissemination such as cooperative farmers, farmer promoters, FFS facilitators and the Sector agronomist because of the Training topic; cultivation technique of nutrition dense crop. In addition to these farmers, malnutrition families and caregivers were also invited. However, malnutrition families and caregivers did not have any motivation for the crop cultivation. Therefore, it was better to invite only the people who have a high motivation for the cultivation techniques. On the other hand, the distribution of seedling of fruit trees, vine of sweet orange potato and stem of yellow cassava should included malnutrition families and caregivers.

#### **(2) Manures and Mulching Materials for the Cultivation Training**

In order to carry out the Cultivation Training, manure and mulching materials were prepared by the farmers at the site. However, some farmers could not prepare appropriate materials due to the lack of knowledge, so RAB officials suggested to include in the training how to make and prepare the cultivation materials.

#### **(3) Training Implementation by RAB officers**

Some RAB offices were mainly in charge of the research area, and they have not much experience for teaching participants. They gave a lecture in very detailed information for the crop and many participants could not understand it. However, in the Training, several topics were included, and several instructors gave a lecture; they could improve the lecture for the farmers by sharing the experience. Moreover, the RAB officials got experienced to work as a training team, which is important for the next training.

#### **(4) Leadership of Sector Agronomist**

Appropriate preparation work is necessary to carry out an effective Cultivation Training. The preparation work such as site selection, 1<sup>st</sup> ploughing, as well as leveling were necessary. To carry out these preparations, the strong leadership of the Sector Agronomist is a key. It is better to consider the leadership of the Sector Agronomist when selecting the target cooperative.

In the implementation of this cultivation technology training, the sector agronomist was involved in the training in which the RAB staff gave lectures and farming demonstrations as in the activities at SMAP, and then the sector agronomist himself was instructed to carry out the training as a lecturer.

#### **(5) Improvement of Training Materials**

Through the Cultivation Training, participants requested to mention the supplier of the seed and seedlings and to put more photos or figures for easy understanding of the training material. Based on the requests from the participants, the materials were received.



## (6) Cultivation Training for Primary and Secondary Schools

The training in Rutsiro District was held on 25<sup>th</sup> February 2020, and the site was located at a neighboring primary school<sup>1</sup>, so the teachers and students watched the training carefully. Some teachers requested the JICA Project team to participate in the training and the JICA Project team provided agricultural tools and seedlings of fruit trees to the school. Nutrition improvement issue is closely related to education, it is better to include schools as the target of the Training. Also, the Team suggested to include the cultivation techniques of nutrition dense crops in the school curriculum.

### 3.4 Support for Nutrition Training by RAB (April-June 2021)

Since there was unexpected spending due to the COVID-19 epidemic, the budget for RAB activities in 2020 became insufficient. Therefore, SMAP decided to provide financial support to RAB to conduct the nutrition improvement training which is a part of “Sector Policy Loan for Nutrition Improvement through Agriculture Transformation”. As a result of discussions with RAB focal persons in April 2021, it was agreed that SMAP would provide expenses, such as i) hiring the training venue, ii) allowance for participants, iii) allowance for RAB officials, iv) material used for cooking demonstration.

#### (1) Schedule of nutrition training in target districts

The schedule of nutrition training in 6 Target Districts conducted by RAB is shown in the Table 3.4.1. It was originally planned to include cooking demonstration in the training. However, the environments of training venues in Rubavu, Gicumbi, and Gisagara Districts could not allow to conduct cooking demonstration because of several reasons, such as the lack of appropriate space for cooking at the site, or rejection by the owner of the venue to conduct cooking demonstration under COVID-19 situation, and so on. Therefore, it was planned that the cooking demonstration would be conducted only in Musanze, Burera, and Nyamasheke Districts.

**Table 3.4.1 Schedule of Nutrition Training in Target Districts**

Date	District	Venue
27 April 2021	Rubavu (Western Province)	Kivu Peace View Hotel
28 April 2021	Musanze* (Northern Province)	Musanze Home Saint Vincent de Paul
29 April 2021	Burera* (Northern Province)	BDF Burera Conference Hall
4 May 2021	Gicumbi (Northern Province)	EAR Gicumbi Conference Hall
6 May 2021	Gisagara (Southern Province)	Gisagara Montana Guest House
11 May 2021	Nyamasheke* (Western Province)	Munini Hill Motel

Source: JICA Project Team (2021)

\* Districts where cooking demonstration is conducted in the training.

#### (2) Composition of participants of nutrition training

The number of participants of the training was planned to be 18, and the composition of participants was determined as shown in Table 3.4.2. It was decided that five RAB instructors would be in charge of training instructors in each District. As a measure against COVID-19, it was planned to avoid having more than 20 people in one classroom at once. So, it was considered that not more than 2 instructors would take the responsibility to lecture one topic in the classroom.

<sup>1</sup> G.S. Rwamiko, Manihira Sector, Rutsiro District

**Table 3.4.2 Planned Composition of RAB Nutrition Training**

No.	Status	Number of
1	Agriculture Unit of District Office	1
2	Health Unit of District Office	1
3	Representatives from Agriculture Cooperative	5
4	Health Workers	3
5	Sector Agronomists	3
6	Nutrition Officer of Health Centre	3
7	Mother Representatives of Early Child Development Program	2
	Total	18

Source: JICA Project Team (2021)

### (3) Implementation of RAB nutrition training

#### 1) Participants of training

The following table shows the number of participants of RAB Nutrition Training in 6 Target Districts. The actual number of participants ranges from 23 to 26, which is slightly higher than the planned number of 20 participants.

**Table 3.4.3 Participants of RAB Nutrition Training in Target Districts**

Participants Name/ Date	Rubavu District			Musanze District			Burera District			Gicumbi District			Gisagara District			Nyamasheke District			Total		
	27 Apr. 2021			28th Apr. 2021			29th Apr. 2021			4th May 2021			6th May 2021			11th May 2021					
	M	F	Total	M	F	Total	M	F	Total	M	F	Total	M	F	Total	M	F	Total	M	F	Total
Health Workers including Community Health Workers and Care Giver	1	3	4	1	3	4	5	8	13	0	3	3	1	5	6	1	2	3	9	24	33
Local Government Office and Health Center Officer	6	3	9	5	6	11	0	3	3	4	5	9	4	5	9	4	6	10	23	28	51
Cooperative Representative	4	1	5	3	2	5	2	2	4	4	3	7	3	2	5	3	2	5	19	12	31
RAB	1	4	5	2	4	6	1	4	5	2	3	5	1	3	4	1	4	5	8	22	30
Sub Total	12	11	23	11	15	26	8	17	25	10	14	24	9	15	24	9	14	23	59	86	145
SMAP Local Staff	2	1	3	2	1	3	2	1	3	2	1	3	2	1	3	2	1	3	12	6	18
Total	14	12	26	13	16	29	10	18	28	12	15	27	11	16	27	11	15	26	71	92	163

Source: JICA Project Team (2021)

#### 2) Contents of training

RAB nutrition training took one day including cultivation technique training and cooking demonstration. The content the training is summarized as follows.

- i) Opening remarks: Greetings from the Mayor of District
- ii) Lecture: Cultivation technology by RAB officials
- iii) Lecture: Cooking demonstration by RAB officials

The lecture explained the importance to intake highly nutritional crops and introduced the cooking recipes using high nutrient crops. In Musanze, Burera, and Nyamasheke Districts, the recipes of soy milk, sweet potato dishes, and soybean flower dumpling were introduced and demonstrated.

- iv) Closing remarks: Greeting from representatives of RAB and the Mayor of District

#### 3) Conclusion and suggestion

Due to measures aimed at preventing the spread of COVID-19 infection, the training was conducted with a limited number of trainees and training period (1 day), so explanations by the RAB instructor were relatively insufficient compared to the previous training session which was organized by JICA

Project Team. Despite the situation, trainees participated actively. It was observed that the training seemed to have contributed to nutrition improvement at District level. Comments from participants are as follows.

- The cooking demonstration was very interesting. Most of the participants usually eat cassava leaves, but we learned from the training that the ingredients of food can be diversified and that there are other cooking methods in addition to just boiling.
- It was good experience to participate in the training as we learned the importance of well-balanced eating habits.
- We understood how to cultivate nutrient rich crops and expect that we will be able to improve the nutrient balance of our daily meals by consuming those harvests.

## CHAPTER 4: PREPARATION OF THE TRAINING MATERIALS

### 4.1 Objective

For the Nutrition Loan Project described before, one of the executing agencies on the Rwandan side for nutrition improvement activities is RAB, however training materials for enlightenment and dissemination regarding nutrition improvement had not been developed so far. Therefore, the JICA Project Team planned to support RAB on the implementation of nutrition improvement activities and the creation of training materials. In addition, the JICA Project Team aimed that this training material would be used as a formal training material by MINAGRI and RAB in nutrition improvement activities at central and district levels in the future.

### 4.2 Formulation of Nutrition Training Materials

#### (1) Process from preparation to approval of training materials

The preparation and approval of nutrition training materials was conducted at a series of workshops shown in Table 4.2.1 below. Twenty-four members from four Programs involved in RAB Nutrition Improvement Activities participated the preparation of nutrition training materials (see Annex 7).

**Table 4.2.1 Main Activities Related to the Creation of Training Materials**

Date	Activity/ Place	Activity Content
1 <sup>st</sup> Oct. 2019	Kick-off WS Venue: Rwamagana District Participants: 17 RAB officials	<ul style="list-style-type: none"> <li>• Identification of Bio-fortified Crops (BFCs), Nutrition Dense Crops (NDCs) and fruit trees:               <ul style="list-style-type: none"> <li>- BFCs: Iron beans, yellow cassava, sweet orange potato, bio-fortified Irish potato.</li> <li>-NDCs: Soybean, vegetables.</li> <li>-Fruit trees: Avocado, tree tomato, passion fruit, papaya.</li> </ul> </li> <li>• Discussion of training material contents by each Program.</li> </ul>
23 <sup>rd</sup> to 25 <sup>th</sup> Oct. 2019	WS for formulation of training material Venue: Rwamagana Participants: 13 RAB officials	<ul style="list-style-type: none"> <li>• Formulation of training materials for dissemination of nutrition improvement: Iron beans, sweet orange potato, bio-fortified Irish potato, soybean, vegetables, fruits (avocado, tree tomato, passion fruit, papaya) and sensitization on the priority of the Nutrition Dense Food (NDF).</li> </ul>
5 <sup>th</sup> to 7 <sup>th</sup> Nov. 2019	Same as above Venue: Kigali Participants: 6 RAB officials	<ul style="list-style-type: none"> <li>• Formulation of training materials for dissemination of nutrition improvement: Yellow cassava and sweet orange potato.</li> </ul>
20 <sup>th</sup> to 21 <sup>st</sup> Jan. 2020	WS for formulation of training materials Venue: Rwamagana Participants: 25 RAB officials	<ul style="list-style-type: none"> <li>• Formulation of training materials for dissemination of nutrition improvement: Iron beans, sweet orange potato, bio-fortified Irish potato, soybean, vegetables and Fruits (avocado, tree tomato, passion fruit, papaya)</li> </ul> <p>⇒ 1st edition of training materials (8 modules) in Kinyarwanda was finalized.</p>
Mar. to Apr. 2020	Finalizing of training materials	<ul style="list-style-type: none"> <li>• Reflecting the results and lessons learned from the cultivation technique training and cooking demonstration; the contents of each training material were reviewed and finalized by exchanging e-mails with concerned RAB officials.</li> </ul>
Apr. 2020 to Mar. 2021	Project interruption	<ul style="list-style-type: none"> <li>• Project activities suspended due to the spread of COVID-19 infection.</li> </ul>
Apr. to Jun. 2021	Confirmation of training material for official use Printing and delivery of training materials to target districts, etc.	<ul style="list-style-type: none"> <li>• As a result of discussions with MINAGRI PS and RAB DDG, it was confirmed to be used as an official training material.</li> <li>• Printing and delivery of Nutrition Improvement Pamphlet.</li> <li>• Preparation of Video for introducing training materials.</li> <li>• Web posting of nutrition improvement material data.</li> </ul>

Source : JICA Project Team (2021)

**(2) Composition of nutrition training materials**

As shown in Table 4.2.2, nutrition training materials consists of 6 items of Bio-fortified crops, Nutritional Dense Crops, fruit trees and nutritional crop dissemination/ enlightenment and cooking menu.

**Table 4.2.2 Contents of Training Materials**

Training materials	Program in charge	Remarks
Iron beans	Pulses & Oil Crops Program	Bio-fortified Crop (BFC)
Soybeans		Nutrition Dense Crop (NDC)
Sweet orange potato	Roots & Tubes Program	Bio-fortified Crop (BFC)
Irish potato		Idem
Yellow cassava		Idem
Promotion to reduce malnutrition utilizing profit created by RAB-SMAP activities	Horticulture Program	It was involved to the SMAP training material.
Fruits		Avocado, tree tomato, passion fruit, papaya, mango
Nutrition improvement using nutrients dense foods	Food Quality and Nutrition Program	The cooking menu is for the above BFCs and NDCs.

Source : JICA Project Team (2021)

**(3) Approval of nutrition training materials**

In April 2021, discussions on the nutrition training materials were held with RAB DG and MINAGRI PS. Since RAB officials of each Program were involved in the process of creating the training materials, it was agreed between MINAGRI/RAB and the JICA Project Team that it was not necessary to hold a workshop on approval of nutritional training material again. The nutrition training material called “SMAP Technical Manual for Nutrition Dense Crops” has been compiled as a separate document of the Project Completion Report.

**(4) Printing and distribution of nutrition training materials**

As shown in Table 4.2.3 below, the nutrition training material and its pamphlets were distributed to RAB and 12 target districts from April to June 2021. The pamphlet is displayed in Annex 8. In the vegetable seed support project by JICA, seeds and SMAP cultivation technology training materials were distributed, and the nutrition pamphlet created by the project was distributed.

**Table 4.2.3 Distribution of Nutrition Training Materials and Pamphlets**

Beneficiary District	Material		Pamphlet	Soft copy with flash memory (Material/Pamphlet)
	Kinyarwanda	English	Kinyarwanda	Kinyarwanda/English
Ngoma District	100 sets	-	100 sets	1
Ngororero District	100 sets	-	100 sets	1
Gakenke District	100 sets	-	100 sets	1
Nyamagabe District	100 sets	-	100 sets	1
Rutsiro District	100 sets	--	100 sets	1
Nyaruguru District	100 sets	-	100 sets	1
Rubavu District	100 sets	-	100 sets	1
Burera District	100 sets	-	100 sets	1
Nyamasheke District	100 sets	-	100 sets	1
Gisagara District	100 sets	-	100 sets	1
Gicumbi District	100 sets	-	100 sets	1
Musanze District	100 sets	-	100 sets	1
RAB	1,000 sets	100 sets	1,000 sets	10
<b>Total</b>	<b>2,200 sets</b>	<b>100 sets</b>	<b>2,200 sets</b>	<b>22</b>

Source : JICA Project Team (2021)

### 4.3 Public Relations

Public relations activities in the Project activities include (i) issuing a Weekly Activity Report and (ii) posting articles on the Project activities on Facebook and Twitter. In addition, the following nutritional introduction video was created, and nutritional training material data was posted on the web through following link: <https://www.minagri.gov.rw/publications/extension-materials>.

#### (1) Making an introduction video of nutrition training materials

The JICA Project Team planned a workshop to introduce the nutrition training materials, however due to the spread of COVID-19 infection, it was difficult to hold a workshop because large gatherings of people were prohibited. Therefore, it was decided to create a video material explaining how to introduce and use the training materials by RAB officials who were involved in the creation of nutrition training materials and distribute them to the people concerned. Each topic in the video and the person who explained it were determined as shown in Table 4.3.1. The length of the nutrition training material introduction video was about one hour. In addition, the JICA Project Team created a short-time video of about 5 to 10 minutes (including audio only) that can be used for TV and radio broadcasting.

**Table 4.3.1 Topics in the Introduction Video and Presenters**

No.	Topic	Name of Presenter	Title/ Organization
1	Remarks	Mr. MARUO Shin	Chief Representative, JICA Rwanda Office
		Mr. MUSABYIMANA Jean Claude	PS/ MINAGRI
		Dr. BUCAGU Charles	DDG/ RAB
2	Overview	Dr. NIYIBITURONSA Margueritte	Program Leader for Nutrition and Food Quality/ RAB Rubona Station
		Ms. MUKAYIRANGA Agnes	Crop Innovation and Technology Transfer Coordination Specialist/ RAB HQ
3	Sub Program 1: Soybean	Mr. RURANGWA Edouard	Research Technician/ RAB Rubona Station
4	Sub Program 2: High Iron bean	Ms. MUKAMUHIRWA Floride	Research and Technology Transfer Specialist/ RAB Rubona Station
5	Sub Program 3: Bio-Fortified Irish Potatoes	Mr. SENKESHA NTIZO	Research Assistant/ RAB Musanze Station
6	Sub Program 4: Yellow Cassava	Dr. NDUWUMURENYI Athanase	Researcher/ RAB Muhanga Station
7	Sub Program 5: Orange Fleshed Sweet Potatoes	Dr. SHUMBUSHA Damien	Researcher/ RAB Rubona Station
8	Sub Program 6: Fruits	Mr. KAGIRANEZA Boniface	Horticulture Program Leader/ RAB Rubona Station/
9	Sub Program 7: Nutrition improvement using nutrients dense crops	Dr. NIYIBITURONSA Margueritte	Program Leader for Nutrition and Food Quality/ RAB Rubona Station

Source : JICA Project Team (2021)

#### (2) Posting of nutrition training materials on the website

The JICA Project Team obtained approval to post the nutrition training materials on the MINAGRI and RAB websites; it also obtained approval to post not only nutritional materials but SMAP-related materials as well. The JICA Project Team coordinated with the persons in charge of each institution in Table 4.3.2 below and posted nutritional materials on the web.

**Table 4.3.2 Person in Charge of Posting of Nutritional Materials on the Web site**

Name	Position / affiliation	Remarks
Mrs. NEZERWA Martine	Chief Digital Officer/ MINAGRI	<a href="https://www.minagri.gov.rw/publications/extension-materials">https://www.minagri.gov.rw/publications/extension-materials</a>
Mr. KARANGWA Janvier	Marketing and Communication Specialist/ RAB HQ in Rubona	Adjusting, As of June 2021

Source : JICA Project Team (2021)

The screenshot displays the MINAGRI website interface. At the top, there is a navigation menu with links for HOME, ABOUT, MANDATE, SERVICES, UPDATES, PUBLICATIONS, and MIS. A search bar and language selector (English) are also present. Below the navigation, the 'PUBLICATIONS' section is active, and the 'EXTENSION MATERIALS' sub-section is highlighted. The main content area shows a list of extension materials under the heading 'Extension Materials'. The list includes two items:

Title	Info
<a href="#">Imfashanyigisho_yo_kongera_umusaruro_no_kurya_ibihingwa_bikungahaye_ku_ntungamubiri.pdf</a>	2 MB
<a href="#">Technical_Manual_to_Enhance_Production_and_Consumption_of_Nutrient_Dense_Crops_SMAP.pdf</a>	2 MB

Below the list, there is a blue button with the number '1'.

**Figure 4.3.1 Nutrition Improvement Pamphlet Posted on MINAGRI Website  
(Kinyarwanda version, English version)  
(URL : <https://www.minagri.gov.rw/publications/extension-materials>)**

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## **CHAPTER 5 ACHIEVEMENTS/ LESSONS LEARNT AND RECOMMENDATION**

### **5.1 Achievements and Lessons Learnt**

#### **(1) Establishment of the extension system for Nutrition Improvement Activity**

##### **1) Implementation structure for Nutrition Improvement Activity by RAB**

The RAB nutrition extension system for the Nutrition Improvement Activities which was established in the Project, consisted of the Coordination Bureau and the four RAB programs namely, Pulses & Oil Crop Program, Roots & Tubers Program, Horticulture Program and Food Quality & Nutrition Program (see Figure 1.3.1 “Implementation Structure of JICA Project activities and RAB Nutrition Improvement Activities”). It was first attempt for RAB officials to work together between different programs to carry out one activity under such a system. It was also first experience for all concerned parties to meet together to prepare an implementation plan and budget for Nutrition Improvement Activities in 2020/2021, prepare nutrition training materials, and provide training instructors in the target districts. Furthermore, information sharing and dissemination methods among the RAB officials of each program were improved, and the modality among them was strengthened.

In this time, the JICA Project Team cooperated with RAB officials to implement a series of workshops and training. Since the Coordination Bureau will take on these duties from the next fiscal year, further cooperation from the officials of each program is required to disseminate nutrition activity according to RAB's basic policy for Nutrition Improvement Activities. In addition, it is predicted that new crops will be added as the target crops for Nutrition Improvement Activities in the future, however basically it is considered that the current four programs can be in charge. However, RAB DG / DDG approval is required if other programs need to participate.

##### **2) Nutrition improvement extension system at the district level**

The district-level nutrition extension system established in this project consists of the district Agriculture and Natural Resources Unit (ANRU), the district Health Unit (HU), Sector and Cell in charge of Social affairs staff, and target cooperatives and farmers' groups. Through nutrition training, problems at the field level (mediation / cooperation and communication system between district-sector-cell-village organizations, selection of training participants, identification of cooking class venues and DT-Farm were clarified. During discussions on coping strategies, capacity development of participants and their modality have been strengthened (see Figure 1.3.2).

##### **3) Need of Coordination and Cooperation of Cooking Demonstration among RAB, RBC and district office**

Originally, Ministry of Health is in charge of cooking demonstration, and Rwanda Biomedical Center (RBC) under this umbrella recommends cooking demonstration to residents through health volunteers at Health Centers and villages. However, there is no place or system for coordination and cooperation among the activities of RAB, RBC and district offices, so immediate improvement is needed.

The **National Child Development Agency (NCDA)** and the district offices are responsible for coordinating activities among different sectors related to nutrition improvement at the central and district levels, respectively. When the RAB formulates a nutrition improvement plan, it needs to coordinate with



the RBC through these institutions, so it is necessary to strengthen the coordination capacity of these institutions.

## **(2) Nutrition Training Material by RAB**

The nutrition training materials elaborated this time consist of four RAB programs, which consist of cultivation techniques for NDCs, BFCs and fruit trees, the need for nutritional improvement using these crops and fruit trees as ingredients, and introduction of cooking menus. This is a comprehensive summary of nutritional awareness and dissemination methods. It is officially recognized as a training material by MINAGRI and RAB, and it is expected that it will be effectively used by district level, other donors, and NGOs in the future.

## **(3) Support of RAB Nutrition Improvement Project Plan and Budget for 2020/2021**

The newly established system including project implementation coordination bureau and the representatives of the four programs formulated the RAB nutrition project plan and budget for 2020/2021. This kind of cross-cutting project implementation system was the first attempt in Rwanda's vertically divided administrative system. In the future, it will serve as a model for RAB to formulate annual implementation plans and budgets during and after the Nutrition Loan Project.

Regarding the project related to nutrition improvement, the daily allowance and accommodation expenses of RAB and district officials accounted for more than 60% of the project cost. It is necessary to reduce this budget and allocate it to activity costs at the field level. For example, RAB Station officials and sector agricultural officers near the training site should be used as instructors to reduce these costs.

## **(4) Enlightenment and Cooking Demonstration for Nutrition Improvement**

### **1) Content of Training Material**

The implementation of the cooking demonstration was highly evaluated by the participants. However, although gas cylinders were used as fuel in the cooking demonstration, most of the fuel for cooking at the village level is firewood, and the equipment and materials are too expensive for the participants, making it difficult to reproduce the menu. It was pointed out that there were too many people and that there were too many menus for the time of the demonstration to catch up with the understanding. It is necessary to clarify these problems and improve the cooking menu through future cooking demonstration.

### **2) Participants of the Cooking Demonstration**

Those community volunteers such as Community Health Workers and Caretakers at the Home-Based Early Childhood Development Center, as well as mothers and malnourished children living near the venue participated in the cooking demonstration as representatives of the residents.

The community volunteers were generally motivated to participate and were willing to prepare vegetables, but on the other hand, mothers with malnourished children were reluctant to participate actively. In the future, in the implementation of cooking demonstration, it will be necessary to devise ways to make it easier for all participants to participate by grouping participants and homogenizing the socio-economic hierarchy as much as possible.

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## **(5) Training on Cultivation Techniques for Nutrition Dense Crops**

### **1) Improvement of Cultivation Techniques**

Participants understood appropriate cultivation methods for NDCs, BFCs, and fruit trees, as well as how to obtain and use seeds, seedlings, microbial materials, and fertilizers such as DAP. The cultivation technique for participants was improved.

### **2) Coordinating the extension of kitchen gardens in RAB and NCDA**

Through the cultivation technique training, participants understood that vegetables and fruit trees are effective for improving nutrition. The number of people who want to have a kitchen garden around their home has increased. The promotion of kitchen gardens has been transferred from RAB to NCDA. In the future, it is expected that the number of participants who will make a kitchen garden through training will increase, so it will be necessary to share information with NCDA.

In addition, in order to avoid duplication of activities among RAB, NCDA and RBC, for example, RAB will hold cooking demonstration for these crops for those who are subject to cultivation guidance for NDCs and BFCs. At the based ECD Center, activities such as holding a kitchen garden and cooking demonstration for the Caretakers, and RBC will hold cooking demonstration for users of health centers and health posts and beneficiaries of CHW services, and it is conceivable that the target and purpose of activities will be clearly separated for each institution.

### **3) Leadership of Sector Agronomist**

The strong leadership of the sector agronomists in charge of the area is the key for the sustainable cultivation by farmers in the DT-Farm. Sector agronomists are in charge of coordinating with RAB and agricultural cooperative-related officials of the district office for the training, mobilizing farmers to be trained, and providing farmers with a guidance on land preparation and farming in DT-Farm. For this reason, it is necessary to invite the relevant sector agronomists to carry out training, etc., and to transfer technology to them so that they can play the role of training instructors. The leadership of these sector agronomists in charge should also be considered as one of the criteria when selecting target cooperatives and groups.

### **4) Involvement of elementary and junior high schools in Cultivation Technology Training**

At the request of the teachers at the elementary school adjacent to the DT-Farm, several teachers participated in the cultivation technique training and NDCs were cultivated at the elementary school. After that, the project team provided some of the farm tools and seedlings used in the training to the school. Since nutrition improvement is closely related to the field of education, the Project, in consultation with RAB and the target district offices, proposes to include schools in the training target and add cultivation techniques for NDCs to the education curriculum.

## **5.2 Recommendations**

### **(1) Reliable budget allocation from MINECOFIN**

As pointed out as a problem in SMAP, the budget for horticulture in 2018/2019 was that only 20% of the application budget was remitted from MINECOFIN, and the remittance every quarter was delayed. As a result, RAB-SMAP dissemination activities stagnated. In this project, about Rwf 2.12 billion was allocated as the budget for the RAB nutrition improvement project implementation plan for 2020/2021

in the Nutrition Loan Project, but due to the influence of COVIC-19, the budget from MINECO FIN was hardly allocated. Budget shortages and delays in allocation will continue to be a concern, but this issue will greatly reduce the motivation of RAB staff. MINAGRI and RAB should urge MINECOFIN to improve budget allocation.

**(2) Clarification of the process of determining the planned budget for RAB nutrition improvement project**

The RAB nutrition improvement project plan and budget estimate for 2020/2021 were submitted to MINECOFIN in December 2019. However, it was not clear how the amount to be allocated to RAB was defined. MINECOFIN should explain to JICA, MINAGRI, RAB, NCDA and RBC how the actual budget amounts of the Nutrition Loan Project were decided and allocated to each implementing agency of the said program.

**(3) Coordination among project executing agencies**

For the Nutrition Loan Project, MINAGRI, RAB, NECDP and RBC were the project implementing agencies. In the Project, RAB promoted kitchen gardens and hold cooking demonstration. Under the framework of this Project, NECDP promoted kitchen gardens and RBC was in charge of conducting cooking demonstration. However, there is no mutual coordination among these organizations when implementing the program activities. At the district level, information on the activities should be shared among these executing agencies, and a system should be built to avoid duplication and implement the activities more efficiently.

**【Central Level】**

The current NCDA (the former NECDP) is to act as a coordinator for different institutions and organizations at the central level. However, NCDA was only one program under the Ministry of Gender and Family Promotion, while RBC and RAB had a higher status in the administrative hierarchy. Such a difference in the status made it difficult for NCDA to coordinate other institutions at the central level.

In order to make the multi-sector approach for nutritional improvement work, it is most desirable to set up a permanent entity directly under the Office of President to coordinate different institutions and organizations at the central level.

As a result, the sector ministries and agencies will be able to carry out their activities smoothly. Because the status of such a permanent entity will be higher than other sector ministries and agencies in the administrative hierarchy, and it will facilitate the permanent entity to play the role of coordinator to other government institutions.

**【District Level】**

At the district level, the District Plan to Eliminate Malnutrition (DPEM) formulated by multi-sector departments is important for the effective and efficient coordination of the activities. In DPEMs, support from the central ministries (NCDA, RBC, RAB, etc.) should be also specified, to ensure the coordination of inputs from these central ministries.

When the new fiscal year begins in July and the budget of each ministry is confirmed, it is desirable that a meeting at the district level be set up under the initiative of the mayor to coordinate relevant ministries and departments working for the nutrition improvement of the district population. It is better that the district mayor or deputy mayor take the initiative in preparing and coordinating the DPEM, rather than

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HU. This will make it easier for different sectors to coordinate one and another (the case of Kirehe District).

In addition, since it is the role of the district office to coordinate different sectors, such as ECD centers, agricultural extension workers, CHW, and schoolteachers<sup>1</sup>, it is necessary to strengthen the coordination function of the district office. Specifically, it is considered effective to enhance the DPEM mechanism: for multisectoral actors to jointly formulate, implement and monitor activity plans and budgets to achieve common goals under the leadership of the district office.

Each district prioritizes geographical areas and issues to be addressed based on data and describes the activities that each sector is going to implement in DPEM to achieve the goal (the same activity is described in the activity plan / budget of each sector). If such a mechanism can be put into place in each district, the coordination function of the district offices will be strengthened.

#### **(4) Effective utilization of nutrition training materials and continuous improvement**

Nutrition training materials contribute to nutrition improvement and dissemination activities of RAB and district offices. By the JICA Project Team, the training materials were distributed to the 12 target districts, however, RAB should distribute them to other districts to expand nutrition improvement activities in the future. In addition, since it is predicted that new NDCs and BFCs will be developed and introduced in the future, RAB should revise the nutrition training materials once every three to four years.

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<sup>1</sup> ‘National Decentralization Policy’, May 2001, ‘Rwanda Decentralization Strategic Policy’, August 2007

# Annex



## Annex 1 Action Plan of Nutrition Improvement Activities in FY2020/2021

Programme: Food Quality and Nutrition, Beans, Fruits, Vegetables, Soybeans, Sweet potatoes, Cassava and Irish potatoes

Subprogramme:

Project: CROP INTENSIFICATION PROGRAM

Total cost: 2,116,005,560 Rwf

EXPECTED OUTPUTS	INDICATORS	BASELINE	2020/2021 ANNUAL TARGET	ANNUAL PLANNED ACTIVITIES	TIME FRAME				Unit cost	PLANNED BUDGET (Rwf)				BUDGET LINES		
					Q1	Q2	Q3	Q4		Q1	Q2	Q3	Q4		TOTAL	
10: Nutrition improvement through agriculture transformation	Number of sites and kitchen cells identified.	12	24	Selection of target groups/ cooperatives/ kitchen cells and confirmation to participants for trainings, and collection of baseline information to kitchen cells and diet habit	24				1,536,000	18,432,000				18,432,000	Domestic Per Diems: 12,960,000 Transportation cost for domestic business travel (airplane, bus, train, taxi): 5,040,000	
	Number of farmers trained on food nutrition	540	1,080	Conduct 24 training sessions in 12 Districts (1 training session for 4 days at 1 site)		360		360	5,586,000	5,000,000	22,344,000	22,344,000	22,344,000	72,032,000	Transportation cost for domestic business travel (airplane, bus, train, taxi): 8,064,000 Domestic Per Diems: 10,368,000 Training Related Per Diems: 48,600,000 other training related services: 5,000,000	
				Monitoring of Trainees (ToTs)			8		8	1,200,000		4,800,000	4,800,000	4,800,000	14,400,000	Meetings and Special Assembly Costs: 576,000 Transportation cost for domestic business travel (airplane, bus, train, taxi): 6,048,000 Domestic Per Diems: 7,776,000
	Materials and ingredients available	0	###	Purchase of raw materials and ingredients, and office supplies	ff	ff	ff	ff	119,794,480	119,794,480				119,794,480	Acquisition of ICT Equipment, software, internet and assets: 30,864,000 Training consumables: 88,930,480	
	Nutrition activities assessed and number of report submitted	0		1 purchase vehicle, fuel, driver, insurance				1	90,000,000		90,000,000				90,000,000	Contractual personnel: 3,600,000 Maintenance and Repairs of Vehicles and Motorbikes: 5,000,000 Fuel & lubricants: 15,000,000 Acquisition of Other Specialized Equipment: 61,500,000
				4 Conduct project assessment to 12 districts, Follow up, workshop for reporting consolidation	1		1		1	6,469,000	8,656,000	19,556,000	19,556,000	19,556,000	67,324,000	Fax and Telephone: 2,400,000 Domestic Per Diems: 3,434,000 Training Related Per Diems: 24,300,000 Training hotel facilities: 2,300,000 Transportation cost for domestic business travel (airplane, bus, train, taxi): 3,980,000
	<b>S/Total Food Quality and Nutrition</b>														<b>381,982,480</b>	
	Number of sensitization meeting workshops conducted		12	inception meeting workshop with local government authorities for selection of cooperatives	Activity 1: Mobilization and selection of target groups	12	meeting workshops			1,449,000	17,388,000				17,388,000	Transportation cost for domestic business travel (airplane, bus, train, taxi): 4,032,000 Domestic Per Diems: 5,256,000 Training Related Per Diems: 8,100,000
	Number of nursery and Field equipment purchased		16	16 sprayers, 400Kg of fertilizer, 62 watercans, 1000kg potting plastic	Fruit nursery and field equipment purchased	16	sprayers, 400Kg of fertilizer, 62 watercans, 1000kg potting plastic		0	1,993,000	15,944,000				15,944,000	Agricultural and Veterinary Supplies: 3,144,000 Acquisition of ICT Equipment, software, internet and assets: 9,600,000 Training consumables: 3,200,000
	Number of trainings conducted on market, cooperative and gender management		12	12 training workshops conducted on market analysis, cooperative management and gender	Training on cooperative management and gender	12	training workshops for 4 days			2,739,000	32,868,000				32,868,000	Transportation cost for domestic business travel (airplane, bus, train, taxi): 3,024,000 Domestic Per Diems: 1,944,000 Training Related Per Diems: 24,300,000 Training hotel facilities: 3,600,000
Number of nurseries constructed		8	8 fruit nurseries constructed for production of grafted and non grafted seedlings	construction and management of fruit tree nurseries	Nursery construction	Potting of seedlings	Management of the nursery	8,100,000	16,200,000	16,200,000	16,200,000	16,200,000	64,800,000	64,800,000	Fuel & lubricants: 64,800,000	
Number of Farmer field demonstrations conducted		12	12 farmer field demonstrations will be conducted at 12 sites in one year cycle	Trainings of selected cooperatives on fruit production through farmer field demonstrations	FFS1 on transplanting conducted at all 12 demonstration sites	FFS2, FFS3 of season to conducted all 12 demonstration site	FFS4, FFS5 on pests and diseases and harvesting conducted at all 12 demonstration site	17,373,600		17,673,600	34,747,200	34,747,200	86,868,000	86,868,000	Transportation cost for domestic business travel (airplane, bus, train, taxi): 21,744,000 Domestic Per Diems: 24,624,000 Training Related Per Diems: 40,500,000	
Number of workshops conducted on season analysis		12	12 workshops sessions will be conducted on season analysis	Workshop on season evaluation and report writing			Workshops Season analysis sessions	1,159,000				13,908,000	13,908,000	13,908,000	Transportation cost for domestic business travel (airplane, bus, train, taxi): 2,016,000 Domestic Per Diems: 2,592,000 Training Related Per Diems: 8,100,000 Training hotel facilities: 1,200,000	
<b>S/Total Fruits</b>														<b>231,776,000</b>		

