

ルワンダ共和国
農業・動物資源省

ルワンダ国
小規模農家市場志向型農業
プロジェクト
(第3年次)

事業完了報告書
栄養改善編

2021年7月

独立行政法人
国際協力機構(JICA)

株式会社 三祐コンサルタンツ
日本工営株式会社

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略語表

略語	正式名称 (英)	正式名称 (和)
AAP	District Annual Action Plan	郡年間活動計画
ANRU	Agriculture and Natural Resource Unit, District	郡農業・天然資源局
BFC	Bio-fortified Crop	栄養強化作物
CHWs	Community Health Workers	コミュニティ保健ボランティア
CNF	National Women's Council	中央女性評議会、ジェンダー・家族推進省傘下
CIP	Crop Intensification Program	作物強化プログラム
DDP	District Development Plan	郡開発計画
DDS	District Development Strategy	郡開発戦略
DPEM	District Plans to Eliminate Malnutrition	郡の栄養不良解消計画
DRC	Democratic Republic of the Congo	コンゴ民主共和国
DT-F	Demonstration and Training Farm	展示・研修圃場
ECD	Early Childhood Development	(乳) 幼児の発達
FBF	Fortified Blended Foods	栄養強化混合食糧
FFSFs	Farmer Field School Facilitators	FFS ファシリテーター
FPs	Farmer Promoters	農家普及員
GIRINKA	One Cow per Poor Family Program	貧困一世帯に対する一乳牛プログラム
HU	District Health Unit	郡保健・衛生局
IFNA	Initiative for Nutrition and Food Security in Africa, JICA	食と栄養のアフリカ・イニシアチブ
JICA	Japan International Cooperation Agency	独立行政法人国際協力機構
MAEP	Market oriented Agriculture Extension Package	市場志向型農業普及パッケージ
MIGEPROF	Ministry of Gender and Family Promotion	ジェンダー・家族推進省
MINALOC	Ministry of Local Government	地方政府省
MINAGRI	Ministry of Agriculture and Animal Resources	農業・畜産省
MINECOFIN	Ministry of Finance and Economic Planning	財務・経済企画省
MOU	Memorandum of Understanding	覚書
NAEB	National Agricultural Export Development Board	国家農業輸出振興公社
NCDA	National Child Development Agency	国家保育庁
NDC/ NDF	Nutrition Dense Crop (Food)	高栄養作物
NECDP	National Early Childhood Development Program	(乳) 幼児の発達促進のための国家プログラム
PSTA4	Strategic Plan for Agricultural Transformation Phase 4, 2018-2024	第4次農業改革戦略計画
RAB	Rwanda Agriculture and Animal Resources Development Board	ルワンダ農業・畜産開発公社
RBC	Rwanda Biomedical Center	ルワンダ生物医学センター
RHCC	Rwanda Health Communication Center	ルワンダ健康コミュニケーションセンター
SAP	Single Action Plan	(行政機関の) 単年度事業計画
SAIP	Sustainable Agricultural Intensification and Food Security Project (with support from World Bank)	持続的な農業の集約と食料の安全保障プロジェクト (世銀支援プロジェクト)
SEDO	Social and Economic Development Officer	社会・経済開発担当官 (セルレベルの行政官)
SMAP	Smallholder Market-oriented Agriculture Project	ルワンダ国小規模農家市場志向型農業プロジェクト
SNV	Netherlands Development Organization	SNV (オランダ発祥の国際 NGO)
SPRP	Stunting Prevention and Reduction Project (with support from World Bank)	発育障害予防・削減プロジェクト (世銀支援プロジェクト)
TMC	Quarterly Technical Monitoring Committee	四半期モニタリング委員会
UNICEF	United Nations Children's Fund	国際連合児童基金
USAID	United States Agency for International Development	アメリカ合衆国国際開発庁

単位換算

1 meter (m)	=	3.28 feet
1 are	=	10 m × 10 m = 100 m ²
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	=	1,233.4 cum

通貨換算 (2021年5月時点 JICA 精算レート)

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

ルワンダ国の会計年度

7月1日～6月30日

栄養改善活動支援対象郡 位置図



写真集



キックオフワークショップの開催
プロジェクトチーム側からの支援業務内容説明
(Rwamagana 郡、2019 年 10 月 1 日)



Head of Crop Research & Technology
Transfer Department の挨拶
(Rwamagana 郡、2019 年 10 月 1 日)



C/P 代表、Dr. Margueritte による高栄養作物を
活用した栄養改善の説明
(Rwamagana 郡、2019 年 10 月 1 日)



Manager of Postharvest Management &
Biotechnology Division の挨拶
(Rwamagana 郡、2019 年 10 月 1 日)



栄養改善活動支援対象 Ngoma 郡を訪問、プロジ
ェクト概要の説明、郡長および農業局長と協議
(Ngoma 郡 2019 年 10 月 8 日)



Nyaruguru 郡の郡長や関係職員へのプロジ
ェクト概要の説明、郡長および農業局長と協議
(Nyaruguru 郡、2019 年 10 月 9 日)



栄養改善活動支援対象 Rutsiro 郡を訪問、プロジェクト概要の説明、郡長および農業局長と協議(Rutsiro 郡、2019 年 10 月 10 日)



Gakenke 郡への表敬、プロジェクト概要の説明、郡長、保健衛生担当農業担当と協議 (Gakenke 郡、2019 年 10 月 14 日)



RAB/Irish Potato グループによる研修教材のレビュー (Rwamagana 郡、2020 年 1 月 20 日～21 日)



RAB/Soybean, Iron Beans グループによる研修教材のレビュー (Rwamagana 郡、2020 年 1 月 20 日～21 日)



Yellow Cassava グループによる研修教材のレビュー (Rwamagana 郡、2020 年 1 月 20 日～21 日)



野菜・果物グループによる研修教材のレビュー (Rwamagana 郡、2020 年 1 月 20 日～21 日)



Sweet Orange Potatoes グループによる研修教材のレビュー (Rwamagana 郡、2020 年 1 月 20 日～21 日)



栄養改善啓発グループによる研修教材のレビュー (Rwamagana 郡、2020 年 1 月 20 日～21 日)



野菜の価格は、都市部においても地方部においても大きく変動はない。(Huye Market)



穀類の値段も都市部、地方部で大きな変動はない。(Muhanga Market)



ルワンダで最も流通しているインゲン豆を使用。交雑が進み、異なる色、形状の豆が混じっている。(Muhanga Market)



油や調味料を販売する雑貨屋。油や調味料の価格も都市部と地方部でほとんど変わらない。(Muhanga Market)



栄養改善啓発・料理講習会の前後で参加者には質問票に回答してもらった（プレテスト・ポストテストの実施）。（Ngororero 郡、2020 年 2 月 12 日）



料理講習会では、調理実習の前に栄養の基礎講義を実施した。（Gakenke 郡、2020 年 2 月 6 日）



料理講習会でオレンジサツマイモの下準備をする保健ボランティア（Gakenke 郡、2020 年 2 月 6 日）



料理講習会でネギの下準備をする保健ボランティア（Rutsiro 郡、2020 年 2 月 12 日）



各料理講習会会場では、セルの職員や、Caregivers に、調理用の水の調達、運搬を依頼した。（Rutsiro 郡、2020 年 2 月 12 日）



料理講習会で、かぼちゃの葉等野菜類の下準備をする保健ボランティア（Gakenke 郡、2020 年 2 月 6 日）



料理講習会での豆腐作り。会場の最寄りのローカルマーケットにおいて、挽いたキャッサバの葉を販売している業者に依頼し、一晩水に付けたダイズを挽いてもらった。料理講習会で挽いたダイズを煮立てて、豆乳を濾した。(Nyaruguru 郡)



料理講習会での豆腐作り。醸造酢で豆乳からたんぱく質を分離させ、型に入れて上から圧力をかけて押し固める。(Nyamagabe 郡)

料理講習会での豆腐作り。豆腐を切り分けて、トマトソースの中で煮込む。(Ngoma 郡)



乾燥小魚をお湯で戻し、臼でつぶした後、オレンジサツマイモと一緒に練り、離乳食を作った。(Rutsiro 郡)

キャッサバとオレンジサツマイモが入った 2 種類のドーナツ作り。(Ngororero 郡)



豆腐を入れたトマトソース煮込み (Ngororero 郡)



玉ねぎやニンニクを用いた煮豆(Ngororero 郡)



現地の野菜を使用したオクラ料理(Ngororero 郡)



ジャガイモとカボチャの葉を入れた煮豆料理 (Ngororero 郡)



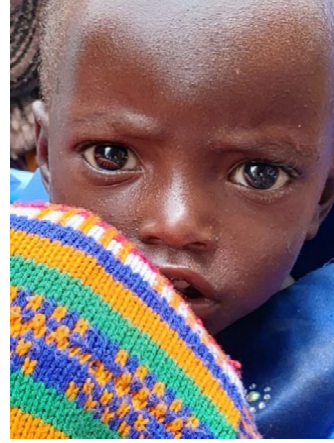
ニンジンとさやいんげんを用いた大豆料理 (Rutsiro 郡)



料理講習会で参加者から最も人気の高かったドーナッツ (Ngoma 郡)



オレンジサツマイモを試食する栄養不良と診断された子ども (Ngoma 郡)



母親と参加した栄養不良の女の子 (Rutsiro 郡)



料理ができるまでの間、栄養強化食品を食べる栄養不良と診断された子ども (Rutsiro 郡)



質問票に答えている栄養不良の子どもの母親 (Rutsiro 郡)



料理研修会中、途中で座り込んでしまった栄養不良の子どもの母親たち (Rutsiro 郡)



Home Based ECD Center の家庭菜園 (Rutsiro 郡)



RAB 職員による栽培技術の講義。研修教材を使用し、栽培技術の説明を行う様子。
(Nyamagabe 郡、2020 年 2 月 17 日)



講義の後、圃場にて栽培技術実習を行った。野菜の苗床に堆肥を施用している様子。
(Nyamagabe 郡、2020 年 2 月 17 日)



降雨のため、組合の倉庫において講義を行う RAB 職員 (Nyamagabe 郡、2020 年 2 月 18 日)



健全な苗の状態を説明する RAB 職員 (Nyamagabe 郡、2020 年 2 月 18 日)



降雨の為にセクターの事務所にある会議室にて講義を行った。(Nyamagabe 郡、2020 年 2 月 19 日)



ジャガイモの作付の様子。元肥を施用した後、種芋を定植した。(Nyamagabe 郡、2020 年 2 月 19 日)



RAB 職員による講義の様子。セクター農務官の呼びかけにより、組合内の多くの農家が研修に参加した。(Nyaruguru 郡、2020 年 2 月 20 日)



RAB 職員による元肥施用の実演。参加者は施肥方法や施肥量について興味深く観察していた。(Nyaruguru 郡、2020 年 2 月 20 日)



農家が準備した堆肥は成熟していなかったため、RAB 職員が状態を詳しく説明している様子。(Nyaruguru 郡、2020 年 2 月 20 日)



多くの農家が各自の圃場で栽培するためにオレンジサツマイモの蔓を持ち帰った。(Nyaruguru 郡、2020 年 2 月 20 日)



展示・研修圃場協の小学校教師も栽培技術研修に参加した。農具や果樹の苗の一部をこの学校に提供した。(Rutsiro 郡、2020 年 2 月 25 日)



栽培技術研修では 4 品種のジャガイモを使用した。同じ面積で栽培し、生育や収量の比較栽培を計画した。(Rutsiro 郡、2020 年 2 月 25 日)



研修の後半では、RAB 職員の指示も的確になり、効率的に研修を実施できるようになった。播種方法を観察する農家。(Rutsiro 郡、2020 年 2 月 26 日)



新しい技術や品種を得られた喜びや感謝を表す歌を歌う農家。セクター農務官も研修から多くの学びを得たと感謝の意を述べた。(Rutsiro 郡、2020 年 2 月 26 日)



郡農務官は冒頭の挨拶で、栄養不良世帯の割合が高いため、高栄養価作物の栽培を強く推奨した。(Ngororero 郡、2020 年 2 月 27 日)



キャッサバの茎の定植。等間隔に植えるため、紐を使って同時に植えていった。(Ngororero 郡、2020 年 2 月 27 日)



ジャガイモの作付け。木の枝を使って間隔を計測し、等間隔で植え付けた。4 品種の種イモを導入した。(Ngororero 郡、2020 年 3 月 10 日)



オレンジサツマイモの蔓の植え付け。研修参加者は FP (ファーマープロモーター) の組合であるため、農作業に無駄がなく、効率的に実習を行う事ができた。(Ngororero 郡、2020 年 3 月 10 日)



RAB 職員による野菜の栽培技術研修。苗床を製作した後、播種方法について詳しく説明を行った。(Ngororero 郡、2020 年 3 月 10 日)



郡農業・天然資源局 (ANRU) 長の閉会の挨拶。郡農業局長も栄養改善に関して、非常に関心が高く、研修に熱心に参加していた。(Ngororero 郡、2020 年 3 月 10 日)



栽培技術研修における講義。プロジェクトチームのスタッフより高栄養作物の必要性、RAB 職員より大豆の栽培技術について説明を行った。(Ngoma 郡、2020 年 3 月 3 日)



大豆の播種溝作り。ここに堆肥や化学肥料(DAP)を元肥として施用した。(Ngoma 郡、2020 年 3 月 3 日)



研修に招待した栄養不良の子を持つ母親。栽培技術研修の内容にはあまり関心がない様子。(Gakenke 郡、2020 年 3 月 5 日)



野菜の苗床作り。苗床を作った後、木の棒を使って播種溝を作った。(Gakenke 郡、2020 年 3 月 5 日)



RAB 職員、Mr.Firmin による栽培技術研修。JICA による SHEP 課題別研修も受けており、研修の進行も滞りなく進められた。(Rubavu 郡、2021 年 4 月 27 日)