EXPECTED OUTPUTS	INDICATORS	BASELINE	2020/2021 ANNUAL TARGET	ANNUAL PLANNED ACTIVITIES	TIME FRAME				Unit cost	PLANNED BUDGET (Rwf)					BUDGET LINES
					Q1	Q2	Q3	Q4		Q1	Q2	Q3	Q4	TOTAL	
	Number of demonstration sites established		12 inception meeting workshop with local government authorities for selection of cooperatives	Mobilization and selection of target groups	12 meeting workshops				1,102,000	13,224,000				13,224,000	Fax and Telephone: 3,240,000 Meetings and Special Assembly Costs: 3,744,000 Contractual personnel: 5,040,000 Research costs: 1,200,000 Transportation cost for domestic business travel (airplane, bus, train, taxi ): 5,040,000 Domestic Per Diems: 3,240,000 Training Related Per Diems: 3,744,000 Training hotel facilities: 1,200,000
	Field equipment purchased		12 sprayers, 600Kg of fertilizer	Procurements of necessary field equipment	Preparing of purchase order and delivery of inputs				365,000	4,380,000				4,380,000	Other professional services fees: 365,000 Agricultural and Veterinary Supplies: 4,380,000
	Number of trainings conducted on market, cooperative and gender management		12 training workshops conducted on market analysis, cooperative management and gender	Training of market analysis, cooperative management and gender	12 training workshops for 4 days				4,060,000	48,720,000				48,720,000	Transportation cost for domestic business travel (airplane, bus, train, taxi ): 5,040,000 Domestic Per Diems: 540,000 Training Related Per Diems: 3,240,000 Training hotel facilities: 4,800,000
	Number of Farmer field demonstrations conducted		10 farmer field demonstrations will be conducted at 12 sites in two cropping seasons	Trainings of selected cooperatives on vegetables through farmer field demonstrations	FFS1 of season one conducted at all 12 demonstration sites	FF2, FFS3 & FFS4 conducted at 12 demonstration site	FFS5 of season one and FFS1, FFS2 of season two conducted at 12 demonstration site	FFS3, & FFS4 and FFS5 of season two conducted at all 12 demonstration site	15,118,000	15,118,000	45,354,000	45,354,000	45,354,000	151,180,000	Fax and Telephone: 400,000 Transportation cost for domestic business travel (airplane, bus, train, taxi ): 28,224,000 Domestic Per Diems: 32,103,000 Fuel & lubricants: 9,201,000 Training Related Per Diems: 81,252,000
	Number of workshops		2 workshops conducted on season analysis per each of the 12 districts, one at every end of the season	Workshop on season evaluation and report writing			Workshop Season one analysis sessions	Workshop Season two analysis sessions	15,108,000			15,108,000	15,108,000	30,216,000	Fax and Telephone: 5,184,000 Meetings and Special Assembly Costs: 16,200,000 Contractual personnel: 4,032,000 Research costs: 4,800,000 Transportation cost for domestic business travel (airplane, bus, train, taxi ): 4,032,000 Domestic Per Diems: 5,184,000 Training Related Per Diems: 16,200,000 Training hotel facilities: 4,800,000
	Number of computers and printers bought		5 computers and 3 printers	Procurement of necessary office equipment	Preparing of purchase order and delivery of computer and printers				5,354,000	5,354,000				5,354,000	Acquisition of ICT Equipment, software, internet and assets : 3,700,000 Training consumables: 1,654,000
	<b>S/Total Vegetables</b>													<b>253,074,000</b>	
	Number of sites identified.	10	32	Identification and selection of target group farmers/cooperatives for training					<b>435,000</b>	3,480,000	3,480,000	3,480,000	3,480,000	<b>13,920,000</b>	Domestic Per Diems: 13,920,000
									<b>420,000</b>	3,360,000	3,360,000	3,360,000	3,360,000	<b>13,440,000</b>	Transportation cost for domestic business travel (airplane, bus, train, taxi ): 13,440,000
									<b>375,000</b>	3,000,000	3,000,000	3,000,000	3,000,000	<b>12,000,000</b>	Agricultural and Veterinary Supplies: 12,000,000
									<b>100,000</b>	300,000	300,000	300,000	300,000	<b>1,200,000</b>	Internet cost: 1,200,000
									<b>500,000</b>	2,500,000				<b>2,500,000</b>	Acquisition of Laptop: 2,500,000
									<b>400,000</b>	1,200,000				<b>1,200,000</b>	Acquisition of Printer: 1,200,000
									<b>51,687</b>	413,496	413,496	413,496	413,496	<b>1,653,984</b>	Miscellaneous Expenses: 1,653,984
	Number of farmers trained on food nutrition in 8 Districts	10	45	Conducting 2 training sessions in 8 Districts (1 training session for 4 days at 1 site)					<b>1,950,000</b>	15,600,000	15,600,000	15,600,000	15,600,000	<b>62,400,000</b>	Domestic Per Diems: 62,400,000
									<b>1,218,000</b>	9,744,000	9,744,000	9,744,000	9,744,000	<b>38,976,000</b>	Transportation cost for domestic business travel (airplane, bus, train, taxi ): 38,976,000
									<b>675,000</b>	5,400,000	5,400,000	5,400,000	5,400,000	<b>21,600,000</b>	Other transport costs: 21,600,000
									<b>387,500</b>	3,100,000	3,100,000	3,100,000	3,100,000	<b>12,400,000</b>	Meetings and Special Assembly Costs: 12,400,000
									<b>310,000</b>	2,480,000	2,480,000	2,480,000	2,480,000	<b>9,920,000</b>	Training consumables: 9,920,000
									<b>324,000</b>	2,592,000	2,592,000	2,592,000	2,592,000	<b>10,368,000</b>	Agricultural and Veterinary Supplies: 10,368,000
	Number of meeting held in each site	0	32	Kick off meeting in each site (with requesting the DT farm Land preparation, (1st plowing)					<b>300,000</b>	2,400,000	2,400,000	2,400,000	2,400,000	<b>9,600,000</b>	Domestic Per Diems: 9,600,000
									<b>84,000</b>	672,000	672,000	672,000	672,000	<b>2,688,000</b>	Transportation cost for domestic business travel (airplane, bus, train, taxi ): 2,688,000
									<b>387,500</b>	3,100,000	3,100,000	3,100,000	3,100,000	<b>12,400,000</b>	Training hotel facilities: 12,400,000
	Quantity of seed supplied in each site	10	32	Request to seed suppliers to prepare seed to introduce in the trainings					<b>648,000</b>	5,184,000	5,184,000	5,184,000	5,184,000	<b>20,736,000</b>	Domestic Per Diems: 20,736,000
									<b>432,000</b>	3,456,000	3,456,000	3,456,000	3,456,000	<b>13,824,000</b>	Transportation cost for domestic business travel (airplane, bus, train, taxi ): 13,824,000
									<b>413,500</b>	3,308,000	3,308,000	3,308,000	3,308,000	<b>13,232,000</b>	Agricultural and Veterinary Supplies: 13,232,000
	Number of report submitted from each site evaluated	0	4	Monitoring and evaluation of Trainees (ToTs) in each Site					<b>510,000</b>	4,080,000	4,080,000	4,080,000	4,080,000	<b>16,320,000</b>	Domestic Per Diems: 16,320,000
									<b>210,000</b>	1,680,000	1,680,000	1,680,000	1,680,000	<b>6,720,000</b>	Transportation cost for domestic business travel (airplane, bus, train, taxi ): 6,720,000
	<b>TOTAL Soybeans</b>													<b>297,097,984</b>	



EXPECTED OUTPUTS	INDICATORS	BASELINE	2020/2021 ANNUAL TARGET	ANNUAL PLANNED ACTIVITIES	TIME FRAME				Unit cost	PLANNED BUDGET (Rwf)					BUDGET LINES	
					Q1	Q2	Q3	Q4		Q1	Q2	Q3	Q4	TOTAL		
	Number of visits	None	24 visits	Identify and select target sweet potato farmer cooperatives for trainings	24				402,000.00	9,648,000.00				9,648,000	Domestic travel: 432,000 Transportation cost for domestic business (car hiring): 4,032,000 Domestic per diem: 5,184,000	
	Number of meetings	None	48	Conduct season preparation meetings in each of the 48 sites	24	24			1,063,000.00	25,512,000.00	25,512,000.00			51,024,000	Meetings and special assembly costs: 37,200,000 Domestic per diem: 7,776,000 Transportation cost for domestic business (car hiring): 6,048,000	
	Number of hectares covered	None	2 ha	Prepare land, plant vine multiplication plots and manage field plots on-station	1	1			2,041,000.00	2,041,000.00	2,041,000.00			4,082,000	Other professional services costs: 2,400,000 Agricultural supplies: 1,682,000	
			24 ha	Procure agricultural inputs for on-farm	2ha					250,000.00	6,000,000.00				6,000,000	Agricultural supplies: 6,000,000
	Number of ha covered of orange-fleshed sweet potato on 48 sites	None	24 ha	Plant field plots			12ha	12ha	1,926,000.00			23,112,000.00	23,112,000.00	46,224,000	Meetings and special assembly costs: 32,400,000 Domestic per diem: 7,776,000 Transportation cost for domestic business (car hiring): 6,048,000	
				Manage field plots			12ha	12ha	1,926,000.00				23,112,000.00	23,112,000.00	46,224,000	Meetings and special assembly costs: 32,400,000 Domestic per diem: 32,400,000 Transportation cost for domestic business (car hiring): 6,048,000
				Collect data & Manage pests and diseases			12ha	12ha	1,926,000.00				23,112,000.00	23,112,000.00	46,224,000	Meetings and special assembly costs: 32,400,000 Domestic per diem: 7,776,000 Transportation cost for domestic business: 6,048,000
				Handle harvest and postharvest			12ha	12ha	1,926,000.00				23,112,000.00	23,112,000.00	46,224,000	Meetings and special assembly costs: 32,400,000 Domestic per diem: 7,776,000 Transportation cost for domestic business: 6,048,000
	Number of season evaluation meetings conducted	None	24 meetings	Evaluate the project		12		12	1,051,000.00		12,612,000.00		12,612,000.00	25,224,000	Meetings and special assembly costs: 18,600,000 Domestic per diem: 2,592,000 Transportation cost for domestic business (car hiring): 4,032,000	
				Coordinate the project	6	6	6	6	179,667.00	1,075,000.00	1,075,000.00	1,075,000.00	1,075,000.00	4,300,000	Fax and telephone: 400,000 Stationery and printing consumables: 1,000,000 IT equipment (laptop): 2,400,000 Small office equipment: 500,000	
	<b>S/Total Sweet</b>													<b>293,729,220</b>		

EXPECTED OUTPUTS	INDICATORS	BASELINE	2020/2021 ANNUAL TARGET	ANNUAL PLANNED ACTIVITIES	TIME FRAME				Unit cost	PLANNED BUDGET (Rwf)					BUDGET LINES
					Q1	Q2	Q3	Q4		Q1	Q2	Q3	Q4	TOTAL	
	Number of sensitization meeting workshops conducted		16 inception meeting workshop with local government authorities for selection of cooperatives	Mobilization and selection of target groups	16 meeting workshops				210,000	3,360,000				3,360,000	Domestic Per Diems: 2,016,000 Transportation cost for domestic business travel (airplane, bus, train, taxi ): 1,344,000
	Number of office and Field equipment purchased		300Kg of NPK and 30 tones of organic manure, decameters, ropes	Procurements of necessary office and field equipment and input delivery	Preparing of purchase order and delivery of inputs				1,261,500	10,092,000				10,092,000	Fax and Telephone: 400,000 Domestic Per Diems: 1,728,000 Agricultural and Veterinary Supplies: 1,098,000 Acquisition of Other Specialized Equipment: 1,622,000 Acquisition of ICT Equipment, software, internet and assets : 3,900,000 Transportation cost for domestic business travel (airplane, bus, train, taxi ): 1,344,000
	Number of meetings conducted in each site		16 meetings with cooperative members and local officers	Kick off meetings in each site (with requesting the DT farm land preparation)	16 meetings				867,000	13,872,000				13,872,000	Domestic Per Diems: 1,728,000 Training Related Per Diems: 10,800,000 Transportation cost for domestic business travel (airplane, bus, train, taxi ): 1,344,000
	Number of cuttings multiplied		80,000 cassava cuttings of clean seed will be multiplied	Own seed multiplication	Field preparation	Management of the field	Management of the field	Management of the field	5,790,000	5,790,000				5,790,000	Other professional services fees: 3,870,000 Domestic Per Diems: 1,080,000 Transportation cost for domestic business travel (airplane, bus, train, taxi ): 840,000
	Number of Farmer field demonstrations conducted		16 farmer field demonstrations will be conducted at 16 sites in one year cycle	Trainings of selected cooperatives cassava production through farmer field demonstrations	FFS1 on seed preparation, manure application and planting conducted at all 16 demonstration sites	FFS2 on crop management, earthing, weeding and fertilization	FFS3 on pests and diseases management	FFS4 on harvesting and transport	15,408,000	15,408,000	15,408,000	15,408,000	15,408,000	61,632,000	Domestic Per Diems: 10,368,000 Training Related Per Diems: 43,200,000 Transportation cost for domestic business travel (airplane, bus, train, taxi ): 8,064,000
	Number of workshops conducted on season analysis		8 workshops sessions will be conducted on season analysis	Workshop on season evaluation and report writing				Workshops Season analysis sessions	1,602,653		12,864,000		12,778,460	25,642,460	Domestic Per Diems: 12,146,460 Training Related Per Diems: 5,976,000 Training hotel facilities: 800,000 Transportation cost for domestic business travel (airplane, bus, train, taxi ): 6,720,000
	<b>S/Total Cassava</b>									<b>48,522,000</b>	<b>28,272,000</b>	<b>15,408,000</b>	<b>28,186,460</b>	<b>120,388,460</b>	
	Number of groups/cooperatives selected	0	36	Selection of target groups/cooperatives and confirmation to participants for trainings	18		18		306,000	5,508,000		5,508,000		11,016,000	Domestic per diem: 6,480,000 Transportation cost for domestic business travel (airplane, bus, train, taxi ): 4,536,000
	Number of ha under biofortified seed increase in station	0	8	Request to seed suppliers to prepare seed biofortified varieties to introduce in the trainings (Potato seed increase on stations(Nvماغabe&Musanze)	4		4		2,935,000	15,355,000	1,625,000	4,875,000	1,625,000	23,480,000	Other professional services fees: 13,000,000 Agricultural and Veterinary Supplies: 10,480,000
				Procurement & Delivery of necessary inputs, Seeds for Bio-Fortified variety, etc.	ff				21,917,000	21,917,000				21,917,000	Agricultural and Veterinary Supplies: 16,263,000 Acquisition of Other Specialized Equipment: 5,354,000 Fax and Telephone: 300,000
	Number of kick off meetings held	0	36	Kick off meeting in each site (with requesting the DT farm Land preparation, (1st plowing))	18		18		911,667	16,410,000		16,410,000		32,820,000	Domestic per diem: 5,832,000 Training Related Per Diems: 24,300,000 Transportation cost for domestic business travel (airplane, bus, train, taxi ): 2,688,000
	Number of FFS sessions conducted	0	8	Activity 5: Conduct FFS trainings( FFS1, FFS2, FFS3,FFS4)	FFS 1 & 2	FFS 3 & 4	FFS 1 & 2	FFS 3 & 4	16,410,000	32,820,000	32,820,000	32,820,000	32,820,000	131,280,000	Training Related Per Diems: 97,200,000 Domestic per diem: 23,328,000 Transportation cost for domestic business travel (airplane, bus, train, taxi ): 10,752,000
	Number of monitoring & follow up visits done in each district	0	36	Monitoring & Follow-up of Training Farm (DTF)	9	9	9	9	300,000	2,700,000	2,700,000	2,700,000	2,700,000	10,800,000	Domestic per diem: 4,752,000 Transportation cost for domestic business travel (airplane, bus, train, taxi ): 6,048,000
	Number of Evaluation meetings held & reports	0	18	Evaluation of the project at each district		9	9	9	1,417,333		12,756,000		12,756,000	25,512,000	Domestic per diem: 3,888,000 Training Related Per Diems: 16,200,000 Training hotel facilities: 2,400,000 Transportation cost for domestic business travel (airplane, bus, train, taxi ): 3,024,000
	<b>S/Total Irish Potatoes</b>													<b>256,825,000</b>	
<b>Grand Total</b>														<b>2,116,005,560</b>	

## Annex 3.1 Summary of Site for Demonstration & Training Farm (DT-F) and Cooking Demonstration at each Target District

### (1) Ngoma District

#### a. Summary of DT-F

<b>Site 1:</b> Cooperative KOTURU/ Rukira Sector, Nyaruvumu Cell, Cyamahehe Village “Koperative Tuzamure Ubuhinzi Rukira”
Contact Person: 1) President of Cooperative: Sibomana Jean de Dieu 1) Nzajyibwami Pierre, <b>Rukira</b> Sector Agronomist
Target Crops: Soybean, Iron Beans
Target Sector: 1. Rukira 2. Murama 3. Kibungo 4. Remera, 5. Kazo, 6. Rurenge, 7. Mutenderi
DT-Farm: Cooperative Farm Land
<b>Site 2:</b> CCT Urumuri, Rukumberi Sector, Gituza Cell, Mfunwe Village
Contact Person: 1. Juvenal Nkeramihigo, Vice President, 2. Rukumberi Sector Agronomist, Rachel UWINGENEYE,
Target Crops; Vegetable, Fruits, Yellow Cassava, Orange Sweet potato
Target Sector: 1. <b>RUKUMBERI</b> , 2. Sake, 3. Karemba, 4. Jarama, 5. Gashanda, 6. Mugesera, 7. Zaza
DT-Farm: Cooperative Farm Land

#### b. Summary of Cooking Place

<b>Site 1:</b> Kibungo HC, Kibungo Sector, Cyasamakamba Cell, Amarembo Village
Contact Person: 1. Peace Venuste, Titulaire Kibungo HC 2. Eric Ndagijimana Sebayange, Nutritionist
Target Health Centre and Sector: 1. Kibungo HC, 2. Rubona HC, 3. Rukira HC, 4 Gituku HC, 5 Remera, HC, 6 Gasetza HC, 7 Mutenderi HC, 8 Gashanda HC
<b>Site 2:</b> Zaza HC, Zaza Sector, Ruhembe Cell, Kabeza Village
Contact Person: 1. Sr Mukashema Marthe, Titulaire 2.Nutritionist
Target Health Centre and Sector: 1.Zaza HC. 2. Nyange HC/ Mugesera. 3. Rukumberi HC, 4. Rukoma HC/Sake, 5. Jarama HC, 6. Kirwa HC/Rurenge

Note) Caregivers in Ngoma are called Ababyeyi b'Urumuri

### (2) Nyaruguru District

#### a. Summary of DT-F

<b>Site 1:</b> KOABI Coop, Agatobwe Marshland, Rusenge Sector, Gikunzi Cell, Rwabujagi Village
Contact Person: 1. Innocent Harelimana, President of Cooperative 2. Sylver Mukeshimana, Rusenge Sector Agronomist
Target Crops: 1.Vegetable, 2.Iron Beans, 3.Soybeans in Marshland 4.Yellow Cassava, @Hill Side
Target Sector: 1. Rusenge, 2.Nyagasozi, 3.Ruramba, 4.Mata, 5.Ngera, 6.Ngoma
DT-Farm: Coop Farm Land
<b>Site 2:</b> Jyambere Muhinzi, Kibeho Sector, Mubuga Cell, Rwoonyoni Marshland
Contact Person: 1. Nsengiyumva Vital, Manager 2, Twizerimana Jean Claude, HoreCo Agronomist
Target Crops; 1. Irish Potato, 2 Fruit @ Hillside, 3. Orange Sweet potato, @ Hillside
Target Sector: 1. Kibeho, 2. Kivu, 3.Muganza, 4. Nyabimata, 5. Munini, 6. Busanze, 7. Cyahinda, 8. Ruramba
DT-Farm: Coop Farm Land and Individual Farm Land (Hillside)

## b. Summary of Cooking Place

<b>Site 1:</b> KIBEHO Sector, Mubuga Cell, Nyarusovu Village
Contact Person: 1. Mrs. Mukandemera Seraphine, Care Giver 2. Chief of Family: Mr.
Target Health Centre and Sector: 1. Nyamyumba HC/Mata, 2. Ngera HC, 3. Maraba HC/Nyagisozi, 4. Nyantango HC/Nyagisozi, 5. Ngoma HC, 6. Ruramba HC/Ruramba, 7. Kabirizi HC/Ruramba, 8. Kibeho HC
<b>Site 2:</b> RUSENGE Sector, Gikunzi Cell, Rwabujogi Villae
Contact Person: 1. Mrs Uwizeyimana Chantal, Care Giver 2. Chief of Family: Mr. Celestin Musabimana
Target Health Centre and Sector: 1. Runyombi HC/Busanze, 2. Cyahinda HC, 3. Coko HC/ Cyahinda, HC, 4. Kivu HC, 5. Muganza HC, 6. Munini HC, 7. Nyabimata HC, 8. Ruheru HC

## (3) Nyamagabe District

### a. Summary of DT-F

<b>Site 1:</b> KOIKWI Coop/ CYOGO Marshland, CYANIKA Sector, Ngoma Cell, Murama Village
Contact Person: 1. Venuste Kanamugire, President of Cooperative 2. Delphine, HoreCo Agronomist in Cyogo Marshland
Target Crops; 1. Vegetable, 2, Orange Sweet Potato
Target Sector: 1. Cyanika, 2. Gasaka, 3. Kamegeri, 4. Mbazi, 5. Kibirizi
DT-Farm: Coop. Farm Land
<b>Site 2:</b> KOTUBAKA Coop / Hill side, KADUHA Sector, Nyabisindu Cell, Muduha Village
Contact Person: KOTUBAKA Coop / Hill side, KADUHA Sector, Nyabisindu Cell, Muduha Village
Target Crops; 1. Yellow Cassava, 2. Iron Beans, 3. Fruits (Passion Fruits and Tree Tomato)
Target Sector: 1. Kaduha, 2. Kibumbwe, 3. Mugano, 4. Musange, 5. Gatare, 6. Tare, 7. Uwinkingi, 8. Kitabi, 9. Nkomane, 10. Mushubi, 11. Musebeya, 12. Buruhukiro
DT-Farm: Coop Farm Land in Consolodate Farm Land
<b>Site 3:</b> GATARE Sector, Gatare Cell, Rwamakara Village
Contact Person: Celestin Nzaramba
Target Crops; Irish Potato
Target Sector: 1. Gatare, 2. Tare, 3. Uwinkingi, 4. Kitabi, 5. Nkomane, 6. Mushubi, 7. Musebeya, 8. Buruhukiro
DT-Farm: Individual Farm Land

### b. Summary of Cooking Place

<b>Site 1:</b> Kigarama Health Post, Cyanika Sector, Gitega Cell, Kigarama Village
Contact Person: 1. Claude Manirarora 2. Mediatrice Nyiransabimana 3. Caritas Nizeyimana
Target Health Centre and Sector: 1. Cyanika HC, 2. Kigeme HC/ Gasaka, 3. Nyamagabe HC/ Gasaka, 4. Nyarusizi HC/ Kamegeri, 5. Kibirizi HC
<b>Site 2:</b> Home Based ECD at Kaduha Sector, Kavumu Cell, Bamba Village
Contact Person: Marie Goreth Mukandekwe
Target Health Centre and Sector: 1. Kaduha HC, 2. Mugano HC, 3. Jenda HC/Musange, 4. Mbuga HC/Tare, 5. Kitabi HC, 6. Shaba HC/Kitabi, 7. Mushubi HC, 8. Musebeya HC

#### (4) Rutsiro District

##### a. Summary of DT-F

<b>Site 1:</b> MANIHIRA Sector, Haniro Cell, Gisunzu Village
Contact Person: 1. Land Owner: Jean Baptiste, 2. Manihira Sector Agronomist: Mr. Emmanuel KUBWIMANA
Target Crops: 1. Irish Potato, 2. Fruits ( Passion Fruits and Tree Tomato)
Target Sector: 1. Manihira, 2. Gihango, 3. Murunda, 4. Mushubati, 5. Rusebeya, 6. Mukura
DT-Farm: Individual Farm Land in Consolidate land Site
<b>Site 2:</b> BONEZA Sector, Nkira Cell, Munanira Village
Contact Person: 1. Land Owner: Jacqueline Nyiranzayino 2. Act Sector agronomist/ Veterinary
Target Crops: 1. Vegetable, 2. Iron Beans, 3. Soybean, 4. Yellow Cassava, 5. Orange Sweet Potato
Target Sector: 1. Boneza, 2. Mushonyi, 3. Ruhango, 4. Musasa, 5. Kigeyo, 6. Nyabirasi, 7.Kivumu
DT-Farm: Individual Farm Land in Consolidate land Site

##### b. Summary of Cooking Place

<b>Site 1:</b> Home Based ECD at Manihira Sector, Haniro Cell, Gisunzu Village
Contact Person: 1. Mrs. IZABAYO Pauline, She manages Home Based Tuesday and Thursday and Cooking Demonstration at Village level Twice per Month
Target Health Centre and Sector: 1. Mushubati HC, 2. Kibingo HC/Gihango, 3. Congo Nill HC/Gihango, 4. Rutsiro HC/Manihira, 5. Kaboya HC/Rusebeya, 6. Mukura HC, 7. Murunda HC, 8. Karumbi HC/Murunda
<b>Site 2:</b> Home Based ECD at Boneza Sector, Bushaka Cell, Kinunu Village
Contact Person: Uwimanimpaye Emeline She manages a combined Home and School Based ECD.
Target Health Centre and Sector: 1. Boneza HC, 2. Kayove HC/Ruhango, 3. Bitenge HC/Ruhango, 4. Musasa HC, 5. Biruye HC/Mushonyi, 6. Kihira HC/Kigeyo, 7. Cyimbiri HC/Kigeyo, 8. Kivumu HC, 1 9. Nyabirasi HC

#### (5) Ngororero District

##### a. Summary of DT-F

<b>Site 1:</b> Coop. Zamuka Muhinzi wa Ngororero in NGORORERO Sector, Nyange Cell, Nyange Village at Bwafu Marshland
Contact Person: 1. President of the Coop, Mr. Ndayambaje Charles, He is a FFS Facilitator 2. Nzasabimana Pierre, President of Supervisory Committee
Target Crops; 1. Soybeans, 2. Iron Beans, 3. Orange Sweet Potato, 4. Vegetables, 5. Irish Potato
Target Sector: 1, Ngororero, 2. Matyazo, 3. Hindiro, 4. Muhororo, 5. Kageyo, 6. Kavumu, 7. Sovu, 8. Kabaya, 9. Muhanda
DT-Farm: Coop Farm Land
<b>Site 2:</b> NYANGE Sector, Gaseke Cell, Gaseke Village
Contact Person: 1. Hakizimana Boneventure 2. Murekatete Emerita, SEDO of Gaseke Cell 3. Bakundakuvuga Celestin, Gaseke Village Leader
Target Crops: 1. Yellow Cassava, 2. Fruits
Target Sector: 1, Nyange, 2. Gatumba, 3. Ndaro. 4. Bwira
DT-Farm: Individual Farm Land

## b. Summary of Cooking Place

<b>Site 1:</b> Home Based ECD Ngororero Sector, Nyange Cell, Gatare Village
Contact Person: 1. Uwamahoro Jeannette. She manage Home Based ECD 2. Head of Family: Gatsinzi Iddi 3. Representative of CHWs in Nyange Cell, UWINEZA Antoinette
Target Health Centre and Sector: 1, Ngororero HC, 3. Nyange A HC/Ngororero, 3.Gashonyi HC/Matyazo, 4.Muramba HC/Hindiro, 5.Ntaganzwa HC/Muhororo, 6Kageyo HC, 7. Ramba HC/Kavumu, 8. Sovu HC, 9.Kabaya HC, 10.Rubaya HC/ Muhanda
<b>Site 2:</b> Home Based ECD at Nyange Sector, Gaseke Cell, Gaseke Village
Contact Person: Uwitonze Immaculée She manages a combined Home and School Based ECD.
Target Health Centre and Sector: 1, Nyange B HC, 2. Muhororo HC/ Gatumba, 3.Rubona HC/ Gatumba, Ntobwe HC/ Ndaró. 4.Gashubi HC/Bwira

In Ngororero District a Staff in Charge of Gender Officer is tasked to Manage and coordinate all Cooking Demonstration. Her Name: Mrs. Julienne NYIRAHABIMANA

## (6) Gakenke District

### a. Summary of DT-F

<b>Site 1:</b> COKO Sector, Mbirima Cell, Burengo Village
Contact Person: 1. NDACYAYISENGA Patrick, COKO Executive Secretary 2. SAFARI Justin, Owner of DT-Farm
Target Crops; 1. Yellow Cassava, 2. Orange Sweet Potato, 3. Fruits (Passion Fruits and Tree Tomato, 4.Irish Potato
Target Sector: 1. <b>COKO</b> , 2. Minazi, 3. Ruli, 4, Muhondo, 5. Muyongwe, 6. Rushashi
DT-Farm: Farm Land of Seed multiplier
<b>Site 2:</b> Mukinga Coop, in KIVURUGA Sector, Rugimbu Cell, Rurambo Village
Contact Person: 1. TWAHIRWA Jean de Dieu. Kivuruga Executive Secretary 2. BAZIMAZIKI Cyprien, Kivuruga Sector Agronomist
Target Crops; 1. Soybeans, 2. Iron Beans, 3. Vegetables
Target Sector: 1. KIVURUGA, 2. Cyabingo, 3. Kamubuga, 4. Busengo, 5. Mataba, 6. Muzo, 7. Janja, 8. Mugunga, 9. Rusasa, 10. Gakenke, 11. Gashenyi, 12.Nemba, 13. Karambo
DT-Farm: Coop Farm Land

### b. Summary of Cooking Place

<b>Site 1:</b> Home Based ECD Minazi Sector, Murambi Cell, Kabuga Village
Contact Person: 1.NZAKAMWITA Samuel, Kabuga Village Leader 2. MUKAKAMARI Pelagie, CHW at Kabuga Village 3. KAMANA Elias, CHW at Kabuga Village
Target Health Centre and Sector: 1. Coko HC, 2. Nyange HC/Coko, 3. Minazi HC, 4. Ruli HC, 5.Muhondo HC, 6. Muyongwe HC, 7. Rushashi HC, 8. Rwankuba HC/Rushashi, 9.Rukura HC/Gashenyi
<b>Site 2:</b> Home Based ECD Kivuruga Sector, Gasiza Cell, Nturo Village
Contact Person: 1. NYIRAKAMANA Petronille, Responsible for Cooking Demonstration in Gatare 2. UWIRAGIYE Jeanine, CHW in Charge of Nutrition in Gatare Village 3. DUKUZUMUREMYI Jean, CHW Binome in Gatare Village 4. MUSABYIMANA Patricie, CHW inome at Gatare Village
Target Health Centre and Sector: 1. Gakenke HC, 2. Rutenderi HC/Gashenyi,3. Janja HC., 4. Rutaki HC/Janja

### Annex 3.2 1<sup>st</sup> Cycle Cooking Demonstration Schedule (Feb. 2<sup>nd</sup> to Feb. 21<sup>st</sup>, 2020)

Month	Day	Activities	Accommodation	
Feb	Mon	3	Preparation of the week	
	Tue	4	Moving from Kigali/ Rubona to <b>Ngoma</b> Preparation of Kibungo HC, Kibungo Sector, Ngoma	Ngoma
	Wed	5	Demonstration in Kibungo HC, Kibungo Sector, Ngoma Moving from Ngoma to Kigali	Kigali
	Thu	6	Moving from Kigali to <b>Gakenke</b> Preparation in Home Based ECD at Kivuruga Sector, Gakenke	Musanze
	Fri	7	Demonstration in Kivuruga Sector, Gakenke Returning to <b>Kigali/ Rubona</b>	Kigali/ Rubona
	Sat	8		
	Sun	9		Musanze
	Mon	10	Preparation of the week	Kigali/ Rubona
	Tue	11	Moving from Kigali/ Rubona to <b>Ngororero</b> Preparation of Ngororero Sector, Ngororero	Ngororero
	Wed	12	Demonstration in Ngororero Sector, Ngororero, Moving to from Ngororero to <b>Rutsiro</b>	Karongi
	Thu	13	Preparation of Home Based ECD at Manihira Sector, Rutsiro	Karongi
	Fri	14	Demonstration in Home Based ECD at Manihira Sector, Rutsiro Returning to <b>Kigali/ Rubona</b>	Kigali/ Rubona
	Sat	15		
	Sun	16		
	Mon	17	Preparation of the week	Kigali/ Rubona
	Tue	18	Moving from Kigali/ Rubona to Huye Preparation in Home Based ECD at Kibehe Sector in <b>Nyaruguru</b>	Huye
	Wed	19	Demonstration in Home Based ECD at Kibehe Sector in Nyaruguru	Huye
	Thu	20	Preparation in Home Based ECD at Cyanika Sector, <b>Nyamagabe</b>	Huye
	Fri	21	Demonstration in Home Based ECD at Cyanika Sector, Nyamagabe Returning to <b>Kigali/ Rubona</b>	Kigali/ Rubona

### Annex 3.3 2<sup>nd</sup> Cycle Cooking Demonstration Schedule (Mar. 9<sup>th</sup> to Mar. 27<sup>th</sup>, 2020)

Month	Day	Activities	Accommodation	
March	Mon	9	Preparation of the week	Kigali/Rubona
	Tue	10	Moving from <b>Kigali/ Rubona to Ngororero/Nyange</b> , Preparation in Home Based ECD at Nyange Sector, Gaseke Cell, Gaseke Village, <b>Ngororero</b>	Muhanga
	Wed	11	Demonstration in Home Based ECD at Nyange Sector, Gaseke Cell, Gaseke Village, <b>Ngororero</b> , Moving from <b>Nyange to Karongi</b>	Karongi
	Thu	12	Preparation in Home Based ECD at Kigeyo Sector, Buhindure Cell, Nturo Village, <b>Rutsiro</b>	Karongi
	Fri	13	Demonstration in Home Based ECD at Kigeyo Sector, Buhindure Cell, Nturo Village, <b>Rutsiro</b> , Returning to <b>Kigali/ Rubona</b>	Kigali/ Rubona
	Sat	14		
	Sun	15	Preparation of the week	
	Mon	16	Validation WS	Rwamagana
	Tue	17	Validation WS Moving from <b>Rwamagana to Ngoma</b> , Preparation in ZAZA Health Centre, Zaza Sector, Ruhembe Cell, Kabeza Village, <b>Ngoma</b>	Ngoma
	Wed	18	Demonstration in Zaza HC, Zaza Sector, Ruhembe Cell, Kabeza Village, <b>Ngoma</b> Moving from <b>Zaza to Kigali</b>	Kigali
	Thu	19	Moving from <b>Kigali to Gakenke</b> , Preparation in Home Based ECD Minazi Sector, Murambi Cell, Kabuga Village, <b>Gakenke</b>	Musanze
	Fri	20	Demonstration in Home Based ECD Minazi Sector, Murambi Cell, Kabuga Village, <b>Gakenke</b> , Returning to <b>Kigali/ Rubona</b>	Kigali/ Rubona
	Sat	21		
	Sun	22		
	Mon	23	Preparation of the week	Kigali/Rubona
	Tue	24	Moving from <b>Kigali/Rubona to Huye</b> , Preparation in Home Based ECD at Kaduha Sector, Kavumu Cell, Bamba Village, <b>Nyamagabe</b>	Huye
	Wed	25	Demonstration in Home Based ECD at Kaduha Sector, Kavumu Cell, Bamba Village, <b>Nyamagabe</b>	Huye
	Thu	26	Preparation in Home Based ECD at Rusenge Sector, Gikunzi Cell, Rwabujogi Village in <b>Nyaruguru</b>	Huye
	Fri	27	Demonstration in Home Based ECD at Rusenge Sector, Gikunzi Cell, Rwabujogi Village, <b>Nyaruguru</b> , Returning to <b>Kigali/Rubona</b>	Kigali/Rubona



### Annex 3.4 Provision List of Cooking Equipment for a Cookind Demonstration

No.	Items	Number	Number of Site	Total	Unit price (Rwf)	Total price (Rwf)
1	Frying pan	3	6	18	20,000	360,000
2	Plate	40	6	240	1,200	288,000
3	Saucepan	1	6	6	13,000	78,000
4	Tablespoon	24	6	144	300	43,200
5	Big Spoon	24	6	144	300	43,200
6	Cooking spoon (wood)	2	6	12	1,000	12,000
7	Perforated Ladle	1	6	6	2,500	15,000
8	Ladle	3	6	18	1,000	18,000
9	Bucket	2	6	12	5,000	60,000
10	Cup	25	6	150	1,200	180,000
11	Cotton Napkins	4	6	24	1,500	36,000
12	Jug	2	5	10	2,500	25,000
13	Small basin	3	6	18	800	14,400
14	Forks	24	6	144	300	43,200
15	Strainer	1	6	6	15,000	90,000
16	Big Knife	4	6	24	1,200	28,800
17	Knife small	6	6	36	1,000	36,000
18	Small siever and big siever	2	6	12	2,500	30,000
21	Muslin clothes	1	6	6	7,000	42,000
22	Soap liquid ( 5 litter)	1	6	6	5,000	30,000
23	Sponges	1	6	1	800	800
<b>Total (Rwf)</b>						<b>1,473,600</b>

### Annex 3.5 Cooking Ingredient and Condiments List for a Cookind Demonstration

N <sup>o</sup>	Designation	Quantity	Unit price (Rwf)	Total price (Rwf)
1	Sugar	2 kg	900	1,800
2	Water	70 cups (1 of 20-liter jerrycan of JIBU water)	4,500	4,500
3	Salt	0.5kg	250	250
4	Citronelle leaves	1 bunch	200	200
5	Onion	1 kg	1000	1,000
6	Vinegar	1 bottle	600	600
7	Sweet pepper	1 kg	1,100	1,100
8	Garlic			1,000
9	Tomato	2 kg	900	1,800
10	Tomato sauce	4	300	1,200
11	Oil	5l	8,500	8,500
12	Amaranths	5 bunches	200	1,000
13	Carrots	2kg	700	1,400
14	Beans	2kg	1,000	2,000
15	Irish potato	6 kg	400	2,400
16	Pumpkin leaves	20 leaves	50	1,000
17	Celery	2 bunches	200	400
18	Orange sweet potato	5kg	500	2,500
19	Small fishes	1/4 kg	2500	2,500
20	Leak	2 bunches	400	800
21	Spinach	2 bunches	400	800
22	Wheat Flour	4 kg	750	3,000
23	Baking powder	1 package	200	200
24	Yeast	1 package	1,000	1,000
25	Eggs	6 units	150	900
26	Vanilla sugar	1 package	900	900
27	Cassava flour	1 kg	500	500
28	Lemon for zest	1 kg	1,000	1,000
29	Rice	2kg	1,200	2,400
30	Cube muggy	1 package	1,500	1,500
31	French beans	1 package	1,000	1,000
<b>Total (Rwf)</b>				<b>49,150</b>

### Annex 3.6 Participants List for 1st Cycle Cooking Demonstration

Participants Name	Training name/ District	Cooking Demonstration Training/ in Ngoma District			Cooking Demonstration Training/ in Gakenke District			Cooking Demonstration Training/ in Ngororero District			Cooking Demonstration Training/ in Rutsiro District			Cooking Demonstration Training/ in Nyaruguru District			Cooking Demonstration Training/ in Nyamagabe District		
	Date	5th Feb 2020			7th Feb 2020			12th Feb 2020			14th Feb 2020			19th Feb 2020			21st Feb 2020		
	Particulary	M	F	Total	M	F	Total	M	F	Total	M	F	Total	M	F	Total	M	F	Total
<b>Health Workers</b>	Community Health Workers	2	5	7	5	9	14	7	2	9	9	6	15	2	2	4	4	13	17
	Care giver	1	5	6	3	2	5	3	6	9	0	8	8	0	5	5	2	6	8
<b>Government Officers</b>	District Health Unit	2	1	3	1	0	1	2	0	2	2	1	3	2	1	3	0	2	2
	Head of Health Center	1	1	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Community Environment Health Officer	3	1	4	3	1	4	0	0	0	4	1	5	7	2	9	3	2	5
	Health Center Nutritionist	2	2	4	1	0	1	0	8	8	1	5	6	0	1	1	1	5	6
	Sector Executive Secretary	0	0	0	0	0	0	1	0	1	0	0	0	0	1	1	1	0	1
	Sector Social affairs	4	3	7	1	2	3	0	0	0	4	2	6	9	1	10	3	1	4
	Sector Education Officer	0	0	0	0	0	0	4	1	5	0	0	0	0	0	0	0	0	0
	Cell Executive Secretary	0	0	0	1	0	1	0	1	1	0	1	1	0	0	0	0	1	1
	SEDO	1	3	4	2	4	6	1	6	7	3	0	3	4	1	5	4	1	5
	Sector Agro	0	0	0	2	0	2	0	0	0	0	0	0	0	0	0	0	0	0
RAB	0	4	4	0	4	4	1	4	5	1	4	5	1	4	5	1	4	5	
<b>Others</b>	Others	0	0	0	2	0	2	0	0	0	0	0	0	0	0	0	0	0	0
	Family with malnutrition	0	3	3	0	8	8		5	5	0	5	5	0	2	2	0	4	4
<b>Project (Others)</b>	JICA Team & Volunteer	0	2	2	1	1	2	2	1	3	0	0	0	0	0	0	0	0	0
	SMAP Team	0	2	2	3	2	5	0	2	2	0	2	2	0	2	2	0	2	2
<b>Total</b>				<b>48</b>		<b>58</b>			<b>57</b>			<b>59</b>			<b>47</b>			<b>60</b>	

## Annex 4.1 Pretest Questionnaire for Cooking Demonstration

PRETEST				
District				
Sector				
Cell				
Village				
Date				
Name of respondent				
S/N	QUESTION	OPTIONS		ANSWER
		S/N	ITEM	
1	Sex	0	Female	
		1	Male	
2	Age	1	up to 20	
		2	21 to 30	
		3	31 to 40	
		4	41 to 50	
		5	over 51	
3	Position	1	District Health Director	
		2	District Health Officer	
		3	Sector Social Affair Officer	
		4	Nutritionist or Community Health Environment Officer of Health Center	
		5	Cell Social and Economic Development Officer	
		6	CHW	
		7	Resident	
		8	Village CHW in charge of Nutrition	
		9	Care givers at the Home Based ECD Center	
		10	Others	
4	Why nutrition is important? (Multiple answers are acceptable.)	1	It helps my children grow.	
		2	It prevents me and my family from diseases.	
		3	It helps me and my family work better and longer.	
		4	I do not know.	
		5	Others (Specify)	
5	How can malnutrition affect children?(Multiple answers are acceptable.)	1	The height of child remains shorter as of his/her age.	
		2	The weight of child remains lighter to his/her height.	
		3	The weight of child remains heavier to his/her height.	
		4	The performance of child at school or work may not be good, when the child is grown up.	
		5	The child is weak and sick frequently.	
		6	I do not know.	
		7	Others (Specify)	
6	What can cause malnutrition in children? (Multiple answers are acceptable.)	1	Have something else than maternal milk before being 5 months old	
		2	Have only maternal milk even after being 6 months old	
		3	Not have egg, meat or fish after being 6 months old	
		4	Not have a variety of vegetables after being 6 months old	
		5	Eat without washing hands	
		6	Drink untreated water	
		7	I do not know.	
		8	Others (Specify)	
7	What can cause malnutrition in	1	Eat too much	

	adult?(Multiple answers are acceptable.)	2	Eat too little	
		3	Not to eat egg, beef, pork, chicken or fish	
		4	Not to eat beans	
		5	Not to eat a variety of vegetables	
		6	Not to have milk or dairy products	
		7	Eat without washing hands	
		8	Drink untreated water	
		9	Have repeated diarrhea.	
		10	I do not know.	
		11	Others (Specify)	
		8	What is the source of heat for cooking at home?	1
2	Charcoal			
3	Gas			
4	Electricity			
5	Others (Specify)			
9	What is the source of drinking water at home?	1	Rain water	
		2	River, Pond or Spring water	
		3	Well at home	
		4	Well for the village	
		5	Public water point	
		6	Tap water	
		7	Others (Specify)	
10	Do you treat drinking water?	1	Yes, we boil it	
		2	Yes, we purify it with chlorine.	
		3	No	
		4	Others (Specify)	
11	Do you have a latrine/ toilet at home?	1	Yes, we have a latrine/ toilet	
		2	No, but we have public latrines in the village.	
		3	No, we do not have any access to a latrine/ toilet	
		4	Others (Specify)	
12	How many times does your family eat egg, beef, pork, chicken, fish, milk or dairy products per month?	1	Everyday. More than 30 times.	
		2	Between 21 and 30 times	
		3	Between 11 and 20 times	
		4	Between 1 and 10 times	
		5	None	
13	How many times does your family eat soybeans per month?	1	Everyday. More than 30 times.	
		2	Between 21 and 30 times	
		3	Between 11 and 20 times	
		4	Between 1 and 10 times	
		5	None	
14	How many times does your family eat other types of beans than soybeans per month?	1	Everyday. More than 30 times.	
		2	Between 21 and 30 times	
		3	Between 11 and 20 times	
		4	Between 1 and 10 times	
		5	None	
15	How many times does your family eat sweet potato per month?	1	Everyday. More than 30 times.	
		2	Between 21 and 30 times	
		3	Between 11 and 20 times	
		4	Between 1 and 10 times	
		5	None	
16	How many times does your family eat Irish potato per month?	1	Everyday. More than 30 times.	
		2	Between 21 and 30 times	

		3	Between 11 and 20 times	
		4	Between 1 and 10 times	
		5	None	
17	How many times does your family eat cassava per month?	1	Everyday. More than 30 times.	
		2	Between 21 and 30 times	
		3	Between 11 and 20 times	
		4	Between 1 and 10 times	
		5	None	
18	How many times does your family eat fruits per month?	1	Everyday. More than 30 times.	
		2	Between 21 and 30 times	
		3	Between 11 and 20 times	
		4	Between 1 and 10 times	
		5	None	
19	How many times does your family eat vegetables per month?	1	Everyday. More than 30 times.	
		2	Between 21 and 30 times	
		3	Between 11 and 20 times	
		4	Between 1 and 10 times	
		5	None	
20	How many times does your family eat other vegetables, such as tomato, carrot, onion, eggplant, cucumber, etc.?	1	Everyday. More than 30 times.	
		2	Between 21 and 30 times	
		3	Between 11 and 20 times	
		4	Between 1 and 10 times	
		5	None	
21	What does your family do to improve the nutrition of your family? (Multiple answers are acceptable.)	1	Making and utilizing kitchen garden with different vegetables.	
		2	Raring small livestock such as chickens, rabbits, goats, etc.	
		3	Eating eggs, beef, pork, chicken, fish, milk and dairy products	
		5	Washing hands after using latrines and before cooking and eating.	
		6	Using latrines/ toilets	
		7	Drinking safe or treated water.	
		8	Others (Specify)	

## Annex 4.2 Post Test Questionnaire for Cooking Demonstration

POST TEST								
District								
Sector								
Cell								
Village								
Date								
Name of respondent								
S/N	QUESTION	OPTIONS		ANSWERS				
		S/N	ITEM					
1	Position	1	District Health Director					
		2	District Health Officer					
		3	Sector Social Affair Officer					
		4	Nutritionist or Community Health Environment Officer of Health Center					
		5	Cell Social and Economic Development Officer					
		6	CHW					
		7	Resident					
		8	Village CHW in charge of Nutrition					
		9	Care givers at the Home Based ECD Center					
		10	Others					
2	Why nutrition is important? (Multiple answers are acceptable.)	1	It helps my children grow.					
		2	It prevents me and my family from diseases.					
		3	It helps me and my family work better and longer.					
		4	I do not know.					
		5	Others (Specify)					
3	Why the menus demonstrated today are recommended to eat? (Multiple answers are acceptable.)	1	Because they are delicious.					
		2	Because they are cheap to cook.					
		3	Because their ingredients are accessible.					
		4	Because they are nutritious.					
		5	I do not know.					
		6	Others (Specify)					
4	Please evaluate how much you liked each of the menu between 1 and 5	Score		1	2	3	4	5
				Did not like	Did not like so much	Normal (so-so)	Liked	Liked very much
		1	Soybean processing to make soybean milk					
		2	Tofu making					
		3	Okara and vegetables					
		4	Beans, Potatoes, and Pumpkin Leaves					
		5	Irish Potatoes with mushrooms					
		6	Tofu in sauce					
		7	Soybean flour and sweet potatoes/ Irish potatoes puree with small fish					
		8	Soybean/ Cassava/ OFSP with wheat flour doughnuts					
5	Which menu would be difficult for you to cook by yourself at	1	Soybean processing to make soybean milk					
		2	Tofu making					
		3	Okara and vegetables					
		4	Beans, Potatoes, and Pumpkin Leaves					

	home? (Multiple answers are acceptable.)	5	Irish Potatoes with mushrooms	
		6	Tofu in sauce	
		7	Soybean flour and sweet potatoes/ Irish potatoes puree with small fish	
		8	Soybean/ Cassava/ OFSP with wheat flour doughnuts	
6	Which menu are you going to share with your village people? (Multiple answers are acceptable.)	1	Soybean processing to make soybean milk	
		2	Tofu making	
		3	Okara and vegetables	
		4	Beans, Potatoes, and Pumpkin Leaves	
		5	Irish Potatoes with mushrooms	
		6	Tofu in sauce	
		7	Soybean flour and sweet potatoes/ Irish potatoes puree with small fish	
		8	Soybean/ Cassava/ OFSP with wheat flour doughnuts	
7	What difficulties would you face to replicate the cooking demonstration at your village? (Multiple answers are acceptable.)	1	To find a place with cooking facilities and water supply.	
		2	To have necessary equipment.	
		3	To have necessary ingredients.	
		4	To have audience.	
		5	To duplicate the manual.	
		6	To have a team of instructors to together manage the demonstration with a lot of audience.	
		7	Others (Specify)	
8	Any suggestions to improve the cooking demonstration? (Multiple answers are acceptable.)	1	Everything was OK/ excellent and there is no suggestion.	
		2	The duration should be shorter.	
		3	The duration should be longer.	
		4	The explanation needs to be more friendly or detailed.	
		5	More time may be given to all the participants to see and understand how to cook.	
		6	The selection of menu needs to be reconsidered based on the availability of ingredients or materials in the rural context.	
		7	I do not know.	
		8	Others (Specify)	



## Annex 5.1 Living Environment of Participants of the Cooking Demonstrations

Items		Site 1+2		Site 1		Site 1		Site 1		Site 2		Site 1		Site 2		Site 1		Site 1	
		Six Districts (8 locations) No. of respondents: 288		Ngoma No. of respondents: 33		Gekenke No. of respondents: 40		Ngororero No. of respondents: 42		Ngororero No. of respondents: 23		Rutsiro No. of respondents: 42		Rutsiro No. of respondents: 27		Nyaruguru No. of respondents: 32		Nyamagabe No. of respondents: 49	
		No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Heat source for cooking	Firewood	211	73.26%	17	51.52%	30	75.00%	31	73.81%	20	86.96%	32	76.19%	21	77.78%	23	71.88%	37	75.51%
	Charcoal	182	63.19%	23	69.70%	34	85.00%	25	59.52%	10	43.48%	22	52.38%	14	51.85%	23	71.88%	31	63.27%
	Gas	50	17.36%	16	48.48%	4	10.00%	8	19.05%	3	13.04%	6	14.29%	0	0.00%	5	15.63%	8	16.33%
	Electricity	15	5.21%	3	9.09%	3	7.50%	2	4.76%	0	0.00%	2	4.76%	3	11.11%	1	3.13%	1	2.04%
	Others	3	1.04%	3	9.09%	0	0.00%	0	0.00%	0	0.00%	0	0.00%	0	0.00%	0	0.00%	0	0.00%
Source of drinking water	Rain water	18	6.25%	0	0.00%	3	7.50%	4	9.52%	3	13.04%	7	16.67%	0	0.00%	0	0.00%	1	2.04%
	River/ Pond/ Spring water	17	5.90%	2	6.06%	3	7.50%	3	7.14%	0	0.00%	4	9.52%	2	7.41%	0	0.00%	3	6.12%
	Private well/ borehole	125	43.40%	14	42.42%	19	47.50%	17	40.48%	11	47.83%	17	40.48%	5	18.52%	18	56.25%	24	48.98%
	Shared or Community well/ borehole	106	36.81%	5	15.15%	13	32.50%	16	38.10%	9	39.13%	15	35.71%	14	51.85%	9	28.13%	25	51.02%
	Public tap	38	13.19%	9	27.27%	2	5.00%	7	16.67%	3	13.04%	6	14.29%	1	3.70%	5	15.63%	5	10.20%
	Private tap	115	39.93%	11	33.33%	19	47.50%	20	47.62%	6	26.09%	15	35.71%	17	62.96%	19	59.38%	8	16.33%
	Others	7	2.43%	6	18.18%	0	0.00%	1	2.38%	0	0.00%	0	0.00%	0	0.00%	0	0.00%	0	0.00%
Home treatment of drinking water	Boiling	217	75.35%	21	63.64%	31	77.50%	29	69.05%	17	73.91%	30	71.43%	21	77.78%	27	84.38%	41	83.67%
	Chlorine	74	25.69%	12	36.36%	14	35.00%	14	33.33%	2	8.70%	8	19.05%	6	22.22%	6	18.75%	12	24.49%
	Untreated	16	5.56%	0	0.00%	2	5.00%	2	4.76%	1	4.35%	7	16.67%	2	7.41%	1	3.13%	1	2.04%
	Others	14	4.86%	6	18.18%	1	2.50%	4	9.52%	0	0.00%	2	4.76%	0	0.00%	0	0.00%	1	2.04%
Access to sanitation facilities	Private latrine	262	90.97%	29	87.88%	36	90.00%	36	85.71%	19	82.61%	39	92.86%	25	92.59%	30	93.75%	48	97.96%
	Public latrine	18	6.25%	2	6.06%	1	2.50%	6	14.29%	2	8.70%	3	7.14%	2	7.41%	1	3.13%	1	2.04%
	No access	1	0.35%	0	0.00%	0	0.00%	0	0.00%	0	0.00%	1	2.38%	0	0.00%	0	0.00%	0	0.00%
	Others	3	1.04%	0	0.00%	1	2.50%	0	0.00%	0	0.00%	1	2.38%	1	3.70%	0	0.00%	0	0.00%

Source: JICA PROJECT TEAM (2020)

Notes: 1) Multiple answers were accepted for each item.

2) Options that the most respondents selected for each item are highlighted in blue.

## Annex 5.2 Monthly Meal Frequency of Participant's Households of the Cooking Demonstrations

Meal Frequency		Site 1+2		Site 1		Site 1		Site 1		Site 2		Site 1		Site 2		Site 1		Site 1	
		Six Districts (8 locations) No. of respondents: 288		Ngoma No. of respondents: 33		Gekenke No. of respondents: 40		Ngororero No. of respondents: 42		Ngororero No. of respondents: 23		Rutsiro No. of respondents: 42		Rutsiro No. of respondents: 27		Nyaruguru No. of respondents: 32		Nyamagabe No. of respondents: 49	
		No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Egg, Beef, Pork, Chicken, Fish, Milk, Dairy products	Every day, More than 30 times	9	3.13%	0	0.00%	1	2.50%	1	2.38%	1	4.35%	2	4.76%	0	0.00%	3	9.38%	1	2.04%
	21 to 30 times	33	11.46%	3	9.09%	9	22.50%	5	11.90%	2	8.70%	6	14.29%	1	3.70%	3	9.38%	4	8.16%
	11 to 20 times	39	13.54%	11	33.33%	3	7.50%	2	4.76%	1	4.35%	10	23.81%	5	18.52%	5	15.63%	2	4.08%
	1 to 10 times	178	61.81%	16	48.48%	27	67.50%	28	66.67%	14	60.87%	22	52.38%	19	70.37%	19	59.38%	33	67.35%
	None	25	8.68%	2	6.06%	1	2.50%	4	9.52%	3	13.04%	3	7.14%	2	7.41%	2	6.25%	8	16.33%
Soy beans	Every day, More than 30 times	19	6.60%	3	9.09%	3	7.50%	2	4.76%	0	0.00%	1	2.38%	6	22.22%	0	0.00%	4	8.16%
	21 to 30 times	38	13.19%	4	12.12%	4	10.00%	6	14.29%	2	8.70%	3	7.14%	8	29.63%	4	12.50%	7	14.29%
	11 to 20 times	48	16.67%	6	18.18%	2	5.00%	12	28.57%	4	17.39%	11	26.19%	7	25.93%	2	6.25%	4	8.16%
	1 to 10 times	124	43.06%	14	42.42%	22	55.00%	17	40.48%	10	43.48%	14	33.33%	7	25.93%	14	43.75%	26	53.06%
	None	52	18.06%	6	18.18%	7	17.50%	3	7.14%	5	21.74%	12	28.57%	1	3.70%	12	37.50%	6	12.24%
Beans other than soy beans	Every day, More than 30 times	54	18.75%	4	12.12%	10	25.00%	12	28.57%	1	4.35%	10	23.81%	4	14.81%	5	15.63%	8	16.33%
	21 to 30 times	90	31.25%	16	48.48%	12	30.00%	11	26.19%	7	30.43%	8	19.05%	11	40.74%	14	43.75%	11	22.45%
	11 to 20 times	69	23.96%	7	21.21%	9	22.50%	9	21.43%	5	21.74%	9	21.43%	8	29.63%	6	18.75%	16	32.65%
	1 to 10 times	63	21.88%	5	15.15%	7	17.50%	8	19.05%	8	34.78%	14	33.33%	5	18.52%	6	18.75%	10	20.41%
	None	3	1.04%	1	3.03%	0	0.00%	0	0.00%	0	0.00%	1	2.38%	0	0.00%	0	0.00%	1	2.04%
Sweet potato	Every day, More than 30 times	35	12.15%	2	6.06%	11	27.50%	7	16.67%	3	13.04%	2	4.76%	1	3.70%	1	3.13%	8	16.33%
	21 to 30 times	50	17.36%	1	3.03%	6	15.00%	10	23.81%	5	21.74%	4	9.52%	7	25.93%	8	25.00%	9	18.37%
	11 to 20 times	68	23.61%	9	27.27%	5	12.50%	11	26.19%	7	30.43%	11	26.19%	7	25.93%	10	31.25%	8	16.33%
	1 to 10 times	124	43.06%	20	60.61%	16	40.00%	13	30.95%	7	30.43%	24	57.14%	11	40.74%	14	43.75%	19	38.78%
	None	4	1.39%	0	0.00%	0	0.00%	0	0.00%	0	0.00%	1	2.38%	0	0.00%	0	0.00%	3	6.12%

Meal Frequency		Site 1+2		Site 1		Site 1		Site 1		Site 2		Site 1		Site 2		Site 1		Site 1	
		Six Districts (8 locations) No. of respondents: 288		Ngoma No. of respondents: 33		Gekenke No. of respondents: 40		Ngororero No. of respondents: 42		Ngororero No. of respondents: 23		Rutsiro No. of respondents: 42		Rutsiro No. of respondents: 27		Nyaruguru No. of respondents: 32		Nyamagabe No. of respondents: 49	
		No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Irish potato	Every day, More than 30 times	22	7.64%	3	9.09%	3	7.50%	5	11.90%	1	4.35%	7	16.67%	0	0.00%	0	0.00%	3	6.12%
	21 to 30 times	74	25.69%	6	18.18%	11	27.50%	9	21.43%	4	17.39%	15	35.71%	5	18.52%	15	46.88%	9	18.37%
	11 to 20 times	90	31.25%	17	51.52%	8	20.00%	14	33.33%	7	30.43%	8	19.05%	13	48.15%	10	31.25%	13	26.53%
	1 to 10 times	86	29.86%	7	21.21%	15	37.50%	12	28.57%	7	30.43%	11	26.19%	6	22.22%	7	21.88%	21	42.86%
	None	10	3.47%	0	0.00%	1	2.50%	0	0.00%	3	13.04%	2	4.76%	2	7.41%	1	3.13%	1	2.04%
Cassava	Every day, More than 30 times	8	2.78%	0	0.00%	2	5.00%	1	2.38%	0	0.00%	2	4.76%	0	0.00%	1	3.13%	2	4.08%
	21 to 30 times	32	11.11%	4	12.12%	6	15.00%	5	11.90%	2	8.70%	3	7.14%	4	14.81%	0	0.00%	8	16.33%
	11 to 20 times	57	19.79%	9	27.27%	6	15.00%	11	26.19%	7	30.43%	7	16.67%	7	25.93%	5	15.63%	5	10.20%
	1 to 10 times	162	56.25%	18	54.55%	19	47.50%	20	47.62%	13	56.52%	25	59.52%	16	59.26%	21	65.63%	30	61.22%
	None	18	6.25%	2	6.06%	5	12.50%	3	7.14%	0	0.00%	4	9.52%	0	0.00%	3	9.38%	1	2.04%
Fruits	Every day, More than 30 times	22	7.64%	5	15.15%	3	7.50%	4	9.52%	1	4.35%	3	7.14%	2	7.41%	0	0.00%	4	8.16%
	21 to 30 times	73	25.35%	13	39.39%	8	20.00%	8	19.05%	3	13.04%	12	28.57%	10	37.04%	9	28.13%	10	20.41%
	11 to 20 times	79	27.43%	11	33.33%	14	35.00%	12	28.57%	6	26.09%	15	35.71%	3	11.11%	9	28.13%	9	18.37%
	1 to 10 times	97	33.68%	5	15.15%	8	20.00%	15	35.71%	11	47.83%	12	28.57%	11	40.74%	12	37.50%	23	46.94%
	None	10	3.47%	0	0.00%	4	10.00%	1	2.38%	1	4.35%	1	2.38%	0	0.00%	2	6.25%	1	2.04%
Vegetables	Every day, More than 30 times	104	36.11%	16	48.48%	15	37.50%	11	26.19%	5	21.74%	14	33.33%	10	37.04%	12	37.50%	21	42.86%
	21 to 30 times	91	31.60%	17	51.52%	14	35.00%	12	28.57%	5	21.74%	16	38.10%	2	7.41%	13	40.63%	12	24.49%
	11 to 20 times	61	21.18%	2	6.06%	7	17.50%	11	26.19%	10	43.48%	7	16.67%	11	40.74%	6	18.75%	7	14.29%
	1 to 10 times	31	10.76%	0	0.00%	3	7.50%	6	14.29%	2	8.70%	7	16.67%	4	14.81%	1	3.13%	8	16.33%
	None	1	0.35%	0	0.00%	0	0.00%	0	0.00%	0	0.00%	1	2.38%	0	0.00%	0	0.00%	0	0.00%

Source: JICA PROJECT TEAM (2020)

Note: Options that the most respondents selected for each item are highlighted in blue.

## Annex 6 Monitoring Report of DT-Farms after FFS-1 of Cultivation Training

### Site monitoring report in April 2020

Site name	Cultivated crops	Crop condition	Recommendations
Nyamagabe site 1 (Cyanika Sector)	Vegetable, Orange Sweet Potato	-Good germination of vegetables, but some beetroots growth is not good.  -Orange sweet potatoes grow well.	-Hoeing seed bed using a small stem, keep watering in cases the soil is looking dried.
Nyamagabe site 2 (Kaduha Sector)	Yellow Cassava, Iron Beans, Fruits		
Nyamagabe site 3 (Gatare Sector)	Irish Potato	Irish potato, Gikungu and Kirundo varieties have grown well but Twihaze has slow growth.  Now they started planting Kinigi variety which was not yet germinated.	I recommended to spray fungicide as preventive way, unfortunately, we didn't provide sprayers at this site, which is urgent.
Nyaruguru site 1 (Rusenge Sector)	Vegetable, Iron Beans, Soybeans, Yellow Cassava,	All crops have grown well. But soybeans leaves are turning yellow.	-I recommended to increase watering for vegetables because there were days without rain.  -I also recommended to spray insecticide on vegetables and iron beans, as well as weeding to avoid weed germination.
Nyaruguru site 2 (Kibeho Sector)	Irish Potato, Fruit, Orange Sweet potato,	-Irish potatoes have grown well except Kinigi variety which was planted later.  -Orange sweet potatoes and fruits also have good growth.	I recommended to keep plant management well. For Irish potatoes and fruits, it is required to start fungicide spray as preventive way, and insecticide as well.
Rutsiro site 1 (Manihira Sector)	Irish Potato, Fruits	-Irish potato started germination and fruits also are growing but very slowly. This may be caused by low temperature of the area.	-I recommended to spray fungicide on both fruit trees and Irish potato for fungus prevention.
Rutsiro site 2 (Boneza Sector)	Vegetable, Iron Beans, Soybean, Yellow Cassava, Orange Sweet Potato.	-Vegetables have well germinated but they have slow growth, especially zucchini which started yellowing leaves. This is due to low soil minerals, and it is required to apply NPK.  -Beans have well grown and they reach the stage of staking.  -Other crops have good growth and as there is enough rainfall it will keep growing well.	-I recommended the farmer to do required crop management activities such as weeding, hoeing the nursery bed, watering in case there is no rain.  -I recommended to spray insecticide for control of insects which hole the leaves.
Ngororero site 1 (Ngororero Sector)	Soybeans, Iron Beans, Orange Sweet Potato, Vegetables, Irish Potato	-Iron beans and soybeans have started germination, but they are still small.  -Some Irish potatoes have not yet germinated.	-I recommended to keep follow up the field, do weeding as soon as weed germinated in the field  -I recommended watering in vegetable nursery bed.

Site name	Cultivated crops	Crop condition	Recommendations
		-vegetables also started germination	
Ngororero site 2 (Nyange sector)	Yellow Cassava, Fruits	-Plants have grown well and they are in good condition.  -Farmers extended fruits plot with the remaining seedlings.	-I recommended to spray insecticide on fruits to prevent some insect which may attack fruits trees.
Gakenke site 1 (Kivuruga Sector)	Soybeans, iron Beans, Vegetables	-Vegetables germinated well, except zucchini which growth is not good.  -Iron beans and soybeans also germinated but their growth is not good, and leaves turn yellow. For beans there is holes on leaves caused by insect damage	-I recommended softening the soil and watering in vegetable seed bed and on zucchini as well.  -Spray insecticide (Rocket) in iron beans  -Keep weeding in all crops.
Gakenke site 2 (Coko Sector)	Yellow Cassava, Orange Sweet Potato, Fruits, Irish Potato	-Yellow cassava and Orange sweet potatoes started growing  -Irish potatoes have not yet germinated  -Fruits have also good growth but there were stolen 3 seedlings of tamarillo and 11 passion fruits. Farmers already replaced 11 passion fruits but there was no tamarillo for replacing	-I recommended to keep crop management such as weeding, for all crops  - spray insecticide to fruit trees and replace tamarillo if they found seedlings.
Ngoma site 1 (Rukira Sector)	Soybean, Iron Beans	-Good growth of iron beans and soybeans, health with green leaves	-I recommended weeding and hoeing the soil
Ngoma site 2 (Rukumberi Sector)	Vegetable, Fruits, Yellow Cassava, Orange Sweet potato	-Vegetables have all well germinated and they are good looking.  -Other crops have good growth especially passion fruit which need to build staking.	-I recommended the farmer to do required crop management activities such as weeding, hoeing the nursery bed, watering in case there is no rain.  -I recommended to spray insecticide and fungicide to fruits.

In general, there have been good growth to all crops. For some sites require frequent follow up to help farmers to do appropriate crop management. This is especially sites which are planted vegetables and fruits as this require regular monitoring to ensure crops are doing well or if there is any problem, they should take immediate action before crops are completely damaged.

As for Irish potato, it is strongly recommended to start spraying fungicide as to prevent fungus diseases. RAB staffs recommended to start firstly by spraying Ridomil as a systemic product which is both preventive and curative. For this it is required to visit all Irish potato site in order to distribute Ridomil and provide some recommendations to the farmers.





It is required to prepare staking poles for climbing beans and also for passion fruits.

I would also recommend applying lime for plots where vegetables will be transplanted.

**Pictures taken from the fields**

		
Zucchini growth in Nyaruguru 1 (Rusenge) site	Iron bean growth in Nyaruguru 1 (Rusenge) site	Soybean growth in Nyaruguru 1 (Rusenge) site
		
Zucchini growth in Gakanke 1 (Kivuruga) site.	Carrot growth in Gakanke 1 (Kivuruga) site.	Soybean growth in Gakanke 1 (Kivuruga) site.
		
Iron bean and Soybean plots in Gakanke 1 (Kivuruga) site	Soybean growth in Gakanke 1 (Kivuruga) site	Iron bean growth in Gakanke 1 (Kivuruga) site.

		
<p>Irish potato germination in Rutsiro 1 (Manihira) site</p>	<p>Fruit tree growth in Rutsiro 1 (Manihira) site. The seedling growth is too slow, and they are not good looking. The leaves are yellow.</p>	<p>Irish potato growth in Nyamagabe 1 (Kibeho) site.</p>
		
<p>Orange sweet tomato growth at Nyaruguru 2 (Kibeho) site</p>	<p>Tamarillo growth at Nyaruguru 2 (Kibeho) site</p>	<p>Irish potato growth at Nyaruguru 2 (Kibeho) site</p>
		
<p>Passion fruit growth at Nyaruguru 2 (Kibeho) site</p>	<p>Farmer is weeding iron beans in Rutsiro 2 (Boneza) site</p>	<p>Cabbage growth in in Rutsiro 2 (Boneza) site</p>

		
<p>Zucchini growth in in Rutsiro 2 (Boneza) site</p>	<p>Beet root growth in in Rutsiro 2 (Boneza) site</p>	<p>Farmer is weeding iron beans in Rutsiro 2 (Boneza) site</p>
		
<p>Orange sweet potato growth in Rutsiro 2 (Boneza) site</p>		



## **Annex 7 Participants List for Nutrient Training Materials**

- 1) Dr. Placide RUKUNDO Program Leader/ Roots and Tubes Program-RAB
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# Annex 8 Pamphlet for “Introduction of Training Material by Nutrition Improvement through Agriculture Transformation Program in Rwanda”



## Introduction of Training Material by Nutrition Improvement through Agriculture Transformation Program in Rwanda



### Training material: Cultivation of Nutrition Dense Crops

#### Example of Planting time of Nutrition Dense Crops

Crops	Season	Planting time
Soybean	A	October
	B	Early March
	C	June
High-Iron Bean	A	Sep. – Oct.
	B	Feb. – Mar.
	C	May – Jun.
Bio-fortified Irish potato	A	September
	B	March
	C	May in marshland
Yellow Cassava	A	Sep. – Nov.
Orange Fresh Sweet Potato	A	September
	B	March

#### List of Suppliers for nutrition dense crops and vegetables

Crop	Required amount per 1 are	Unit Price (Rw/)	Supplier
Soybean	500g	Free of charge	RAB/ Rubona station
	500g		RAB/ Rubona station
Iron Beans	150 cuttings		RAB/ Rubona station
Yellow Cassava	40kg	420	RAB/ Musanze station
Bio-Fortified Irish Potato	50 trees	600	RAB/ Rubona station
	50 trees	600	RAB/ Rubona station
	7 trees	1,300	RAB/ Rubona station
Fruits	Avocado	7 trees	RAB/ Rubona station
	Mango	7 trees	RAB/ Kigali station
Orange Sweet Potato	600 cuttings	25	Supplier
Vegetables	Zucchini	1.5 cans	3,500
	Beetroots	1.5 cans	3,000
	Carrots	1.5 cans	3,000
	Cabbages	1.5 packages	6,000
	Dodo	1.5 Packages	2,000
Watermelon	0.25 package	6,000	Green farm, Ltd. in Kigali

Nutrition Improvement through Agriculture Transformation Program has been done by RAB and JICA/SMAP in 2020 to support the Sector Policy Loan Program implemented by MINAGRI.

“Training manual/material” which has 2 components has been established in this program:

1. Training manual of Nutrition improvement using nutrients dense foods
2. Cultivation training materials of Nutrition Dense Crops

Soybeans, High Iron Beans, Bio-fortified Irish Potatoes, Yellow Cassava, Orange Fleshed Sweet Potatoes, Tree tomato, Passion fruits, Papaya, Avocado, Mango



#### Contact

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#### [Cultivation]

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## Training manual: Nutrition improvement using nutrient dense foods

### Purpose of the training manual:

to **boost the nutrition status** of the target population with nutrient-dense foods through the capacity building of farmers, health workers, agronomists and any other stakeholders.

### What is Malnutrition?

**Malnutrition** = "deficiencies, excesses or imbalances of energy and/or nutrients as results of food consumption".

If all of the people below are at the same age, only the green pair is healthy and not in malnutrition among them.



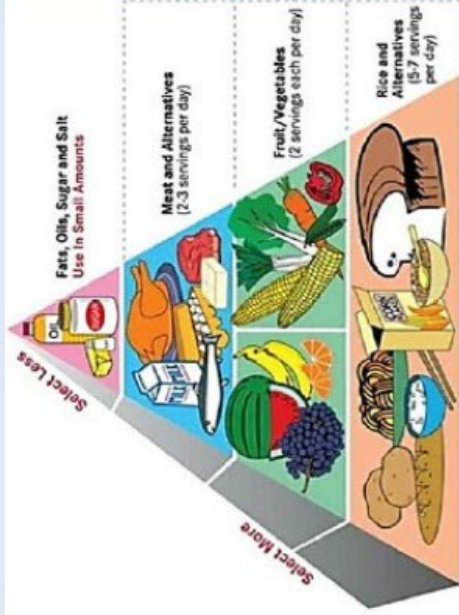
### What does malnutrition bring about?

Weaknesses, illness, or death



### How to prevent from malnutrition?

To eat a **balanced meal in a right proportion** to achieve and maintain a healthy body weight. A balanced meal includes one food from each of the food groups indicated in the diet pyramid below.



### What crops do we better eat?

Examples:



**Soybean**  
→ to build healthy body  
**Protein**



**Orange Sweet Potato**  
→ for better growth, skin and eye-sight  
**Vitamin A and Carbohydrate**



**Vegetables and Fruits**  
→ to prevent body from risk of disease  
**Vitamins**

### How to prepare nutritious meals?

Examples of complementary food for children

Soybean flour, sweet potatoes and fish powder

Ingredients (Serve for 1 kid)

- 70 g cubed, orange-fleshed sweet potato
- 20 g roasted soybean flour
- 10 g powdered fish or any other animal product.
- 1 teaspoon vegetable oil
- 50 ml water

Preparation

1. Boil cubed OFSP until soft and strain.
3. Add little water to soybean flour and mix into paste.
4. Add paste to boiled OFSP and stir over gentle heat to form porridge.
5. Add powdered fish.
6. Marsh boiled OFSP and add oil and stir to mix.
7. Leave to simmer over gentle heat for 5 minutes.



Examples of balanced diet for the entire family



Irish potato with mushroom



Fresh Beans, Iron beans, carrots



High-Iron Beans Stew

Beet juice

Ingredients (Serve for 2 persons)

- 1 beet • 1 ginger • ¼ pineapple • ½ lemon • 500 ml water

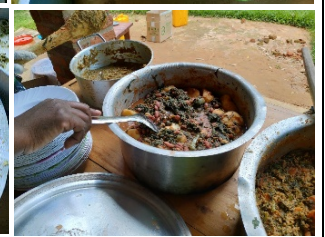
Preparation: Clean all ingredients; Peel beet and cut into small pieces; Peel pineapple, cut a quarter and add to the beet in a grinder; Add ginger and grind with water; Filter and drink





# SMAP Technical Manual

to enhance production and consumption of  
Nutrient Dense Crops



March 2020  
Smallholder Market-oriented Agriculture Project  
in Rwanda (SMAP)



## CONTRIBUTORS

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3) Ms. Gisele KARANGWA	Nutrition Expert (3)
4) Mr. Didier SEMANYENZI	Coordinator/Translator



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## PREFACE

I am very glad to present this “SMAP Technical Manual to enhance the production and consumption of Nutrient-Dense Crops” to all the populations of Rwanda, especially farmers. This is an achievement of Rwanda Agriculture and Animal Resources Development Board (RAB) with the “Smallholder Market-oriented Agriculture Project in Rwanda” (SMAP), a technical cooperation project with support from the Japan International Cooperation Agency (JICA).