RAB 職員 Ms. Agnes による高栄養作物の栽培技術の講義。(Rubavu 郡、2021 年 4 月 27 日)



RAB 職員 Ms. Lea による料理講習会の調理実習風景。(Musanze 郡、2021 年 4 月 28 日)



Burera 郡の郡農業・天然資源局 (ANRU) 長による研修開催の挨拶。(Burera 郡、2021 年 4 月 29 日)



研修参加者は熱心に受講し、今後、バランスの取れた食事を摂るよう気を付けたいと述べた。(Gisagara 郡、2021 年 5 月 6 日)



Nyamasheke 郡での料理研修会での調理実習風景。(Nyamasheke 郡、2021 年 5 月 11 日)

はじめに

本報告書は2014年10月から2019年10月に亘り実施された「ルワンダ国小規模農家市場志向型農業プロジェクト（SMAP）」の追加業務を業務完了報告書（栄養改善編）として取りまとめたものである。追加業務では、栄養改善に関する普及活動や普及体制の支援をRABや対象郡に対して行った。本業務は2019年10月より開始された。2020年初めよりCOVID-19蔓延の影響のため、プロジェクトは約1年間延期され、2021年7月末に終了した。

第1章 プロジェクトの概要

1.1 プロジェクトの背景・目的

ルワンダでは、大統領が緊急課題として掲げた栄養の中でも発育阻害（Stunting）の改善が喫緊の課題となっている¹。これに呼応し、JICAは「農業改革を通じた栄養改善のための政策借款（以下、栄養借款事業）」を、2019年から2021年に掛けて実施した。本プロジェクト（市場志向型農業編）はルワンダにおける小規模農民に対する市場志向型農業を目指すものであるが、本プロジェクトの成果は上記栄養借款事業の目的に貢献する。同時に栄養借款事業の成功はカウンターパート機関（RAB）の普及業務の強化に資する。このため、2020年度からRABが独自に実施する栄養借款事業を円滑に行うことが出来る様に、本プロジェクトの追加的な活動として、農業分野を中心とした栄養改善主流化に係る研修教材作成支援、RABにおける栄養改善普及体制の確立支援、および対象郡農家グループに対する研修の実施を行った。追加業務は2019年10月より開始され、2020年3月より蔓延したCOVID-19の影響のため、約1年間延期されたが2021年6月末にルワンダでのプロジェクト活動を終了した。主な活動は以下の通りである。

- (1) RABの栄養改善活動に係る予算申請支援（FY2020/2021）
- (2) RABの栄養改善活動に係る実施計画策定支援（FY2020/2021）
- (3) 4つのプログラムに所属するRABスタッフへのTOT研修の実施
- (4) 支援対象郡に対する、RAB職員による栄養改善啓発・普及活動の支援（4郡）
- (5) 支援対象郡に対する、RAB職員が実施する栄養改善啓発・普及活動の管理（2郡）
- (6) 栄養改善研修教材の作成支援
- (7) 栄養借款事業における2021年度のRABの栄養改善普及研修の支援（6郡）

なお、予定されていたRAB関係者、ドナー等対象のセミナー開催はCOVID-19の影響のため、中止となった。

1.2 プロジェクト対象地域

本プロジェクトは工期が約7カ月と限られていたが、RABが主体的に栄養借款事業にかかる活動を実施出来るよう支援するため、第2章2.1(2)にて述べるJICA栄養借款事業対象12郡の内、以下の6郡を対象地域とすることをキックオフワークショップにて決定した（巻頭位置図参照）。

¹ 参考：1) ‘Kagame tasks leaders to urgently eradicate persistent stunting among children’, The Inspirer, 2018年8月10日, (<https://rwandainspirer.com/2018/08/10/kagame-tasks-leaders-to-urgently-address-persistent-stunting-burden/>) (最終アクセス：2021年6月), 2) ‘Rwanda Economic Update’, World Bank Group, 2018年6月, (<https://openknowledge.worldbank.org/handle/10986/29908>), (最終アクセス：2021年6月)

なお、COVID-19 の感染拡大によるプロジェクト活動の停止後、2021 年 4 月より活動を再開した際には、栄養借款事業対象 12 郡の内、残りの 6 郡に対して RAB による栄養改善普及研修の支援を実施した。

(1) プロジェクトチームが RAB の活動を支援した郡

プロジェクトチームが RAB 職員による栄養改善啓発・普及活動を支援する対象郡として、以下の 4 郡が決定された。

- Ngoma 郡（東部県）：JICA 円借款事業により建設された中規模ダムおよびその水利組合支援実施中、
- Gakenke 郡（北部県）：RAB-SMAP 活動に対する郡や支援対象組合の対応が良い、
- Ngororero 郡（西部県）：JICA による栄養改善事前調査対象郡、協力的である、
- Nyamagabe 郡（南部県）：郡と RAB で栽培技術研修プロジェクトの MoU を取り交しており、本プロジェクトにも積極的に取り組む姿勢が見られる。

(2) RAB が活動を実施した郡

RAB 職員が実施する栄養改善啓発・普及活動に関し、事前準備等の運営管理のみをプロジェクトチームが支援する対象郡として、以下の 2 郡が決定された。

- Nyaruguru 郡（南部県）：RAB-SMAP 活動に対する郡や支援対象組合の対応が良い、
- Rutsiro 郡（西部県）：JICA による栄養改善事前調査対象郡であった。

(3) 2021 年度に RAB が活動を実施した郡

RAB 職員が以下の 6 郡に対して実施する栄養改善啓発・普及活動に関し、運営管理のみをプロジェクトチームが支援を行った。

- Gisagara 郡、Rubavu 郡、Burera 郡、Nyamasheke 郡、Musanze 郡、Gicumbi 郡

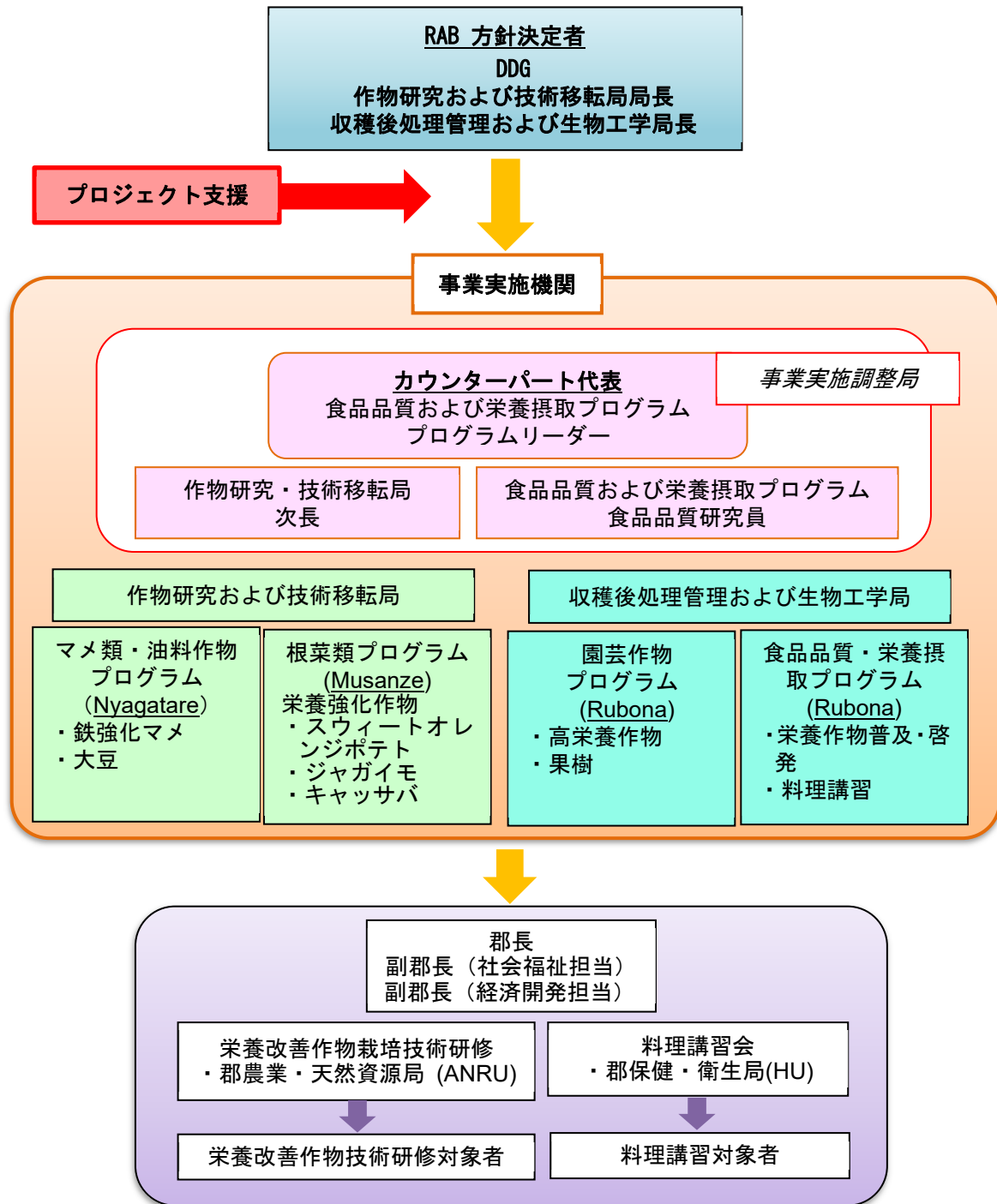
1.3 プロジェクト実施体制の構築

1.3.1 キックオフワークショップの開催

2019 年 10 月 1 日に Rwamagana 郡においてキックオフワークショップを開催し、RAB 内の栄養改善事業実施関係部署の職員を召集し、本追加業務の目的、業務内容につき情報共有を行った。また、栄養改善普及対象作物の特定を行い、これらの普及活動に対する実施部署の確認およびプロジェクト実施体制の確定を行った。

1.3.2 プロジェクト実施体制の確定

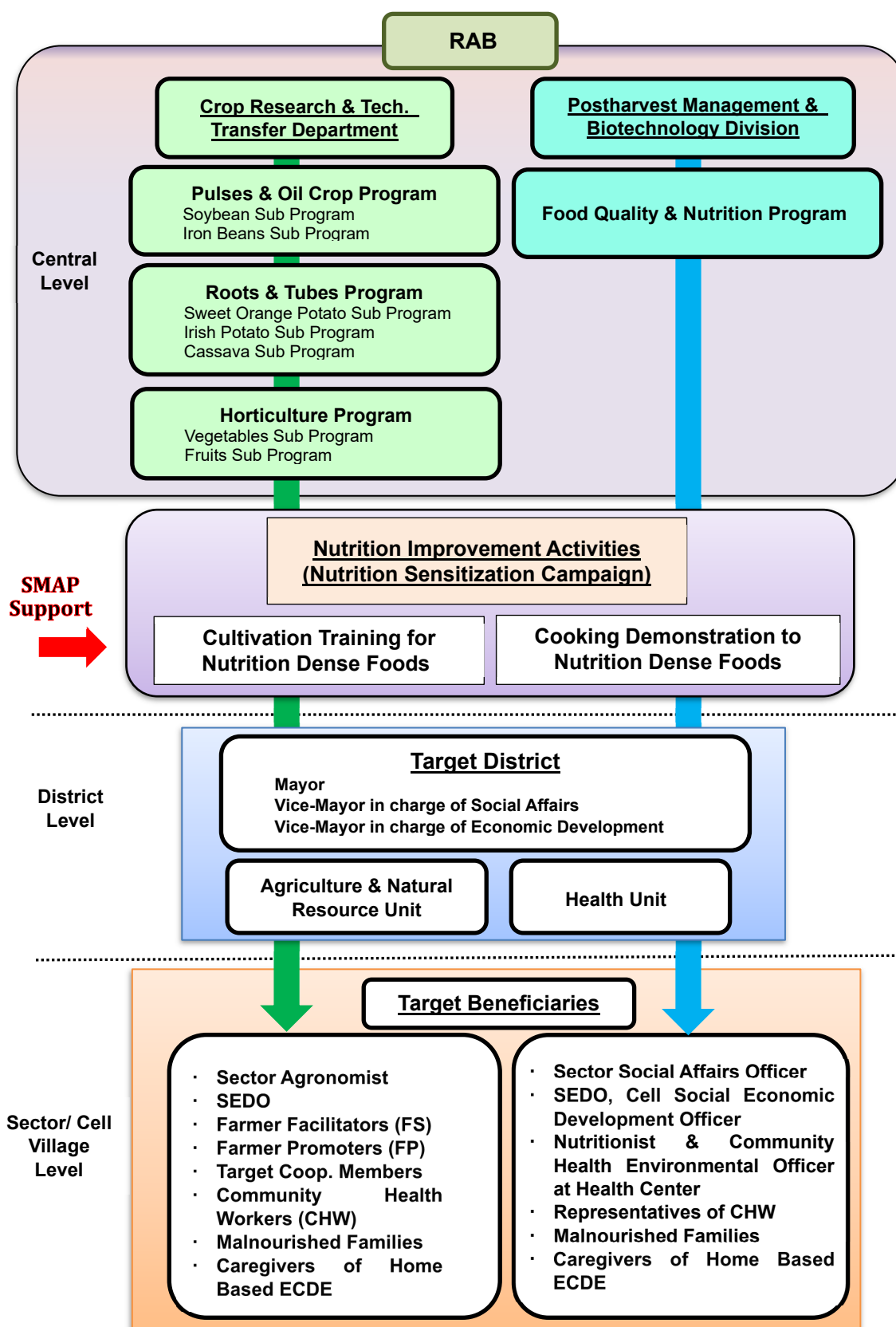
プロジェクト（RAB の栄養改善活動）の実施体制は次図に示す。カウンターパート機関（事業実施機関）は、マメ類・油料作物プログラム、根菜類プログラム、園芸作物プログラムおよび食品品質・栄養摂取プログラムの 4 プログラムが決定された。また、これらプログラム間のワークショップ開催や対象郡での研修実施等の調整を行う部局として、事業実施部局を新設した。RAB 内での 4 つのプログラムの協働で横断的に事業実施を行うのは RAB 内でも初めての試みであった。