Malnutrition, especially stunting in children under 5 years old, is one of the challenges the Government of Rwanda has been addressing as priority, and to this end, RAB together with the Ministry of Agriculture and Animal Resource Development (MINAGRI) has been engaged to the Nutrition Sensitive Agriculture.

To further enhance the fight against malnutrition, the Government of Rwanda signed the agreement with the Government of Japan on 16th August 2019, on the provision of the “Sector Policy Loan for the Nutrition Improvement through Agriculture Transformation”. RAB is one of the executing agencies of this sector policy loan project, being in charge of improving the availability and utilization of nutrient dense crops in the target twelve (12) districts, by providing the training on how to cultivate and cook them in a cascade manner. There are 7 crops identified as nutrient dense crops, namely Vegetables, Soybean, High Iron bean, Bio-Fortified Irish Potato, Yellow Cassava, Orange Fleshed Sweet Potato, Fruits (Avocado, Tree Tomato, Passion Fruit, Papaya, Mango).

It is against this background that RAB and SMAP jointly developed this technical manual, based on the results of and lessons learnt from a series of cultivation trainings and cooking demonstrations conducted in collaboration with the district offices of Ngoma, Gakenke, Ngororero, Rutsiro, Nyaruguru and Nyamagabe during the pilot phase between October 2019 and April 2020.

I take this opportunity to express my gratitude for the collaboration between RAB DG, DDG, Head of Crop Production and Mrs. Illuminée, Division Manager for Postharvest Management and Biotechnology for their leadership and commitment to carry out this project in order to implement the training and finalize the training materials.

This technical manual will be applied by RAB and the district offices of the target districts to further promote production and consumption of the nutrient dense crops under the framework of the mentioned sector policy loan, in the target districts. Moreover, it is expected that the manual will be disseminated to and applied by any other Rwandan households, including those beneficiary cooperative members of SMAP and RAB-SMAP, in order to contribute to an improvement of nutritional status of not only children under 5 years old but also the entire household members.



Mr. Michio GOTO  
Smallholder Market-oriented Agriculture Project  
in Rwanda (SMAP)  
March 2020



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  - Fruits
    - ◆ Avocado
    - ◆ Tree Tomato
    - ◆ Passion Fruit
    - ◆ Papaya
    - ◆ Mango
  - Nutrition improvement using nutrients dense crops



# Soybean Cultivation Technics



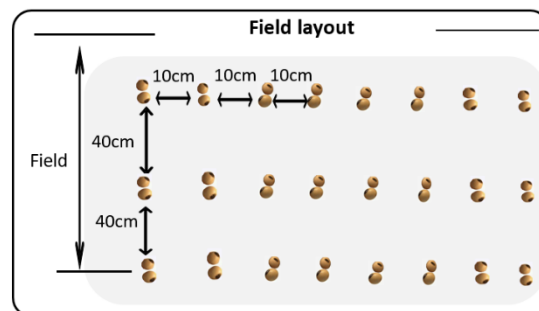
Manual Number: SMAP-NDC-01

## Land Preparation

- An ideal field for soybean cultivation should comprise well-drained and fertile soils that are loose and well aerated. The soils that are easily compacted should be avoided.
- Before the land preparation, it is better to think about the crop rotation and avoid selecting a field where a family of beans such as French beans, Iron beans, and Peas has been planted.
- The Land preparation for soybean cultivation requires controlling erosions. The techniques to be applied depending on the field location. First, the land should be plowed deeply to a depth of 20 cm, and all debris should be removed. Then, the field should be leveled. Adequate land preparation allows eliminating most of the weeds.
- In the case of acidic soil, it is recommended to apply lime 2 weeks before planting.

## Field layout

- Soybeans should be planted with a row spacing of 40 cm and an interval between seedlings of 10 cm. With this spacing and interval, about 0.6 kg of seed is required for 1 are of the field.
- It is recommended to plant seedlings as shown in the figure on the right.



## Seed preparation, planting time and planting methods

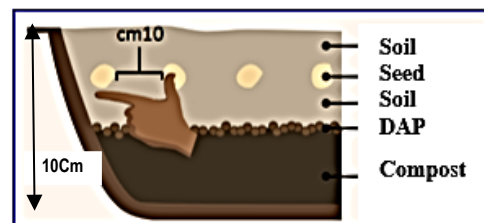
After addressing the crop rotation, seeding rate, row spacing, other conditions such as planting time, seeds preparation, water requirements, seed depth and cropping system should be considered before sowing.

### Planting time and seeds preparation

- For **A Season**, soybean should be planted in October. For **B season**, Soybean should be planted at the beginning of March. In **C season**, soybean should be planted preferably in June, as far as it is cultivated in marshland or irrigated schemes.
- Select certified seeds and purchase them at reliable agro-dealers. In addition to chemical fertilizers and compost, rhizobium is also used before planting. Rhizobium increases the ability of soybean to fix nitrogen, which is a very important element and nutrient for the good growth of soybean. 40g of rhizobium should be mixed with 1Kg of seeds.

### Planting and sowing methods

- Planting soybean should be done on ridges or on flat land. Ridge planting should be done 50 to 75 cm apart. Flat planting should be done with row spacing of 40 cm, as mentioned above.
- First of all, a ditch of 10 cm depth is made on row. Compost and a pinch of DAP are put into the ditch and covered with soil. After that, the seeds are sowed 10 cm apart from each other. Please see the figure presented on the right side.
- It is recommended to sow the seeds with a depth of 5 cm, thereafter the seeds are covered lightly with soil. Please note that exposed seeds are pecked by birds.



## Fertilizer application

The table below summarized the required fertilizers and their application time and recommended quantities:

Fertilizers	Application time	Quantity	Importance of fertilizers and other comments
Lime (For acidic soil)	Two weeks before planting	25Kg per 1Are	<ul style="list-style-type: none"> <li>● It reduces the acidity of the soil and slowly releases nutrient supply.</li> <li>● It helps increase the nutrient holding capacity to increase the yield.</li> </ul>
Rhizobium	Mixed with seeds at planting time	40g per 1Kg of seeds	It has the ability to fix nitrogen in symbiosis on roots. The nitrogen fixed on the roots increases the number of nodules until the time when new seeds are formed in pods.
Compost	Planting time	150 - 200 kg per 1Are	<ul style="list-style-type: none"> <li>● It contributes to the improvement of soil fertility.</li> <li>● It improves the water holding capacity of the soil.</li> <li>● It increases the air and water permeability of the soil.</li> <li>● It increases the number of beneficial microorganisms in the soil and the nutrient-holding capacity of the soil.</li> </ul>
DAP	Planting time	1Kg per 1Are	<ul style="list-style-type: none"> <li>● As a basal dressing, it enhances the formation of roots, plant, foliage, and pods development by holding necessary nutrients.</li> </ul>



## Rhizobium Application

Prepare 8 to 10 Kg of clean soybean seeds and put them in a clean basin. Prepare 300ml of water and mix with 80 soda caps of sugar, then shake well to dissolve in order to become an inoculum sticker. Mix well that inoculum sticker with seeds. Add 80 gr. of Rhizobium and mix the seeds thoroughly so that each seed is uniformly coated with the inoculant. Put the seeds coated with the inoculant on a plastic sheet or a tarpaulin to dry. All those activities are conducted on the field in the shadow of sunlight to protect the bacteria (Rhizobia). Sow the inoculated seeds as soon as possible. Rhizobium is kept in its original container out of sunlight.

### Procedures of Rhizobium Application in Soybean



## Crop management

- During a few days after sowing, the growth of soybean is slow, and the crop must be kept weeds-free. The spaces which did not germinate should be sowed by the original seed.
- It is necessary to take measures for bird repelling during the first 2 weeks when the sprouts of soybeans are emerging.

## Weeding

- Weeds are a major threat to the production of soybean because they compete with soybean's essential resources for growing, such as water, nutrients, and light.
- After the crops have fully taken roots, hand weeding should be conducted at least twice in a cropping season. Firstly, 3 to 4 weeks after sowing and secondly, just before the flowering stage. Weeding should be done whenever necessary, depending on the degree of infestation in the field.
- Avoid weeding immediately after rains as it would lead to weed growth. Weeding during flowering may reduce soybean yield as sometimes flowers are damaged.
- A properly timed weed control is very important because it reduces competition for nutrients. After weeding, the soil is softer as it is well aerated and unpacked. Poor weeding or delay in weeding could cause significant reductions in soybean yields.



*Farmers have to conduct weeding and earthing up on time*

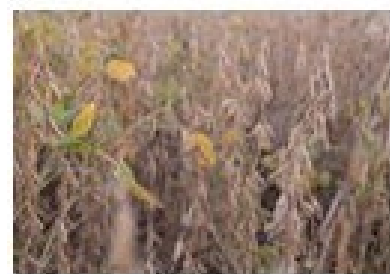
## Earthing up

- Earthing-up needs to be conducted just after the 1st weeding.
- By conducting earthing-up, farmers make sure that all roots are well covered and put enough soil around the base of a plant.

## Harvesting, and post-harvest activities

### Harvesting

- The maturity period ranges from 90 to 140 days, depending on the varieties.
- When the pods are dry and have gone brown, they can be harvested. Harvest them when 90-100% of pods are brown and dry, but before they become brittle and shattered. Note that when soybean plants are mature, they start dropping their leaves.
- Cut the matured plants just above ground level and harvest early in the day to avoid pods shattering. The roots left in soil increase organic matters such as nitrogen for the subsequent seasons.



*Mature soybeans are identified by dry pods*

### Drying

- The purpose of drying is to reduce the moisture content of soybeans to a level recommended for medium or long-term storage.
- Sun drying is the most common method to reduce moisture. Dried pods or whole plants with pods should be spread on a clean surface like a plastic sheet or tarpaulin. Collect pods or plants before sunset to avoid the effect of soil moisture and low temperature.
- Total drying time is determined by the degree of initial moisture content of the pods, as well as the temperature and humidity of the atmosphere. It is necessary to turn over pods or plants periodically to dry evenly.

### Threshing

- Threshing of soybeans is to separate the beans from pods. It can be done by hand with simple tools or with simple handy machines. Thresh manually or mechanically as soon as the plants are properly dried.
- Threshing should be conducted when pods become fully shakable. It should be carried out on plastic sheets or tarpaulin to avoid being contaminated with stones and dirt.
- Threshing should be done carefully. Otherwise, this operation can cause breakage in the protective hull of beans, thus reducing the product's quality and leading to subsequent losses caused by insects and molds.



*It is necessary to turn over drying soybeans periodically to dry evenly*

### Winnowing

- After the threshing, the soybeans need to be winnowed to remove debris. It can be carried out by using a winnowing machine or traditional tools. The purpose of winnowing is to ensure that diseased, cracked, insect-damaged, and shriveled grains, debris, and any other foreign matters are removed.

### Storage

- Soybean should be stored with a moisture content of 12 - 15% or less.
- When a soybean seed cannot be dented with the teeth or fingernails, it is dry enough for storage.
- Good storage management can improve the storability of soybeans and the germination rate when planted in the field.
- Dry soybeans shall be packed in containers or packages which are clean, sound, free from insects and fungal infestation.
- If dry soybeans are packed in bags for storage, the bags shall be free from pests and contaminants. Put the bags on pallets or logs to protect them from mold. Each package shall be securely closed and sealed.



*It recommended to put the bags of stored soybeans on pallets to protect them from mold.*







# Soybean

## Pests and diseases control

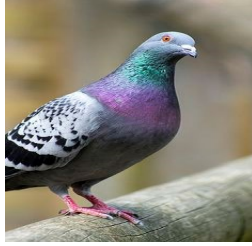


Manual Number: SMAP-NDC-01

Name of pest/disease and their characteristics	Control methods
<p><b>Rust</b> Cause: fungus known as <i>Phakopsora pachyrhizi</i></p> <ul style="list-style-type: none"> <li>Symptoms are small and water-soaked lesions on the underside of leaves.</li> <li>Lesions gradually increase in size and later turn from gray to tan, reddish-brown or dark brown and form a polygonal shape restricted by leaf veins.</li> <li>Pustules produce a large number of spores. Brown or rust-colored powder falls when severely infected leaves are tapped over a white paper or cloth.</li> </ul> 	<ul style="list-style-type: none"> <li>Use of certified seeds.</li> <li>Use of resistant varieties.</li> <li>Use of appropriate chemicals:                             <ul style="list-style-type: none"> <li>➤ <b>Azoxystrobin 25% SC:</b> 10ml/ 20 Liters of water;</li> <li>➤ <b>Tebuconazole 25% EC:</b> 20ml / 20 Liters of water;</li> <li>➤ <b>Copper hydroxide:</b> 30 mg / 20 Liters of water.</li> </ul> </li> </ul>
<p><b>Soybean mosaic</b> Cause: Virus usually transmitted by insects</p> <ul style="list-style-type: none"> <li>Characterized by leaf deformation, infected plants can be stunted with shortened petioles and internodes.</li> <li>Seed mottling may occur and the seed germination rate may be reduced.</li> </ul> 	<ul style="list-style-type: none"> <li>Use of certified seeds.</li> <li>Application of crop rotation.</li> <li>Remove the infected plants as soon as found and bury them in the ground.</li> <li>Aphid is one of the vectors of the disease, and this vector can be controlled by applying the following chemicals:                             <ul style="list-style-type: none"> <li>➤ <b>Lambda-Cyhalothrin:</b> 1ml / 1 liter of water;</li> <li>➤ <b>Cypermethrin:</b> 1ml / 1 liter of water;</li> </ul> </li> </ul>
<p><b>Leaf roller</b> Cause: Insect (Moth is known as <i>Lamprosema indicata</i>)</p> <ul style="list-style-type: none"> <li>The adult moth is creamy yellow to light brown.</li> <li>After one week of hatching, young larvae eat the epidermal layer of the leaves.</li> <li>The larvae roll up leaves from the tip to downwards and then eat young leaves and insides of buds. Damaged leaves look a silvery-brown papery look and are noticeable from a distance.</li> </ul> 	<ul style="list-style-type: none"> <li>On-time planting helps to escape diseases.</li> <li>Eradicate the weeds and voluntary plants in the vicinity of the soybean farms as they act as host agents of soybean diseases.</li> <li>Use appropriate chemicals:                             <ul style="list-style-type: none"> <li>➤ <b>Lambda-cyhalothrin 5% EC:</b> 1ml / 1 liter of water;</li> <li>➤ <b>Azadiractin 0.3% EC:</b> 1ml / 1 liter of water;</li> <li>➤ <b>Acetameprid 1.8 % EC:</b> 10ml / 20 liters of water;</li> </ul> </li> </ul>
<p><b>Aphids</b> Cause: Insect</p> <ul style="list-style-type: none"> <li>Aphids suck sap from the soybean leaves and feed gregariously on plants.</li> <li>The aphids parasitize young leaves and stems as well as flowers.</li> <li>Aphids are the vectors of many viruses and diseases.</li> <li>Eggs overwinter on the buds and leaves. Thus, the leaves are and suffocated.</li> </ul> 	<ul style="list-style-type: none"> <li>On-time planting helps to escape diseases.</li> <li>Cultivate at the appropriate distance and respect the recommended quantities of seeds.</li> <li>Application of sufficient amount of fertilizer and practice all techniques learned.</li> <li>Use appropriate chemicals:                             <ul style="list-style-type: none"> <li>➤ <b>Lambda-cyhalothrin 5% EC:</b> 1ml / 1 liter of water;</li> <li>➤ <b>Azadiractin 0.3% EC:</b> 1ml / 1 liter of water;</li> </ul> </li> </ul>

## **Birds damages**

- Birds damage soybean seeds during the first 2 weeks after the onset of germination. It is necessary to repel birds early in the morning and later in the evening.
- Birds, especially pigeons and hens, damage soybeans at the germination stage and also at the maturing stage.



- Make sure that the seeds are well covered by soil after planting.
- Deep sowing is also effective in preventing bird damage.
- The most common method of protecting crops in the field is to scare birds away. Repelling birds should be done at least, 2 weeks after the planting and from the beginning of the maturity stage up to the end of harvesting activities.
- Harvesting at an opportune timing reduces the shattering of pods, hence, repelling birds.



# High-Iron Bean Cultivation Technics



Manual Number: SMAP-NDC-02

## Field Preparation

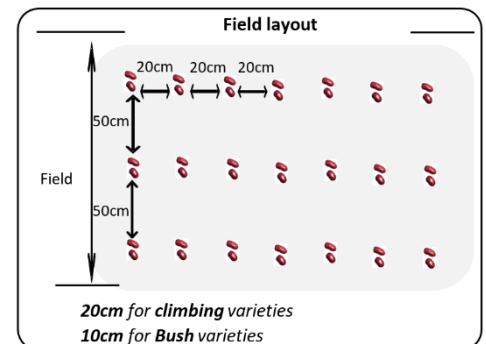
- At the selection of land for High-Iron beans cultivation, farmers have to think about crop rotation. Avoid a field where any variety of beans, such as French bean, Soybean, and Peas, was cultivated in order to keep the land fertile and to avoid diseases that could spread among the plants of the same family.
- Firstly, make deep ploughing at a depth of 20 cm at least to ensure good soil aeration. Remove all debris and plant residues at least 2 weeks before planting to reduce the effects of weeds on crop growth and yield and to prevent pests and diseases.
- When the soil got enough water in the middle of the rain period, clear all vegetation and prepare the field by making field leveling.
- After that, it is recommended to make hilled rows that are 50 cm apart (50 cm equal to the length of 2.5 hands).



Ploughing the Field

## Field layout

- It is recommended to plant seeds, as shown in Figure on the right.
- High-Iron beans are planted with a spacing between rows of 50 cm, and an interval of 20 cm for climbing varieties and an interval of 10cm for Bush varieties.



## Seed preparation, planting time and planting methods

### Seed preparation

- A good High-Iron bean variety that suits their agro-ecological zone should be selected, having recommendations of concerned agricultural extensionists.
- It is recommended to buy certified seeds and disease-free at reliable agricultural dealers and registered trustworthy commercial suppliers.
- With the spacing and interval mentioned above, about 0.4 to 0.6 kg of seeds are required for one are of field.

### Planting time

High-Iron beans are cultivated in three seasons of the year, as shown in the following table:

Season	Planting time	Comments
A season	September – October	It is better to prepare the field before the onset of rains and to sow early in the season in order to get a good yield. High-Iron beans should be sowed in moist soil.
B Season	February – March	
C Season	May – June	

### Planting and sowing methods

- Make hilled rows of the depth of 5 cm, with a spacing of 50 cm between rows.
- High Iron Beans are sowed when the soil got enough water. Climbing varieties are sowed on hilled rows by putting 2 seeds per stand 20 cm apart (length of a hand) while Bush varieties are sowed by putting 1 seed per stand on 10 cm apart. Plant seeds of both varieties at a depth of about 5 cm.
- At each planting hole, it is recommended to apply one handful of compost or well-decomposed manure and a pinch of mineral fertilizer DAP or NPK, 3 to 5 gr taken by 3 fingers. An amount of 0.5kg of DAP should be applied per are. Mix well manure and mineral fertilizer.



Iron bean cultivated on hilled rows with spacing of 50 cm grow well

## Fertilizer application

- As a basal fertilizer, compost made from grass or well-decomposed manure is applied and mixed with soil well. It is recommended that 200 to 300 kg of compost will be applied on 1 are. For low fertility soil, manure and mineral fertilizers should be added into the planting rows before sowing.
- For acidic soil, 5 tons of lime per ha or 50 kg per are should be applied at least 2 weeks before planting. The lime will last for 4 cultivation seasons.
- It is recommended to apply balanced fertilizers at the right stage to produce high yields. The table below summarizes the required fertilizers, the application time and recommended quantities:

Fertilizers	Application time	Quantity per one are	Importance of fertilizers and other comments
Compost	Planting time (Basal fertilizer)	200 - 300 Kg	<ul style="list-style-type: none"> <li>Improvement of water holding capacity and physical property of the soil by increasing soil nutrient.</li> <li>Increase air and water permeability.</li> <li>Compost makes an essential contribution to maintaining and increasing soil fertility.</li> <li>Increase the helpful microorganisms and holding of nutrients.</li> </ul>
DAP	Planting time (Basal fertilizer)	0.5-1 Kg	<ul style="list-style-type: none"> <li>As basal fertilizer, it enhances plant growth, foliage, and pod development by holding nutrients.</li> </ul>
NPK	Planting time (Basal fertilizer)	2 - 3 Kg	<ul style="list-style-type: none"> <li>As basal fertilizer, it is effective for leaves and stems development when DAP is not applied.</li> </ul>
UREA	Earthing - up time (Top dressing)	0.5-1 Kg	<ul style="list-style-type: none"> <li>It enhances plant development.</li> </ul>

## Crop management

### Weeding and hoeing

- The 1st weeding is done 3 to 4 weeks after planting. Meanwhile, earthing - up is recommended to ensure good root development. Hoeing is very important to increase air and water permeability.
- Weed 1 or 2 more times repeatedly before maturity, as necessary. The frequency of weeding depends on the degree of weed infestation; generally, it is better to keep the field weeds free as much as possible to avoid the competition of nutrients, sunlight, and water between the crop and weeds.
- Weeding by hoe is also effective in preventing weeds.

### Earthing up

- Earthing up is conducted just after the 1<sup>st</sup> weeding. If the plants are not growing well, earthing up is conducted with the top dressing of urea. Earthing up is very important in terms of erosion control, prevention of root diseases, and promotion of plant growth.

### Staking

- High-Iron beans are classified by growth habit into two major groups, "Bush varieties" and "Climbing varieties".
- For climbing varieties, the staking which provides support to the plants is indispensable.
- Start the staking to the plant of climbing varieties weeding and hoeing.
- 500 stakes should be prepared for 1 are of field (10mx10m). The longer and stronger stakes are, the better.
- Use 1 stake between 4 plants. Stakes should have a length of at least 2.5 meters and be made of woody trees such as bamboo, Eucalyptus, or Grevillea, or of forage shrubs such as Cedrella, Leucaena, Alnus, Calliandra and Griricidia.
- Ropes can be used as stakes in modern techniques. Hang down the ropes vertically over the climbing varieties, and it acts as a stake. Ropes are usually cheaper than good wooden stakes and the number of wooden stakes can be reduced.



*One stake is used between 4 plants*

### Harvesting, threshing and storage

- High-Iron beans will be ready for harvest from 75 to 120 days after planting, depending on the varieties and soil conditions. Generally, climbing types take more time to be grown than Bush types. Matured High-Iron beans have dry and yellow-brown color pods.
- It is recommended to harvest on a warm day (before noon). Avoid loss of the beans in the field by pods shattering.
- Do not remove all the roots from the field because they contain nitrogen which contributes to soil fertility. Cut the whole mature plant at ground level or only pods with knives or sickles.



*Mature High-Iron beans have dry and yellow-brown pods.*

- Dry the pods or the whole plants under the sunshine on a clean plastic sheet or tarpaulin. Do not dry them directly on the soil to avoid moisture and rubbish.
- Thresh the dried beans in a clean place to avoid shattering.
- Dry the threshed beans on a clean sheet for 2 sunny days by protecting them from rain and animals.
- Clean the beans by winnowing to remove dust and other rubbish. Also, remove shriveled, diseased, broken, deformed beans and beans of other varieties. The chaff, stones, or any remaining plant parts should also be removed. Broken and deformed beans can be eaten immediately.
- Check the beans are dry enough by biting or pinching with nails. The beans will be broken or cracked, not bent or stuck between your teeth.
- Keep the dried and sorted beans in clean bags or any other containers. If those bags in which beans have been stored are reused, they must be washed and then disinfected with boiling water for 5 minutes before putting beans into them.
- Store the bags with beans indoors on a pallet or log, avoiding high temperature and humidity.
- For measures of pest control in storage, chemicals like “*Super-Skana*” and “*Detia*” can be used.



***It is recommended to check the beans are dry enough before storage***



***Bags of beans are stored on pallets or logs avoiding the humidity***








# High Iron Bean

## Pests and diseases control



Manual Number: SMAP-NDC-02

### Major Disease and Pest in Rwanda

Name of pest/disease and characteristics	Control methods
<p><b><u>Anthracnose</u></b> Cause: Funguses (Seed borne and seed transmitted disease)</p> <ul style="list-style-type: none"> <li>For symptoms, dark red to black lesions develop on the whole plant, including the pods. On stems and pods, the lesions are sunken.</li> <li>Anthracnose especially occurs in a cool and humid climate.</li> </ul> 	<ul style="list-style-type: none"> <li>Practice crop rotation.</li> <li>Use of certified seeds and resistant varieties.</li> <li>Desinfect seeds before planting by using fungicides like Benomyl (1 gr / 1kg of seeds).</li> <li>Remove the infected plants as soon as it is found and bury them in the ground.</li> <li>Application of fungicides;                             <ul style="list-style-type: none"> <li>➤ <b>Benlate</b>: 50g / 20L of water (once/ 2weeks)</li> <li>➤ <b>Dithane M45</b>: 50g/ 20L of water (once/ week)</li> </ul> </li> </ul>
<p><b><u>Bean Mosaic Virus</u></b> Cause: Virus</p> <ul style="list-style-type: none"> <li>Leaves may have considerable puckering, stunting, malformation and/or downward curling.</li> <li>Early infected bean plants are usually yellowish and dwarfed. The growth of the plant may be reduced.</li> <li>Infected seeds may spread the angular leaf spot</li> </ul> 	<ul style="list-style-type: none"> <li>Reinforce the prevention by using crop rotation or by planting disease-free seeds and resistant varieties.</li> <li>Remove the infected plants as soon as it is found and bury them in the ground.</li> <li>Aphid is one of the vectors of the disease, so controlling the vector is important by using appropriate chemicals;                             <ul style="list-style-type: none"> <li>➤ <b>Superimetrine</b>: 20 ml/ 20 liters of water</li> <li>➤ <b>Rocket</b>: 20 ml/ 20 liters of water</li> </ul> </li> </ul>
<p><b><u>Angular leaf spot</u></b> Cause: Fungal disease</p> <ul style="list-style-type: none"> <li>Primary leaves have round lesions. After that, funguses cause too many small angular spots to cause some defoliation. The disease also attacks the beans pods, although the spots on the pods are usually small.</li> <li>The lesions are the first grey and then become dark brown in color.</li> <li>Infected bean debris may spread the angular leaf spot</li> </ul> 	<ul style="list-style-type: none"> <li>Plant disease-free seeds and disinfected them.</li> <li>Use resistant varieties.</li> <li>Use appropriate chemicals;                             <ul style="list-style-type: none"> <li>➤ <b>Benlate</b>: 50g / 20 liters of water (once/ 2weeks)</li> <li>➤ <b>Dithane M45</b>: 50g/ 20 liters of water (once/ week)</li> </ul> </li> </ul>
<p><b><u>Ascochyta blight</u></b> Cause: Fungal (Ascochyta Phaseoli) disease</p> <ul style="list-style-type: none"> <li>Symptoms are black or brown concentric lesions on the leaves and pods.</li> <li>Stems can show black nodes.</li> </ul> 	<ul style="list-style-type: none"> <li>Use the certified and disease-free seeds.</li> <li>Use resistant varieties.</li> <li>Avoid using compost from bean debris.</li> <li>Seed treatment before planting by using fungicides like Benomyl + Thiram(2 gr each / 1kg of seeds).</li> <li>Use appropriate chemicals;                             <ul style="list-style-type: none"> <li>➤ <b>Benlate</b>: 50g / 20L of water (once/ 2weeks)</li> <li>➤ <b>Dithane M45</b>: 50g/ 20L of water (once/ week)</li> </ul> </li> </ul>
<p><b><u>Halo Blight</u></b> Cause: Bacteria</p> <ul style="list-style-type: none"> <li>Firstly, small, mahogany color, water-soaked spots appear on the lower leaf surface. As these spots increase in size, a characteristic halo of yellow tissue develops around each water-soaked spot.</li> <li>As enlarging the area of disease, the whole leaf surface changes brown color, and the plant dies.</li> <li>Both leaf and pod lesions often coalesce. The upper foliage of diseased plants develops a characteristic yellow color. The infected seed becomes smaller than the normal, has a wrinkled seed coat, and be discolored.</li> <li>The disease development is favored in humid and cloudy conditions.</li> </ul> 	<ul style="list-style-type: none"> <li>Use certified seeds.</li> <li>Use resistant varieties.</li> <li>Practice crop rotation.</li> <li>Avoid using compost from bean debris.</li> </ul>



<p><b>Rust</b></p> <p>Cause: Fungus</p> <ul style="list-style-type: none"> <li>Firstly, symptoms appear on the undersurface of leaves as tiny, raised spots. These spots gradually enlarge and form reddish-brown or rust-colored pustules spreading the infection.</li> <li>Green pods also may become infected and develop rust pustules. These spots gradually enlarge and form rust spreading the infection.</li> <li>Infected bean debris may spread the rust.</li> </ul>	<ul style="list-style-type: none"> <li>Use of certified seeds and resistant varieties.</li> <li>Practice crop rotation.</li> <li>Avoid using compost from beans debris;</li> <li>Use appropriate chemicals like <i>Copper oxychloride</i></li> </ul>
<p><b>White mold (<i>Sclerotinia sclerotium</i>)</b></p> <p>Cause: Fungus</p> <ul style="list-style-type: none"> <li>This disease attacks beans in the pod formation stage.</li> <li>On stem and pods, symptoms appear initially as greyish-green water-soaked lesions, followed by white mold growth, accompanied by a watery soft rot on the affected plant.</li> </ul>	<ul style="list-style-type: none"> <li>Use of certified seeds and resistant varieties.</li> <li>Practice crop rotation.</li> <li>Avoid using compost from bean debris.</li> <li>Use appropriate chemicals:                             <ul style="list-style-type: none"> <li>➤ <b>Benlate:</b> 50g / 20L of water (once/ 2weeks)</li> <li>➤ <b>Dithane M45:</b> 50g/ 20L of water (once/ week)</li> </ul> </li> </ul>
<p><b>Aphid</b></p> <p>Cause: Insect</p> <ul style="list-style-type: none"> <li>With dark green body color, aphids feed gregariously on plants. This insect is a vector of a kind of mosaic virus and other viruses.</li> <li>The disease development is favored in the dry season.</li> </ul>	<ul style="list-style-type: none"> <li>Cultivate the beans on time.</li> <li>Use appropriate chemicals:                             <ul style="list-style-type: none"> <li>➤ <b>Rocket:</b> 20ml / 20L of water</li> <li>➤ <b>Dithane M45:</b> 50g/ 20L of water</li> </ul> </li> </ul>
<p><b>Coleoptera</b></p> <p>Cause: Insect</p> <ul style="list-style-type: none"> <li>Its eggs are laid in the soil, near the roots of the host plant on which the emerging white larvae and develop in the form of C letter.</li> <li>This pest feeds on the stem and roots. Thus the growth of the plant is significantly reduced.</li> </ul>	<ul style="list-style-type: none"> <li>Plant on recommended time;</li> <li>Use appropriate chemicals:                             <ul style="list-style-type: none"> <li>➤ <b>Rocket:</b> 20ml / 20L of water</li> <li>➤ <b>Supermetrine M45:</b> 20ml/ 20L of water</li> </ul> </li> </ul>
<p><b>Pod Borers (<i>Maruka Vitrata</i>)</b></p> <p>Cause: Insect</p> <ul style="list-style-type: none"> <li>A full-grown larva has a pale body lined by rows of conspicuous black spots on its dorsal surface.</li> <li>They characteristically attack young pods, and they form webs for protection against natural enemies. Climate change helps the spread of this pest.</li> </ul>	<ul style="list-style-type: none"> <li>Plant on recommended time;</li> <li>Use appropriate chemicals:                             <ul style="list-style-type: none"> <li>➤ <b>Rocket:</b> 20ml / 20L of water</li> <li>➤ <b>Supermetrine M45:</b> 20ml/ 20L of water</li> </ul> </li> </ul>
<p><b>Diseases that affect the Roots</b></p> <ul style="list-style-type: none"> <li>Iron Beans are exposed to many root diseases caused by a complex of several different soil-borne fungi like <i>Fusarium</i> spp, <i>Pythium</i> spp, <i>Sclerotium</i> spp, <i>Rhizoctonia</i> spp, and so on.</li> <li>It frequently occurs for Iron Beans cultivation in the field where another variety of beans cultivated before.</li> <li>General symptoms are: the attacked plants may become stunted, leaves become yellow, the plant wilt and die.</li> <li>They are common in bean crops cultivated in low soil fertility and high humidity. They frequently attack young plants.</li> </ul>	<ul style="list-style-type: none"> <li>Practice crop rotation.</li> <li>Use of certified seeds and resistant varieties.</li> <li>Apply organic and chemical fertilizers in order to enhance the plants' immunity and their capacity to resist to the diseases.</li> </ul>

**Cutworms**

Cause: Insect

■ The cutworms are frequent in the field fertilized by not fully decomposed compost.

■ The damage for beans is by cutting young seedlings at the base, near the ground.



- Apply fully decomposed compost.
- Handpick off the cutworms.

**Bean weevils**

Those pests damage harvested beans before storage, but common bean weevil infestation starts in the field and multiplies in storage.



- Use appropriate materials of storage and store under hygienic conditions;
- Don't use tools used in the infected field. Clean them with enough water or Chlorine.
- Use appropriate chemicals:
  - *Super-Skana*: 1gr / 1kg of seeds.
  - *Detia* tablets placed near the bags of Iron beans in the storage.



# Bio-Fortified Irish Potatoes

## Cultivation Technics



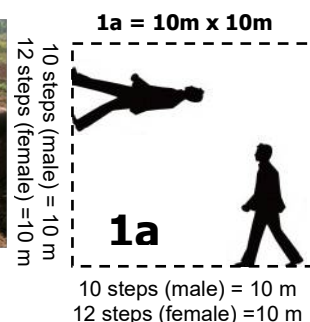
Manual Number: SMAP-NDC-03

### Land Preparation

- The Bio-Fortified Irish potatoes require deeply ploughed, fertile, and well-drained lands. It grows well in sandy or muck soils. It prefers ground with a bit low pH, from 6 to 6.5.
- For the cultivation site selection, farmers have to choose a field where those crops of the same family of Solanaceae (e.g., eggplant, tomato, sweet pepper, chili pepper, and tobacco) have not been cultivated. Also, Irish potato has not been planted at least last 3 seasons.
- The field should be ploughed to a depth of about 15 cm to 20 cm at the first ploughing. Debris in the field should be removed at the same time. Then, the planting ridges should be established at the 2nd ploughing, in accordance with the field layout.
- On a sloping field, it is recommended to apply appropriate erosion control techniques.

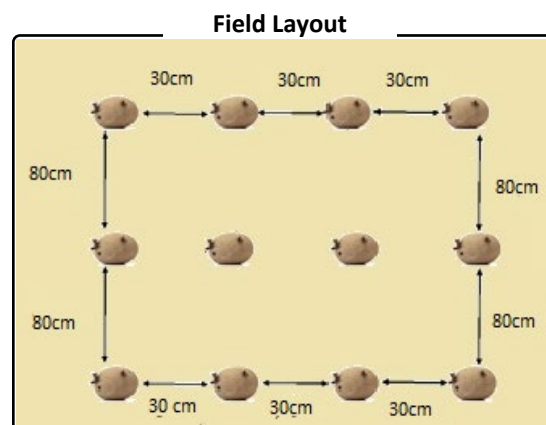


Ploughing the Field



### Field layout

- It is recommended to plant seedlings as illustrated in the Figure on the right.
- Irish potatoes are planted with a spacing between rows of 80 cm and an interval between tubers of 30 cm. In this case, about seeds of 20 kg to 25 kg are required for a one Are (10mx10m) field.



### Seed preparation, planting time and planting methods

#### Seed preparation

- The criteria to identify a good quality seed potato are: free from disease, without any damage, medium size with a diameter of 25 to 35 mm.
- Good quality seed potato will germinate well with enough sprouts (at least 3 to 4 shoots). Before planting, seed potatoes should be kept under the sunlight to produce enough sprouts.
- Seed potatoes must be well sorted and certified. It is better to purchase good seed potatoes from those seed multipliers or dealers approved by competent Authorities. Seed potato must be renewed every 4 seasons of cultivation.
- It is recommended to separate the varieties of planted potato by plots; do not mix more than one variety in a plot.



Good quality of Irish Potatoes seeds with enough sprouts

#### Planting time

- Generally, the optimum planting time for A season is September, while it is March for B season. For C season, it is better to plant in May in marshlands.

#### Planting methods

- Bio-Fortified Irish potatoes are planted in holes or on hilled rows.
- To plant in holes, make the planting holes on rows, with a spacing between rows of 80 cm and an interval between holes of 30 cm.
- On hilled rows, dig straight shallow trenches in prepared soil 80 cm apart and plant seed potatoes 30 cm.
- Put a seed into one planting hole or on hilled rows at a depth of 8 – 10 cm. The amount of seeds required for planting 1 Ha of land is between 2 and 2.5 tons, depending on the size of seed potatoes.
- The sprouts should be set upwards, then covered with a thick layer of soil.



The soil fertility is an important factor for the yield

## Fertilizer application

- Soil fertility is an important factor for the yield and the size of potato production.
- It is recommended to use manure and mineral fertilizers, especially NPK 17-17-17, for Bio- Fortified Irish potatoes cultivation. Apply well-decomposed manure or compost at the 2<sup>nd</sup> plowing before planting, at the rate of 20 to 30 tons per Ha, or 200 to 300 kg per Are.
- The mineral fertilizer, NPK 17-17-17, is applied twice. Firstly, during the planting period, approximately 3-5g of NPK should be applied in one hole and mixed well with manure and soil. 1.5 kg of NPK is used for 1 Are. Secondly, NPK should be applied 4 weeks after weeding and during the earthing-up activities. As same as the first time, 1.5 kg of NPK is applied per Are.
- For acidic soil (Nyamagabe, Nyaruguru Districts, and others), lime should be applied at the 2<sup>nd</sup> plowing (2 weeks before the planting), with an amount of between 25 and 50 Kgs per 1 Are.
- After making the planting holes on rows, put the manure or compost and add mineral fertilizer, then cover with a thick layer of soil. Place seed potatoes in the holes following the spacing specified and cover them with a thick layer of soil.
- The table below summarizes the fertilizer application techniques for Bio-Fortified Irish potatoes.

Fertilizers	Application time	Quantity per Are	Effect of fertilizers
Compost	Before planting at the 2 <sup>nd</sup> plowing	200 Kg	<ul style="list-style-type: none"> <li>● Compost improves the physical property of soil by releasing nutrients slowly.</li> <li>● Compost increases the water holding capacity as well as the air and water permeability of the soil.</li> <li>● Compost increases the number of beneficial microorganisms in soil and improves the nutrient-holding capacity of the soil.</li> </ul>
NPK 17-17-17	1 <sup>st</sup> application: at planting time	1.5 Kg	<ul style="list-style-type: none"> <li>● Basal dressing: NPK enhances the roots and stems development by holding nutrients.</li> </ul>
	2 <sup>nd</sup> Application: at earthing up	1.5 Kg	<ul style="list-style-type: none"> <li>● Topdressing fertilizer: NPK enhances the development of plants and roots by supplying mineral elements.</li> </ul>
Lime (for acidic soil)	2 weeks before planting	25 – 50 Kg	<ul style="list-style-type: none"> <li>● The lime reduces the acidity of soil and releases nutrients slowly.</li> <li>● The lime increases the nutrient holding capacity of the soil, hence, an increase in the yield</li> </ul>

## Crop management

### Weeding

- Weeding should be done at least twice a season: 2 to 3 weeks after the germination of potatoes, when the plants have a height of about 10 cm, and 2 to 3 weeks after the first weeding.
- Don't damage the plant's roots when weeding.



Weeding of potatoes is done after germination



Earthing up helps potatoes to grow well and protect the tubers into the soil

### Earthing up

- Earthing up is done twice a season: when the height of plants is around 20 cm and when it is more than 30 cm. It helps potatoes grow well, and it also protects the tubes in soil from turning green and being contaminated with diseases.
- Earthing up is conducted 2 – 3 weeks after weeding. By earthing-up, enough soil must be pulled toward the plant as it grows. This gives the tubers a place to form and helps to prevent diseases. By hilling up soil over plants, the tubers grow well. It is recommended to cultivate around plants carefully to avoid damaging the roots and tubers.

### Prevent diseases

It is necessary to prevent diseases by applying chemicals like *Ridomil* and *Dithan M 45* and pesticides like *Supermethrin* and *Rocket*. Apply *Ridomil* twice at seven days intervals. After that, apply *Dithane M45* with also seven days intervals.

### Harvesting

- At flowering, the potato is starting to grow. It is better to remove flowers to avoid the competition of nutrition between flowers and potatoes.
- It is time to harvest when stems and leaves are turning yellow. As preparation for harvesting, farmers use to slash Irish potato vines. This action is crucial for crops to store.
- Harvesting methods affect tubers' quality. Harvesting by hand allows obtaining potatoes of good quality and undamaged.

- Potatoes are ready to harvest when the tops begin to die, and the potato skin becomes firm. After harvesting, Irish potato tubers should be put in a clean and cool place. For storing the potato for selling, it should be kept in the dark and well-ventilated place, and potatoes for seed should be stored in an area with light. Harvested potatoes should be carefully transported to a storage yard for sorting and grading before storage. Damaged and diseased potato tubers must be sorted out and disposed of it.
- The harvested potatoes should be removed from the vine carefully to prevent any damage to them. Damaged potatoes may not be stored for a long time.



*Sorting and grading are conducted prior to storage*

## Drying and storage

- It is best to harvest on a clear, sunny weather day because the sunshine hardens and dries tubers quickly. As a result, the risk of diseases decreases since excess soil can be removed from the skin soon.
- The sunshine and light in storage should be avoided because it induces greening, which indicates an accumulation of poisonous sugar compounds.






# Bio-Fortified Irish Potatoes

## Pests and diseases control








Manual Number: SMAP-NDC-03

### Major Diseases and Pests in Rwanda

Name & characteristics	Control methods
<p><b>Mildew</b>  <u>Cause:</u> Fungus known as “<i>phytophthora infestans</i>”</p> <ul style="list-style-type: none"> <li>Initially, infected leaves are covered with whitish spore masses resembling soil residues.</li> <li>The disease requires high humidity.</li> <li>Old infected leaves superficially resemble the late blight as leaves turn black, die, and drop from the plant.</li> </ul> 	<ul style="list-style-type: none"> <li>Use the disease-free seed potatoes and resistant varieties (late in the rainy season).</li> <li>Remove and destroy any potato debris.</li> <li>Burn-off the foliage 3 weeks before harvesting and harvest mature roots.</li> <li>Apply sorting by removing rotten, diseased, infected and cut tubers before storage.</li> <li>Appropriate application of sulfur or fungicides such as Mancozeb: 50g/ 20 liters of water at least once a week or every 4 days (After the tuber initiation stage), Ridomil: 50g/ 20 liters of water at least once or twice a month.</li> </ul>
<p><b>Early Blight</b>  <u>Cause:</u> Fungus known as “<i>Alternaria solani</i>”.</p> <ul style="list-style-type: none"> <li>Early blight is also known as target spot. It affects older leaves first, and spots are rarely found on young and vigorously growing plants.</li> <li>Early Blight and Late Blight can occur at the same time in the field. The terms ‘early’ and ‘late’ refer to the relative time of their appearance in the field. Early blight thrives with warm temperatures and humid conditions.</li> <li>Brown lesions appear first on older, lower leaves, then spread upward.</li> <li>Small (1-2 mm), dry, and papery lesions appear on leaves. It may develop into brown-black circular or oval spots with raised dark concentric rings and necrotic tissue.</li> <li>The leaf tissue at the edge of the lesion often turns chlorotic (yellow). As the disease progresses, the entire leaf can become chlorotic and then necrotic (brown).</li> <li>Tubers get irregular spots that are dark and circular. The sunken lesions on the tubers are often surrounded by a purplish raised border.</li> <li>The tissue under the lesions is dry, leathery, and brown. The lesions will increase in size during storage, and they will remain on the surface.</li> </ul> 	<ul style="list-style-type: none"> <li>Use the disease-resistant varieties or late-maturing varieties, which are more resistant than early maturing varieties.</li> <li>Watering at the base of the plant in the morning by avoiding overhead irrigation.</li> <li>Keep plants healthy with proper watering and fertilizer application to prevent the disease.</li> <li>Avoid crop rotation with solanaceous plants such as tomatoes, pepper, eggplant, etc., since the disease is common among them.</li> <li>Avoid bruising seed tubers and mature tubers when harvesting.</li> <li>Application fungicides such as <b>Mancozeb</b>, <b>chlorothalonil</b>, and <b>copper</b> with approximately 7-10 days intervals. Spraying should commence at the first sign of disease or immediately after bloom.</li> </ul>
<p><b>Common scab</b>  <u>Cause:</u> Bacteria, <i>Streptomyces scabies</i>.</p> <p>It survives in soil, on infected tubers, and on vegetable debris. Infection occurs when the bacterium penetrates the thin tuber skin or enters through wounds or natural openings such as the lenticels (pores on tubers). It can survive indefinitely in slightly alkaline soils but is rare in highly acidic soils.</p> <ul style="list-style-type: none"> <li>It thrives in soil with a pH greater than 5.2 or under drought conditions.</li> </ul> 	<ul style="list-style-type: none"> <li>Use the certified seed potatoes and disease-resistant varieties.</li> <li>Practice crop rotation. Try to plant potatoes in the same field only once every 3 to 4 years.</li> <li>Use acid-type fertilizer if the soil has a high pH. Do not use animal manure, wood ashes, or lime in the field.</li> <li>Keep potato plants well-watered, especially during the tuber growth initiation. However, avoid excess watering.</li> </ul>

Name & characteristics	Control methods
<ul style="list-style-type: none"> <li>● The tubers are most susceptible but stems and roots may be infected only occasionally.</li> <li>● Scab is carried by wind and water from infected seed tubers. It can also be transmitted by manure that is not well composted.</li> <li>● No above-ground symptoms are apparent on infected potato plants, and scab does not adversely affect potato tubers in storage.</li> <li>● Scab infections may appear as either raised or pitted lesions on the skin of potatoes. Raised lesions on the tuber skin are dark, rough, and corky, while pitted lesions are sunken (1 to 3 mm in depth), dark-colored, corky.</li> </ul>	<ul style="list-style-type: none"> <li>■ Remove and destroy any potato debris and tubers at the end of every season.</li> </ul>
<p><b>Verticillium Wilt</b></p> <p>Cause: Verticillium wilt is mainly transmitted through soil. It can be carried by two different soil-borne fungi: <i>Verticillium albo-atrum</i> or <i>Verticillium dahliae</i>, which spread in the soil with repeated potato production and can survive for a long period.</p> <p>The pathogens can also be carried via seed tubers. Transmission is through the movement of soil through farm machinery, footwear, animals, water, and wind.</p> <ul style="list-style-type: none"> <li>● The fungi penetrate into plants from roots and spread upwards in the vascular tissues restricting water uptake and infecting stems, petioles and leaves.</li> <li>● Usually, after flowering, the lower leaves begin to turn yellow between leaf veins. The symptoms then move upwards to younger leaves.</li> <li>● Leaf edges and areas between veins turn yellow and then brown. The stems usually remain upright even as the leaves wilt. However, grey to brown discoloration can be seen in the lower part when cut lengthwise.</li> <li>● As the symptoms of this disease are easily confused with those symptoms of other diseases or early maturity, it is important to carry out a plant and soil pathogen analysis for determination.</li> </ul>	<ul style="list-style-type: none"> <li>■ Carry out a soil analysis to detect the level of Verticillium infestation in the soil.</li> <li>■ Scouting for Verticillium wilt should be done regularly before rows close. Fields should be monitored at least twice a week. Check wilted plants if brown discoloration of the vascular area of stems can be observed.</li> <li>■ Practice crop rotation by alternating potatoes with non-susceptible cereal crops.</li> <li>■ Plant certified seed tubers, selecting cultivars that are resistant to wilt.</li> <li>■ Control host weeds and dispose of infected crop debris.</li> <li>■ Avoid over-irrigation.</li> </ul>
<p><b>Bacterial soft rot</b></p> <p>Cause: Bacteria, "<i>Erwinia atroseptica</i>", "<i>E. Carotovora</i>". These bacteria can live in soil, in decaying plant debris, and in seed tubers. Infected vines release bacteria to the soil, and the bacteria can move to new tubers through soil water. Soft rot can also enter tubers through the stem end, wounds, or through other infected parts.</p> <ul style="list-style-type: none"> <li>● Soft rot brings about rot of tubers during storage accompanied by foul odors.</li> <li>● It also develops in the harvested tubers, which were infected by blackleg during the growing season.</li> <li>● Infected seed tubers cause curling of leaves, stunting, and leaves fading from green to yellow-green. The lower stems gradually rot away, and the plant dies.</li> <li>● First, small and moist cream spots appear on the surface of tubers, and they will progress gradually inwards.</li> <li>● The infection expands quickly in tubers results in rotting tissues that are slimy and wet. This decay is enhanced under moist conditions in storage, leading to very unpleasant odors.</li> </ul>	<ul style="list-style-type: none"> <li>■ Planting certified seed potatoes obtained from credible sources and practicing crop rotation.</li> <li>■ Control weeds like nightshades that harbor the disease organisms.</li> <li>■ Avoid harvesting under wet conditions and dry wet tubers as quickly as possible.</li> <li>■ Avoid bruising, and do not wash tubers before storage.</li> <li>■ Remove vines, clods, and soil adhered to tubers before piling.</li> <li>■ Sanitize storage facility and eliminate condensation/ moisture during storage.</li> <li>■ Keep storage well ventilated.</li> </ul>



Name & characteristics	Control methods
<p><b>Bacterial wilt</b></p> <p>Cause: Bacteria called "<i>Pseudomonas solanacearum</i>". It spreads by seed potatoes or soil.</p> <ul style="list-style-type: none"> <li>● The symptom is wilting of the leaves at the end of the branches.</li> <li>● The leaves of affected plants turn pale green, and then the leaflets take on a bronze color. They shrivel and then die.</li> <li>● From a cut node, a grayish-white slime exudes. The bacterial streaming can also be observed from a stem section soaked in clear water.</li> </ul> 	<ul style="list-style-type: none"> <li>■ Plant certified seed potatoes (not cut ones) and disease-resistant varieties.</li> <li>■ Practice crop rotation, with an interval of 3 seasons.</li> <li>■ Remove and destroy any tubers and their debris.</li> <li>■ Control irrigation water from the infected fields.</li> <li>■ Don't use tools used in the infected field. Clean them with enough water or Chlorine.</li> <li>■ Remove the infected plants as soon as it is found and be careful not to spread the bacteria into the soil. Bury the infected plants, and put ash (two pinches) or lime (one pinch) in place from where they were removed.</li> </ul>
<p><b>Aphid borne virus disease</b></p> <p>Cause: Virus</p> <ul style="list-style-type: none"> <li>● The symptoms appear firstly as rolling of older and lower leaves. Later, the leaves become leathery and tough.</li> <li>● Infected plants are stunted and produce fewer leaves and smaller tubers.</li> </ul> 	<ul style="list-style-type: none"> <li>■ Plant certified seeds with disease-resistant varieties.</li> <li>■ Apply insecticide for prevention against aphids like <b>Imidachloprid</b> or <b>Lambda-cyhalothrin</b>: 10 ml diluted in 20 liters of water.</li> <li>■ Remove the infected plants and destroy any potato debris.</li> </ul>
<p><b>Potato Tuber Moths</b></p> <p>Cause: Moth called "<i>Phthorimaea operculella</i>"</p> <ul style="list-style-type: none"> <li>● The larvae of moth damage tubers or leaves by mining and the attacked plants become brown and rot.</li> <li>● The larvae also attack the branches by lowering their vigor.</li> <li>● Adult moths are gray-brown in color, and they principally attack tubers stored.</li> </ul> 	<ul style="list-style-type: none"> <li>■ Make planting holes with the recommended depth (10 to 15 cm).</li> <li>■ Make an earthing up during the tuber initiation period.</li> <li>■ Don't use seed potatoes from the infected plants.</li> <li>■ Apply pyrethroid insecticides such as <b>Deltamethrine</b> or <b>cypermethrin</b> for prevention purposes.</li> </ul>
<p><b>Leaf Miner Flies</b></p> <p>Cause: Flies known as <i>Liriomyza sp</i></p> <ul style="list-style-type: none"> <li>● The flies are small, and the larvae tunnel into the leaves.</li> <li>● The cocoons are formed on the underside of leaves and then fall to the ground.</li> <li>● The feeding and egg-laying by adult flies appear as white specks on potato leaves. These white leaf specks are seen easily with the naked eyes and are a good indication that the potato crop is infested.</li> </ul> 	<ul style="list-style-type: none"> <li>■ Plough the field more than twice, at least one week before planting, as the flies cannot withstand solar rays/sunshine.</li> <li>■ Application of insecticides such as <b>Imidacloprid</b> or <b>Lambda-cyhalothrin</b>: 10 ml / 20 liters of water.</li> </ul>
<p><b>Cutworm</b></p> <p>Cause: Moth larvae called <i>cutworms</i></p> <ul style="list-style-type: none"> <li>● Cutworms are larvae of several noctuid moth species that cut through the stems of young plants.</li> <li>● Tubers closer to the ground surface may suffer occasional damages.</li> </ul> 	<ul style="list-style-type: none"> <li>■ Weed control in the field and around before planting.</li> <li>■ Regular weeding and handpick at night (with a flashlight and gloves) to pick off the cutworms. Repeating this every few nights.</li> </ul>





# Yellow Cassava Cultivation Technics

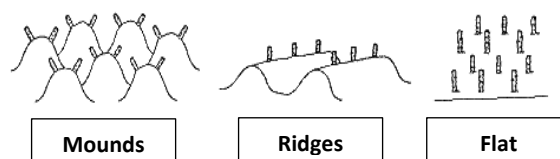


Manual Number: SMAP-NDC-04

## Land preparation

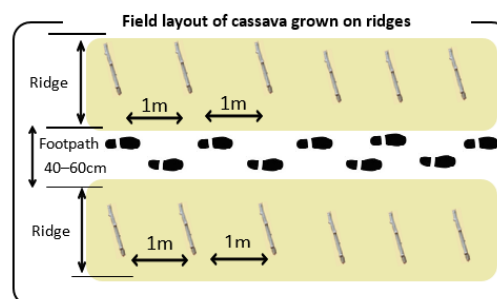
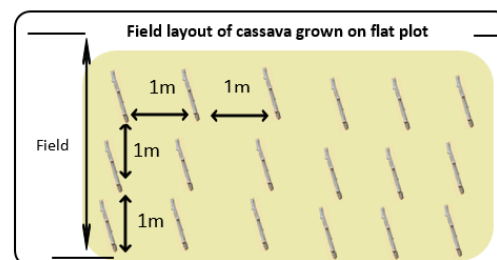
- Cassava is grown in light, deep, and well-drained soil of good texture.
- Cassava is one of the root crops. However, unlike other root crops, it is advisable to cultivate a legume crop as a cover plant during the rest period of cassava cultivation in the intercropping. It is best to plant the cassava at the end of the rotation, just before the fallow period, as it depletes the soil.
- Land preparation for planting cassava in upland differs from that in valleys. In upland, it is better to plant it on flat ground, mounds, and ridges. However, in valleys, cassava should be planted in mounds above ground level to control waterlogging. Ridges are recommended to be built in the fields exposed to soil erosion.
- The field is ploughed while removing debris. It is important to till deeply to about 25 to 30 cm that allows cassava roots to grow deep into the soil.

### Different methods of cassava land preparation



## Field layout

- The Spacing is 1m between rows and 1m between cuttings by placing one cutting in one hole of 15 cm deep. Please see the figures on the right.
- About 10,000 cuttings are planted on 1 Ha, which means 100 cuttings per Are.
- The height of mounds ranges from 30 to 60 cm.

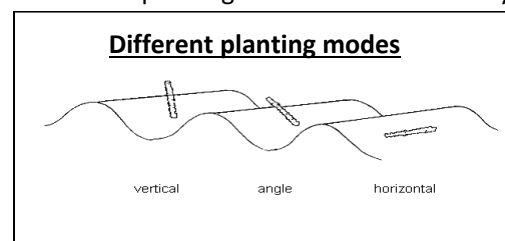


## Preparation of planting materials, planting time and planting methods

### Preparation of planting materials

- Ideally, cassava is propagated by semi-hardwood cuttings. Healthy and fresh stem cuttings from mature plants are best for planting.
- The quality of cassava stem cuttings depends on the age of the stem, thickness, number of nodes, and health of stems.
- Take stem cuttings from the plants which are between 8 and 18 months old. Select planting materials from healthy, disease-free, and vigorously growing plants.
- Use thick stems for good production, and avoid thin stems.
- Use 20-25 cm long cuttings with 5-7 nodes. Cut the plants with a well-sharpened machete, knife or saw, and cut them when you are ready for planting.

### Different planting modes



### Planting time

- It is recommended to plant cassava in Season A, specifically from September to November, according to the availability of rain. A high yield can be obtained in that season because of enough rain.
- Sometimes cassava is planted in Season B, from February to April, but the production may be limited because young plants cannot grow their roots deeper, as the topsoil begins to dry out with the arrival of the dry season.

### Planting methods

- Before planting, holes with 10 to 15 cm depth are made. Recommended space between plants is 1m as mentioned above.
- Cassava cuttings can be planted vertically, at an angle, or horizontally. When it is planted at an angle or vertically, 2 nodes should be left up-soil.
- One cutting per hole is appropriate.



Mixing soil with organic manure

Applying NPK 17-17-17



## Fertiliser application

- Good growth and yields of cassava require balanced nutrients in appropriate amounts. The application of 200 to 300 Kg/ Are of organic manure at planting time is recommended.
- Apply organic fertilizer before land preparation for their proper incorporation into the soil.
- After 4 to 6 weeks of planting, add 3 kg of NPK 17-17-17 per Are. To apply NPK, make small ditches of 15-20 cm deep around the bases of the plant by hands. Apply around 20g (two soda bottle caps) of NPK into every ditch. Cover the fertilizer with soil immediately after the application.



## Post planting management activities

- As part of maintenance, the replacement of missing plants is the first post-planting management activity.
- Weeding should be done at least every month up to 4 months of planting. After that, weed if necessary.
- For flat seeding, make ridges of 10 cm high in 8 weeks after planting.
- Earthing-up should be carried out at the same time as weeding in order to ensure that storage roots are well covered.



## Harvesting

- Early-maturing varieties are ready for harvesting at 8 months, while late-maturing varieties are ready at 18 months after planting.
- Harvesting is easier when the soil is moist and also if plants are on ridges or mounds.
- The harvest involves cutting stems at the height of 25 to 30 cm from the ground and removing the tubers by machete. Make sure not to damage them.
- Harvesting cassava roots is usually done by hand if the soil is light, otherwise using a hoe or a stick. On heavier soils or during the dry season, harvesting usually requires digging around the roots to free them and lifting the plant.



## Post harvesting activities

- Roots may be harvested any time between six months and three years after planting. Thus, Farmers use to harvest only the quantity required for immediate use, or they can be harvested whenever needed.
- Harvested tubers of cassava are highly perishable crops as tubers can be rot within 2 to 3 days after harvesting.
- One way to store cassava is peeling in raw or grating it into a mash and drying it with solar driers or under the sun in a hygienic condition.
- Another way is to soak cassava by submerging it in potable water for 3– 5 days. After that, well-soaked cassava is dried under the sun in a hygienic condition.
- For both methods, well-dried cassava can be kept and used within six months.
- When dried cassava chips are not milled right away, store them properly to prevent moisture re-absorption. Place the chips either in pails with cover, thoroughly washed sacks with cellophane lining, jute sacks, or containers that can be closed properly.



# Yellow Cassava







## Pests and diseases control



Manual Number: SMAP-NDC-04

### Pests and diseases control

There are two important viral diseases, namely Cassava Mosaic Disease (CMD) and Cassava Brown Streak Disease (CBSD).

Name of disease and characteristics	Control method
<p><b>1. Cassava mosaic disease (CMD)</b></p> <p><i>Cause: Virus</i></p> <p><i>Symptoms</i></p> <ul style="list-style-type: none"> <li>Leaves of recently infected plants are discolored and present pale green or yellow mosaic.</li> <li>Progressively, there is a distortion of leaves, and plants suffer stunting; general decline and extreme narrowing of leaves. The size and number of tubers are considerably reduced.</li> <li>An infected cutting cannot develop the roots. When the cutting is infected after planting, the size of tubers is reduced; and the severer the infection, the lower the root yield.</li> </ul>   	<ul style="list-style-type: none"> <li>Use the varieties with good tolerance.</li> <li>Use healthy planting materials from the disease-free plants or the plants derived from multiplication farmlands (produced by registered farmers/ companies).</li> <li>Visit the field regularly to check the plants at least once per month.</li> <li>Uproot and burn any infected plants and crop residues.</li> <li>Don't use the tools used in an infected field or clean them with Chlorine clean Up (750 ml diluted in 15 liters of water) before use in other fields.</li> <li>The application of fungicide is not effective, because this is not a fungus disease but a virus disease.</li> </ul>
<p><b>2. Kabore (Cassava brown streak disease - CBSD)</b></p> <p><i>Cause: Virus</i></p> <p><i>Symptoms</i></p> <ul style="list-style-type: none"> <li>The characteristics of CBSD are an irregular yellow blotchy chlorosis that is most pronounced on lower leaves. Chlorosis is often also associated with the secondary and tertiary veins.</li> <li>Unlike Cassava mosaic disease, there is no leaf distortion.</li> <li>Brown streaks on cassava stems are observed.</li> <li>In severe cases, there may be leaf drying and shoot dieback.</li> <li>The disease also affects the tuberous roots, which develop a yellow/brown color, dry, corky necrosis within the starch-bearing tissues.</li> </ul>   	<ul style="list-style-type: none"> <li>Use the varieties with good tolerance.</li> <li>Use healthy planting materials from the disease-free plants or plants derived from multiplication farmlands (produced by registered farmers/ companies).</li> <li>Visit the field regularly to check the plants at least once per month.</li> <li>Put in quarantine the roots and cuttings from the infected region/ zone.</li> <li>Don't use tools used in the infected field or clean them with Chlorine clean - Up (750 ml diluted in 15 liters of water) before using on other fields.</li> <li>The application of fungicide is not effective, because this is not a fungus disease but a virus disease.</li> </ul>



# Orange Fleshed Sweet Potatoes

## Cultivation Technics



Manual Number: SMAP-NDC-05



### Land preparation

- Cultivation aims to turn over the topsoil and loosen the compacted soil below, to achieve a good tilth for forming the hills or ridges, and provide a soft, uniform medium where storage root growth is not impeded.
- Orange Fleshed Sweet Potato (OFSP) is planted on ridges (*See Picture No.1*) or mounds. Mounds range from 30 to 60 cm high (see picture No. 1). The benefits of ridges with loose and friable soil are better because: (c) They provide the developing roots to expand to their potential size and shape without restriction; (b) It also allows adequate drainage, weeding and provides easy harvesting; (c) Mounds and ridges ensure good drainage and prevent the rotting of roots.

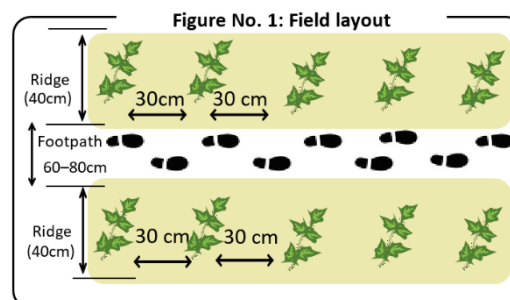


Picture No.1: The ridges provide developing roots to expand to their potential size



### Field layout

- It is recommended to transplant vines of OFSP by the following figure No 1 shown on the right side. Vines with at least 3 nodes (about 30 – 40 cm long) are usually planted at a spacing of 30 cm between plants, and 80 cm between ridges are recommended. 420 cuttings are required per one Are.
- Ridges are oriented along contours on sloping land to maximize rain infiltration and minimize erosion.
- On flat irrigated land, ridges may be oriented East-West for the maximum light interception or any direction for convenience of furrow irrigation.
- Ridges should be approximately 30 cm high and 40 cm wide at the base. The main consideration is that the developing roots remain under the soil within the heaps.



### Preparation of planting material, planting time and methods

#### Preparation of planting materials and Planting time

- Ideally, farmers prepare sufficient planting materials of OFSP improved varieties. Those planting materials are supplied by seed multipliers officially registered by RAB.
- The timing of planting is critical to farm success. Planting sweet potatoes as early as possible in the rainy season is beneficial in terms of maximizing the growing period. At the hillside, farmers are recommended to grow OFSP in September (A Season) and in March (B Season). In marshland, farmers can grow anytime, preferably before the rainy period.

#### Planting methods

- Planting is mostly done by hands, but farmers can plant sweet potatoes using forked sticks to dig holes.
- Use the top 30 cm of the vine and plant 2/3rds in the soil at least 2 nodes below the surface. Just plant 1 vine per hole. Plant the vines 30 cm apart. Position the slip so that the bottom half will be covered with soil while the top half with all the new leaves is above ground (*See Pictures No. 2 and No. 3*).
- Carefully fill the hole with soil so that the new leaves and stem will not be bruised.
- The vines should be growing well with no wrinkles or different colors. Those signs mean the plant has a virus.



Picture No. 2: one vine is planted per hole.



Figure No. 2: Stem cuttings with 25-30 cm long for planting sweet potato



Picture No. 3: 2/3rds of the vine is planted in the soil at least 2 nodes below the surface



### Fertiliser application

- Organic manure is applied by spreading 25 – 30 kg per Are and then incorporating it into the soil prior to planting. NPK 17-17-17 at a rate of 42 g per sq. meter or urea at 13 g per sq. meter are recommended as fertilizer application. 6 – 8 weeks after planting, during the storage roots initiation phase.

- Sweet potato, as with most root crops, absorbs more potassium (K) as it is the most important element for storage root development, and so in many places, sweet potato will need extra potassium. It can be provided using ash, as ash is rich in potassium.

**Post planting management activities**

Field management activities involve post-planting activities that need to be undertaken. Those key activities comprise watering, weeding, gap filling.

**Watering**

Although sweet potato is considered to be fairly drought tolerant, water is one of the most limiting factors for sweet potato production. The effect of drought conditions depends on when during the growth stage, the water shortage occurs. A well-distributed rainfall during the growth cycle is sufficient for high productivity. If necessary, watering can be used to ensure that the orange sweet potato crop can be established in moist soil and has sufficient water throughout the growing season.

Watering helps soften the soil for root initiation and maintain adequate soil moisture for plant growth. Watering also activates applied fertilizers. Water in the evening or morning when it is comparatively cool and thus less loss of moisture through evaporation. Withdraw watering two weeks prior to harvesting to allow for hardening off.

**Weeding**

There is also a need to minimize competition for nutrients by weeding whenever necessary. If weeds are not controlled during plant establishment and within the first two months after planting, they compete with the sweet potato plants for nutrients and water and may harbor pests and diseases. Weeds are typically removed manually.

**Hoeing and Hilling up**

Hoeing is an operation in which soil around plants is loosened. Hilling-up is done to ensure that the developing storage roots are well covered and not exposed to sun or attack by weevils. Soil is hoed up around the base of the plant, closing cracks in the soil caused by expansion of storage roots or erosion of the ridge or mound away from the crown of the plant.

**Harvesting and post-harvesting activities**

**The time of harvesting**

- Sweet potato roots is determined by the variety’s maturity period, the environmental conditions (soil condition, weather, water supply, etc.), pest and diseases incidence need to use the field for planting the next/ consecutive crop, the economic value of the next/ consecutive crop and labor availability.
- Sweet potato roots are typically ready for harvesting between 3 and 8 months after planting, depending on the altitude (agricultural zones). Generally, many varieties are normally ready from 4 to 5 months after planting.

**Harvesting**

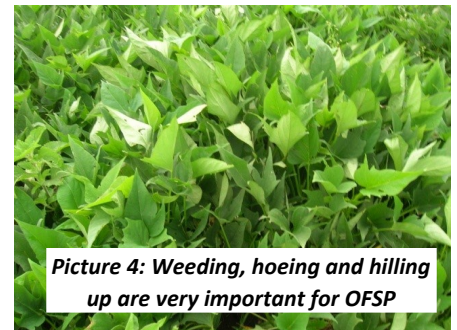
- Low yields can result if the crop is harvested too early or too late. If too early, the storage roots will not have had enough time to develop to their maximum size. If too late, the storage roots may have become fibrous or have been attacked by weevils or root rots. However, other factors such as the immediate need for food, cash, or land may be bigger priorities than the amount of lost potential yield.
- Farmers can harvest roots after 3-5 months by digging carefully. Only remove larger roots, do not damage others. Re-cover the remaining roots well, so they continue to grow without weevil damage. If harvesting a lot at once, cut the vines 2-3 days prior to the harvest so the skin of the sweet potato hardens, and the roots will stone longer outside of the ground.

**Post-harvest, how to safely pack and transport fresh sweet potato roots**

- Proper harvesting and post-harvest handlings are important because sweet potato root is usually covered by a thin layer of skin that is easily broken.
- In post-harvest activities, the tubers should not be injured for keeping the market value. Also, it is recommended that harvested sweet potatoes are packed by ventilated bags during transportation (See Pictures No. 5 and No. 6).

**Factors underlying low sweet potato yields and recommendations to address them**

Factor contributing to low yield	Recommended practice
Use of varieties with low yield potential	Use high yield varieties
Failure to plant on time under rain fed condition	Have planting material available when required
Poor quality planting material	Use healthy planting material
Poor cultural practices, including water management, weeding, fertility,...	Ensure water at planting and early growth, weeding, fertility,...
Pests (particularly weevil) infestation and rodents	Prevent weevil infestation by using clean planting material, preventing cracking of the soil by “hilling-up” and timely harvest.



Picture 5: Handling with care in harvesting



Picture 6: sweet potatoes are packed by ventilated baqs



# Orange Fleshed Sweet potatoes

## Pests and diseases control






Manual Number: SMAP-NDC-05

### Pests and diseases control

The diseases of sweet potatoes frequently known are the Sweet potato virus and fungal disease (blight). The pests are Sweet potato weevils. The pests and diseases are blown in the wind or spread through the movement of infested soil, plant materials, agricultural tools, shoes, and livestock.

The characteristics, symptoms, and control methods of important pest (Sweet potato weevils) and disease (Sweet potato virus) in Rwanda are presented in the table below:

Name & Characteristic	Control Method
<p><b>1. <u>Sweet potato weevils</u></b></p> <ul style="list-style-type: none"> <li>● Many weevils found on foliage indicates roots heavily infested</li> <li>● In vine and roots: Feeding and egg-laying punctures</li> </ul> <div style="display: flex; justify-content: space-around;">   </div>	<ul style="list-style-type: none"> <li>● Use of clean planting materials;</li> <li>● Hilling up soil around the roots protect them from infestation;</li> <li>● Crop rotation;</li> <li>● Field sanitation: Destroying volunteer plants and old plant material;</li> <li>● Use of natural enemies;</li> <li>● Timely harvesting;</li> <li>● Plot separation by planting new crops at a long distance from old crops as OFSP weevils do not fly farther than 500m to 1000m.</li> </ul>
<p><b>2. <u>Sweet potato virus</u></b></p> <p><u>Cause:</u> one Virus spread by aphids, other by whiteflies.</p> <ul style="list-style-type: none"> <li>● On infected plants, growth is diminished (stunting);</li> <li>● Pigmented leaves;</li> <li>● Reduced production of storage roots.</li> </ul> <div style="text-align: center;">  </div>	<ul style="list-style-type: none"> <li>● Use clean sweet potato planting materials;</li> <li>● Destroy any plants showing signs of infection;</li> <li>● Use resistant varieties;</li> <li>● Rotate crops by season;</li> <li>● Plant new crops at a distance from old crops;</li> <li>● Take cuttings from young plants.</li> </ul>



# Avocado

## Cultivation Technics



Manual Number: SMAP-NDC-06



### Seedling preparation

Avocado seedlings are prepared in a nursery bed. They are grafted and then planted in the main field.

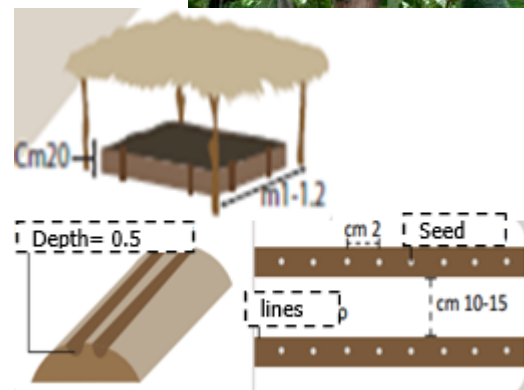


### Seedbed preparation

There are 2 methods for raising avocado seedlings:

- To make a seedbed, sow in the bed avocado pits and prick them out into nursery pots after germination.
- The direct sowing method of avocado is directly put the seed into the nursery pots.

- For the first method, make high ridges with a height of 20-30cm and a width of 1 –1.2m
- Apply 3 handfuls of well-decomposed manure (3-5 kg) for 1sqm.
- Make sowing ditches with a depth of 5 cm and a spacing between lines of 10 cm by using a stick.
- Seeds are sowed into ditches closely each other, the top upward and slightly above the soil, then, it is covered with mulching grasses and watered every day.
- Roof the seedbed with dried grasses.
- It is recommended to check the seedling condition frequently. If any seedling has disease signs, it should be removed and burned.
- As the nursery bed is subjected to fungus diseases such as damping off and phytophthora, it is recommended to spray fungicides (Copper Hydroxide - Funguran or Sulphur (Thiovit) (50 g/ 20 liters of water), and insecticides: Lambda-Cyhalothrin (15 ml / 20 liters of water).