出典：プロジェクトチーム（2019）

図 1.3.1 プロジェクトおよび RAB 栄養改善活動実施体制図

また、RAB および対象郡での栄養改善活動実施体制は次図に示す。



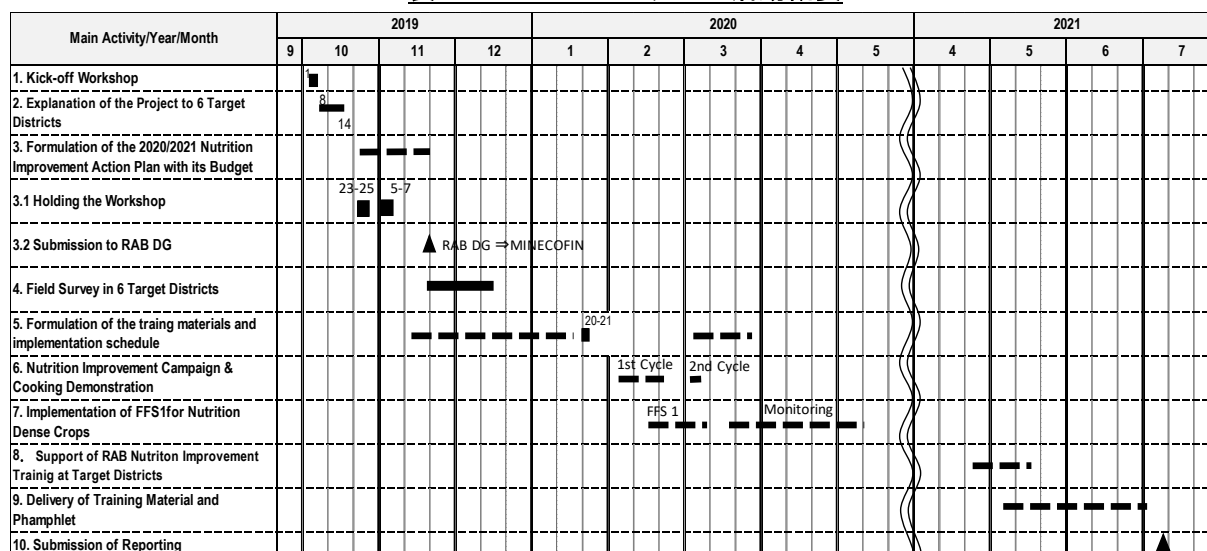
出典: プロジェクトチーム(2019)

図 1.3.2 RAB-対象郡 栄養改善活動実施体制図

1.4 プロジェクトの活動概要

2019年10月から2021年6月までの活動概要は表1.4.1に示す。2020年3月から2021年3月までの期間、COVID-19感染拡大の影響のため、プロジェクト活動は中断されたが、2021年4月より活動が開始された。主な活動内容は、表1.4.1および表1.4.2に示す。

表 1.4.1 プロジェクトの活動概要



出典：プロジェクトチーム（2021）

表 1.4.2 主な活動内容

日時	主な活動	活動内容
2019年10月1日	キックオフ WS 場所：Rwamagana 郡 参加者：RAB 職員 17 名	<ul style="list-style-type: none"> ・ 栄養借款事業の説明、対象支援郡の決定 ・ プロジェクト支援郡：Ngoma、Gakenke、Ngororero、Nyamagabe ・ RAB 支援郡：Rutsiro、Nyaruguru ・ 栄養改善普及作物の特定 <p>栄養強化作物：Iron Beans、Yellow Cassava、Sweet Orange potato、Bio-fortified Irish potato</p> <p>高栄養作物：Soybean、Vegetables</p> <p>果樹：Avocado、tree tomato、passion fruit、papaya</p> <ul style="list-style-type: none"> ・ 事業実施体制の確認 ・ 各プログラムによる研修教材の作成内容協議（目次等）
2019年10月8日～14日	対象6郡に対する事業実施説明協議	対象6郡の郡長、農業・栄養改善関連職員等に対する事業内容説明協議の実施、RABと協働実施
2019年10月23日～25日	2020/2021年のA/Pおよび予算策定WS 栄養改善普及の研修教材の策定 場所：Rwamagana 郡 参加者：RAB 職員 13 名	<ul style="list-style-type: none"> ・ RABの栄養改善活動に係る実施計画策定支援およびその予算申請（FY2020/2021） ・ 栄養改善普及の研修教材の策定； <p>Iron Beans、Sweet Orange Potato、Bio-fortified Irish potato、Soybean、Vegetables、Fruits（Avocado、tree tomato、passion fruit、papaya）および高栄養作物啓蒙・普及の7種類対象</p>
2019年11月5日～7日	場所：Kigali 参加者：RAB 職員 6 名	<ul style="list-style-type: none"> ・ RABの栄養改善活動に係る実施計画策定およびその予算申請（FY2020/2021） ・ 栄養改善普及の研修教材の策定 <p>Yellow Cassava 対象</p>

第1章 プロジェクトの概要

日時	主な活動	活動内容
2019年11月18日～12月13日	対象支援6郡の現地調査	<ul style="list-style-type: none"> 各対象郡の栄養改善対象作物の決定 研修対象者の決定 栽培技術研修圃場／料理講習会の開催地の決定
2020年1月20日～21日	研修教材策定WS 場所：Rwamagana 郡 参加者：RAB 職員 25名	<ul style="list-style-type: none"> 栄養改善普及の研修教材の策定； Iron Beans、Sweet Orange potato、Bio-fortified Irish potato Soybean、Vegetables および Fruits (Avocado, tree tomato, passion fruit, papaya) ⇒8 作物別の第1稿の研修教材 (Kinyarwanda 語版) が完成した
2020年2月4日～21日	第1サイクル料理講習会の実施	6郡×1地区=6地区
2020年3月10日～13日	第2サイクル料理講習会の実施	Ngororero 郡および Rutsiro 郡の2郡(各1地区)、その後の残り4郡は COVID-19 の感染拡大の影響のため中止となった
2020年2月18日～3月6日	栽培技術研修 FFS1 の実施	対象6郡、13研修圃場で栽培研修の実施
2020年3月19日	一時帰国	COVID-19 の感染拡大の影響によりプロジェクトチーム日本人専門家が一時帰国
2020年4月～2021年3月	プロジェクトの中断	COVID-19 の感染拡大の影響により、プロジェクト活動を中断
2021年4月2日～21日	現地調査実施	<ul style="list-style-type: none"> プロジェクトチームのローカルスタッフによる対象6郡の展示・研修圃場への現地視察 関係機関への表敬・打合せ、今後の活動計画策定
2021年4月27日～5月11日	RAB の栄養改善普及研修実施の支援	Rubavu 郡、Musanze 郡、Burera 郡、Gicumbi 郡、Gisagara 郡および Nyamasheke 郡で栽培技術研修および料理講習会の実施支援
2021年4月～6月	正式栄養研修教材の承認の確認 研修教材等の印刷・配布	<ul style="list-style-type: none"> MINAGRI PS、RAB DDG との協議の結果、公式教材として活用することが承認された。 研修教材パンフレットの印刷・配布 栄養教材紹介ビデオ作成 栄養教材データのウェブ掲載
2021年7月	報告書の提出	業務完了報告書(栄養改善編)

出典：プロジェクトチーム(2021)

SMAP における市場志向型農業編に係る事業の追加事業としての栄養改善に係る活動に関し、日本人専門家の配置スケジュールを Annex 1 に示した。

第2章 RABの栄養改善活動に係る実施計画および予算策定支援

2.1 2020/2021年度栄養改善活動に係る実施計画および予算策定ワークショップの開催

2020年度および2021年度に実施された栄養借款事業に対する、RABの栄養改善活動に係る事業実施計画およびその予算策定支援のためのワークショップを、2019年10月下旬から11月上旬にかけて実施した。出席者は、RABの栄養改善活動に係る事業実施調整局とその傘下の4つのプログラム（マメ類・油料作物プログラム、根菜類プログラム、園芸作物プログラムおよび食品品質・栄養摂取プログラム）の代表からなる（Annex 7参照）。同ワークショップでは以下の項目を協議し、確認・決定した。

(1) ワークショップの目的

ルワンダの発育阻害率¹を改善するために栄養価の高い農産物の普及・増産を図ると共に、その消費量増加を図るため、RABの栄養改善事業に係る事業実施計画（2020年/2021年）およびその予算策定支援を目的とする。

(2) 栄養借款事業の対象地域

ルワンダ政府およびJICAは、30郡の内、発育阻害率が高い郡で世界銀行による事業対象地域との重複がないよう、以下の12郡を栄養借款事業の対象地域として選定した。次図に12対象郡の位置を示す。

- ◆ 東部県：Ngoma 郡
- ◆ 南部県：Nyaruguru、Nyamagabe、および Gisagara の3郡
- ◆ 西部県：Rubavu、Rutsiro、Ngororero、および Nyamasheke の4郡
- ◆ 北部県：Musanze、Gicumbi、Burera、および Gakenke の4郡

¹ 発育阻害率（Stunting rate）とは、5歳未満の子どもの内、年齢に不相应な低身長の子どもの割合を示す。

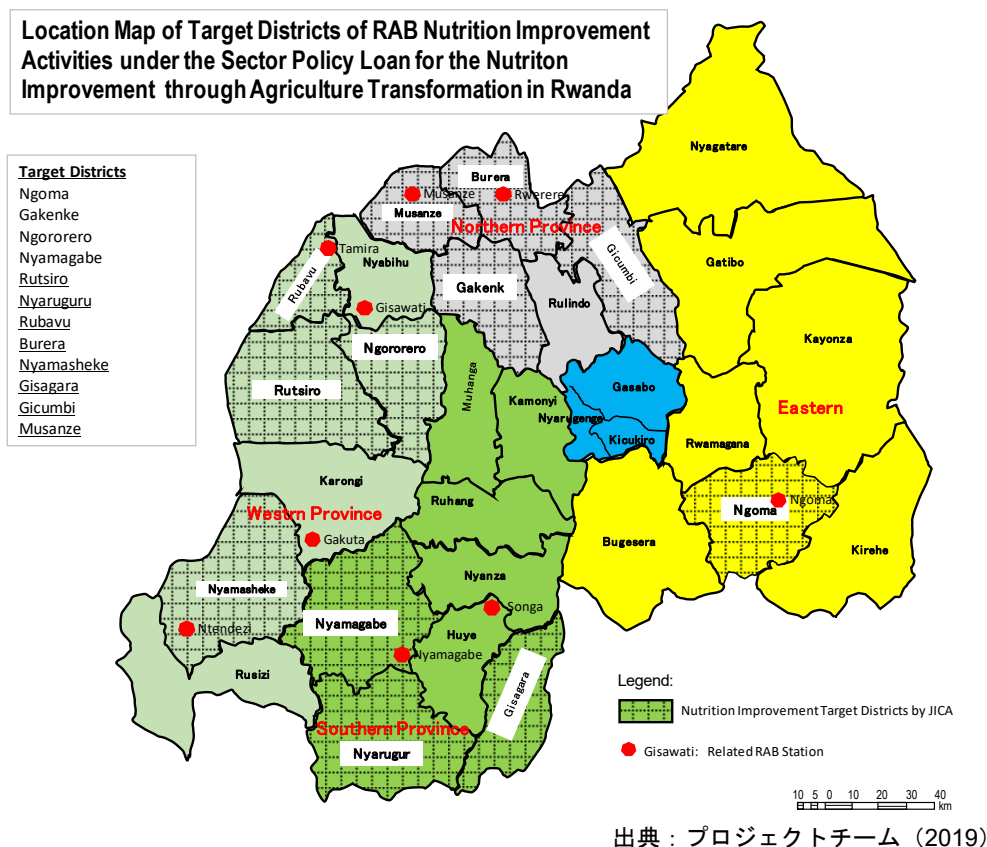


図 2.1.1 栄養借款事業の支援対象郡位置図

(3) RAB による栄養改善活動の研修対象者

栄養改善のための高栄養作物の栽培技術研修（FFS）、および栄養改善啓発・料理講習会（以下、料理講習会）の対象者は、RAB および対象郡関係者との協議の結果、以下の様に決定された。各研修の参加者は最大 45 名を原則とした。

1) 高栄養作物の栽培技術研修（FFS）対象者

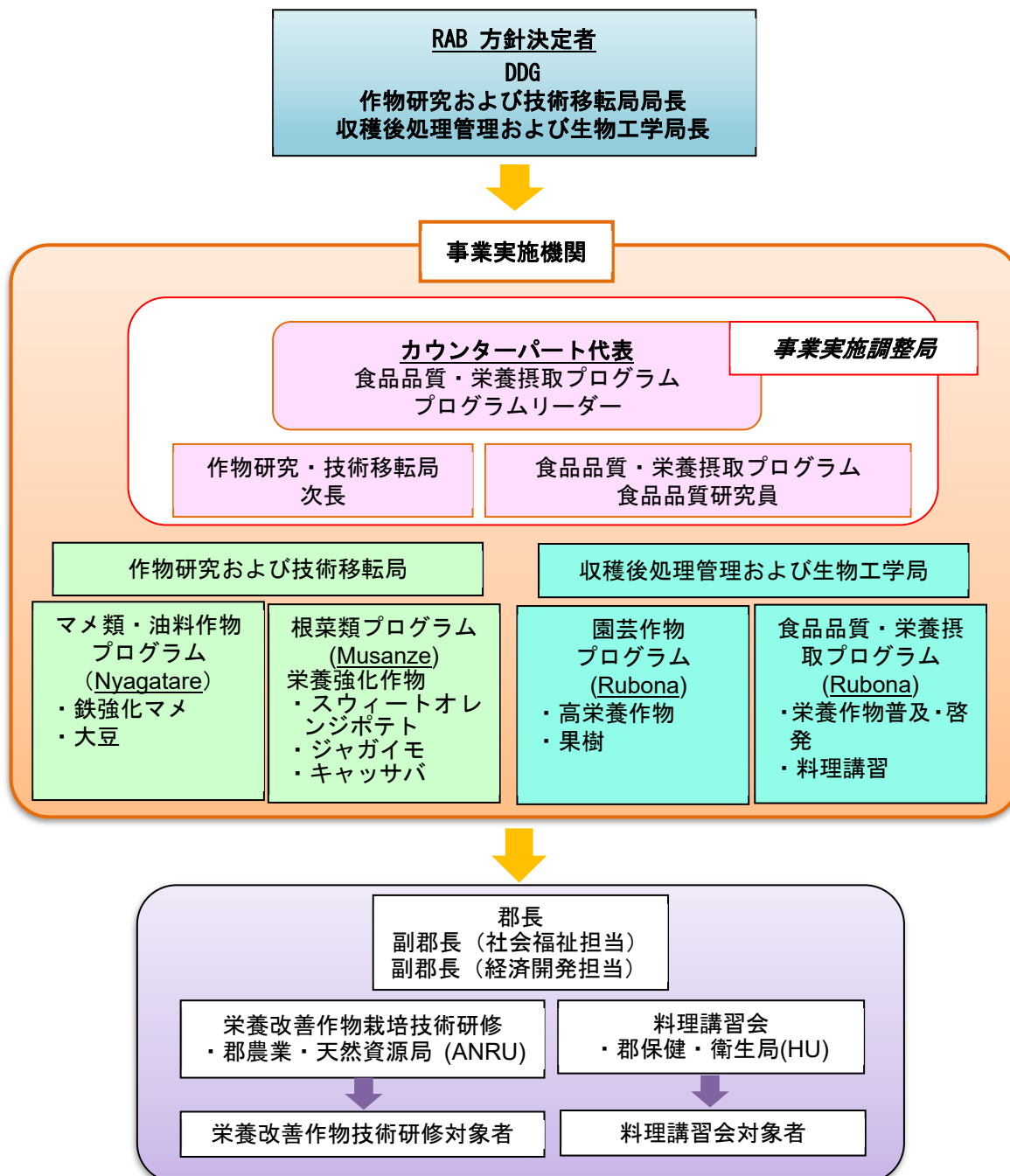
- District Agriculture and Natural Resource Unit
- Sector Agronomist Officer of Target Sector per site
- Social Economic Development Officers (SEDO) of Cells in Sector where identify training site
- Farmer Facilitators of target crops in the target Sectors
- Farmer Promoters of villages in the Cell where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

2) 料理講習会対象者

- 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 located Cooking Demonstration site
- CHWs in charge of nutrition at village of cell where located Cooking Demonstration site
- Caregiver representatives at each village in Cell where located Cooking Demonstration site
- Malnourished Families
- Farmer Promotor at Village where located Cooking Demonstration site

(4) RABによる栄養改善活動の事業実施体制

RAB内では、マメ類・油料作物プログラム、根菜類プログラム、園芸作物プログラムおよび食品品質・栄養摂取プログラムの4部門が事業実施機関となり、プログラムの全体統括、対象郡との折衝、報告書の作成等を担う事業実施調整局を新たに設けた。また、これらの部局は対象郡内の農業・天然資源局（Agriculture Natural Resources Unit: ANRU）および保健衛生局（Health Unit: HU）と協働で事業を実施した。全体の事業実施体制は図2.1.2 事業実施体制図に示す。



出典：プロジェクトチーム（2019）

図 2.1.2 RABによる栄養改善活動の事業実施体制図

(5) RABによる栄養改善活動の事業実施期間

事業実施期間は、2020年7月～2021年6月までの1年間であった。

2.2 2020/2021年度におけるRABの栄養改善活動に係る活動計画及びその予算の策定支援

2.2.1 概要

2019年10月および11月にRAB関係職員を召集し、2020/2021年度におけるRABの栄養改善活動に係る活動計画およびその予算の策定支援のためのワークショップを開催した。各プログラムの活動計画およびその予算はAnnex 2に示す。策定された計画・予算は2019年11月にRABのDGに提出され承認された。その後、RABから財務・経済企画省(MINECOFIN)に提出され、予算が確定された。しかし、COVID-19感染拡大の影響等もあり、2020年度はMINECOFINからの予算の配布はなかった。

2.2.2 2020/2021年度におけるRABの栄養改善活動に係る実施計画の策定支援

(1) 対象郡で導入する高栄養作物の決定

各郡の自然条件(標高、気温、土壌等)を考慮し、RABおよび各対象郡の栄養改善活動の関係部署職員との協議の結果、各郡で導入する高栄養作物は以下の様に決定された。

表 2.2.1 対象郡で導入した高栄養作物

対象郡名/ 導入作物	栄養強化作物/ 野菜/ 高栄養作物						
	Soybean	Iron Beans	Vegetables	Yellow Cassava	Orange Sweet Potato	Bio-fortified Irish Potato	Fruits (Avocad, 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
Nyamasheke	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: 作付け可能

N: 作付け不可

*1) 2019年SMAP支援対象郡

出典: プロジェクトチーム (2019)

(2) 対象郡での研修場所の決定

栄養改善活動の対象郡職員と協議を行い、次表に示す通り、展示・研修圃場および料理講習会の場所等が決定された。

表 2.2.2 展示・研修圃場、料理講習会の場所

導入作物	対象郡の数	展示・研修箇所数	耕作面積(ha)	備考
栽培技術研修				
Soybean	8	16	0.25	2 地区/郡
Iron Beans	12	12	0.25	2 地区/郡
Irish Potato	9	27	0.1	3 地区/郡
Vegetable	12	12	0.5	1 地区/郡
Fruit Trees*1)	12	12	0.4	1 地区/郡
Yellow Cassava*2)	8	16	0.25	2 地区/郡
Orange Sweet potato	12	24	0.25	2 地区/郡
料理講習会	12	24	-	2 地区/郡

出典：プロジェクトチーム（2019）

*1): Passion Fruits や Tree Tomato は展示・研修圃場で作付けを行ったが、その他の果樹は苗木を参加者に配布した。

*2): Yellow Cassava の作付け期間は1年以上を要する。

(3) RABによる栄養改善活動の実実施計画

栄養借款事業における2020/2021年度の栄養改善活動の実実施計画は、下表の通り策定された。

表 2.2.3 栄養借款事業におけるRAB栄養改善活動計画（2020/2021年の概要）

活動内容	2020年						2021年					
	7	8	9	10	11	12	1	2	3	4	5	6
対象12郡へのアクションプランの説明・協力要請（対象12郡への表敬） キックオフワークショップの開催	キックオフワークショップ						対象12郡名 Ngoma, Gakenke, Ngororero, Nyamagabe, Rutisiro, Nyaruguru, Rubavu, Nyamasheke, Gisagara, Gicumbi, Musanze, Burera					
支援対象グループ/農業組合の選定	■											
支援対象圃場/料理講習会会場への現地調査 研修参加者の確認 料理講習のための基礎情報の収集	■											
高栄養作物の苗木、種子および料理講習資機材の調達	■											
12対象郡での栽培技術研修および料理講習会の実施												
1. 園芸（野菜および果樹）				■	■	■	■	■	■	■	■	■
2. 豆類および油料プログラム（鉄強化マメおよび大豆）				■	■	■	■	■	■	■	■	■
3. 根菜類（スウィートオレ인지ポテト、ジャガイモ、キャッサバ）				■	■	■	■	■	■	■	■	■
4. 食品品質および栄養摂取プログラム				■	■	■	■	■	■	■	■	■
研修参加者へのモニタリング				■	■	■	■	■	■	■	■	■
各郡での四半期毎の評価ワークショップ				■	■	■	■	■	■	■	■	■
アクションプランの提出・承認						▲ RAB DGへの提出		▲ MINECOFINへの提出			▲ MINECOFINによる承認	
RAB DG/DDGへの四半期毎の報告書の提出				▲			▲		▲			▲

出典：プロジェクトチーム（2019）

2.2.3 2020/2021年度におけるRABの栄養改善活動に係る事業予算の策定支援

(1) 前提条件の確認

各プログラムで栄養改善活動に係る事業予算を策定するに当たり、前提条件として以下の表に示す項目別単価をワークショップ参加者で確認・合意した。

表 2.2.4 日当・宿泊、車両借上げ費等の単価の確認

項目	単価/日 (Rwf)	備考
RAB 職員の日当・宿泊	54,000	宿泊 (47,000RWF)+日当 (7,000RWF)
対象郡職員の日当	6,000	郡およびセクター職員
対象郡の職員や農家への交通費および昼食代	15,000	交通費 (10,000RWF)+昼食代(5,000RWF)
車両借り上げ	84,000	4 輪駆動車
研修会場借り上げ	100,000	

出典：プロジェクトチーム (2019)

(2) 栄養改善活動に係る事業予算の策定

次表に、各プログラムの事業予算を示す。各プログラム内で、事業費を積算した後、事業実施調整局がそれらを取りまとめて RAB 内での申請手続きを行った。総事業費は約 Rwf 21.2 億となった。その内、対象郡との折衝や研修日程の調整、報告書の作成等は新たに設立された事業実施調整局が行うため、これらの活動に必要な予算として約 Rwf 1.3 億が計上された（詳細は Annex 2 を参照）。

表 2.2.5 各プログラムの事業予算

プログラム名	役割／普及対象作物	事業予算 (Rwf)
事業実施調整局	事業の管理およびモニタリング	129,624,000
食品品質・栄養摂取	栄養強化・作物の普及	252,358,480
小計		381,982,480
マメ類および油料作物	大豆	297,880,000
	鉄強化マメ	280,350,400
小計		578,230,400
根菜類	スイートオレンジポテト	293,729,220
	ジャガイモ	256,825,000
	黄色キャッサバ	120,388,460
小計		670,942,680
園芸作物	野菜類（高栄養作物） ※2019年10月に終了した SMAP による市場志向型農業研修で対象とした作物も含めた。	253,074,000
	果樹	231,776,000
小計		484,850,000
合計 (Rwf)		2,116,005,560

出典：プロジェクトチーム (2019)

第3章 対象郡に対する研修の実施支援

3.1 研修前準備

(1) 現地調査

プロジェクトチームはRAB職員と協働で、対象6郡に対する研修実施概要の説明・協力要請および展示・研修圃場の場所、栄養改善啓発・料理講習会（以下、料理講習会）会場の場所、研修参加者数等を確認するために、以下の日程で現地調査を実施した。

表 3.1.1 対象6郡の現地調査日程

対象郡	現地調査期間	備考
Ngoma	18-19 Nov., 2019	東部県
Nyaruguru	20-21 Nov., 2019	南部県
Nyamagabe	21-22 Nov., 2019	南部県
Rutsiro	28-29 Nov., 2019	西部県
Ngororero	5-6 Dec., 2019	西部県
Gakenke	12-13 Dec., 2019	北部県

出典：プロジェクトチーム（2019）

(2) 対象作物および展示・研修圃場での耕作面積の決定

対象6郡で対象とする高栄養作物および、それらの研修圃場の耕作面積を次表に示す。展示・研修圃場での耕作面積は、6郡で7,600m²となった。果樹に関しては将来の事業効果をモニタリングできるように展示・研修圃場はアクセスの良い村落を特定し、農家に果樹の種子・苗木を展示・研修用として無償で配布する計画とした。なお、展示・研修圃場は原則として組合の協働圃場を使用した。なお、キャッサバ等のいくつかの作物について、個人的に栽培している地区では、個人の圃場を展示・研修圃場として選定した。

表 3.1.2 対象6郡に導入した高栄養作物の耕作面積

対象郡/ 対象作物	栄養強化作物/ 野菜/ 高栄養作物						
	Soybean	Iron Beans	Vegetables	Yellow Cassava	Orange Sweet 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 ²	600m ²	2,400m ²	600m ²	600m ²	500m ²	2,400m ²

出典：プロジェクトチーム（2019）

(3) 各対象作物別の展示・研修圃場および料理講習会会場の決定

研修地はアクセスの容易さを最優先とし、対象郡の関係者と協議して、各対象作物別の展示・研修圃場および料理講習会会場が決定された（表 3.1.3 および表 3.1.4 参照）。展示・研修圃場は、各郡2カ所を原則とした。なお、Nyamagabe 郡ではジャガイモは高地での栽培が適しており、展