### Making a nursery bed, pricking seedlings and management.

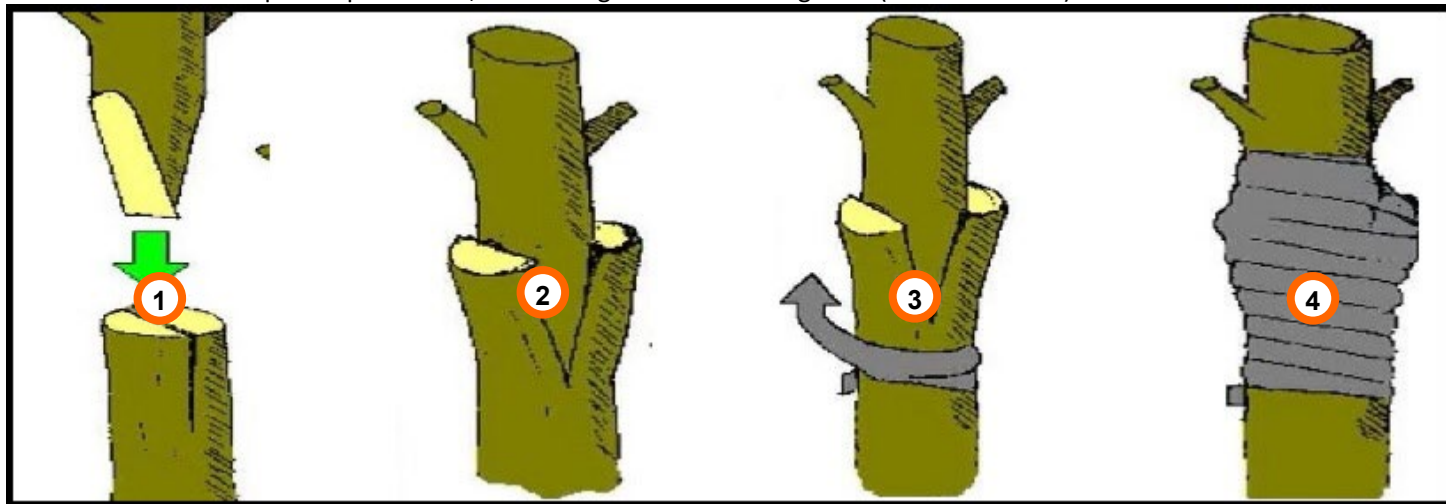
- A nursery bed should be established near a water source to ease watering and near a road to ease seedling transportation.
- After choosing a place where the nursery is established, proceed with the following steps:
  - Level well the nursery place.
  - Measure the land with the width of 1.20 m for the nursery bed and the width of 50 cm for foot pass, and delimiting the land with stakes.
  - Surround the measured land with tree stems that can protect nursery pots.
  - Make a Roof above the nursery bed with dried grasses.
  - Fill the Seedling pots with a mixture of soil and well-decomposed manure at a ratio of 2:1 (Example: 2 baskets of soil and one basket of manure). You can add sand in case of clay soil. Seedling pots have a diameter of 15-20 cm and a height of 20 cm.
  - Place the pots under the roof.
- After germination, when the seedlings have reached 10cm of height, they are pricked out into perforated polyethylene pots.
- It is important to maintain the seedlings by regular watering, weeding, etc. They have to be grafted before they are transplanted in the main field.



### Grafting seedlings

- At 4 to 5 months after germination, when the seedlings have a size of a pen and 30-40cm of height, it is the proper timing for grafting.
- The graft should be taken from a variety of good production and good taste, with at least 2 well-formed eyes (buds) and 10 cm of length and size of a pen.
- Cut the upper part of the rootstock at 10 to 15 cm above the root bulb, where the stem is hardening.
- Cut the basal part of the graft, trim on both sides of the shoot at around 1-2cm. Remove the leaves of the shoot but keep the peduncles.
- Make a slit in the middle of the rootstock section with the length of 1-2 cm.
- Insert the graft cut into a slit made in the middle of the rootstock section to coincide the two sapwoods.
- Ligate with the plastic film at the level of the wounds to reinforce the contact between the graft and the rootstock.

- Cover the graft up to the insertion part with transparent plastic film then... for preventing air, water or other product to enter
- Check frequently if the grafts are healthy and if budding is started. The degree of moisture can be checked by perspirations inside the transparent plastic film that is covering the graft.
- Remove the transparent plastic film, when the graft starts making buds (after 2-3 weeks).



## Grafting with old plants

- The non-grafted old trees can also be grafted.
- The tree is cut in a dry period at 30cm above the root bulb.
- The trunk grows a lot of shoots, which are removed to remain with 3 well-grown shoots, which will be grafted at 30-40 cm of length.
- The grafting methods are the same as for seedlings raised in a nursery bed.

## Transplanting in the main field

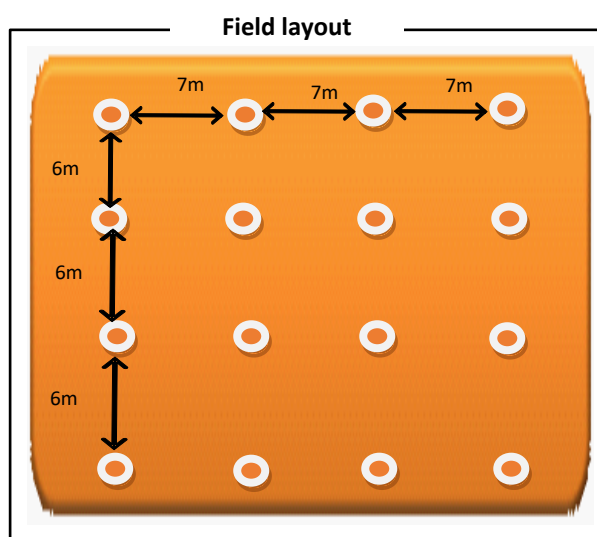
- It is recommended to plant avocado seedlings at the beginning of the rainy periods to ensure they get enough water for root development. It is better to be done in September and October.
- The seedling should be planted early morning or late afternoon to avoid withering caused by direct sunlight.
- Grafted seedlings are transplanted 3 to 4 months after grafting.
- Avocado tree grows well under moderate precipitations (1250-1750 mm per year), on well-drained and loose soil.
- Avocado can grow at an altitude less than 2500m for varieties like Fuerte, Hass and Ettinger which are preferred to provide grafts.
- It grows well on soil with pH of 5.5-6.
- Before planting avocados, the field should be ploughed at a depth of about 15 to 20 cm. Debris in the field should be removed. Then, the field is leveled.

## Field layout

- For avocado cultivation, the recommended spacing is 6-7m between trees and between lines as well. It means that 278-204 trees can be planted on a field of 1Ha of the surface. In this case, farmers can intercrop with other short-cycle crops like beans, soybeans, and etc.
- The field layout figure on the right side of the page show spacing put in the plants when planting avocados.

## Methods for planting avocado tree

- Make a planting hole of 60 by 60 cm in the prepared soil.
- Put aside the soil from the hole and mix it with well-composed manure (2 basins) before it is returned into the hole and fill it.
- Put the seedling in the middle of the hole. Before planting seedlings, it is recommended to remove the polyethylene plastic pots which have been protecting the root balls, then fill them with soil until the level of root balls.
- Compact the soil around the seedling.





- During the first week after transplanting, the seedlings should be protected from sunshine, and it is important to water after transplanting at least once or twice a day when there is no rain.

## Post planting management activities

- Within the juvenile period of avocado trees, other crops such as beans of a short cycle can be planted in the middle of rows to allow proper management of trees. Alternatively, fodder herbs that cover the soil, like desmodium, can be planted.

## Mulching

- Mulching should be applied around the base of trees, but not to close the stem.
- Well-dried grasses can be used for mulching. Mulching is effective for keeping the soil moisture and preventing weeds from growing in the field.
- Thick mulching is applied by keeping the distance of 5-10cm from the plant stems to prevent the transmission of pests and diseases and pests from mulching materials to the plant.

## Watering

- Watering must be done directly after planting. It is also done whenever necessary.
- Water gently without wetting leaves in order to prevent the plant from the contagion of soil-borne diseases.

## Weeding

- Weeding can contribute to the destruction of weeds.
- It can be done by hoe, but special attention will be required not to injure the roots.
- Weeding is done whenever weeds appear on the field.
- Weeds can become the host of pests and diseases and can block plants from growing by taking nutrients from the soil and by competing with seedlings for sunlight.

## Topdressing

- At transplanting time, 50kg of manure mixed with 200g of superphosphate should be applied into a planting hole. From the first year, apply the top dressing (NPK 20-10-10) in the following manner: 0.5 kg/tree in the 1st year, 1 kg/tree in the 2nd year, and 1.5 kg/tree from the 3rd year.

## Pruning avocado tree

### Pruning avocado tree: training size

- In the first year after transplanting avocado, it is recommended to conduct side shoot pruning and remove dried shoots.
- At the upper part of a tree, the growing graft is pruned at the height of 40 cm. At the same time, new 3-5 shoots are also pruned at the length of 40 cm to allow them to grow.
- This pruning practice will be continued until the avocado tree reaches 2m.

### Pruning avocado tree: maintenance size

- For good maintenance of grafted avocado tree, it is recommended to continue removing all side shoots and branches bent or dead to allow light in all parts of the tree.



## Harvesting avocado fruits and post-harvest handling

### Time for harvesting

- Grafted avocado will start bearing fruits after 3-4 years.
- The production cannot be the same every time, and it depends on the variety and the region. Old trees can have 500 fruits per year.

### Sorting and grading avocado fruits

- It is recommended to make sorting of avocado fruits by selecting unmaturred, stunted, damaged, and those with the disease.
- Sorting and grading may increase the selling price by around 40 to 60%.
- Sorting and grading may contribute to a decrease in post-harvest loss.



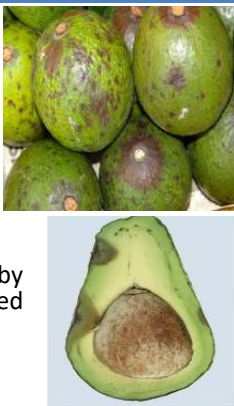


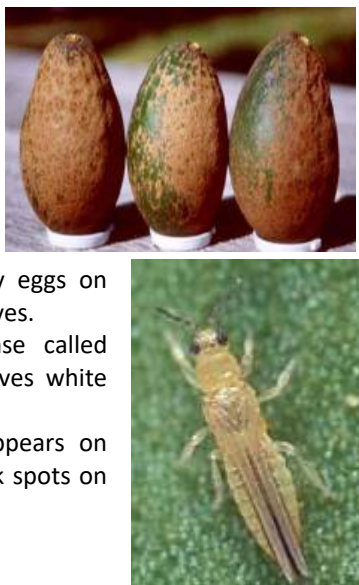
# Avocado

## Pests and diseases control



Manual Number: SMAP-NDC-06

### Major pests and diseases in Rwanda

Name & characteristics	Control methods
<p><b>Anthraxnose</b></p> <ul style="list-style-type: none"> <li>It is caused by a fungus called <i>Colletotrichum gloeosporioides</i>.</li> <li>It attacks young stems, branches, leaves, and fruits.</li> <li>The symptoms are mainly found on leaves as grey spots. Later, the leaves fall, and the tree is torn.</li> <li>It spreads during the rainy period, by planting infected seeds or by using infected grafts.</li> </ul> 	<ul style="list-style-type: none"> <li>Pruning branches to allow sunlight to the tree.</li> <li>Planting grafted and healthy seedlings.</li> <li>Spraying fungicides such as Copper oxychloride/hydroxide, carbendazim or chlorothalonil.</li> </ul>
<p><b>Scab</b></p> <ul style="list-style-type: none"> <li>It is caused by a fungus called <i>Sphaceloma percae</i>.</li> <li>Brown spots appear on the fruit exocarp, and they make cracks of the fruit exocarp, which will be rot. It occurs mainly on those varieties with thin and soft exocarp. It is not such a dangerous disease.</li> <li>The fungus attacks mainly the veins of leaves in the upper part of the plant.</li> </ul> 	<ul style="list-style-type: none"> <li>Remove all the infected plants from the field.</li> <li>Clean the field by removing the fallen fruits.</li> <li>Apply the fungicides such as Copper oxychloride/hydroxide, carbendazim, or chlorothalonil.</li> </ul>
<p><b>Cercosporiose spots</b></p> <ul style="list-style-type: none"> <li>It is caused by a fungus called <i>Sphaceloma purpurea</i>.</li> <li>The fungus attack mainly fruits and leaves, and the infected fruits have yellow or brown spots.</li> <li>It spreads during the rainy periods or under high humidity conditions in the field.</li> <li>It also spreads during watering activities.</li> </ul> 	<ul style="list-style-type: none"> <li>Apply the fungicides such as Copper oxychloride/hydroxide, carbendazim, or chlorothalonil during flowering periods, fruiting, and after harvesting.</li> <li>Clean the field by removing the fallen avocado fruits.</li> </ul>
<p><b>Thrips</b></p> <ul style="list-style-type: none"> <li>Thrips have many varieties, and they make fruits turn different colors like white, black or brown.</li> <li>They are spread through agriculture tools.</li> <li>They damage fruits mainly during dry periods. They lay eggs on leaves, and larvae eat the leaves.</li> <li>They can carry virus disease called tospovirus, which makes leaves white and dried.</li> <li>The virus disease mainly appears on branch buds and leaves black spots on flowers.</li> </ul> 	<ul style="list-style-type: none"> <li>Visit and observe the field frequently.</li> <li>Weed properly.</li> <li>Keep an appropriate spacing between plants.</li> <li>Apply organic insecticide made from the plants like chili pepper, tobacco or pyrethrum, etc.</li> <li>Spray an insecticide such as UMEME (Lambdacyhalothrin, Imidachloprid (confidor), Aster extrim, cypermethrin, Rocket)</li> </ul>



## Tamarillo (Tree tomato)

### Cultivation Technics

Manual Number: SMAP-NDC-07



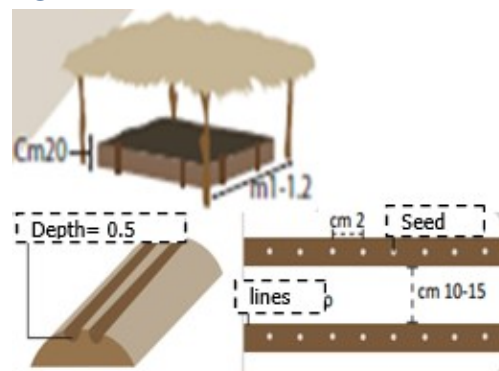
#### Seed preparation

- Tree tomato seeds are prepared from well-grown and matured tree tomato picked up at the first time of harvesting and without any sign of disease to avoid seed-borne diseases.
- Pick up well-grown fruits without any disease and well ripen (with red or yellow color).
- Put those fruits in a dark environment for shriveling for one or two weeks.
- Wash them in a diluted solution of chlorine bleach at 1%. For Example, For Jik with a concentration of 5%, one cup is diluted with 3 cups of water. When bleach is not available, you can use concentrated salt. This can sterilize the skin of fruits.
- Bisect tree tomato, remove all the inner content, including seeds using a spoon and put it into a bucket, add water and close it well, then keep for fermentation during 1-2 days while shaking bottle at least once per day (morning or evening time) to mix well the content.
- Wash fermented seeds into a diluted solution of chlorine bleach (Jik) at 1% to sterilize them. You must wash well and remove all aryl flesh until the seeds are well cleaned.
- Washed seeds are put on paper or tissue under the shadow to wring out water.
- Then spread out seeds on a flat basket under the shadow for 3 to 4 days, mix many times to avoid that them stick together.
- The seeds produced can be sowed directly. In case that they are not sowed immediately, it is kept in a clean and dry container like a paper bag, but it cannot exceed 3 months to avoid losing germination capacity. When the seeds will be sown after keeping longer, they should be immersed for a half-day to induce seed germination.



#### Making seedbed, sowing seeds, and seedbed management

- The location of seedbed should be away from other tree tomato fields and avoid fields which were planted with solanaceous crop (tomatoes, Irish potatoes, pepper and eggplants).
- Make high ridges with a height of 20cm and a width of 1 –1.2m.
- Apply well-decomposed manure: 3 handfuls (3-5 kg) for 1sqm.
- Make sowing ditches with 0.5 – 1 cm of depth using a stick, with a spacing of 10 –15 cm between lines.
- Seeds are sowed into ditches, with 2cm intervals, then covered by a thick layer of soil.
- Cover the seedbed with mulching of well-dried grasses, which will be removed after seeds start germinating.
- The roof should be built above the seedbed to protect seedlings against strong sunshine. However, the roof must have spaces for solar rays because seedlings also require few solar lights to grow.
- It is recommended to visit the seedbed frequently to check seedling conditions. If any seedling has the sign of a disease, then it should be removed and burned.
- It is recommended to water seedbed early in the morning before sunrise or late in the evening after sunset. Water should not remain stagnant or stay in the seedbed.
- When is required, spray chemicals to prevent pests and diseases which attack seedlings (Mancozeb, 50g/litter, Copper Hydroxide - Funguran, or Sulphur (Thiovit): 50 gr/ 20L of water and insecticide: Lambda-Cyhalothrin 15 ml / 20 Liters of water).



#### Making nursery bed, transplanting seedlings into pots, and raising seedlings

- Nursery beds should be established near a water source to ease watering and near a road to ease seedling transport. Meanwhile, it should be away from another tree tomato to avoid disease contaminations.
- After choosing where to place the nursery, you proceed to the following steps:
  - Level well the place of the nursery.
  - Measure the land with 1.20 m of width and 50 cm for foot pass and delimitating by stakes;
  - Strip lands are surrounded by tree stems that protect nursery pots.
  - Make a roof and covering it with dried grasses.
  - Fill into seedling pots a mixture of soil and well-decomposed manure at a ratio of 2:1 (Example: 2 baskets of soil and one basket of manure). Seedling pots have 8-10 cm of diameter and 15 cm of height.
  - Put the pots in strip lands.

- When seedlings have at least 5 cm of height and 2 to 3 leaves, around one month after sowing in the seedbed, they are transplanted into nursery pots.
- Before uprooting seedlings, it is recommended to water the seedbed with enough water in order to ease uprooting without damage roots.
- Uproot each seedling using a small well-cut stick or knife, then put it in a nursery pot.
- Seedlings must be well maintained by frequent watering, weeding, and control of diseases and pests when it is required. It is also important to make a roof to protect from strong sunshine. The roof is gradually removed as seedlings are growing.
- After around 2 months, seedlings will have around 20 cm of height. They can be planted in a prepared main field.



## Land preparation and planting seedlings

- Tree tomato grow well in all agro-ecological zones of Rwanda from lowlands to the highlands.
- Select a field that has not been planted with tree tomato at least for a period of one year, and it must be away from old fields for 50m in the opposite direction of the wind to avoid transfer of pests and diseases by the wind from old fields.
- Before transplanting, the field should be ploughed at a depth of about 15 cm to 20 cm. Debris in the field should also be removed. Then the field is leveled.



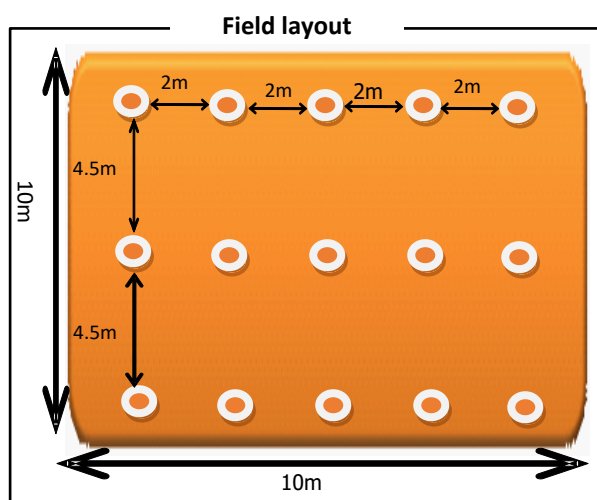
## Field layout

- Make planting holes of 40 cm of width and 40 cm of depth with a spacing of 2m between lines and 4.5-5m between holes, as it is shown in the left side figure.
- The lines must be in a horizontal direction which helps to avoid erosion.



## Planting

- The soil taken from each planting hole is mixed with well-decomposed manure and returned into the hole. It requires around 160 – 320 kg of manure per one are (one basin per hole).
- Remove the polyethylene plastic pot and put the seedling in the middle of the hole, and add the soil in the manner that the soil reaches the same level as the seedling motte.
- Only healthy seedlings with green leaves without any disease should be planted.



## Time for planting

- It is recommended to plant tree tomato seedlings at the beginning of the rainy period to ensure they get enough water for root development.
- Seedlings should be planted in the early morning or late afternoon to avoid withering caused by direct sunlight.



## Post planting management activities



### Mulching

- Well-dried grasses can be used for mulching. Mulching is effective for keeping the moisture of the soil and prevent weeds from growing in the field.
- Thick mulching is applied at 10cm from the plant stem to prevent the transfer of diseases and pests from mulching material.



### Watering

- Watering must be done directly after planting seedlings. It is also done every day there is no rain or when it is insufficient.
- Water gently without wetting the leaves to avoid contagion of soil-born diseases.



### Weeding

- Weeding is done every time when weeds appear in the field.
- Weeds can be the origin of pests and diseases, and they block plants from growing because they take nutrients from the soil and compete with seedlings for sunlight.

## Topdressing

- For the good growth of plants, it is important to apply enough fertilizer to the soil. Tree tomato require both manure and chemical fertilizers. It is not recommended that the amount of fertilizer plant need is applied once at planting time, yet it is applied in different steps. Topdressing is applied around the plant at the ends of the roots.
- Fertilizer application is divided into 3 batches as follow:  
The first application at planting time, the second after 4 months and the last one after 8 months, in raining time. From the following years, the chemicals are divided into 3 batches and applied every 4 months, as the table below.

**The required amount of fertilizer apply every year per each tree. (g/tree)**

Year	Urea	DAP	Ammonium sulfate	KCl
1	74	52	127.5	266
2	52	104	262.5	625
3	39	156.5	382.5	918

**Remark:** In case farmers cannot find weighting scale for measuring the amount of fertilizer to apply per tree, they can use some items around them like a cup of water bottle. One cup full of fertilizer is 10 grams.

## Harvesting tree tomato and post-harvest handling

### Time for harvesting

- Tree tomato is harvested when they are well matured and the color of the fruit changed to red or yellow according to the variety.
- Harvesting should be done early morning or late afternoon to avoid water loss caused by strong sunshine.

### Methods for harvesting

- Tree tomato is harvested within their peduncle to avoid rotting.
- It is important to avoid harvested fruits stay under strong sunshine because sunshine causes post-harvest production loss.

### Sorting and grading tree tomato

- After harvesting tree tomato, sorting is removing unmaturred, stunted, damaged, and those with the disease.
- Sorting and grading increase production selling prices by around 40 to 60%.
- Sorting and grading decrease post-harvest loss as:
  - It prevents fruit disease contamination in case there are infected fruits.
  - It decreases damages by ethylene gas (For example, pre-ripening), which normally occurs damaged or ripen fruits are mixed healthy and unripe fruits.
- When sorting is done, fruits are put into grades according to size, ripening, etc.








# Tamarillo (Tree tomato)


## Disease and pest control



Manual Number: SMAP-NDC-07

### Major Diseases and pests in Rwanda

Name & Characteristics	Prevention and control methods
<p><b><u>Powdery mildew</u></b></p> <p>Cause: Fungus</p> <ul style="list-style-type: none"> <li>It mainly appears on the upper leaf surface, on the young stem, on the plant apical part, on flowers and fruits.</li> <li>It is evident as pale grey spots.</li> <li>Flowers first become yellow, dry, then become black and die.</li> <li>Infected leaves become yellow and may drop from all branches.</li> </ul> 	<p><b>Prevention:</b></p> <ul style="list-style-type: none"> <li>Use of healthy seeds from approved seed multiplier.</li> <li>Avoid planting tree tomato closer to old tree tomato fields.</li> <li>Respect plant spacing.</li> <li>Avoid watering when it is not necessary.</li> </ul> <p><b>Control:</b></p> <ul style="list-style-type: none"> <li>Use of fungicide containing sulfur such as Thiovit.</li> <li>They can be controlled by using milk (a half-liter of milk diluted into 4 L of water then apply it on the infected plant).</li> </ul>
<p><b><u>Virus diseases of Tree tomato</u></b></p> <ul style="list-style-type: none"> <li>Tree tomato has many kinds of virus diseases which cause the plant stunting and spots which appear on fruits reduce the quality of production.</li> <li>The plant leaves become yellowish-green color, young leaves curl, and apical part stunts.</li> <li>Matured fruits become yellow-reddish color, harden, and low juicy.</li> <li>Young fruits present mixed in red and green color. Flowers drop, and terminal buds dry.</li> </ul>	<p>Virus disease is difficult to control after symptoms appeared. However, prevention methods are most important:</p> <ul style="list-style-type: none"> <li>Remove infected plants.</li> <li>Balanced fertilization to grow strong plants.</li> <li>Control of aphids and other vector insects.</li> </ul> 
<p><b><u>Whitefly</u></b></p> <ul style="list-style-type: none"> <li>They feed minerals from the plant host.</li> <li>They leave excreta on leaves and fruits then the color of leaves and fruits will change.</li> <li>They live under the leaf</li> </ul> 	<p><b>Prevention:</b></p> <ul style="list-style-type: none"> <li>Monitor the field frequently and remove the old leaves, which attract a lot of flies.</li> <li>Proper weeding.</li> <li>Avoid using the same tools from infected plants to healthy ones.</li> <li>Use of yellow sticky traps.</li> </ul> <p><b>Control:</b></p> <ul style="list-style-type: none"> <li>Use of insecticide such as:                     <ul style="list-style-type: none"> <li>*Lambda-cyhalothrin (Lamdex): Dilute 15 ml into 20l of water.</li> <li>*Alpha cypermethrin: Dilute 20 ml into 20l of water.</li> <li>*Abamectin: Dilute 10 ml into 20l of water.</li> </ul> </li> </ul>
<p><b><u>Aphids</u></b></p> <ul style="list-style-type: none"> <li>Aphids feed plants gregariously.</li> <li>They parasitize mainly young leaves and stems, flowers as well as lower leaves.</li> <li>They are a vector of a wide range of viruses.</li> <li>Their excreta causes black fungus, which covers the surface and inhibited photosynthesis.</li> </ul> 	<p><b>Prevention:</b></p> <ul style="list-style-type: none"> <li>Preservation of natural enemies such as ladybug.</li> <li>Remove old leaves to lighten the field.</li> <li>Avoid much nitrogen</li> <li>Use of yellow sticky traps.</li> </ul> <p><b>Control:</b></p> <ul style="list-style-type: none"> <li>Use of insecticide such as:                     <ul style="list-style-type: none"> <li>*Lambda-cyhalothrin (Lamdex): Dilute 15 ml into 20l of water.</li> <li>*Alpha cypermethrin: Dilute 20 ml into 20l of water.</li> <li>*Abamectin: Dilute 10 ml into 20l of water.</li> </ul> </li> </ul> 

Name & Characteristics	Prevention and control methods
<p><b>Thrips</b></p> <ul style="list-style-type: none"> <li>■ Trips and mites are dangerous in dry periods.</li> <li>■ They eat leaves surface and make them pale color;</li> <li>■ On fruits, they make a wound.</li> <li>■ They multiply in clones on the lower part of the leaf, which weighed it down.</li> </ul> 	<p><b>Prevention:</b></p> <ul style="list-style-type: none"> <li>■ Remove weeds and grasses within and around the field.</li> <li>■ Plough the soil after harvesting.</li> <li>■ Proper spacing between plants.</li> <li>■ Use of bleu or white sticky traps.</li> </ul> <p><b>Control:</b></p> <ul style="list-style-type: none"> <li>■ Use of insecticide such as:</li> </ul> <p>*Lambda-cyhalothrin (Lamdex): Dilute 15 ml into 20l of water.</p> <p>*Alpha cypermethrin: Dilute 20 ml into 20l of water.</p> <p>*Abamectin: Dilute 10 ml into 20l of water.</p>



## Passion fruit Cultivation Technics



Manual Number: SMAP-NDC-08



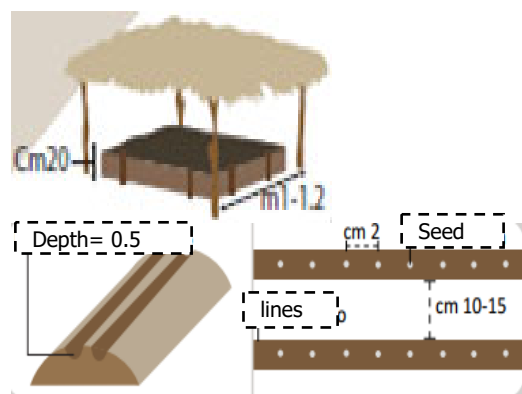
### Seed preparation

- Passion fruits seeds are prepared from well-matured passion fruits.
- Seeds likely to provide good quality seedlings must be prepared from fruits picked up at the first time of harvesting and without any sign of disease to avoid seed-borne diseases.
- Select a well-grown passion fruit tree that bears many and bigger fruits.
- From the tree, select well-matured passion fruits, flawless and well ripen.
- Put the fruits in a dark environment for shriveling for about one or two weeks.
- Fruits are washed into a diluted solution of chlorine or bleach at 1%. Example: For Jik with a concentration of 5%, one cup is diluted with 3 cups of water. When bleach is not available, you can use a concentrated solution of salt. This can sterilize the skin of fruits.
- Bisect passion fruits, remove all the inner content that including seeds, and put it into a plastic container for fermentation for 24 hours.
- Wash in a diluted solution of chlorine bleach (Jik) at 1% to sterilize seeds. You must wash well and remove all aryl flesh until seeds are clean, then spread out on a flat basket under the shadow for 3 to 10 days, and mix well by hands to avoid that which stick together.
- The seeds produced can be sowed directly. In case it is not sowed immediately, it is kept in a clean and dry container like a paper bag, but it cannot exceed 3 months. When the seeds are sown after keeping for longer, they should be immersed for a half-day to induce the seed germination.



### Making seedbed, sowing seeds, and seedbed management

- The location of the seedbed should be away from other passion fruit fields according to the crop rotation principles.
- Make high ridges with a height of 20cm and a width of 1 –1.2m.
- Apply well-decomposed manure: 3 handfuls (3-5 kg) for 1sqm.
- Make sowing ditches with 0.5 – 1 cm of depth using a stick, with a spacing of 10 –15 cm between lines.
- Seeds are sowed into ditches, with 2cm intervals, then covered by a thick layer of soil.
- Cover the seedbed with mulching of well-dried grasses and which should be removed after the seeds start germinating.
- The roof should be built above the seedbed to protect seedlings against strong sunshine. However, there must be spaces for solar rays because seedlings also require few solar lights to grow.
- It is recommended to visit the seedbed frequently to check seedling conditions. If any seedling has the sign of a disease, then it should be removed and burned.
- It is recommended to water seedbed early in the morning before sunrise or late in the evening after sunset. Water should not be stagnant or stay in the seedbed.
- When is required, spray chemicals to prevent pests and diseases attack seedlings: Copper Hydroxide - Funguran, or Sulphur (Thiovit): 50 gr/ 20L of water) and insecticide: Lambda-Cyhalothrin 15 ml / 20 Liters of water.



### Making nursery beds, transplanting seedlings into pots, and raising seedlings.

- Nursery beds should be established near a water source to ease watering and also near a road to ease seedling transport. Meanwhile, it should be away from other passion fruit fields to avoid disease contaminations.
- After choosing where to place the nursery, you proceed to the following steps:
  - Leveling well the place of the nursery.
  - Measuring the lands of 1.20 m of width and 50 cm for foot pass and delimitating by stakes.
  - Strip lands are surrounded by tree stems that protect nursery pots.
  - Making up the roof and covering it with dried grasses.



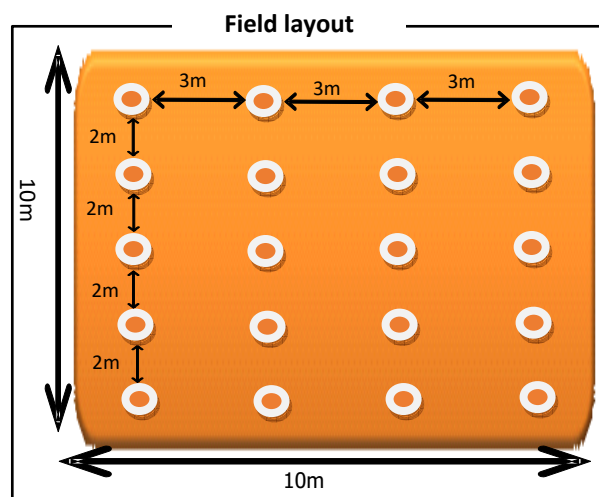
- Fill up into pots a mixture of soil and well-decomposed manure at the ratio of 2:1 (Example: 2 baskets of soil and one basket of manure). Seedling pots have 8-10 cm of diameter and 15 cm of height.
- Put the pots in strip lands between stems of trees surrounding them.
- When seedlings have reached 5 cm of height and 2 to 3 leaves, around one week after sowing in the seedbed, they can be transplanted into nursery pots.
- Before uprooting seedlings, it is recommended to water the seedbed with enough water in order to ease seedling uprooting without damage roots.
- Uproot each seedling using a small well-cut stick or knife, then put it into a nursery pot.
- Seedlings must be well maintained by frequent watering, weeding, and control of diseases and pests when it is required. It is also important to make a roof to protect from strong sunshine. The roof is gradually removed as seedlings are growing.
- After around 2 months, seedlings will have around 20 cm of height, they can be planted in a prepared main field.

## Land preparation and planting seedlings

- Passion fruit trees grow well in all agro-ecological zones of Rwanda from lowlands to the highlands.
- Select a field which has not been planted with passion fruit at least for a period of one year, and it has to be away from old fields for 50m in the opposite direction of a wind, to avoid transfer of pest and diseases by the wind from old fields.
- Before transplanting, the field should be ploughed at a depth of about 15 cm to 20 cm. Debris in the field should also be removed. Then the field is leveled.

## Field layout

- Passion fruits are planted into planting holes of 40 cm of width and 40 cm of depth with a spacing of 2m between lines and 3m between holes, as is shown in the following figure of field layout on the left side of the page.
- The lines must be in a horizontal direction which helps to avoid erosion.



## Planting

- The soil dug from each planting hole is mixed with well-decomposed manure and returned into a hole. It requires around 160 – 320 kg of manure per 1 are.
- Remove the polyethylene plastic pot and put the seedling into the hole into a mixture of soil and manure.
- Only healthy seedlings with green leaves without any disease should be planted.

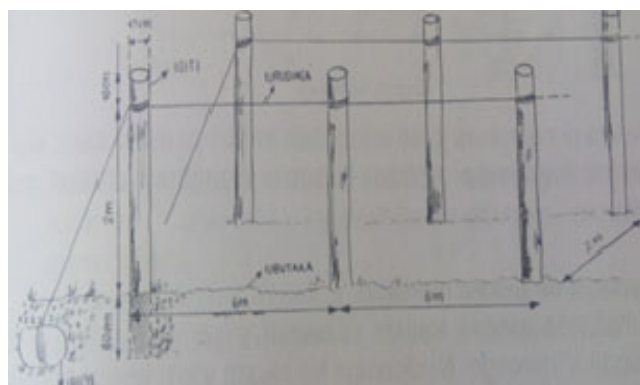
## Time for planting

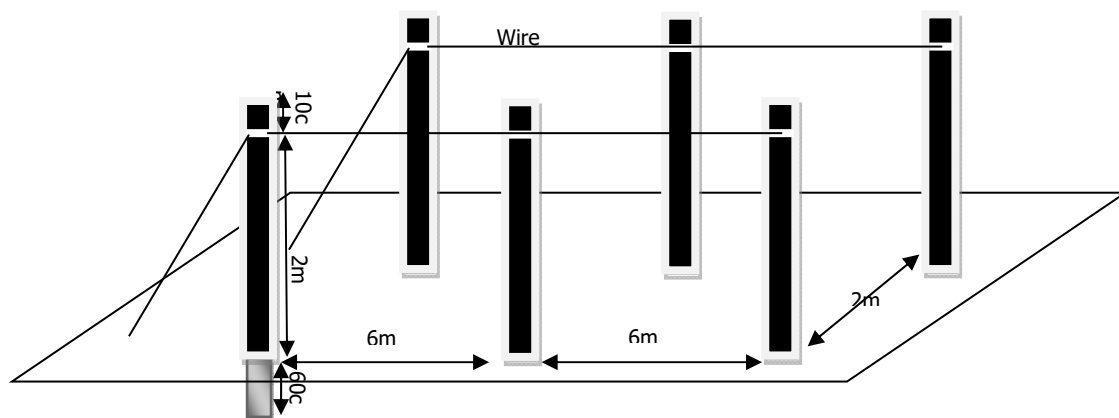
- It is recommended to plant passion fruit seedlings at the beginning of the rainy period to ensure they get enough water for root development. It is better in September and October.
- Seedlings should be planted in the early morning or late afternoon to avoid withering caused by direct sunlight.

## Post planting management activities

### Support structure establishment

- Support structures must be strong to support the weight of the vines.
- Stakes establishment should be done before planting passion fruits seedlings. Use tree stems that have 15cm of diameter and 2.70m of length.
- Stakes are plunged into the soil to remain 2.1m upper soil. They should be spaced 6m apart and oriented north-south.
- Run horizontal wire between stakes at 2m of stake's length.





### Mulching

- Well-dried grasses should be used for mulching. Mulching is effective for keeping the moisture of the soil and protect it, and prevent weeds from growing in the field.
- Thick mulching is applied at 5-10cm from the plant stem to prevent the transfer of diseases and pests from mulching material.

### Watering

- Watering must be done directly after planting seedlings. It is also done every day there is no rain or when it is insufficient.
- Water gently without wetting the leaves to avoid contagion of soil-born diseases.