示・研修圃場を他の作物と異なる場所に設置する必要があったため、3カ所を選定した。展示・研修圃場の詳細は、Annex 3.1 に示す。

1) 各郡における対象作物別の展示・研修圃場とその耕作面積

各郡における展示・研修圃場と対象作物別の耕作面積を次表に示す。各郡との協議の結果、全13カ所、総耕作面積は7,600m²となった。

表 3.1.3 対象郡の各展示・研修圃場で導入した高栄養作物およびその耕作面積

対象郡	研修圃場1	研修圃場2	研修圃場3	備考
Ngoma	Coop. KOTURI, Rukira Sector, Nyaruvumu Cell	CCT Urumuri, Rukumberi Sector, Gituza Cell		
導入作物	Soybean, Iron Beans	Vegetable, Fruits, Yellow Cassava, Orange Sweet potato		
耕作面積	200m ²	1,000m ²		
Nyaruguru	KOABI Coop., Rusenge Sector, Gikunzi Cell	Jyambere Muhinzi, Kibeho Sector, Mubuga Cell		
導入作物	Vegetable, Iron Beans, Soybeans, Yellow Cassava	Irish Potato, Fruit Orange Sweet potato,		
耕作面積	700m ²	600m ²		
Nyamagabe	KOIKWI Coop. Cyanika Sector, Ngoma Cell	KOTUBAKA Coop. Kaduha Sector, Nyabizindu Cell	Gatare Sector, Rwamakara Cell	
導入作物	Vegetable, Orange Sweet Potato	Yellow Cassava, Iron Beans, Fruits	Irish Potato,	
耕作面積	500m ²	600m ²	100m ²	
Rutsiro	Manihira Sector, Haniro Cell	Boneza Sector, Nkira Cell		
導入作物	Irish Potato, Fruits	Vegetable, Iron Beans, Soybean, Yellow Cassava, Orange Sweet Potato		
耕作面積	500m ²	800m ²		
Ngororero	Coop. Zamuka Muhinzi, Ngororero Sector, Nyange Cell	Nyange Sector, Gaseke Cell		
導入作物	Soybeans, Iron Beans, Orange Sweet Potato, Vegetables, Irish Potato	Yellow Cassava, Fruits		
耕作面積	800m ²	500m ²		
Gakenke	Coko Sector, Mubirima Cell	Mukinga Coop. Kiburuga Sector, Rugumbu Cell		
導入作物	Yellow Cassava, Orange Sweet Potato, Fruits, Irish Potato	Soybeans, Iron Beans, Vegetables		
耕作面積	700m ²	600m ²		
Total	6カ所、3,400m ²	6カ所、4,100m ²	1カ所、100m ²	計13カ所

出典：プロジェクトチーム（2019）

2) 各郡における栄養改善啓発・料理講習会会場

料理講習会の会場は各対象郡で2カ所とし、計12カ所を選定した。各研修の参加者数は、45人を原則とした。

表 3.1.4 各対象郡における料理講習会の会場地

対象郡名	第1サイクル	第2サイクル	備考
Ngoma	Kibungo HC, Kibungo Sector, Cyasamakamba 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	
計	6カ所	6カ所	

出典：プロジェクトチーム（2019）

(4) 研修対象者

RAB および対象 6 郡の関係職員と協議し、栽培技術研修および料理講習会の参加候補者は以下の様に決定された。

1) 栽培技術研修（FFS）対象者

- 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
- CHWs in charge of Nutrition at village of cell where located training site
- Caregiver of Home Based ECDE in the Village located DT-Farm

2) 料理講習会対象者

- 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
- CHWs 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) 研修参加者

交通費や講習会場の広さ等の制約、時間通りの WS 開催のため、可能な限り近距離からの参加者を前述の研修対象者から募ることとした。前節（4）研修対象者を参考に郡関係者とも協議し、栽培技術研修および料理講習会の研修参加者は原則として最大 45 名とした。計画した研修参加者は 6 郡で総計 1,005 名と推定された。

表 3.1.5 対象郡別の研修参加予定者数

対象郡	栽培技術研修/ FFS			料理講習会会場		計
	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

出典：プロジェクトチーム（2019）

3.2 栄養改善啓発・料理講習会の実施

3.2.1 事前準備

料理講習会の実施に当たり、プロジェクトチームは RAB 職員や対象 6 郡の職員と協議し、開催日、講習会会場、参加者、プロジェクトチームによる供与資機材等を決定した。料理講習会の開催場所は、2 カ所/対象郡、計 12 カ所と決定された。第 1 サイクルは 6 カ所（各郡 1 カ所）を対象に 2020 年 2 月 3 日～2 月 21 日、第 2 サイクルの 6 カ所（各郡 1 カ所）は 3 月 9 日～3 月 27 日での実施を計画した。

第 1 サイクルの 6 カ所での研修は予定通りに終了した。第 2 サイクルの研修の内、3 月 11 日に Ngororero 郡で、3 月 13 日に Rutsiro 郡の 2 カ所での研修を実施したが、その後、ルワンダ国保健省の COVID-19 感染拡大防止のための集会の禁止令が公布されたため、3 月 15 日以降の残り 4 対象郡での料理講習会は中止となった。対象 6 郡での料理講習会日程は Annex 3.2 および Annex 3.3 に示す。

(1) RAB による講師の選定

RAB 食品品質・栄養摂取プログラムから、次表に示す通り、4 名の職員と 1 名の RAB 所属のインターン生が講師として参加することとなった。

表 3.2.1 TOT 対象の RAB 食品品質・栄養摂取プログラムの職員リスト

No.	氏名	職位	機関
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. Gerardine NYIRAHANGANYAMUNSI	Research Technician	
5	Ms. Sabine MUGWANEZA	Internship Student	

出典：プロジェクトチーム（2019）

(2) 料理講習会で使用した調理用資機材および食材の供与

料理講習会后、講習会で使用したフライパン、皿、フォーク、スプーン等の 23 種類の調理用資機材を、会場となったヘルスセンターやセル事務所等に供与した。また、余った食材や調味料等も供与した。詳細は Annex 3.4 および Annex 3.5 に示す。次表に示す様にプロジェクトは、講習会ごとに各研修会場に対し Rwf 172,450 相当の調理用資機材および余った食材等を供与した。

表 3.2.2 調理用資機材および食材の提供（購入金額より Rwf に換算）

供与資機材等	合計費用 (Rwf)	費用/回 (Rwf)
料理講習会用資機材	1,473,600	Rwf 122,800
食料品	595,800	Rwf 49,650
合計	10,930,900	Rwf 172,450

出典：プロジェクトチーム（2020）

3.2.2 JICA 海外協力隊（JOCV）との連携

赴任地で栄養改善活動を行っている JOCV から、当プロジェクトの料理講習会への参加により研鑽を図り、今後の彼らの栄養改善普及活動に役立てたいとの希望があった。このため、JICA ルワンダ事務所との協議の結果、6名の JOCV が料理講習会の実施を支援した。以下に JOCV への支援依頼事項、研修参加スケジュール等を記す。

(1) JOCV への支援依頼事項

以下の項目について、JOCV に支援を依頼した。

- ◆ 食生活や栄養に関する知識、料理講習会の内容理解度を把握するための質問票への記入に際し、非識字者等の参加者に対する支援
- ◆ 料理講習会の準備、調理、後片付け等の支援
- ◆ 料理講習会での写真、ビデオ撮影の支援
- ◆ 参加後、料理講習会における気づきや改善点について、提言等の簡易な文書の提出（次年度の料理講習会の改善に資するため）

(2) JOCV 参加者リストおよび講習会参加日程

料理講習会に参加した JOCV の氏名、参加した料理講習会の場所や参加日等を次表に示す。

表 3.2.3 料理講習会における JOCV の参加リスト

参加者名	職種	赴任先	講習会参加日	料理講習会会場
Noda. E	Community Development (Water Sanitation)	Ngoma, Rukira	5 th Feb 2020	Kibungo Health Center, Kibungo Sector, Ngoma
Tagawa. S	Community Development (Water Sanitation)	Ngoma, Kibungo	同上	同上
Ota. N	Community Development (Agriculture)	Rulindo, Bushoki	6 th Feb 2020	Cell Office at Kivuruga Sector, Gakenke
Sato. H	Vegetable Growing	Rulindo, Shorongi	同上	同上
Ota. K	Vegetable Growing	Bugesera, Nyamata	12 th Feb 2020	Nyange Cell Office, Ngororero Sector, Ngororero
Kuma. A	Vegetable Growing	Huye, Ngoma	21 st Feb 2020	Cyanika Health Post at Cyanika Sector, Nyamagabe

出典：プロジェクトチーム（2020）

3.2.3 第1サイクル料理講習会

2020年2月5日から2月21日にかけて第1サイクル料理講習会（全6郡、計6カ所）を実施した（会場の場所は、前述の表3.1.4を参照）。

(1) 料理講習会の参加者

第1サイクルの料理講習会の参加者は以下の通りである。概ね計画通りの参加者を得ることができたが、郡からの参加者数は平均46.5人/カ所となり、講習会会場の広さに比べ参加人数が多すぎる結果となった。また、時間の制約もあったため、実際の調理は一部の政府職員のみによる実演となった。会場によっては、調理実習状況が参加者からよく見えないこともあった。料理講習会参加者の詳細はAnnex 3.6に示す。

表 3.2.4 第1サイクル料理講習会の参加者数

Participants Name/ Date	Ngoma District			Gakenke District			Ngororero			Rutsiro District			Nyaruguru			Nyamagabe District			Total		
	5/Feb./2020			7th Feb 2020			12th Feb 2020			14th Feb 2020			19th Feb 2020			21st Feb 2020			Total		
	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
Sub Total	16	28	44	21	30	51	19	33	52	24	33	57	25	20	45	19	39	58	124	183	307
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
Total	16	32	48	25	33	58	21	36	57	24	35	59	25	22	47	19	41	60	130	199	329

出典：プロジェクトチーム（2020）

(2) 料理講習会の内容

料理講習会の初めに、ルワンダでの子ども（5歳未満）や妊婦の栄養不良の状況、栄養改善の必要性等についての説明を行い、次いで栄養改善のために摂取が必要な高栄養作物を紹介した。その後、乳幼児が摂取できる離乳食等を含めた8種類のメニューの調理講習が実施された。主な講義内容は次表に示す。

表 3.2.5 第1サイクル料理講習会の内容

内容	所要時間
Need for nutrition improvement, need for high nutrition crop intake Pre-test implementation, post-test questionnaire distribution	20分
Importance of soybean, bean, sweet potato, Irish potato and vegetables	3.5時間
Preparation of all ingredients with participants	
Soybean processing to make soybean milk	
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)	30分

出典：プロジェクトチーム（2020）

3.2.4 第1サイクル料理講習会の振り返りワークショップの実施

2020年2月27日に、料理講習会の講師として参加したRAB職員らと共同で、第1サイクル料理講習会の振り返りワークショップを開催した。第1サイクル料理講習会を通して確認された課題に対し、第2サイクルの講習会ではどのように対応するかをRAB職員と協議した。以下に、対応が求められる課題に対する参加者からのコメントを示す。これらへの対応の一環として、第2サイクルでは参加者の絞り込みとメニュー数の削減による講習会の時間短縮等の対応策を検討した。

(1) 第1サイクル料理講習会の参加者からのコメント

参加者からの主なコメントは以下の通りである。

- ◆ 使用された調理器具、材料は高く買えない。
- ◆ 参加者が多すぎて全員が講師の手元を見ることができなかった。
- ◆ 同じ講習会をもう一度、実施してほしい。
- ◆ 講習会をビデオ撮影して、何度でも見直せるようにしてほしい。
- ◆ 講習会はセクターごとに実施してほしい。
- ◆ もっと講習会を数多く実施してほしい。
- ◆ 参加者に対して調理器具が足りない。
- ◆ 調理器具を全てのECDセンターに供給してほしい。
- ◆ 質疑応答の時間が設けられなかった。
- ◆ 講習会の開催時間が長すぎた。
- ◆ 講習会の時間に対して、扱うメニューの数が多すぎた。一つのメニューについて参加者が理解できるように教えてほしい。
- ◆ ダイズとニンジン、インゲンの煮物がおいしかった（20人中16人）。

3.2.5 第2サイクル料理講習会

(1) 料理講習会の参加者

COVID-19の感染拡大の影響により、日本人専門家は本邦に緊急帰国したため、講師を務めるRAB職員を、プロジェクトチーム雇用のローカルスタッフが支援する形で料理講習会を開催した。郡からの出席者数はNgororero郡で27名、Rutsiro郡で33名、合計で60名となった。郡関係職員やHealth Center職員は他の会議や研修と重なってしまったため、全体として参加者は少なくなった。また、前述の振り返りワークショップの反省を踏まえ調理講習のメニュー数を減らし、6種類とした。なお、研修を実施した両郡のHealth Centerには施設資機材等が未整備であったため、料理講習会はセル事務所で実施した。

表 3.2.6 第2サイクル料理講習会の参加者数

参加者名	Ngororero 郡			Rutsiro 郡			計		
	男	女	計	男	女	計	男	女	計
Health Workers including Community Health Workers and Care Giver	7	4	11	3	13	16	10	17	27
Local Government Office and Health Center 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
小計	10	17	27	8	25	33	18	42	60
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
合計	11	18	29	9	26	35	20	44	64

出典：プロジェクトチーム（2020）

(2) 料理講習会の内容

前述の振り返りワークショップでの協議を基に、調理講習の料理メニューは8種類から6種類に減らしたことで、参加者にとってわかりやすく記憶に残りやすい料理講習会を実施することができ、参加者からも好評価を得ることができた。

表 3.2.7 第2サイクル料理講習会の内容

内容	所要時間
Concept of Malnutrition, Balanced meal and Nutrients dense foods.	20分
Importance of soybean, bean, sweet potato, Irish potato and vegetables	
Pre-test implementation, post-test questionnaire distribution	
Preparation of all ingredients with participants	2.5時間
Soybean processing (preparation of Soymilk, Okara and Tofu);	
Fresh Beans	
Soybeans and carrots	
Orange Sweet Potato Doughnut;	
Soybean	
Sweet potatoes and fish (small) powder.	
Exchange of opinions (comments, suggestions, etc. from participants)	30分

出典：プロジェクトチーム（2020）

3.2.6 プレテストおよびポストテスト

料理講習会では、以下5点の情報収集を目的として、毎回プレテストとポストテストを実施した。これら5点について、テスト結果の集計、分析から判明したことや想定される課題を踏まえ、今後の講習会の改善点を把握し提言として取りまとめた。なお、プレテストおよびポストテストの質問票は Annex 4.1 および Annex 4.2 に示す。

- 参加者の特性の把握。
- 料理講習会参加者の生活概要の把握。
- 講義の成果の把握。
- メニューの妥当性の評価。
- テスト結果による課題と改善点の把握。

(1) 料理講習会参加者のプロフィール

下表に、各サイクルの講習会への参加者（プレテスト及びポストテストの回答者）のプロフィールを示す。各講習会において、全参加者の内、女性が約6割、男性が約4割を占めたことから、ジェンダーバランスは良かった。なお、第1サイクルと第2サイクルでは参加者の属性に変化が見られた。第1サイクルでは、全参加者に対して保健所の職員である Nutritionist や Community Health Environment Officer の占める割合が最も多く、Community Health Workers がそれに続いていたが、第2サイクルでは、Home Based Early-Childhood Development Center における子どもたちの介助者の割合が最も多く、住民とセル事務所の Social and Economic Development Officer がそれに続いた。第2サイクルでは、参加者が調理工程を見て学ぶことができるよう、出来るだけ参加者数を減らす必要があったため、日常的に調理することがない Nutritionist や Community Health Environment Officer や、Community Health Workers を参加対象者から除外した。そのため、結果的に ECD Center の介助者の数が一番多くなったと考えられる。

表 3.2.8 料理講習会参加者のプロフィール

	第1サイクル				第2サイクル				
	プレテスト		ポストテスト		プレテスト		ポストテスト		
講習実施郡	Ngoma, Gakenke, Ngororero, Rutsiro, Nyaruguru, Nyamabage (6郡)				Ngororero, Rutsiro (2郡)				
主要情報項目	人数	割合	人数	割合	人数	割合	人数	割合	
料理講習会参加者の属性	合計	238	-	212	-	50	-	66	-
	女性	132	55.46%	N/A	N/A	30	60.00%	N/A	N/A
	男性	104	43.70%	N/A	N/A	20	40.00%	N/A	N/A
	郡役場保健部：部長	4	1.68%	0	0.00%	0	0.00%	0	0.00%
	郡役場保健部：職員	3	1.26%	4	1.89%	0	0.00%	0	0.00%
	セクター：Social Affair Officer	28	11.76%	22	10.38%	2	4.00%	1	1.52%
	保健所：Nutritionist/Community Health Environment Officer	39	16.39%	45	21.23%	0	0.00%	4	6.06%
	セル：Social and Economic Development Officer	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%
	住民	30	12.61%	24	11.32%	11	22.00%	10	15.15%
	CHW（栄養担当）	29	12.18%	24	11.32%	9	18.00%	7	10.61%
	Home Based ECD Center 介助者	27	11.34%	31	14.62%	12	24.00%	15	22.73%
その他	7	2.94%	4	1.89%	0	0.00%	10	15.15%	

出典：プロジェクトチーム（2020）

注：最も人数が多かった属性を青色で、次に人数が多かった属性を水色でハイライトした。

(2) 料理講習会参加者の生活概要

生活環境はその世帯の栄養改善を左右する。今後の栄養改善推進のための基礎情報として、料理講習会の参加者たちの生活環境を確認するため、プレテストを通して以下の項目を確認した。

1) 料理用の熱源、飲料水の水源等

各世帯の料理の際の燃料、飲料水の水源、飲料水の自宅での処理方法、トイレの有無を確認した。結果として、料理の燃料は薪、飲料水の水源は自家用井戸、飲料水は自宅で煮沸処理をし、自宅にトイレがある、と答えた参加者数が、それぞれ最も多かった（詳細は Annex 5.1 参照）。

表 3.2.9 料理用の熱源、水源等の概要

主要情報項目		サイクル 1+2 (延べ 8 回分)	
		合計回答者数：288	
		人数	割合
調理の熱源 (複数回答可)	薪	211	73.26%
	炭	182	63.19%
	ガス	50	17.36%
	電気	15	5.21%
	その他	3	1.04%
飲料水の水源 (複数回答可)	雨水	18	6.25%
	川/池/湧水	17	5.90%
	自家用井戸	125	43.40%
	共同井戸	106	36.81%
	共同水栓	38	13.19%
	水道水	115	39.93%
	その他	7	2.43%
飲料水の自宅での 処理 (複数回答可)	煮沸	217	75.35%
	塩素消毒	74	25.69%
	未処理	16	5.56%
	その他	14	4.86%
トイレ設備 (複数回答可)	自宅トイレ	262	90.97%
	公共トイレ	18	6.25%
	トイレへのアクセ	1	0.35%
	その他	3	1.04%

出典：プロジェクトチーム (2020)

2) 食品の摂取頻度

次表に示す通り、動物性タンパク質の摂取を促進する肉類、魚、乳製品の摂取は、月に1~10回程度とした参加者が、いずれの講習会においても最も多かった。また植物性タンパク質が摂取できる大豆についても、第2サイクルの Rutsiro 郡以外の参加者は、やはり月に1~10回程度摂取すると回答しており、頻繁に摂取しているわけではなかった。

最も頻繁に食されている主食はジャガイモであり、サツマイモやキャッサバはその代替品として食されていた。なお、果物や野菜の摂取頻度は、講習会ごとに変化がみられたものの、毎日の摂取には至っていない参加者も一定数いることがわかった。栄養強化のための野菜の普及は、野菜を毎日摂取できない世帯の栄養改善にも効果があると考えられるため、販売目的だけでなく、意識的な自家消費を推奨していくことが重要であることも確認された（詳細は Annex 5.2 参照）。

表 3.2.10 摂取食品とその頻度

摂取食品と頻度		サイクル 1+2		摂取食品と頻度		サイクル 1+2	
		全6郡(延べ8回)				全6郡(延べ8回)	
		合計回答者数: 288				合計回答者数: 288	
		人数	割合			人数	割合
卵、牛肉、豚肉、鶏肉、魚、牛乳、乳製品	毎日/月30	9	3.13%	ジャガイモ	毎日/月30	22	7.64%
	21~30回	33	11.46%		21~30回	74	25.69%
	11~20回	39	13.54%		11~20回	90	31.25%
	1~10回	178	61.81%		1~10回	86	29.86%
	食べない	25	8.68%		食べない	10	3.47%
大豆	毎日/月30	19	6.60%	キャッサバ	毎日/月30	8	2.78%
	21~30回	38	13.19%		21~30回	32	11.11%
	11~20回	48	16.67%		11~20回	57	19.79%
	1~10回	124	43.06%		1~10回	162	56.25%
	食べない	52	18.06%		食べない	18	6.25%
大豆以外の豆類	毎日/月30	54	18.75%	果物	毎日/月30	22	7.64%
	21~30回	90	31.25%		21~30回	73	25.35%
	11~20回	69	23.96%		11~20回	79	27.43%
	1~10回	63	21.88%		1~10回	97	33.68%
	食べない	3	1.04%		食べない	10	3.47%
サツマイモ	毎日/月30	35	12.15%	野菜	毎日/月30	104	36.11%
	21~30回	50	17.36%		21~30回	91	31.60%
	11~20回	68	23.61%		11~20回	61	21.18%
	1~10回	124	43.06%		1~10回	31	10.76%
	食べない	4	1.39%		食べない	1	0.35%

出典：プロジェクトチーム（2020）

(3) 講義の成果

プレテストとポストテストでは栄養に関する知識が高まったかどうかを確認するため、「何故、栄養が重要なのか」を尋ねる設問を含めた。第1サイクルおよび第2サイクルにおいても、既に大半の参加者は栄養についての基礎知識を持っていることがプレテストで確認できた。その上で、第1サイクルでは講義後に栄養の効果を認識する参加者の割合が増え、かつ、栄養が何故重要かわからないとした参加者の割合が減ったことから、講義の成果があったと結論づけられた。一方、原因は定かではないが、第2サイクルでは、講義後に、免疫が上がることも栄養の効果であるとする参加者の割合が減少した。しかしながら、それ以外のオプションについては、第1サイクル同様、知識の増加を示す結果となったことから、講義の成果として一定程度、知識の増加があったことが確認された。

表 3.2.11 料理講習会前後の参加者の栄養に関する認識の違い

何故、栄養は重要なのか（複数回答可）	第1サイクル プレテスト (合計回答者数：238)		第1サイクル ポストテスト (合計回答者数：212)		増減 割合	第2サイクル プレテスト (合計回答者数：50)		第2サイクル ポストテスト (合計回答者数：66)		増減 割合
	人数	割合	人数	割合		人数	割合	人数	割合	
子どもの成長を促進するから	194	81.51%	200	94.34%	12.83%	36	72.00%	50	75.76%	3.76%
自分と自分の家族を病気から守ってくれるから	201	84.45%	198	93.40%	8.94%	40	80.00%	41	62.12%	-17.88%
自分と自分の家族がより良く、長く働けるようにしてくれるから	170	71.43%	175	82.55%	11.12%	34	68.00%	47	71.21%	3.21%
分からない	3	1.26%	0	0.00%	-1.26%	1	2.00%	1	1.52%	-0.48%

出典：プロジェクトチーム（2020）

(4) メニューの妥当性

第1サイクルでは、各メニューに対して「嫌い」、「好きではない」と回答した参加者が一定数いた一方、「好き」、「とても好き」と回答した参加者の合計が、いずれのメニューについても全回答者数のほぼ80%を占めたことから、概して食味は悪くなかったと推察される。最も好評だったのは、“Beans, Potatoes, and Pumpkin Leaves”（92.92%）であり、“Soybean/ Cassava/ Orange Fleshed Sweet Potato with wheat flour doughnuts”（91.98%）がこれに続いた。一方、最も人気がなかったのは、同率（「嫌い」と「好きではない」の合計が5.19%）で、“Tofu in sauce”と“Soybean flour and sweet potatoes/ Irish potatoes puree with small fish”であった。

表 3.2.12 第1サイクルのメニューの食味評価

サイクル1の食味評価（6郡合計） 回答者総数：212		1		2		3		4		5	
		嫌い		好きではない		普通		好き		とても好き	
		数	割合	数	割合	数	割合	数	割合	数	割合
1	Soybean processing to make soybean	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 Leaves	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 small fish	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%

出典：プロジェクトチーム（2020）

注：「好き」と「とても好き」を合わせ最も人数が多かった料理を青色で、次に人数が多かった料理を水色でハイライトした。「嫌い」と「好きではない」を合わせ最も人数が多かった料理（同率一位）をピンクでハイライトした。

なお、下表に示す通り、第1サイクルでは、Tofuを自宅で再現するのは難しいと考える参加者が66.04%おり、Tofu料理の普及定着には課題が残った。その一方、大豆から豆乳を作る方法は近所にも普及したいとする参加者が84.43%おり、必ずしも大豆の摂取そのものに抵抗感があるわけではなさそうであった。

表 3.2.13 第1サイクルのメニューの再現性について

再現性について (合計回答者数: 212)			人数	割合
自宅での再現が難しいメニュー (複数回答可)	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%
近所の住民に教えたいメニュー (複数回答可)	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%

出典：プロジェクトチーム (2020)

注：最も人数が多かった属性を青色で、次に人数が多かった属性を水色でハイライトした。

第2サイクルでは、第1サイクルとは一部メニューを入れ替えた。下表に示す通り、豆乳以外の全てのメニューについて、「嫌い」、「好きではない」と回答した参加者が一定数いた。「好き」、「とても好き」と回答した参加者の割合は、第1サイクルよりも概して低く、「好き」、「とても好き」を合わせても50%台にとどまったメニューが4つあった(Tofu: 59.09%、Tofu in sauce: 59.09%、Beans, Onion and Garlic: 57.58%、Okara and vegetables: 56.06%)。

最も好評だったのは、“Soybeans, Carrots and French beans” (77.27%) であり、“Soybean flour and sweet potatoes/ Irish potatoes puree with small fish” (72.73%) がそれに続いた。最も人気がなかったのは、同率(「嫌い」と「好きではない」の合計が7.58%)で、“Tofu in sauce”と“Soybean flour and sweet potatoes/ Irish potatoes puree with small fish”であった。“Soybean flour and sweet potatoes/ Irish potatoes puree with small fish”は人によって好き嫌いが大きく分かれた。

表 3.2.14 第2サイクルのメニューの食味評価

サイクル2の食味評価 (2郡合計) 回答者総数: 66		1		2		3		4		5	
		嫌い		好きではない		普通		好き		とても好き	
		数	割合	数	割合	数	割合	数	割合	数	割合
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%

出典：プロジェクトチーム (2020)

注：「好き」と「とても好き」を合わせ最も人数が多かった料理を青色で、次に人数が多かった料理を水色でハイライトした。「嫌い」と「好きではない」を合わせ最も人数が多かった料理(同率一位)をピンクでハイライトした。

なお、下表に示す通り、Tofu を自宅で再現するのは難しいと考える第2サイクルの参加者は33.33%、“Soybean flour and sweet potatoes/ Irish potatoes puree with small fish”及び“Orange Fleshed Sweet Potato with wheat flour doughnuts”の再現が難しいと考える参加者は、それぞれ22.73%いた。

Tofu の再現が難しいとする結果は第1サイクルと同じであったが、再現が難しいとする参加者の割合は第1サイクルよりは減少した。第2サイクルの開始に際し、Tofu を作る過程で水分を絞るために使用する機具（RAB 所有の機具）を、Kigali 市内の工場でより小型のものに改造したが、この器具の小型化が Tofu の再現性を危惧する割合の減少に貢献したと推察される。なお、近所に普及したいメニューとしては、“Orange Fleshed Sweet Potato with wheat flour doughnuts”（65.15%）を選んだ参加者が最も多く、“Soybean flour and sweet potatoes/ Irish potatoes puree with small fish”（57.58%）がそれに続いた。

表 3.2.15 第2サイクルのメニューの再現性について

再現性について（合計回答者数：66）		人数	割合
自宅での再現が難しいメニュー （複数回答可）	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 with small fish	15	22.73%
	8 OFSP with wheat flour doughnuts	15	22.73%
	9 None	14	21.21%
近所の住民に教えたいメニュー （複数回答可）	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 with small fish	38	57.58%
	8 OFSP with wheat flour doughnuts	43	65.15%