### Weeding

- Weeding is done every time weeds appear in the field.
- Weeds can be the origin of pests and diseases, and they block plants from growing because they take nutrients from the soil and compete with seedlings for sunlight.

### Topdressing

- For the good growth of plants, it is important to apply enough fertilizer to the soil. Passion fruits require both manure and chemical fertilizers. It is not recommended that the amount of fertilizer plant need is applied once at planting time, yet it is applied in different steps. Topdressing is applied around the plant at the ends of the roots.
- For passion fruits within 1st year after transplanting, the amount of fertilizer to be applied is divided into 3 batches; the first application should be made at the time of transplanting, the second will be done after 4 months, and the last should be done after 8 months, in raining time. From the following years, the chemicals are divided into 3 batches, and applied every 4 months, as the table below shows.

The required amount of fertilizer applied every year per tree. (g/tree)

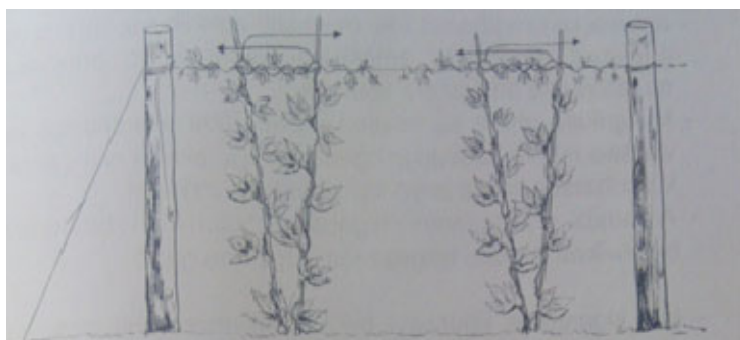
Year	Urea	DAP	Ammonium sulfate	KCl
1	74	52	127.5	266
2	52	104	262.5	625
3	39	156.5	382.5	918

**Remark:** In case farmers cannot find weighting scale for measuring the amount of fertilizer to apply per tree, they can use some items around them like a cup of water bottle. One cup full of fertilizer is 10 grams.

### Vine training and pruning

- Between 2 stakes, 2 passion fruits seedlings are planted with 3 m intervals.
- After transplanting seedlings, when they start growing, select 2 good vines and train them using a stick or string to reach on a top horizontal wire.
- Other vines are pruned to the level of horizontal wire.
- The 2 good vines trained to horizontal wire (or bamboo branch) are reversed from right to left and from left to right.
- The vines that sprout out at the level of horizontal wire are kept for growing, but they are well oriented downward.
- When the vines are near to reach the ground, they are cut at 1.5 m from the ground. They are the ones which bear flowers and fruits.
- As flowers bear on newly grown vines, they are pruned when the harvest is finished to facilitate sprouting out of new vines.
- For pruning, it is better to start by recent fields to the old ones because the old fields contain more diseases.
- Vines and leaves infected with diseases are removed and burned.
- For plants infected with anthracnose disease, you cut the infected vine at 15 cm from the point of infection to the main stem.

- Use well sharpen tools such as scissors, or sickle, to insure hygiene. Before moving from plant to another, clean tools well into bleach.



## Harvesting passion fruits and post-harvest handling

### Time for harvesting

- Passion fruits are harvested when they are well matured, and the fruit's color changed to purple or yellow according to the variety. However, fruits for processing purposes should be harvested when they are fully ripened, even within wrinkles.
- Harvesting should be done early morning or late afternoon to avoid water loss caused by strong sunshine.

### Methods for harvesting

- Passion fruits are harvested within their peduncle, which keeps feeding fruits for nutrients before they are put in a cool place for storage. This extends the life of fruits.
- It is important to use a well sharpen knife to avoid damage to the plant stem.
- Do not leave into the field the remains of plants or harvesting tools after harvesting.
- It is important to avoid putting harvested fruits under strong sunshine during and after harvesting because sunshine causes post-harvest production loss.

### Sorting and grading passion fruits

- Sorting passion fruits is removing unmatured, stunted, damaged, and those with the disease.
- Sorting and grading increase production selling prices by around 40 to 60%.
- Sorting and grading decrease post-harvest loss as:
  - It prevents fruit disease contamination in case there are infected fruits.
  - It decreases damages by ethylene gas (For example, pre-ripening), which normally occurs damaged or ripen fruits are mixed healthy and unripe fruits.
- When sorting is done, fruits are put into grades according to size, color, etc.

### Average production per Ha

- The average production of passion fruits may reach 10 tons per hectare per year. However, when plants are well maintained, the production may increase to 15-20t/Ha.









# Passion fruit Disease and pest control






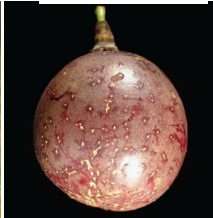


Manual Number: SMAP-NDC-08

## Major Disease and Pest in Rwanda

Name & Characteristic	Prevention and Control Method
<p><b><u>Passionfruit woodiness virus</u></b></p> <ul style="list-style-type: none"> <li>The leaves are often distorted, puckered, and crinkled.</li> <li>The fruit skin become hard or woody and mottling.</li> <li>The fruits are smaller than normal and juiceless.</li> </ul> <p>The infected plant is dwarf; it does not bear fruits <i>NB: This disease is caused by a virus and spread by infected disease, aphids, and agriculture tools,...</i></p> 	<p><b>Prevention:</b></p> <ul style="list-style-type: none"> <li>Plant healthy seedlings from approved dealers/sellers.</li> <li>Manage aphids that may spread the diseases.</li> <li>Not close the field with the old one.</li> <li>Remove infected plants and burn and bury them in the ground.</li> <li>Remove and bury other remains of crops from and around the field.</li> <li>Other agriculture/ harvesting tools (scatter, knives, machetes, etc.) must be cleaned by chloride or by fire.</li> <li>Make a crop rotation.</li> <li>Weeding and cleaning the field.</li> <li>Pruning regularly to remove the parts of plants where insects hide.</li> </ul> <p><b>Control:</b></p> <ul style="list-style-type: none"> <li>There are no chemicals to control the virus. Therefore preventive methods are most recommended, like control of aphids which may spread virus.</li> </ul>
<p><b><u>Cucumber mosaic virus</u></b></p> <ul style="list-style-type: none"> <li>Leaves are distorted or deformed, mainly at the upper part of the leaves.</li> <li>Leaves change their normal color to the yellow lesion.</li> <li>The whole plant is stunted.</li> <li>Matured fruits are abnormally ripened, showing up light green or yellow lesions.</li> <li>The virus which spreads this disease is found in numerous plants or weeds which grow in the field (Solanaceae, cucurbits, etc.).</li> </ul> 	<p><b>Prevention:</b></p> <ul style="list-style-type: none"> <li>Planting healthy seedlings from approved dealers/sellers</li> <li>Pruning of vines to reduce the plant canopy in order to let wind pass through and fungicide reach all parts of the plant.</li> <li>Remove infected parts of the plant (leaves, fruits, etc.) and bury or burn them.</li> <li>Cleaning the field: remove and bury the dropped leaves and fruits.</li> <li>The off-type crops and self-germinated passion fruits should be removed from the field as their origin is unknown.</li> <li>Apply fungicides timely for disease prevention.</li> <li>Under cold weather, spray fungicide every week.</li> </ul> <p><b>Control:</b></p> <ul style="list-style-type: none"> <li>Sulfur (Thiovit): Dilute 50gr of fungicide into 20L of water.</li> <li>Copper hydroxide 50WP (Funguran): Dilute 40gr of fungicide into 20L of water.</li> <li>Tebuconazole (Orius): Dilute 20ml of product into 20L of water.</li> <li>Chlorothalonil: Dilute 20ml of product into 20L of water.</li> </ul>
<p><b><u>Septoria spot</u></b></p> <ul style="list-style-type: none"> <li>Brown spots appear on leaves, stems, and fruits.</li> <li>On fruits, the spots enlarge to form one large spot.</li> <li>Fruits are not well ripening, or they rot and provide very bad flavor.</li> <li>Even when the disease is not severe, it causes the fall of leaves and fruits, and the crop prematurely died.</li> <li>It is mainly infected by seeds.</li> <li>The disease symptoms can start in a nursery bed.</li> <li>Infected plants can contaminate other nearby plants because of rain or water for irrigation.</li> <li>Septoria spots are spread in the rainy period but appear in the dry period.</li> <li>This disease becomes severe for plants without staking and pruning or in dense.</li> </ul> 	

Name & Characteristic	Prevention and Control Method
<p><b><u>Alternaria passiflorae</u></b></p> <ul style="list-style-type: none"> <li>It causes circular reddish-brown spots on leaves and fruits.</li> <li>On fruits, spots are sunken.</li> <li>When the disease is severe, it causes fruit rotting.</li> <li>Likely to septoria spot disease, it causes falling of leaves and fruits, and the plants die earlier.</li> <li>Likely to septoria spot disease, it spread out during the rainy period.</li> <li>It shows up during the dry period and becomes severe for plants without staking, pruning and for the very closed plant.</li> <li>When it is not well treated, one plant can contaminate the whole field.</li> </ul> 	<p><b>Prevention:</b></p> <ul style="list-style-type: none"> <li>Use pathogen-free seeds.</li> <li>Pruning of vines to reduce the plant canopy in order to let wind pass through and fungicide reach all parts of the plant.</li> <li>Remove infected parts of the plant (leaves, fruits, etc.) and bury or burn them.</li> <li>Cleaning the field: remove and bury the dropped leaves and fruits.</li> <li>The off-type crops and self-germinated passion fruits should be removed from the field as their origin is unknown.</li> <li>Apply fungicide, which contains copper, timely for prevention.</li> <li>Under cold weather, spray fungicide every 2 weeks.</li> </ul> <p><b>Control:</b></p> <ul style="list-style-type: none"> <li>Sulfur (Thiovit): Dilute 50gr of fungicide into 20L of water.</li> <li>Copper hydroxide 50WP (Funguran): Dilute 40gr of fungicide into 20L of water.</li> <li>Tebuconazole (Orius): Dilute 20ml of product into 20L of water.</li> <li>Chlorothalonil: Dilute 20ml of product into 20L of water.</li> </ul>
<p><b><u>Anthracnose</u></b></p> <ul style="list-style-type: none"> <li>It is contaminated by infected seeds.</li> <li>The disease pathogen can live long in the soil.</li> <li>They can infect the plant through wounds on the plant.</li> <li>The disease spread can be done by uncleaned agriculture tools, wind, and drops of water from the soil, etc.</li> <li>Vines and fruits wilt from the upper part or from the infection area.</li> <li>The plant becomes black in color from the area of infection.</li> <li>Leaves dry up gradually as they are dehydrated until the plant dries completely.</li> <li>Fruits also are dehydrated and dry.</li> <li>Dried leaves and fruits as well, do not fall. They remain on the stem.</li> </ul> 	<p><b>Prevention:</b></p> <ul style="list-style-type: none"> <li>Make crop rotation.</li> <li>Use pathogen-free seeds.</li> <li>Pruning of vines to reduce the plant canopy in order to let wind pass through and fungicide reach all parts of the plant.</li> <li>Cleaning the field: remove and bury the dropped leaves and fruits as well as infected parts of the plant (leaves, fruits, etc.).</li> <li>The off-type crops and self-germinated passion fruits should be removed from the field as its origin is unknown.</li> <li>Apply fungicide, which contains copper, timely for prevention.</li> <li>Under cold weather, spray fungicide every 2 weeks.</li> </ul> <p><b>Control:</b></p> <ul style="list-style-type: none"> <li>Sulfur (Thiovit): Dilute 50gr of fungicide into 20L of water.</li> <li>Copper hydroxide 50WP (Funguran): Dilute 40gr of fungicide into 20L of water.</li> <li>Tebuconazole (Orius): Dilute 20ml of product into 20L of water.</li> <li>Chlorothalonil: Dilute 20ml of product into 20L of water.</li> </ul>
<p><b><u>Fusarium wilt</u></b></p> <ul style="list-style-type: none"> <li>It is spread by seeds and from the soil. Its pathogen can stay in the soil for many years.</li> <li>The field can be contaminated by uncleaned tools which were previously used on infected fields.</li> <li>It can also be spread by stakes that were supporting infected crops. Human beings can also spread this disease when they pass from infected fields to newly planted fields.</li> <li>This disease becomes severe in dry periods.</li> </ul> 	<p><b>Prevention:</b></p> <ul style="list-style-type: none"> <li>Grafting purple variety (which is loved on the market) on the yellow variety, which is disease resistant.</li> <li>Avoid growing passion fruits in the field affected with this disease at least in 3 past years.</li> <li>Weeding and cleaning the field: remove and bury infected plants, dropped leaves, and fruits.</li> <li>Avoid using the same tools from infected plants to the healthy ones.</li> </ul>

Name & Characteristic	Prevention and Control Method
<ul style="list-style-type: none"> <li>■ They do not attack the yellow variety of passion fruits.</li> <li>■ The symptoms are mainly yellowish leaves.</li> <li>■ The part of the stem above the ground becomes dark and cracks longitudinally.</li> <li>■ General plant wilting and sudden death takes place as the disease progresses.</li> <li>■ When you cut stem, you can observe from inside grey color.</li> </ul>	
<p><b>Aphids</b></p> <ul style="list-style-type: none"> <li>■ Aphids feed gregariously on plants. They stick mainly on young leaves and stem, on flowers and bottom leaves.</li> <li>■ They are the vector of viruses that infect plants.</li> <li>■ The aphid sap attracts many black funguses, which cover the leaf and disturb its photosynthesis.</li> </ul> 	<p><b>Prevention:</b></p> <ul style="list-style-type: none"> <li>■ Preserve insects known as natural enemy.</li> <li>■ Remove of infected leaves and allow light in.</li> <li>■ Avoid high nitrogen content fertilizers.</li> <li>■ Use of yellow sticky traps.</li> </ul> <p><b>Control:</b></p> <ul style="list-style-type: none"> <li>■ Use of following insecticides by alternating;                             <ul style="list-style-type: none"> <li>*Lambda-cyhalothrin (Lamdex): Dilute 15 ml of insecticide into 20 liters of water.</li> <li>*Alpha cypermethrin: Dilute 20 ml of insecticide into 20 liters of water.</li> <li>*Abamectin: Dilute 10 ml of insecticide into 20 liters of water.</li> </ul> </li> </ul>  <p style="text-align: center;">Ladybug</p> 
<p><b>Red Mite and Trips</b></p> <ul style="list-style-type: none"> <li>■ Mites and trips are frequent in the dry period.</li> <li>■ Trips eat plant leaves and tear up all leaves;</li> <li>■ On fruit, trips damages are wounds on the fruit skin.</li> </ul>  <p style="text-align: center;">Mites</p>  <p style="text-align: center;">Trips</p> 	<p><b>Prevention:</b></p> <ul style="list-style-type: none"> <li>■ Weeding in the field.</li> <li>■ Soil should be plowed immediately after harvesting.</li> <li>■ Keep the proper spacing between plants.</li> <li>■ Use of blue or white sticky traps.</li> </ul> <p><b>Control:</b></p> <ul style="list-style-type: none"> <li>■ Spray insecticide such as:                             <ul style="list-style-type: none"> <li>*Lambda-cyhalothrin (Lamdex): Dilute 15 ml of insecticide into 20 liters of water.</li> <li>*Alpha cypermethrin: Dilute 20 ml of insecticide into 20 liters of water.</li> <li>*Abamectin: Dilute 15 ml of insecticide into 20 liters of water.</li> </ul> </li> </ul>



## Papaya Cultivation Technics



Manual Number: SMAP-NDC-09



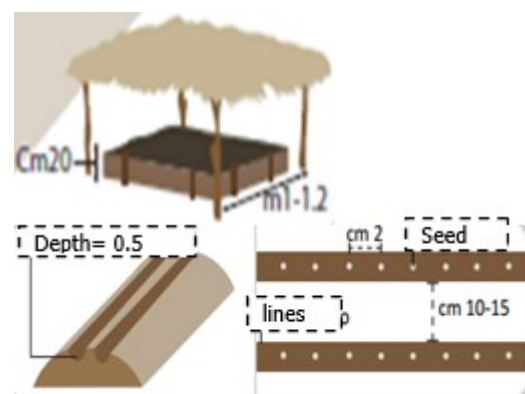
### Seed preparation

- Papaya seeds are prepared from well-matured papaya fruits without any sign of disease to avoid contaminating new plants with seed-borne diseases.
- Seeds are removed from selected fruits which are good and well matured, then let shriveling for 3 to 10 days under the shadow, on a flat basket, keep mixing by hands to avoid that they stick together. Seeds can be sowed even after they are removed from the fruit immediately.
- It is necessary to separate female seeds (black color) and male seeds (white color).
- The seeds produced can be sowed directly. In case that they are not sowed immediately, it is recommended that they are kept in a clean and dry container like a paper bag, but it cannot exceed 10 months to avoid losing germination capacity.



### Making seedbed

- It is important to make a seedbed for making proper seedlings that have 3-4 leaves and a height of 5cm.
- Make high ridges with a height of 20cm and a width of 1 –1.2m.
- Apply well-decomposed manure: 3 handfuls (3-5 kg) for 1m<sup>2</sup>.
- Make sowing ditches with 0.5 – 1 cm of depth using a stick, with a spacing of 10 –15 cm between lines.
- Seeds are sowed into ditches, with 2 cm intervals, then covered by a thick layer of soil.
- Cover the seedbed with mulching of well-dried grasses, which will be removed after seeds start germinating.
- The roof should be made above the seedbed to protect seedlings against strong sunshine. However, the top must-have spaces for solar rays because seedlings also require few solar lights to grow.
- It is recommended to visit the seedbed frequently to check the seedling conditions. If any seedling has the sign of a disease, then it should be removed and burned.
- It is recommended to watering seedbed early in the morning before sunrise or late in the evening after sunset. Water should not be stagnant or stay in the seedbed.
- When is required, spray fungicide to prevent fungus diseases such as powdery mildew, which contaminate seedlings (Copper Hydroxide - Funguran, or Sulphur (Thiovit): 50 gr/ 20L of water) and insecticide such as Lambda-Cyhalothrin (15 ml / 20 Liters of water, rocket or cypermethrin (20-30 ml/ Liters of water).
- Good quality papaya seeds can be sowed into nursery pots and grow without using the seedbed. This time, you sow 1-2 seeds into a nursery pot containing soil mixed with well-decomposed manure, then water well until they germinate.



### Pricking out seedlings into pots

- Nursery beds should be established near a water source to ease watering and near the road to transport the seedlings easily.
- After choosing where to place the nursery, you proceed to the following steps:
  - Leveling well the place of the nursery;
  - Measuring strip lands of 1.20 m of width and 50 cm for foot pass and delimitation by stakes;
  - strip lands are surrounded by tree stems that protect nursery pots.
  - Make the roof for covering it with dried grasses.
  - Fill up into pots a mixture of soil and well-decomposed manure at a ratio of 2:1 (Example: 2 baskets of soil and one basket of dung). Seedling pots have 8-10 cm of diameter and 15 cm of height.
- Put the pots in strip lands between stems of trees surrounding them.
- When seedlings have reached 5 cm of height and 3 to 4 leaves, around one week after sowing in the seedbed, they can be pricked out into nursery pots.
- Before uprooting seedlings, it is recommended to water the seedbed with enough water in order to ease seedling uprooting without damage roots.

- Uproot each seedling using a small well-cut stick or knife, then put it into a nursery pot.
- Seedlings must be well maintained by frequent watering, weeding, and control of diseases and pests when it is required. It is also important to make a roof to protect from strong sunshine. The roof is gradually removed as seedlings are growing.
- After around 2 months, seedlings will have around 20 cm of height, they can be planted in prepared main fields



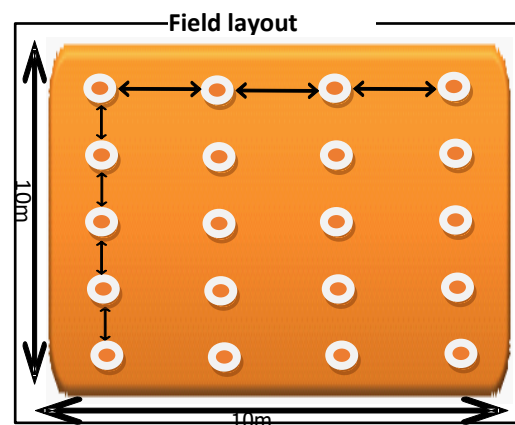
## Land preparation and planting seedlings

- The papaya tree is a sun-loving plant requiring a warm climate with an optimum of between 26o and 30oC. Below 10oC, it is recommended to plant highlands varieties. Papaya requires a high amount of rainfall, which must be abundant and well distributed.
- The field should be far from other old papaya fields.
- Before transplanting, the field should be ploughed at a depth of about 15 cm to 20 cm. Debris in the field should also be removed. Then the field is leveled.



## Field layout

- The field layout shown on the right side of this page shows spacing put between papaya trees during planting.
- According to variety, it is recommended to put spacing of 2m between lines and 3m between planting holes for the common papaya tree, which is also a large variety. In this case, around 1500 trees are planted on 1Ha.
- For Solo variety, the planting space is 2m by 2m, where 2500 trees are planted on 1Ha.
- The lines should be in a horizontal direction which helps to avoid erosion.



## Planting

- Firstly, make planting holes which size will allow to deposit the root ball and the seedlings, cleared of the pot. It should have 50cm of depth and 50cm of width.
- The topsoil removed from the hole should be mixed with compost or well-decomposed manure and returned into the hole. It is required a basin of manure for the planting hole.
- Remove the polyethylene plastic pot and put the seedling into the planting hole so that the soil stays at the same level as the root ball, and then compact a bit of the soil around the seedling.
- Only healthy seedlings with green leaves and without any disease should be planted.



## Time for planting

- It is recommended to plant papaya tree seedlings at the beginning of the rainy period to ensure they get enough water for root development. This is better in September and October.
- Seedlings should be planted in the early morning or late afternoon to avoid withering caused by direct sunlight.



## Post planting management activities

- Within the juvenile period, papaya trees can be associated with other crops with a short cycle, such as beans and soybeans, planted in the center of rows to allow proper management of trees.
- In case it has started by direct sowing in the field, it is necessary to thinning the seedlings to 3 plants after 2 months to allow good growth.
- It is recommended to plant male papaya in 25 female papaya trees.



## Mulching

- Mulching is applied around a tree, avoiding closing the steam.
- Well-dried grasses can be used for mulching. Mulching is effective for keeping the moisture of the soil and protect it and prevent weeds from growing in the field.
- Thick mulching is applied at 5-10cm from the plant stem to prevent the transfer of diseases and pests from mulching material.



## Watering

- Watering must be done directly after planting seedlings. It is also done every time there is no rain or when it is insufficient.
- Water gently without wetting the leaves to avoid contagion of soil-born diseases.



## Weeding

- It consists of the destruction of weeds.
- It can be done by hoeing with hoe taking care not to injure the roots.
- Weeding is done every time weeds appear in the field.
- Weeds can be the origin of pests and diseases, and also they block plants from growing because they take nutrients from the soil and compete with seedlings for sunlight.

## Topdressing

- The papaya tree is a demanding and exhausting plant that proves to be very sensitive to the influence of fertilizers, especially organic.
- It is not recommended that the amount of fertilizer plant need is applied once at planting time, yet it is applied in different steps. Topdressing is applied around the plant at the ends of the roots.
- Apply 50kg of good compost every year per tree for ensuring high production.
- NPK 171717 fertilizers contribute to leaf development, steam growth, and vigor and increase flavor to the fruits.
- The amount of fertilizer to be applied is divided into 3 batches: the first application should be made at the time of transplanting, the second will be done after 3 months, and the last should be done after 8 months, in raining time. From the following years, the chemical fertilizers are applied 2 times per year, every 6 months.
- For each time, they apply 100 g per tree.



## Harvesting papaya fruits and post-harvest handling

### Time for harvesting

- Production begins 8 to 10 months after planting seedlings and extends throughout the year in favorable soil and climate conditions.
- Only matured fruits that started ripening should be harvested.
- Although the papaya tree can live for many years, its production is only interesting for the first four years.
- The production can reach 30 to 150 fruits, depending on the variety.

### Sorting and grading papaya fruits

- Sorting papaya fruits is removing unmaturred, stunted, damaged, and those with the disease.
- Sorting and grading increase production selling prices by around 40 to 60%.
- Sorting and grading decrease the post-harvest loss.
- When sorting is done, fruits are put into grades according to size, color and etc.






# Papaya


## Disease and Pest control



Manual Number: SMAP-NDC-09

### Major pests and diseases in Rwanda

Name & Characteristics	Prevention and Control Method
<p><b>Damping-off</b></p> <p>Cause: Fungus</p> <ul style="list-style-type: none"> <li>■ Damping-off is common during emergence.</li> <li>■ It is caused by various soil fungi (including <i>Rhizoctonia solani</i>, <i>Pythium spp.</i>, <i>Phytophthora spp.</i>).</li> <li>■ The disease is favored by high temperature and humidity.</li> </ul> 	<p><b>Prevention:</b></p> <ul style="list-style-type: none"> <li>■ It is prevented by disinfection of the substrate (by moist or chemical heat) and/or water control</li> </ul> <p><b>Control:</b></p> <ul style="list-style-type: none"> <li>■ application of fungicides before and after emergence,</li> <li>■ seed treatment by fungicides (Mancozeb, Thiovit, Chlorotharonil)</li> </ul>
<p><b>Fruits rot</b></p> <ul style="list-style-type: none"> <li>■ Fruit rot is mainly caused by <i>Colletotrichum papaya</i>, which causes anthracnose in ripening fruits.</li> </ul>	<ul style="list-style-type: none"> <li>■ Control consists of preventive sprays of mancozeb and/or appropriate systemic fungicides, for example, Lidomil.</li> <li>■ Treating the fruit with hot water (49oC, 20 minutes) immediately after harvesting gives good results for protection during transport and storage.</li> </ul>
<p><b>Ringspot virus</b></p> <ul style="list-style-type: none"> <li>■ The papaya ringspot Potyvirus (PRSV) is manifested by the presence of light green circular spots with dark green centers on the fruits, with variable symptoms close to the mosaic on the leaves.</li> <li>■ It is non-persistent, transmitted mechanically and by aphids.</li> </ul>	<p><b>Prevention:</b></p> <ul style="list-style-type: none"> <li>■ Planting healthy seedlings.</li> <li>■ Manage aphids that may spread the diseases.</li> <li>■ Not close the field with the old one.</li> <li>■ Remove infected plants and burn and bury them in the ground.</li> <li>■ Making crop rotation.</li> <li>■ Weeding and cleaning the field.</li> <li>■ Pruning regularly to remove the parts of plants where insects hide.</li> </ul> <p><b>Control:</b></p> <ul style="list-style-type: none"> <li>■ There are no chemicals to control virus, preventive methods are mostly recommended like control of aphids which may spread virus</li> </ul>
<p><b>Mosaic virus</b></p> <ul style="list-style-type: none"> <li>■ Mosaic is caused by several viruses, including papaya mosaic, Potexvirus, PapMV.</li> <li>■ The first main symptom is the appearance of more or less intense discolored or chlorotic macules on the leaf blades.</li> <li>■ As a result, the leaves become deformed, the terminal bud ceases to develop and turns yellow and the crown gradually atrophies.</li> <li>■ Elongated and narrow oily spots appear in an early stage on the petioles and the tender part of the trunk.</li> <li>■ These viruses are transmitted by bite or contact; vector insects, the same as PRSV, remain virulent for a few hours after biting an affected tree.</li> <li>■ Viruses are not transmitted by seed.</li> <li>■ Most of the viruses attacking the papaya tree are found on cucurbits.</li> <li>■ Damage is variable and can go as far as compromising the entire harvest</li> </ul>	
<p><b>Aphids</b></p> <ul style="list-style-type: none"> <li>■ Several species of insects and mites attack the papaya tree. The most harmful are aphids, vectors of viruses.</li> <li>■ They take shelter under the leaves and cause lesions, sometimes similar to symptoms of virus.</li> <li>■ Aphids feed gregariously on plants.</li> </ul>  <p><b>Other insects</b></p> <p>Depending on the region, the fruit fly (<i>Ceratitis capitata</i>) can also be a serious enemy. Other leaf pests are leafhoppers, whiteflies,</p>	<p><b>Prevention:</b></p> <ul style="list-style-type: none"> <li>■ Preserve insects known as a natural enemy.</li> <li>■ Remove infected leaves and allow light in.</li> <li>■ Use of yellow sticky traps</li> </ul> <p><b>Control:</b></p> <ul style="list-style-type: none"> <li>■ Use of following insecticides by alternating;</li> </ul> <p>*Lambda-cyhalothrin (Lamdex): Dilute 15 ml of insecticide into 20 liters of water.</p> <p>*Alpha cypermethrin: Dilute 20 ml of insecticide into 20 liters</p> 

Name & Characteristics	Prevention and Control Method
and thrips.	of water. *Abamectin: Dilute 10 ml of insecticide into 20 liters of water.
<p><b><u>Nematodes</u></b></p> <ul style="list-style-type: none"> <li>Nematodes can cause appreciable damage, which is mainly marked by slower growth, general yellowing, and a sharp drop in production.</li> </ul>	<p><b>Prevention:</b></p> <ul style="list-style-type: none"> <li>Crop rotation with groundnut, maize, sorghum, and guinea grass to prevent nematode damage</li> <li>Mix planting or crop rotation with marigold</li> </ul> <div style="text-align: right;">  <p>African marigold</p> </div>



## Mango Cultivation Technics



Manual Number: SMAP-NDC-10



### Seedling preparation

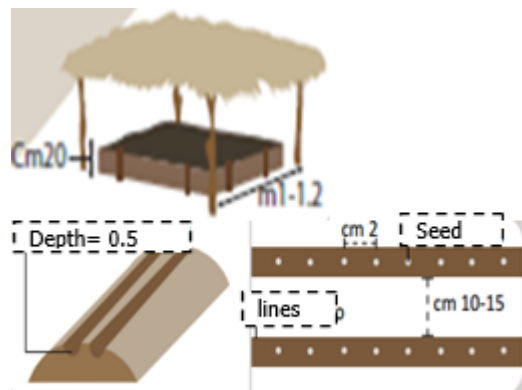
Mango seedlings are prepared in a nursery bed, and they are grafted and then planted in the main field.



### Seedbed preparation

There are two methods for raising mango seedlings:

- To make a seedbed, sow in the bed mango pits and prick them into nursery pots after germination.
- Sow the mango seed to the nursery pots directly.
  - For the first method, make high ridges with a height of 20-30cm and a width of 1 –1.2m
  - Apply three handfuls of well-decomposed manure (3-5 kg) for 1sqm.
  - Make sowing ditches with a depth of 5 cm and a spacing between lines of 10 cm by using a stick.
  - Seeds are sowed into ditches closely each other, the top upward and slightly above the soil, then, it is covered with mulching grasses and watered every day.
  - Prepare the roof of the seedbed with dried grasses.
  - It is recommended to check the seedling condition frequently. If any seedling has disease signs, it should be removed and burned.
  - As the nursery bed is subjected to fungus diseases such as dumping off and phytophthora cunigami, it is recommended to spray fungicides (Copper Hydroxide - Funguran or Sulphur (Thiovit) (50g/ 20liters of water), and insecticides: Lambda-Cyhalothrin (15ml / 20liters of water).



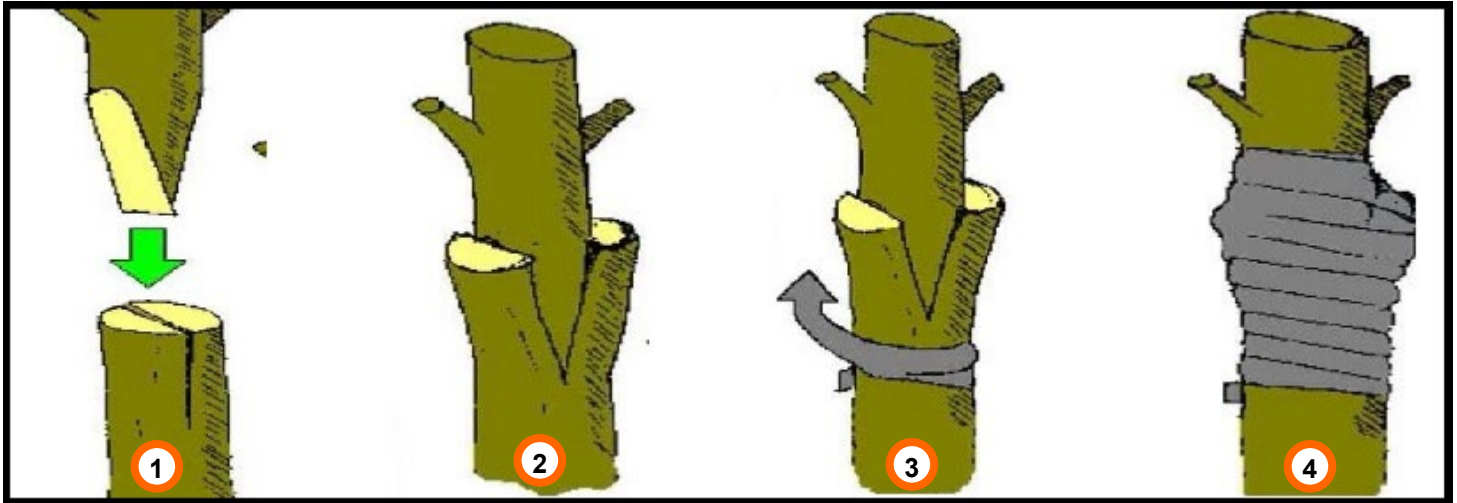
### Making a nursery bed, pricking seedlings and management.

- A nursery bed should be located near a water source to ease watering and near a road to transport the seedling easily.
- After choosing a place where the nursery is established, proceed with the following steps:
  - The nursery should be leveled well.
  - Measure the land with the width of 1.2m for the nursery bed and the width of 50 cm for the foot pass between beds and delimiting the land with stakes.
  - Surround the measured land with tree stems that protect the nursery bed.
  - Make a Roof for the nursery bed with dried grasses.
  - Fill the Seedling pots with a mixture of soil and well-decomposed manure at a ratio of 2:1 (Example: 2 baskets of soil and one basket of manure). You can add sand in case of clay soil. Seedling pots have a diameter of 15-20 cm and a height of 20 cm.
  - Place the seedling pots under the roof.
- After germination, when the seedlings have reached 10cm of height, they are pricked out into perforated polyethylene pots.
- It is important to maintain the seedlings by regular watering, weeding, etc. They have to be grafted before they are transplanted in the main field.



### Grafting seedlings

- After 4 to 5 months of germination, the seedlings have size of a pen and 30-40cm of height, it is a proper timing for grafting.
- The grafting should be taken from a variety of good production and good taste. At least two well-formed eyes (buds) and 10 cm of length and size of a pen.
- Cut the upper part of the rootstock at 10 to 15 cm above the root bulb, where the stem is hardening.
- Cut the basal part of the graft, trim on both sides of the shoot at around 1-2cm. Remove the leaves of the shoot but keep the peduncles.
- Make a slit in the middle of the rootstock section with the length of 1-2 cm.
- Insert the graft cut into a slit made in the middle of the rootstock section to coincide the two sapwoods.
- Ligate with the plastic film at the level of the wounds to reinforce the contact between the graft and the rootstock.
- Cover the graft up to the insertion part with transparent plastic film to preventing the air, water, or others from entering.
- Check the grafts frequently. If the grafts are healthy, the bud will be grown. The degree of moisture can be checked by perspirations inside the transparent plastic film covering the graft.
- Remove the transparent plastic film when the graft starts making buds (after 3-4 weeks).



### Grafting with old plants

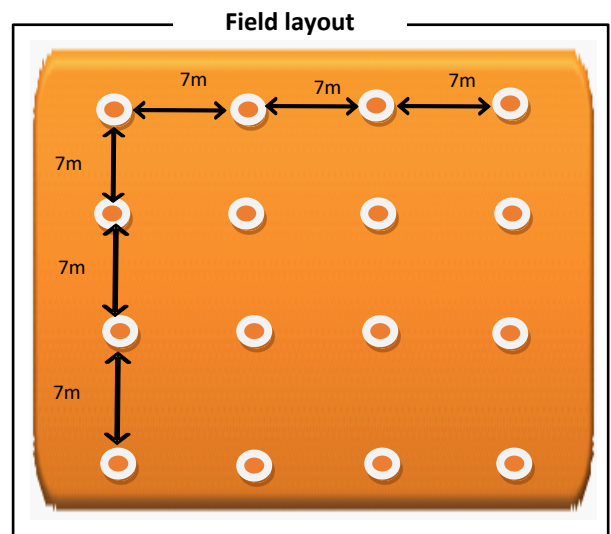
- The non-grafted old trees can also be grafted.
- The tree is cut in a dry period at 30cm above the root bulb.
- The trunk grows many shoots, which are removed to remain with three well-grown shoots which will be grafted at 30-40 cm of length.
- The grafting methods are the same as for seedlings raised in a nursery bed.