出典：プロジェクトチーム（2020）

注：最も人数が多かった属性を青色で、次に人数が多かった属性を水色でハイライトした。

(5) テスト結果における課題と改善点

料理講習会で習ったメニューを他者に紹介するために、再度、講習会を実施する場合に想定される課題について、最も多くの参加者が挙げたのは、必要な資機材の確保の難しさであった。第1サイクルの参加者たちの88.68%、そして第2サイクルの65.15%がこの点を課題として挙げた。第1サイクルでは、必要な材料の確保（41.04%）が、第2サイクルでは、教材の複製（30.30%）が、それぞれ2番目に多くの参加者から課題として認識された。いずれも、複数のメニューの調理を講習会内で行うために必要な大量の鍋や皿等を含む調理器具、大豆を作る過程で水分を絞り豆乳を作る機具等の比較的に入手が困難な調理器具、参加者が食する分も含めた食材の確保等に課題があることを裏付ける結果となった。

一方、料理講習会の改善点としては、第1サイクル、第2サイクル共に、現行のままで問題なく特に改善の必要はない、とした参加者たちが最も多かった。しかしながら、いずれのサイクルでも次点には、「参加者の全員が見ながら学べるように時間を配分する。」が挙げられており（第1サイクルの参加者の56.60%、第2サイクルの参加者の50.00%が選択）、参加者の中に、調理手

順をもっとじっくり見たかったというニーズがあったことが確認された。次回以降は、参加者全員が間近で調理手順を見ることが出来るよう、一回の参加者数を減らす、あるいは、参加者の移動を促進し、特定の人だけが見やすい位置を占めることを防ぐ等の工夫が必要であることが示唆された。

表 3.2.16 料理講習会の展開の課題と改善案

料理講習会の展開の課題と改善案			第1サイクル (合計回答者数：212)		第2サイクル (合計回答者数：66)	
			人数	割合	人数	割合
料理講習会を 村で再現する 際の課題 (複数回答 可)	1	調理設備と給水設備のある会場探し	47	22.17%	10	15.15%
	2	必要な機材の確保	188	88.68%	43	65.15%
	3	必要な材料の確保	87	41.04%	16	24.24%
	4	参加者の確保	26	12.26%	13	19.70%
	5	教材の複製	57	26.89%	20	30.30%
	6	講習会を実施してくれる指導者の確保	57	26.89%	13	19.70%
料理講習会の 改善案 (複数回答 可)	1	問題ない。	123	58.02%	37	56.06%
	2	時間を短縮する。	17	8.02%	1	1.52%
	3	時間を延長する。	98	46.23%	25	37.88%
	4	参加者の理解を促進するために説明の 仕方を工夫する。	62	29.25%	10	15.15%
	5	参加者の全員が見ながら学べるように 時間を配分する。	120	56.60%	33	50.00%
	6	農村部で入手可能な材料や機材で作れ るようなメニューを選定する。	91	42.92%	27	40.91%
	7	分からない。	1	0.47%	0	0.00%

出典：プロジェクトチーム（2020）

注：最も人数が多かった属性を青色で、次に人数が多かった属性を水色でハイライトした。

3.2.7 料理講習会の課題と対策、提案

プレテスト、及びポストテストの結果から、第1サイクル、第2サイクルでは参加者の特性にそれぞれ偏りが見られたものの、いずれも今回の料理講習会のターゲットとして想定していた参加者を獲得でき、紹介されたメニューは、いずれも参加者から受け入れられた。料理講習会における栄養に関する講義は、参加者の知識増強に効果を発揮しているため、今後も料理実演とセットで展開することが望ましい。これまでの結果を踏まえ、次期会計年度にRABが自己予算で料理講習会を実施する際に想定される課題と、その改善策の提案事項を次表に示す。

表 3.2.17 今後の料理講習会の課題と改善策の提案

課題	改善策
対応する課題の明確化	<ul style="list-style-type: none"> ◆ RAB は料理講習会の実施によって、農村部の栄養のどんな課題に対応したいのか、その課題の解決に、料理講習会はどのように貢献するのか、結果として、誰に食べてもらう必要があるのか、誰に料理を作れるようになってもらうことを目指すのかを明確にすることが重要である。 ◆ 栽培研修で扱う栄養強化作物/高栄養価作物の自家消費を促進することを目的に料理講習会を実施するのであれば、両研修の対象者を同じにすることが望ましい。また、栽培カレンダーに合わせ、各作物の収穫の直前に料理講習会が実施できるよう、栽培研修と連動して講習会スケジュールを立案できると良い。
村落での料理用の燃料は電気やガスではなく薪が殆どである。	<ul style="list-style-type: none"> ◆ 薪を燃料としたメニューを考慮すべきである。 ◆ 微妙な火加減を必要としないメニューの選定が今後、重要である。
参加者にとっては資機材、材料が高価すぎて、メニューの再現が難しい。	<ul style="list-style-type: none"> ◆ ピーマン等の高価で入手が難しい食材は使用しない。 ◆ ダイズは Tofu ではなく、煮豆を提唱していく方が現実的である。Tofu 作りのためにダイズの粉碎や Tofu を絞る機械等は、一般の家庭では入手できない。 ◆ 臼や重石を用いた場合、作業時間が増加するため、現実的な普及は難しい。
参加者が多すぎる。	<ul style="list-style-type: none"> ◆ 参加者は多くても 30 名までに絞れるよう、戦略的に開催地と対象者/招待者を選抜する。 ◆ 参加者が 30 名以上想定される郡では、参加者を小グループに分けてローテーションを考える。
講習会の時間に対してメニューが多すぎて理解が追いつかない。	<ul style="list-style-type: none"> ◆ 実際に参加者が再現できるメニューのみを講習会で実施すれば、メニューは自然と淘汰され、メニュー数を減らすことが可能になる。
質疑応答の時間がなかった。	<ul style="list-style-type: none"> ◆ メニュー数と参加者を減らすことができれば、調理途中であっても質疑応答が可能となり、参加者の理解が進む。
参加者達のみで習得したメニューを再現できる程、参加者が調理方法を理解できていない。	<ul style="list-style-type: none"> ◆ RAB は、次期会計年度では、今回のパイロットフェーズにおける料理講習会の参加者を講師とし、新規の参加者に料理講習会を実施する計画である。このため、地産地消を念頭にメニューを簡略化していく必要がある。 ◆ 料理講習会の参加者の習熟度等を確認するモニタリングの実施が重要である。
本来、料理講習会は保健省の管轄と考えられるが、RBC との調整を行う場が設定されていない。	<ul style="list-style-type: none"> ◆ RBC は、保健所や村において、保健ボランティアを通した住民への料理講習会を推奨している。しかしながら、RAB と上記の RBC や郡事務所の活動の間の調整や連携を図る場、システムが存在しない。 ◆ 中央レベル (NCDA) よりは、郡レベルで、郡事務所による調整を図ることが現実的かつ効率的と考えられるため、郡事務所に協力を働きかける必要がある。
RAB 職員の事業実施、管理能力が不十分である。	<ul style="list-style-type: none"> ◆ 事前の調整、準備を始め、各種アドミニストレーション業務は全てプロジェクトチームが支援した。RAB の中で、事業を効果・効率的に監督、推進できるコーディネータを配置したが、事業実施、管理能力が不十分でこの部局の強化が必要である。 ◆ 事業実施調整局 (図 2.1.2 RAB による栄養改善活動の事業実施体制図参照) は栽培技術研修と料理講習会の両方を監督する役目で DDG 付けであるが、初めてのシステムであり、上手く機能していない。
RAB 職員また郡以下の地方政府職員の中にモラルハザードがある。	<ul style="list-style-type: none"> ◆ 最初から最後まで料理講習会に参加しなかった職員には交通費、昼食代を支払わない。 ◆ RAB 職員や地方政府職員がその他の参加者よりも先に食事することをやめさせる。 ◆ モラルハザードを防ぐ意味でも、上述のコーディネータによる監督が重要である。

出典：プロジェクトチーム (2020)

3.3 高栄養作物の栽培技術研修

3.3.1 事前準備

(1) 栽培技術研修スケジュールおよびRABによる講師の選定

各高栄養作物の栽培技術研修に対して、RABは2名の専門家を派遣する計画とした。以下に、栽培技術研修のスケジュール、展示・研修圃場とそこで導入した高栄養作物および講師として派遣されたRAB職員名を示す。なお、プロジェクトチームはRABと協働でFFS-2までを支援する計画であったが、COVID-19感染拡大の影響によりFFS-1のみの研修支援となった。FFS-2以降は対象郡が主体となり研修・フォローアップを実施し、プロジェクトチームやRAB職員が電話やメール、携帯メッセージアプリ等を利用して遠隔支援した。

表 3.3.1 栽培技術研修スケジュールおよびTOT対象RAB職員講師リスト

研修日	対象郡	研修場所	研修作物	RAB職員/作物
Monday, 17th February 2020	Nyamagabe Site 1	KOIKWI Coop./	1. Vegetables	Umulisa Christine/Horticulture Program MUREKEYIMANA Peruth/Horticulture Program
			2. Orange Sweet Potato	Kankundiye Lydie, SweetPotato Sub Program Shumbusha Damien, SweetPotato Sub Program
Tuesday, 18th 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 staff of Vegetable trainers)
Wednesday, 19th February 2020	Nyamagabe Site 3	Gatare Sector	1. Irish Potato	Musabyemungu Anastasie, Potato Sub Program Ndacyayisenga Theophile, Potato Sub Program
Thursday, 20th 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, 21st February 2020	Nyaruguru Site 2	Jyamber Muhinzi wa Kibeho	1. 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 staff of Vegetable trainers)
Tuesday, 25th 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 26th February 2020	Rutsiro Site 2	Individual Farmland Boneza Sector	1. Vegetables	(Same staff of Vegetable trainers)
			2. High Iron Bean	Rumongi Alfred, Bean Sub Program Murwanashyaka Edouard, Bean Sub Program
			3. Soybeans	Kimanyi Martin, Soybeans Sub Program Ayinkamiye Agnes, Soybeans Sub Program
			4. Yellow Cassava	Kanyange Marie Claire, Cassava Program Mukakanyana Cansilde, Cassava Program
			5. Orange Sweet Potato	Ndirigwe Jean/ Sweet Potato Sub Program Shumbusha Damien, Sweet Poatato Sub Program
Tuesday, 10th March 2020	Ngororero Site 1	Cooperative Zamuka Muhinzi wa Ngororero Ngororero Sector	1. Soybeans	Kimanyi Martin, Soybeans Sub Program Ayinkamiye Agnes, Soybeans Sub Program
			2. High Iron Beans	Murwanashyaka Edouard, Bean Sub Program Rumongi Alfred, Bean Sub Program
			3. Orange Sweet Potato	Ndirigwe Jean. Sweet Potato Sub Program Shumbusha Damien, Sweet Potato Sub Program
			4. Vegetables	Filmin Uwizeye/ Horticulture Program

研修日	対象郡	研修場所	研修作物	RAB 職員 /作物
				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 staff of Vegetable trainers)
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	Uwizeyyimana 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. Orange Sweet 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

出典：プロジェクトチーム（2020）

(2) 供与資機材等

栽培技術研修用の資機材、化成肥料・農薬、高栄養作物の種子・苗木等を対象組合等に展示・研修用として供与した。研修は事業期間の制約により FFS-1 のみしか実施支援が出来なかったが、FFS-2 以降に必要な化成肥料等も供与する計画とした。供与額は約 Rwf 680,000/カ所となった。

表 3.3.2 供与資機材等の費用

供与資機材等	費用 (Rwf)	備考
栽培技術研修用農機具等	4,860,000	展示・研修圃場 全 13 カ所
化成肥料、農薬等	1,518,500	同上
高栄養作物の種子・苗木	2,463,000	
合計	8,841,500	Rwf 680,115/カ所

出典：プロジェクトチーム（2020）

表 3.3.3 栽培技術研修用農機具等の購入リスト

項目	研修 圃場数	資機材数	合計 数量	単価 (Rwf)	合計金額 (Rwf)	備考
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	
Sub-total					1,833,000	
Watering cans	13	10	130	6,000	780,000	
Sprayers	13	2	26	60,000	1,560,000	
Sub-total					2,340,000	
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	
Sub-total					272,000	
Transportation					25,000	
Total					4,860,000	

出典：プロジェクトチーム（2020）

表 3.3.4 化成肥料等購入リスト

項目	単 位	対象作物	単価 (Rwf)	研修圃 場数	数量	合計金額 (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	Soy bean, 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 171717	kg	Vegetables, Yellow Cassava, Orange Sweet Potato, Bio-fortified Irish potato	800	13	100	80,000
			合計金額(Rwf)			1,518,500

出典：プロジェクトチーム（2020）

表 3.3.5 高栄養作物の種子・苗木の必要量、価格、購入先リスト

高栄養作物	耕作面積/ 圃場	圃場 数	必要量/ 研修圃場数	数量 合計	購入先	単価 (Rwf)	購入額 (Rwf)
Soybean	1 アール	5	500g	3,000	RAB/ Rubona station	Free of charge	
Iron Beans	1 アール	6	500g	5,000	RAB/ Rubona station		
Yellow Cassava	1 アール	6	150 cuttings	900	RAB/ Rubona station		
Bio-Fortified Irish Potato	1 アール	5	40kg	200	RAB/ Musanze station	420	84,000
Fruits							
Passion fruits	4 アール	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 アール	6	600 cuttings	3,600	Supplier	25	90,000
					Supplier	25	90,000
					Supplier	25	90,000
					Supplier	25	90,000
Vegetables	4 アール	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			
合計金額(Rwf)							2,463,000