### Transplanting seedlings in the main field

- Mango tree likes moderate precipitations (1250-1750mm) per year, and well-drained soil avoids damage of roots and plant death. In the areas with precipitations under 700mm per year, it is recommended to plan for irrigation.
- Mango grows well at an altitude up to 1800m for Tommy, Kent, Zillete, and Bire, which are preferred for grafting, but Apple variety likes lower altitude.
- They grow well in deep soil with a PH of 5 to 7.5.
- It is recommended to plant mango seedlings at the beginning of the rainy period to ensure they get enough water for root development. It is September and October in Rwanda.
- Seedlings should be planted in the early morning or late afternoon to avoid withering caused by direct sunlight.
- Grafted seedlings are transplanted after 7 to 10 months in the nursery bed
- Before planting mango trees, the field should be ploughed with a depth of about 15 cm to 20 cm. Debris in the field should also be removed. Then the field is leveled

### Field layout

- The field layout is shown on the right side of the page; it shows the proper spacing which can be applied when planting mango trees.
- The spacing between plants is 4-5m in case there will not be intercropping after 4 years, while it is 6-7m in case you plan to intercrop with short-cycle varieties.
- Make planting holes of 60cm by 60cm of width for loam soil and 60cm by 80cm of depth for stony soil.
- The soil removed from the planting hole is mixed with compost (2basins) and returned into the hole.
- Before planting seedlings, the plastic pot should be removed. The plastic firm binding the grafting area is also removed after it appears buds (in 2 or 3 months), using a cutting blade, with caution to avoid stem wounds.



- In the first weeks after transplanting, seedlings are protected against sunshine, and it is important to water after transplanting at least 1-2 times per day when there is no rain.
- Only healthy seedlings with green leaves and without any disease should be planted.



## Post planting management activities

- In case of a rainfall shortage, before the seedlings are recovered, it is recommended to do watering at least once in one or two weeks for good recovery of seedlings.
- Within a juvenile period, mango trees can be associated with other crops with a short cycle, such as beans or soybeans, planted in the center of rows to allow proper tree management.
- It is recommended to remove all side shoots as soon as they appear.
- Any flowering in the first year should be removed to allow good growth of trees.



## Mulching

- Mulching is applied around the tree, avoiding closing the steam.
- Well-dried grasses should be used for mulching. Mulching is effective for keeping the moisture of the soil and protect it, and prevent weeds from growing in the field.
- Thick mulching is applied at 5-10cm from the plant stem to prevent the transfer of diseases and pests from mulching material.



## Watering

- Watering must be done directly after planting seedlings. It is also done every time there is no rain or when it is insufficient.
- Water gently without wetting the leaves to avoid contagion of soil-born diseases.



## Weeding

- It consists of the destruction of weeds,
- It can be done by hoeing with hoe taking care not to injure the roots.
- Weeding is done every time weeds appear in the field.
- Weeds can be the origin of pests and diseases, and also they block plant from growing because they take nutrients from the soil and compete with seedlings for sunlight



## Fertilizer application

- The types and amount of chemical fertilizer (g) that should be applied per tree are shown in the table below:

Year	NPK (17-17-17)	Urea (46-0-0)	KCl (0-0-60)
1	147	98	292
2 to 3	294	196	250
4 to 5	441	293	292
6 to 7	588	391	458
8 to 9	735	489	625
10 or more	882	587	792

- The amount shown in the table should be divided into 3 batches within the year and be applied in the rainy period.
- It is necessary to avoid a high amount of fertilizer on mango trees because it causes the overgrowth of leaves and branches and lowers the number of flowers and fruits.
- The minerals containing B, Cu, Fe, Mn, Mo, and Zn are very important for a mango tree.



## Pruning mango tree

- For good maintenance of grafted mango tree, it is recommended to do pruning of side shoots and bent and dead branches.
- Within the first year, it grows side shoots on the rootstock, which must be removed quickly to allow good growth of the graft.
- After the graft has recovered well and started growing, it is better to avoid immediate branching or flowering. This time all branches are removed and kept, one which will grow at 60-80cm.
- If the graft has not yet branched at 60cm, it is better to cut the terminal bud, especially for Tommy variety, to allow new branches.
- When the tree has many branches (apple mango), they are cut and remain 2 or 3 branches. Each branch will also grow and give others after 2 nods. The growth continues until the tree reaches 2m and branched grow easily.



## Pruning mango tree: maintenance size

- It is necessary to continue removing all side shoots and branches bent or dead to allow light in all parts of the tree.



## Harvesting mango and post-harvest handling



### Time for harvesting

- The first harvest will be ready 2 years after transplanting.
- Old trees can produce around 2,000-3,000 kg of fruits equal to 20-30 tons per year.
- The size of fruits will depend on their variety.



### Sorting and grading mango fruits

- Sorting mango is removing unmaturred, stunted, damaged, and those with the disease.
- Sorting and grading increase production selling prices by around 40 to 60%.
- Sorting and grading decrease the post-harvest loss.



# Mango

## Diseases and pest control





Manual Number: SMAP-NDC-10

### Major Diseases and pests in Rwanda

Name & characteristics	Control methods
<p><b>Anthraxnose</b> Cause: Fungus</p> <ul style="list-style-type: none"> <li>It appears in the field and in storage as well.</li> <li>It becomes severe on new branches, flowers, and also fruits.</li> <li>It is severe under humid and raining conditions and temperatures between 24 to 32°C.</li> <li>This disease remains on leaves, flowers, and fruits of the dried branch where the pathogen can remain for 14 months; this shows the disease severity.</li> <li>It causes spots on leaves, death of new shoots, and rotting of fruits.</li> <li>On leaves, the lesions are grey to dark grey irregular spots scattered on the leaf, which appear as water-soaked and shattered.</li> <li>Young leaves are mostly infected.</li> <li>This disease causes black dry spots on branches.</li> <li>Infected flowers fall down.</li> <li>On fruits, this disease shows black spots on fruit skin which will remain even after disease recovery and can be the start of fruit crack when the soil has shortage of water.</li> </ul>	<p><b>Prevention</b></p> <ul style="list-style-type: none"> <li>Respect proper spacing when planting seedlings;</li> <li>Pruning frequently mango trees;</li> <li>Collecting and burning or burring all infected parts;</li> <li>Plant resistant varieties like Tommy atkins, Kent.</li> </ul> <p><b>Control methods:</b></p> <ul style="list-style-type: none"> <li>Infected leaves, branches, and fruits and burry or burn them.</li> <li>Spray fungicide like Carbendazim (Bendazim, Rodazim), copper (Copper hydroxide, Copper oxychloride, copper oxide[Nodox]), Chlorothalonil (Daconil), and Benomyl by alternating them. It is recommended to start spraying the time flowering starts, when small shoots are coming, in flowering time, until the small fruits have grown at least a half of normal size.</li> </ul> <p>Before harvesting, it is recommended to spray Carbendazim or Chlorothalonil, but it has to be done 14 days before harvesting.</p>
<p><b>Powdery mildew</b> Cause: Fungus</p> <ul style="list-style-type: none"> <li>It is spread by wind.</li> <li>It is severe under dry and high humidity conditions with cold nights.</li> <li>It can remain in the field for a long time through cultivation seasons and also remain on infected parts and buds for a long time.</li> <li>It is severe in flowering periods.</li> <li>It presents white powder on leaves, flowers, and small new fruits.</li> <li>Infected flowers don't open and fall, which causes a big loss of production.</li> <li>It attacks young leaves while they change from green to light grey color.</li> <li>The white powder appears on both sides of young leaves but more on the bottom side.</li> <li>Small fruits are finally covered by white powder, and they can remain on the tree for a while, then they fall down.</li> <li>When they are not fallen, the skin cracks when the soil contains much water and the surrounding parts hardened.</li> </ul>	<p><b>Prevention:</b></p> <ul style="list-style-type: none"> <li>Pruning mango trees frequently so that air and light can pass through and limit trees at a lower height to ease tree management;</li> <li>Collecting and burning or burring all infected parts;</li> <li>Plant resistant varieties like Tommy, Kent, Bire, Zillate, and Van dyke.</li> <li>Avoid mixing mango varieties that are not resistant, like Bolibo, apple mango, and those resistants.</li> <li>Surround the field with a long fence longer than the mango trees to reduce the speed of the wind, which can spread the disease.</li> </ul> <p><b>Control methods:</b></p> <ul style="list-style-type: none"> <li>Infected leaves, branches, and fruits and burry or burn them.</li> <li>Spray fungicide containing suffer (Thiovit/Thiogil), alternating it with carbendazime (Bendazim, Rodazim), Chlorothalonil (Glider, Daconil), Tricyclazole (Beem). Spraying will start when new leaves are coming out before flowering and continue when flowers are opening.</li> </ul>



Name & characteristics	Control methods
<p><b>Fly and larvae of mangos</b></p> <ul style="list-style-type: none"> <li>■ Flies lay eggs The flies lay the eggs which give the larvae which grow and become the flies too.</li> <li>■ Larvae damage ripe mangoes and reduce production by more than 50%.</li> <li>■ The fly of the genus Bactrocera and Ceratitis spp are the most dangerous for mangoes.</li> <li>■ The female fly punches the fruit skin with a stinger on the bottom of his abdomen and lays eggs into small clones.</li> <li>■ This causes the fruit to lose fleshy juice through holes made by flies which become brown or red color.</li> <li>■ The eggs give larvae inside the mesocarp and feeding the fleshy thalamus while the epicarp looks healthy.</li> <li>■ When the fruit is cut, you can observe dark traces made by larvae and some larvae moving inside. Latter, the fruit rot and fall down.</li> </ul> <div style="display: flex; justify-content: space-around;">   </div>	<p><b>Prevention:</b></p> <ul style="list-style-type: none"> <li>■ The appropriate time for preventing flies of mango is a little before and during their ripening, which means from the month of November through April and June until August.</li> <li>■ It is recommended to collect and bury or burn all infected fruits and those fallen down to avoid a reproduction of flies.</li> <li>■ It is recommended to harvest matured fruits before ripening to avoid flies that lay eggs on fruit.</li> </ul> <p><b>Control methods:</b></p> <ul style="list-style-type: none"> <li>■ Spray insecticide like acetamiprid (Dudu acelamectin, Aster extreme) and alternating it with lambda cyhalothrin, deltamethrin, Imidachroprid (Confidor) on fruits in 6 weeks until 10-15 days before harvesting.</li> </ul>



# **Training manual: Nutrition improvement Using nutrients dense foods**



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**Food Quality and Nutrition Program**

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# 1. INTRODUCTION

## 1.1 Malnutrition

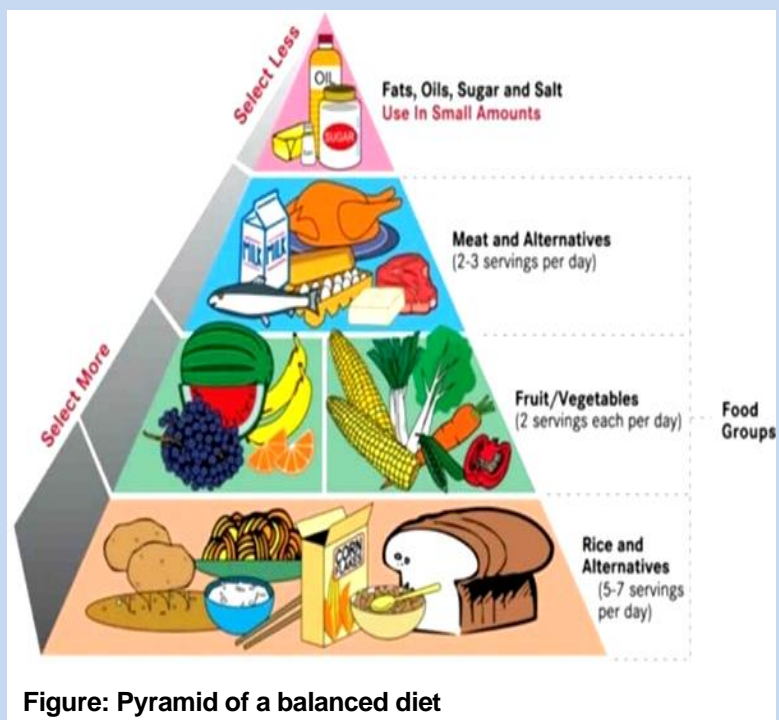
According to World Health Organization (WHO), malnutrition refers to “deficiencies, excesses or imbalances in a person’s intake of energy and/or nutrients”. There are 2 types of malnutrition:

### Under nutrition

- Stunting: Low height for age
- Wasting: Low weight for height
- Underweight: Low weight for age
- Micronutrient deficiencies: Lack of important vitamins and minerals
- Overweight: Obesity are results of malnutrition which cause non-communicable diseases (heart disease, diabetes, different cancers, etc.)
- According to Rwanda Demographic and Health Survey 2014-2015 37.9 % of under five children are malnourished (stunting) with 49.1 % below 2 years of age.
- Moreover, anemia was found at 36.5 % among children and 17.2 % among women. One of the causes include lack or limited consumption of recommended diverse nutrients.
- This needs to be addressed by increasing food production of diversified nutrients dense food crops and creating awareness for consumption of balanced diet.
- This is in line with the Government of Rwanda to eradicate malnutrition as one of the priority areas in the social transformation pillar of the 2017 - 2024 National Strategy for Transformation.
- Hence, this training material was developed to boost nutrition status using nutrients dense foods through capacity building of farmers, health workers, agronomists and any other involved stakeholders.

## 1.2 Balanced meal

- A balanced meal refers to the intake of a wide variety of foods in the right proportions and amount to achieve and maintain a healthy body weight.
- A balanced meal includes one type of food from each of the food groups indicated in the diet pyramid below.



### 1.3 Recommended daily intake (RDI)

It refers to the intake level of a nutrient that is considered to be sufficient to meet the requirements of a healthy individual. The following is an example of RDI:

**Calories: 2100 kcal**  
**Protein: 50 g**

**Vitamins**  
**Vit. A : 1 mg**  
**Vit. C : 2 mg**  
**Vit. B9: 400µg**

**Minerals:**  
**Calcium: 1.2 g**  
**Magnesium: 400mg**  
**Iron:**

- 10mg for men
- 18mg for women to compensate blood lost during menstruation
- 27mg for pregnant women

## 2. NUTRIENTS DENSE CROPS

- Nutrients dense foods consist of foods that are high in nutrients
- They mainly contain vitamins, minerals, complex carbohydrates, lean protein and healthy fats. This training manual focuses on the following nutrients dense crops:

1. Soya bean
2. Vegetable &Fruits
3. Beans
4. Irish Potato
5. Sweet Potato
- 6 Cassava

### 2.1 Soybean

#### Nutritional importance

- Soybean (*Glycine max* L) is rich in proteins and isoflavones associated with prevention of non-communicable diseases.
- Soybean products are appreciated due to their health benefits. Soymilk can be a substitute of cow's milk for lactose intolerant people.



**Table: Nutritional composition of soybean**

<b>Nutrient</b>	<b>Proportion (%)</b>
Proteins	40
Unsaturated fats	20
Fibers	17
Calcium	0.276
Magnesium	0.28
Potassium	1.8
Iron	0.016
Zinc	0.0048

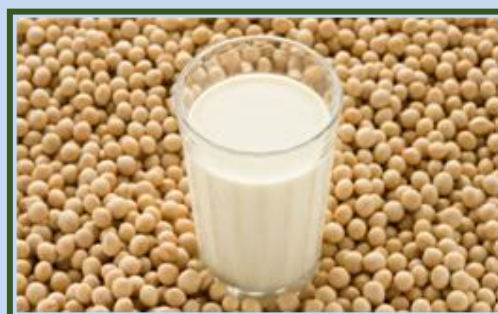
### **Soybean processing and utilization**

- Soybean can be processed into various products including soybean milk, tofu and flour to make soup or mix with other food
- The consumption of soybean milk is gaining popularity as a nutritious and refreshing drink.

### **Soymilk**

#### **Ingredients (serve for 45 persons)**

- 4 cup of soybean (2kg)
- 16 cup of water for soaking
- 24 cup of water to mix with soya pounded
- 8 spoon of sugar
- 1 tea spoon of salt
- Citronelle leaves



#### **Preparation**

1. Clean whole soybeans by removing dirt and damaged soybeans
2. Soak the soybeans 8-12h
3. Drain and rinse with cool water.
4. Grind the soybeans using a mortar and pestle
5. Mix with water and filter through muslin cloth
6. Boil soymilk add salt, sugar and flavors as desired. Serve hot or cold for 45 persons.

#### **Okara**

- After making soymilk, the solid residue that is left is called okara.
- For each cup of dry soybeans used to make soymilk, you will get a little less than two cups of residue.
- Okara contains high-quality protein and fiber and can be used in many different recipes, serve for 45 persons.



#### **Tofu**

1. Soymilk is prepared as above and heated until boiling
2. Remove the pot from the heat and add 4% acetic acid solution (2 tablespoons of vinegar per liter of

soymilk) and stir constantly until a good coagulum is formed

3. Wait for 20 minutes and filter through a clean cloth into a suitable mold
4. Press the cloth lined tofu with a weight to form a block of tofu
5. This can be sliced and fried or eaten plain with salt
6. The curds can be crushed in a saucepan with onion, tomatoes and salt and served on bread



### Soybean flour

- Soybean flour is made from roasted soybeans that have been ground into a fine powder.
- Roast is done to eliminate antitrypsin factors in soybean. Roast lightly on medium fire for 10min.
- The powder can be mixed with vegetables or in soup. For a consistent soup one portion of soybean flour is mixed with 3 portions of water.
- Soybean flour can be mixed with other flour like SOSOMA (Soybean 22%, Sorghum 30% and Maize 48%)



### Soybean flour, sweet potatoes and fish (small) powder

#### Ingredients (Serve for 1 kid)

- 70 g cubed, orange-fleshed sweet potato
- 20 g roasted soybean flour
- 10 g powdered fish (preferably, anchovies) or any other animal product.
- 1 teaspoon vegetable oil
- 50 ml water

#### Preparation

1. Boil cubed OFSP until soft.
2. Strain.





3. Add a little water to soybean and mix into paste.
4. Add paste to filtrate from strained boiled OFSP and stir over gentle heat to form porridge.
5. Add powdered fish.
6. Mash boiled OFSP and add to porridge, add oil and stir to mix.
7. Leave to simmer over gentle heat for 5 minutes.

### **Soybean flour and sweet potatoes**

#### **Ingredients (Serve for 2 children)**

- 140 g cubed, orange-fleshed sweet potato (OFSP)
- 60 g roasted soybean flour
- 2 teaspoon vegetable oil
- 100 ml water

#### **Preparation**

1. Heat oil.
2. Mix soybean flour with water and add to heated oil.
3. Stir until mixture becomes porridge-like.
4. Add cubed OFSP to porridge.
5. Leave to boil until OFSP becomes soft.
6. Mash OFSP until it mixes well with porridge.
7. Leave to simmer for 5 minutes.



### **Soybean doughnuts**

#### **Ingredients(Serve for 10 persons)**

- 1 cup wheat flour
- 1 cup soybean flour
- 2 teaspoons baking powder
- ¼ teaspoon salt
- 1 tablespoon margarine/oil
- 3 tablespoons sugar
- ½ cup milk/water
- 1 egg
- Lemon Zest

#### **Preparation**

1. Sieve the flour, baking powder, salt and spices together
2. Combine the egg, sugar and oil and beat thoroughly
3. Blend the dry ingredients with milk or water into the egg mixture to get a soft dough
4. Roll the dough on a floured board



5. Cut with a top of a glass
6. Fry in deep oil at a moderate heat and turn regularly until golden brown
7. Remove from oil and drain

### **Mixture of Soy beans, French beans and Carrot**

#### **Ingredients (serve for 10 persons)**

- 1 kg of soy beans
- 4 cups of water for soaking soy bean
- 1/2 kg of French beans
- 1 kg of carrot
- 5 tomatoes
- 1 onion
- 1 sweet pepper
- 3 garlic
- 1 tea spoon of iodized salt
- 3 cups of water to boil soy bean



#### **Preparations**

1. Clean whole soybeans by removing dirt and damaged soybeans.
2. Soak the soybeans 8-12h.
3. Boil soybeans in 3 liters of water until they become ready.
4. On the other side clean and cut onion, french beans, tomatoes, sweet pepper, garlic and carrot into small pieces.
5. When soy beans are ready add carrot, french beans and iodate salt, cover until they are cooked.
6. Heat oil, add onion, sweet pepper, tomato and garlic (it is better to grind it), cook it until they become ready and mix it with boiled soybean, french bean and carrot.
7. Serve it with rice or Irish potato.

## **2.2 Fruits and Vegetables**

### **Nutritional and health importance**

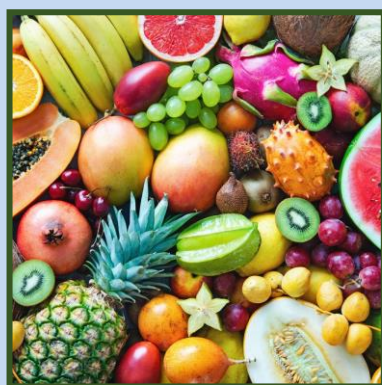
- Vegetable is a part of plant eaten as leaves (Amaranths, spinach), roots (carrots, beet), fruits (eggplant, shallot, green beans), flowers like cauliflower
- Fruits are parts of plants that are eaten when mature
- Fruits and Vegetables are good sources of vitamins, antioxidants, organic acids, minerals and fibers among others
- Promote healthy immune system and reduce risks to



diseases (Different types of cancer, cardiovascular diseases, etc.)

**Table: Contribution of fruits and vegetables to human nutrition and health**

<b>Nutrient</b>	<b>Nutritional and healthy importance</b>	<b>Main source</b>
Vitamin A	Anti-oxidant that protects the body cells, thus prevent diseases like cancer Useful for skin and sight	Carrots, tomatoes, carrot, spinach, pumpkin leaves, cassava leaves
Vitamin B (B1, B2, B5, B6, B9, B12)	Good functioning of the brain (Vitamin B6) Vit B9 is important for pregnant women (growth of fetus), Reduction of risks to cancer, heart diseases	Most vegetables
Vitamin C	Muscles and bone building Prevention of diseases Immunity strength Prevents bleeding through teeth and nose	Pepper, amaranths, raw cabbage, broccoli, cantaloupe, citrus fruits, pineapples, watermelon
Vitamin E	Reduction of risks to cancer, diabetes, heart Diseases Strengthening immune system Preventing oxidation	Avocado, green leafy vegetables
Minerals (iron, calcium, magnesium, phosphorous, etc.)	Iron: Blood production, Oxygen transport, immunity strength, formation of new cells of the fetus in pregnant women Calcium: Strengthening of bones, good functioning of muscles, coagulation of blood in case of bleeding Phosphorus: Bone building	Most fruits and vegetables
Dietary fibers	Reduction of risks to diabetes, heart diseases, colorectal cancer	Most fruits and vegetables



**Preparation**

Fruits and vegetables are consumed as either raw (such as salads) or cooked/processed (boiled, steamed, fried, dried, juice, jam, etc.)

- An example of carrot remedy to reduce diarrhea:
  - prepare 2.5kg, cut into small pieces, boil in 1L of water,
  - Blend in a sieve, add hot water to adjust to 1L, add 3g of salt .



## Beet juice

### Ingredients (Serve for 2 persons)

- 1 beet
- 1 ginger
- ¼ pineapple
- ½ lemon
- 500 ml water

### Preparation

1. Clean all ingredients
2. Peel beet and cut into small pieces
3. Peel pineapple, cut a quarter and add to the beet in a grinder
4. Add ginger and grind with water
5. Filter and drink



## 2.3 Beans

### Nutritional importance of beans

- Beans are used as a staple food to contribute to balanced diet
- In line with bio fortification of food crops, Iron fortified beans were introduced in Rwanda.
- Iron fortified beans improve the iron status for consumers. Their nutrient profile fits with the dietary needs of growing children, teenagers as well as adults.
- They contain cholesterol-free protein, fiber, magnesium, potassium, vitamins, resistant starch, etc.
- For adults who prefer moderate fat and cholesterol intakes, beans consumption is a healthful alternative to meat.
- Iron fortified beans contain various important minerals including potassium, magnesium and iron. In addition, they are sources of antioxidants.



## Different beans recipes

### Beans, Potatoes, and Pumpkin Leaves

#### Ingredients (Serve for 5 persons)

- 10 potatoes, peeled, Irish, white (1kg)
- 1 kg beans cooked
- 2 litter of water
- 2 tsp (13 g) salt, iodized

#### Preparation

1. 15 minutes of preparation and Cooking 40 minutes
2. Peel, wash and cut the potatoes.
3. Cut the pumpkin leaves.
4. Meanwhile, measure 1 kg of cooked beans.
5. Put all the water into the empty cooking vessel. Add potatoes and salt.
6. Boil the potatoes for 20 minutes and add the cut pumpkin leaves. Cover the pot and cook for 2 minutes.
7. Add the cooked beans mixture and cover to cook for 20 minutes.
8. Remove from heat and mash the mixture.
9. Serve hot with mushroom sauce.



### Fresh Beans, Iron beans, carrots

#### Ingredients (Serve for 5 persons)

- ½ kg of green beans
- 1 kg of red bean
- 3 pieces of carrots
- 4 litter of water
- 1 onion
- 1tsp cooking oil
- 5 tsp. (28 g) salt, iodized

#### Preparation:

1. Remove fresh beans from pods. Put in a bowl or container.
2. Mix and wash the green beans and red beans.
3. Boil in 4 litter of water for 40 minutes until cooked.
4. Prepare the onions and chop into a separate bowl.
5. Stewing:
6. Heat cooking fat into a pan and add the onions.
7. Cook the onions until they soften.
8. Add the boiled green beans and red beans mixture. Cover with a pan.



9. Add salt and continue cooking while stirring periodically.
10. Once ready, remove from fire and serve with rice.

### Beans stew

#### Ingredients (Serve for 5 persons)

- 2 cups of beans
- 4 liter of water
- 1 tomato red
- 1 onion red
- 3 tsp of cooking oil
- 2 tsp. (13 g) salt, iodized
- 50 g of amaranths and Persil

#### Preparation

1. Boil all the beans in 4 liter of water for 30 minutes.
2. Prepare and cut the vegetables (amaranths and Persil leaves, tomatoes and onions) into small pieces in separate bowls.
3. In a pot, add 3 tsp of oil and turn on the heat.
4. Add the onions and cook for 1 minutes in a covered pan on low heat.
5. After 10 minutes, add the tomatoes and cook while stirring to mix.
6. Add the amaranths and Persil leaves and mix then add the beans.
7. Add 1 cups of water followed by 1 tbsp. of salt and cover the pot for 5 minutes. Stir to mix.
8. Cover the vessel and cook for 4 minutes.
9. Serve hot with rice, vegetables and fruits.



### High-Iron Beans Stew

#### Ingredients (serve for 5 persons)

- 1 cup dried high-iron beans
- 1 tbsp cooking oil
- 1 Onion 1 Tomato
- ¼ tsp of spices powder garlic, cube maggi, onion, celery etc.)
- ¼ tsp salt
- Water

#### Preparation

1. Put the dried high-iron beans in a bowl and remove any foreign particles
2. Wash the beans in cold water
3. Soak the beans overnight in cold water (this reduces the cooking time)
4. Replace soaking water in the saucepan with fresh water and boil beans until tender



5. Drain the stock from beans and set aside
6. Heat the oil
7. Peel the onions and cut into cubes
8. Fry the onions until tender (do not brown them)
9. Peel the tomatoes and slice into small pieces
10. Add the tomatoes to the onions and stir until tomatoes are tender
11. Add the spices powder and stir
12. Add the beans and salt and stir with a wooden spoon.
13. Add the stock and continue stirring
14. Reduce the heat and simmer for 15-20 minutes
15. Serve warm with ugali or rice.

## **2.4 Irish potatoes**

### **Nutritional importance**

- Irish potatoes are important staple foods, however they need combinations with other types of foods (such as meat, vegetables and grains among others) for a balanced meal.
- They are good sources of dietary energy and some micronutrients.
- They contain about 80 % water and 20 % dry matter. Depend on the variety or type of Irish potato, starch content ranges between 60 to 80 %.
- They contain high protein content in comparison with other roots and tubers.
- They have low fat content
- They are rich in micronutrients, especially vitamin C when they are eaten intact with skin,
- They are moderate sources of iron.
- They are good source of vitamins B6 and minerals such as potassium, phosphorus and magnesium, folate, thiamin and niacin. Potatoes also contain dietary antioxidants such as phenolics, flavonoids and carotenoids. They are also good source of dietary fiber

### **Effects of Irish potato preparation method**

- The nutritive value of a meal containing Irish potato depends on the other foods (components) or ingredients prepared with and served with them. It is also depending on the preparation method. Irish potato is not fattening itself, so that, it requires to serve with other fattening foods for increasing the value of micronutrient of the intake.
- Once the starch in raw potato cannot be digested by humans, they are prepared for consumption by boiling (with or without the skin), baking or frying. Each preparation method affects potato composition in a different way, but all reduce fiber and protein content, due to leaching into cooking water and oil, destruction by heat treatment or chemical changes such as oxidation.

- Boiling is the most common method of potato preparation. This method causes a significant loss of vitamin C, especially in peeled potatoes. For french-fries and chips, frying for a short time in hot oil (140°C to 180°C) results in high absorption of fat and significantly reduces mineral and ascorbic acid content.
- In general, baking causes slightly higher losses of vitamin C than boiling, due to the higher oven temperatures, but losses of other vitamins and minerals during baking are lower.

## Recipes

### Irish potato with mushroom (Serve for 5 persons)

- 5 peeled white or red Irish potato
- 2 mushroom
- 3 Carrots sliced and celery
- 2 chopped onion
- 2 tomatoes
- 1 cup of mushroom
- 1 cup of water
- Oil and salt



### Preparation

1. In saucepan, bring broth, potatoes, carrot, celery and onion to boiling over high heat; reduce heat to low, cover and simmer 5 minutes.
2. Add remaining ingredients except salt.
3. Return to boiling over high heat; reduce heat to low, cover and boil 5 minutes or until potatoes are tender and mushroom is cooked through.
4. Season with salt.

### Irish potato with iron beans

#### Ingredients (Serve for 2 persons)

- 3 potatoes, cleaned and cut into a very small dice
- 2 tablespoons oil
- 1 big white onion
- 2 small shallot thinly sliced
- 2 cups cooked black beans or iron beans

### Preparation

1. Place the oil in a heavy bottomed skillet over medium-high heat.
2. Add the potatoes and a generous squeeze of acceptable salt, toss well to coat.
3. Cover the skillet with a tight fitting lid and cook for 7-9 minutes, tossing.
4. Add the onions and Swiss chard stems to the





skillet and cook for an additional 2-3 minutes until softened.

5. Add the black beans to the skillet and mix well; gently arrange into a single layer in the pan.
6. Leave to cook for 2-3 minutes, flipping once or twice, to ensure that the beans are heated through and getting crisp.

### **Potato, eggplant and Pumpkin Leaves**

#### **Ingredients (Served for 2 persons)**

- 6 Irish potatoes peeled
- 4 bunches (31 g) pumpkin leaves
- 2 cups (453 g) water
- 2 tsp. (12 g) salt, iodized

#### **Preparation**

1. Cooking 45 minutes
2. Peel the potatoes and wash.
3. Wash the pumpkin leaves and chop finely.
4. Put 2 cups of water into a pot. Add the potatoes, pumpkin leaves and salt.
5. Cover the pot and boil the mixture for 20 minutes.
6. Add the boiled black eggplant and cover to cook for 10 minutes.
7. Remove from fire and mash to serve.



## **2.5 Sweet Potato**

#### **Nutritional importance**

- Sweet potato is an important food security crop in Rwanda
- Recently, beta-carotene-rich orange-fleshed sweet potato (OFSP) varieties have been introduced in the country. They contribute to combating Vitamin A deficiency,

#### **Orange sweet potato puree**

#### **Preparation**

1. Harvest orange fresh sweet potatoes
2. Sort the sweet potatoes in good condition, wash well two or three times with clean water.
3. Boil without peeling, until cooked
4. After the box, peel and purée with a blender or colander (Strainer)

#### **Orange sweet potato doughnut**

#### **Ingredients (Serve for 45 persons)**

- Puree orange sweet potato: 400 g
- Wheat flour: 600 g
- Sugar: 150 g
- Oil: 2 Tablespoons



- Salt iodized : 7 g
- Vanilla Sugar: 20 g
- Yeast: 2 teaspoons
- Chapa mandazi: 1 teaspoon

### Preparation

1. Put a small amount of warm water (300 ml) in a small basin (1)
2. Add yeast, sugar, salt, oil, vanilla sugar to the basin (1) and mix well
3. Weigh wheat flour and puree of orange sweet potato into another bowl (2), add the mandazi chapa and mix well
4. Take the basin (2) pour into the basin (1), mix well until the dough is soft and thin, let stand for the lifting
5. After raking, roll out the dough on a board and cut into small pieces
6. Heat oil at medium temperature, immerse cut pieces in oil and fry
7. Remove from the fire



## 2.6 Cassava

### Nutritional Importance

- Cassava (*Manihotesculenta* Crantz) is a staple food for approximately 500–800 million people living in developing countries and worldwide.
- Cassava plays a key role as a food security and income-generating food crop for many smallholder farmers in developing countries.
- It serves as a cheaper and rich source of calories, minerals and vitamins.
- In East Africa, cassava is eaten after boiling and processing to flour to make porridge, local brew, ugali and bread. Sweet varieties lacking cyanogenic glycosides can be eaten raw.
- In addition, cassava can be used in industries for production of animal feed and starch for use in pharmaceuticals, textiles and more.
- In Rwanda, cassava is an important staple food and is currently being promoted as a cash crop feeding cassava processing plants. In addition to its tuberous roots, its leaves are consumed as a popular vegetable called 'Isombe'.
- Cassava is consumed in various forms (raw, paste/bread or ugali, boiled for breakfast, mixed with beans, vegetables, etc.) and its cooking and preparation methods vary from one individual to another (mixed with beans, boiled, paste or ugali, etc.).

### Fortified cassava paste (Ubugali)

#### Ingredients (Serve for 2 persons)

- Cassava flour: 600 g
- Maize flour: 400 g
- Water: 2000 ml



## Preparation

1. Put the two liters of water in a casserole, put in the fire and wait until the ebullition
2. Put a few grams of maize flour in a casserole, add cold water and mix well;
3. Add this mixture more and more porridge to have a porridge and add the rest of two flours mix well and knead in the heat for a few minutes, the dough (Ubugali) is ready.

## Cassava leaves

### Ingredients (Serve for 10 persons)

- Fresh and soft cassava leaves
- Red onions
- Eggplant to taste
- Green onion
- Celery
- Pepper to taste
- Palm oil 150 ml
- Garlic
- Water 1 liter
- Salt iodized to taste
- Peanuts



## Preparation

1. Select tender and young leaves, remove leaves from stalks and whiten; how to whiten, put a pan of water on the fire and wait until the water boils, pass these cassava leaves in boiling water for two seconds, then put in cold water and finally squeeze to eliminate any water and pound in a mortar with onion, celery, pepper, green onion until all the leaves are broken into tiny pieces.
2. Put pounded leaves in a pan of hot water over a heat and wait 30 minutes.
3. Put palm oil, eggplant cut into small and boil for about 30 minutes
4. Add the peanuts, garlic and salt and wait 20 minutes, the dish is ready
5. Serve with rice, Ugali etc.

## Cassava and beans

### Preparation

1. Prepare beans until well cooked
2. Peel the cassava, cut into small pieces and wash well
3. Place the cassava pieces over the beans and wait until the food is ready
4. Prepare a mixture of vegetables (Amaranth, carrot, eggplant)
5. Serve with this mixture of cassava and Vegetables to have balanced food.



### **Cassava croquets (Recipes from fresh Cassava roots)**

#### **Ingredients (Serve for 45)**

- Grated Cassava 450 g
- Grind onion 30 g
- 2 eggs
- Iodized salt for taste
- Oil 480 ml

#### **Preparation**

1. Add grated onion and beaten eggs into grated cassava roots.
2. Mix thoroughly.
3. Salt iodized to taste.
4. Drop into hot oil by teaspoonful.
5. Fry until golden.



### **Cassava doughnuts (Recipes from fresh Cassava roots)**

#### **Ingredients (Serve for 45 persons)**

- Grated cassava roots 2 kgs (9 cups)
- Mashed ripe banana 250 g (2 cups)
- Granulated sugar 200 g (1 cup)
- Yeast 15 g (1 tablespoon)
- Vegetable oil for frying 700 ml (3 cups)

#### **Preparation**

1. Add sugar, yeast, and mashed banana to dewatered grated cassava.
2. Mix together.
3. Cover and set aside for 1hour.
4. Heat vegetable oil, mold mixture into balls (2-4 cm in diameter).
5. Deep fry until evenly brown.



### **Cassava soup**

#### **Ingredients (serve for 5 persons)**

- Fresh sweet cassava roots 1 Kg
- Fresh beans 1 cup
- Beef 1/2kg
- Carrot 1
- Eggplant 1
- Tomato 3
- Salt iodized 1/2 tablespoon



## Preparation

1. Peel the cassava roots, wash, and cut into small pieces.
2. Boil the roots until soft.
3. Wash the meat, cut into small pieces, and stir fry with the tomatoes until cooked.
4. Add boiled beans, cut carrots and eggplant and the boiled chopped cassava
5. Simmer, season with salt.

## 3. CONCLUSION

Training by Food Quality Nutrition Program will be done in collaboration with programs promoting cultivation of nutrients dense crops: Beans, soybeans, Irish potatoes, cassava, vegetables to encourage local people to consume more nutritious food, thus, improve nutrition status in Rwanda. Malnutrition in family may cause different diseases, death, disability, low fertility, etc. malnutrition must be prevented because it affects health and the country in general. This training material can be used to prepare a balanced diet.