出典：プロジェクトチーム（2020）

注）スイートオレンジポテトはRABがファーマーズプロモーターと苗木の増殖を委託契約しており、必要に応じて農家に苗木を販売している。

3.3.2 栽培技術研修の実施

2020年2月17日から3月10日にかけて対象6郡、13カ所での栽培技術研修 FFS-1 を実施した。日程、展示・研修圃場等の詳細は表 3.3.1 参照のこと。なお、COVID-19 の感染拡大の影響により日本人専門家は2020年3月19日に急遽、帰国となった。また、ルワンダ国内でも移動制限や集会の制限のため、ルワンダでの FFS-2 の実施支援は中止となった。このため、プロジェクトチームやRAB関係者は、対象郡の関係者と電話やメールを活用してその後の支援を行った。

(1) 栽培技術研修 FFS-1 の実施

1) 栽培技術研修参加者

研修参加者数は次表の通りであり、最小で29人、最大で64人、平均で45人/カ所となった。

表 3.3.6 対象6郡13カ所での栽培技術研修参加者数

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	
Location	District	Nyamagabe	Nyamagabe	Nyamagabe	Nyaruguru	Nyaruguru	Rutsiro	Rutsiro	Ngororero	Ngoma	Ngoma	Gakenke	Gakenke	Ngororero
	Sector	Cyanika	Kaduha	Gatare	Rusenge	Kibeho	Manihira	Boneza	Nyange	Rukira	Rukumeri	Kivuruga	Coko	Ngororero
Cell Level	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
	Farmers	10	9	2	20	31	4	12	13	11	16	20	12	3
Sector Level	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
District Level	Agronomist	0	2	5	4	9	4	7	3	7	4	13	6	9
	Others	0	0	1	0	0	0	0	0	0	0	2	0	0
RAB	Agronomist	0	0	0	0	0	1	1	1	1	0	1	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
Total	Others	1	0	0	0	0	0	0	0	0	0	0	0	1
	RAB Officer	5	6	6	9	4	3	8	8	3	6	10	7	8
Grand Total		29	41	34	51	64	40	56	44	40	42	71	49	59

出典：プロジェクトチーム（2020）

2) 栽培技術研修の参加者からのコメント

研修実施後、各展示・研修圃場で参加者から、以下のコメントや提言があった。

- ◆ これまでキャッサバは畝に植えていなかったが、適切な畝栽培方法がわかった。
- ◆ キャッサバは 20cm 間隔で植えていたが、1m 間隔が適切であることがわかった。
- ◆ サツマイモの植え方が新しかった。これまでは間隔などはあまり考えて植えていなかった。
- ◆ ダイズを播種するときに菌根菌を増やすための微生物資材を使った事がなかった。RAB に連絡すればこれを入手できる事もわかった。
- ◆ マメを播種する時に肥料として DAP を使っていなかったが、入手方法や使い方がわかった。
- ◆ 栄養強化作物の良さがわかったので、家庭菜園用として苗や蔓、マメを持って帰りたい。
- ◆ 堆肥の成熟が不十分なまま使っていた事がわかった。
- ◆ 適切な堆肥の量がわかった。
- ◆ ビートやズッキーニの栽培方法がわかった。
- ◆ これまで果樹の苗を植えた直後に水を撒かなかつたが、撒いた方が良いことがわかった。
- ◆ 果樹の苗を植える前に元肥を入れていなかったが、適切な元肥栽培方法がわかった。
- ◆ 果樹の病気についてもっと教えてもらいたい。
- ◆ 他の作物の栽培方法も知りたい。

(2) FFS-1 後のモニタリング

2020年4月に13カ所の展示・研修圃場に対するモニタリングをプロジェクト雇用のローカルスタッフで実施した。作付けした高栄養作物は概ね順調に生育していた。但し、野菜や果樹に関し、対象組合からプロジェクトチームや RAB による継続的な栽培技術支援の要請があったため、栽培上の問題が生じた場合は電話やメールで対応することとした。例えば、ジャガイモに関しては早急に殺菌剤の散布を行う必要があることを対象組合に指導した。モニタリング結果は Annex 6 に示す。

3.3.3 栽培技術研修の実施における成果および課題とその対策

(1) 研修参加者の選定基準

栽培技術研修では、高栄養作物を対象としたことから、栽培技術普及に関係する人（組合農家、ファーマープロモーター、FFS ファシリテーター、セクター農務官等）に加え、栄養不良世帯や Care Givers といった人達も招聘した。しかし、栄養不良世帯や Care Givers は作物栽培に対して高い関心を持っていないことが判明した。そのため、今後、栽培技術研修を実施する場合は、栽培技術の習得や普及に興味のある人達のみを対象を絞った方が良い。一方、今回は果樹の苗木やオレンジサツマイモの蔓、黄色キャッサバの茎等の配布も行ったが、これらを配布する対象としては、栄養不良世帯や Care Givers は適切であった。

(2) 堆肥やマルチの材料

栽培技術研修を実施するにあたり、堆肥やマルチの材料となる刈草などは現地の組合等に依頼して準備をしてもらった。しかし、適切な堆肥やマルチ用の材料が入手できない場合もあり、RAB 職員からは適切な栽培技術を指導できないという意見も挙げられた。生産量を高めるために栽培に適したこれら材料の準備（入手）方法についても研修内容に加える必要がある。

(3) RABによる栽培技術研修の実施（普及活動の改善、団結力強化）

研修講師を担ったRAB職員の内、研究分野所属の職員は農家に対する説明に慣れておらず、栽培技術の理論等非常に専門的な説明となり、農家が十分に理解できない場面も見られた。そのため、RAB職員による農家向けの説明の簡易化や、農家への説明に慣れているセクター農務官等の巻き込みが必須である。一方で、展示・研修圃場では複数の高栄養作物の栽培指導を行ったため、RAB職員らは他のプログラムの栽培方法や普及活動を理解することができ、RAB職員間の団結力の強化や農家の講師となる良い経験が得られた。

(4) セクター農務官のリーダーシップ

展示・研修圃場の選定、研修前の整地、FFS-1の実施等を時間通りに速やかに行うためには当該セクターの農務官の強力なリーダーシップが鍵となる。対象組合やグループを選定するときには、これらの当該セクター農務官のリーダーシップも考慮する必要がある。今回の栽培技術研修の実施では、SMAPでの活動と同様にRAB職員が講義・営農実演を行った研修にセクター農務官を巻き込み、その後セクター農務官自身が講師として研修を実施出来るように指導した。

(5) 研修教材の改善

展示・研修圃場での研修を通じて、研修参加者（農家）から、種子や苗木の入手場所を明示して欲しい、図表を増やして欲しい、理解が難しい箇所がある等の指摘を受け、研修教材の改善の機会を得られた。

(6) 小・中学校への栽培技術研修の実施

2020年2月25日に研修を実施したRutsiro郡では、展示・研修圃場が小学校に隣接していた。そのため、教師や生徒から大きな注目を浴びた。また、教師からの要請により、数名の教師が栽培技術研修に参加すると共に、農具や苗の一部も小学校に提供した¹。栄養改善は教育分野とも関係が深いため、今後、研修の対象に学校を含める事を検討すると共に、教育のカリキュラムに高栄養作物の栽培技術を加える事を提案する。

3.4 RABによる栄養研修実施の支援（2021年4月～6月）

COVID-19感染拡大の影響により、2020/21年度のRABの活動予算が不十分となったため、栄養借款事業の一部であるRABの支援対象郡に対する栄養改善活動の研修の費用の一部をプロジェクト事業費から捻出することとした。2021年4月のRAB職員との協議の結果、プロジェクトからの支援は費用負担のみとし、その範囲は、i) 研修会場借上費、ii) 参加者手当、iii) RAB職員への手当、iv) 調理実習の材料費とした。

(1) 対象郡の栄養研修実施日程

RAB職員と協議を行い、対象6郡における研修日程、研修会場を表3.4.1の通り決定した。なお、研修会場敷地内で調理実習を実施する予定であったが、Rubavu郡、Gicumbi郡、Gisagara郡の会場敷地内では調理実習を実施することが難しい環境であったため、Musanze郡、Burera郡、Nyamasheke郡のみで調理実習を実施することとした。

¹ 資機材等を提供した小学校は、Rutshiro郡、ManihiraセクターのG.S. Rwamiko。

表 3.4.1 対象郡の栄養研修日程

日時	対象郡	研修会場
4月27日(火)	Rubavu 郡 (西部県)	Kivu Peace View Hotel
4月28日(水)	Musanze 郡* (北部県)	Musanze Home Saint Vincent de Paul
4月29日(木)	Burera 郡* (北部県)	BDF Burera Conference Hall
5月4日(火)	Gicumbi 郡 (北部県)	EAR Gicumbi Conference Hall
5月6日(木)	Gisagara 郡 (南部県)	Gisagara Montana Guest House
5月11日(火)	Nyamasheke 郡* (南部郡)	Munini Hill Motel

* 調理実習を実施した郡

出典：プロジェクトチーム (2020)

(2) 栄養改善研修の参加者の構成

COVID-19 の感染拡大防止として集会の際の参加人数が制限されていたため²、研修参加者は 18 名とし、参加者構成を次表の通り決定した。研修講師は 1 回あたり 5 名の RAB 講師が担当することを決定した。COVID-19 対策として教室内に 20 名以上となることを避け、講師は最大 2 名で説明し、交代して教室を出入りすることとした。

表 3.4.2 RAB が実施した栄養研修参加者の構成

No.	所属	人数
1	郡事務所農業ユニット	1 名
2	郡事務所保健ユニット	1 名
3	農業組合代表者	5 名
4	ヘルスワーカー代表者	3 名
5	セクター農務官	3 名
6	ヘルスセンター栄養職員	3 名
7	ECD プログラム母親代表	2 名
	合計	18 名

出典：プロジェクトチーム (2020)

(3) 研修の実施

1) 研修参加者

次表に対象 6 郡における参加者数を示す。研修参加者数は 23~26 名となり、計画していた 20 名よりは若干増えた。

表 3.4.3 RAB が実施した対象 6 郡の栄養研修参加者数

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

出典：プロジェクトチーム (2021)

² 2021 年 4 月時点において、ルワンダ政府により、COVID-19 の感染拡大防止のため 20 名以上の集会が禁止されていたため。

2) 研修内容

研修は、栽培技術研修および料理講習会を合わせて1日間とし、内容は以下の通りである。

- i) 開会の辞：郡代表の挨拶
- ii) 栽培技術研修内容の説明：RAB 職員
- iii) 料理講習会内容の説明：RAB 職員

栄養改善のためには高栄養作物の摂取が重要であること、およびこれらの作物の料理メニューの紹介を行った。なお、Musanze 郡、Burera 郡、Nyamasheke 郡の3郡に対しては豆乳の作成、サツマイモ料理および小魚粉末を入れたきな粉団子の料理の実演を行った。

- iv) 閉会の辞：RAB 代表、および郡代表

3) コメント、結論

COVID-19 の感染拡大防止の影響により、参加者数や研修期間（1日間）を制限して研修は開催されたため、前回の研修と比べて RAB 講師による説明は不十分となった。しかしながら、参加者は熱心に受講し、この研修は郡レベルでの栄養改善普及に十分に寄与したと推察される。参加者からの主なコメントは以下の通りである。

- ▶ 豆乳の作成、サツマイモ料理および小魚粉末を入れたきな粉団子の料理の3つの調理実習は非常に良かった。参加者の多くは一般にキャッサバの葉を食していたが、研修を受けて、食材の幅が広がり、煮炊き以外にも料理方法があることが理解できた。
- ▶ 乳児を持つ母親からはバランス取れた料理が栄養改善には重要であることが理解でき、研修に参加できてとても良かったとの発言が多く挙げられた。
- ▶ 高栄養作物の栽培方法が理解出来たこと。また、これらの作物を使った料理でバランスの取れた栄養摂取が出来ることを学ぶことが出来た。

第4章 栄養研修教材の作成および広報活動

4.1 目的

前述の栄養借款事業の内、農業分野における栄養改善活動に係るルワンダ側の実施機関は RAB であるが、これまでに栄養改善に関する啓発・普及のための研修教材は未整備であった。そのため、当プロジェクトの中で、栄養改善活動の実施支援と共に研修教材の作成を支援することとなった。また、この研修教材が MINAGRI や RAB の正式教材として、今後、中央レベル、郡レベルで栄養改善活動の中で活用されることを目指した。

4.2 栄養研修教材の作成

(1) 研修教材作成・承認までの経緯

栄養研修教材の作成・承認については、次表に示す一連のワークショップ等で行われた。栄養改善活動に係わる4つの部署の職員24名が栄養研修教材の作成に参加した（Annex 7 参照）。

表 4.2.1 研修教材作成に係る主な活動内容

日時	活動名等	研修教材作成にかかる活動内容
2019年10月1日	<u>キックオフ WS</u> 場所：Rwamagana 郡 参加者：RAB 職員 17 名	・ 栄養改善普及作物の特定 <u>栄養強化作物</u> ：Iron Beans、Yellow Cassava、Orange Sweet potato、Bio-fortified Irish potato <u>高栄養作物</u> ：Soybean、Vegetables <u>果樹</u> ：Avocado、tree tomato、passion fruit、papaya ・ 各プログラムによる研修教材の作成内容の協議
2019年10月23日～25日	<u>2020/2021年のA/Pおよび予算策定および研修教材策定 WS</u> 場所：Rwamagana 郡 参加者：RAB 職員 13 名	・ 栄養改善普及の研修教材の策定 Iron Beans、Orange Sweet potato、Bio-fortified Irish potato、Soybean、Vegetables および Fruits (Avocado、tree tomato、passion fruit、papaya) の6種類
2019年11月5日～7日	<u>同上</u> 場所：Kigali 参加者：RAB 職員 6 名	・ Yellow Cassava および Sweet Orange Potato 対象
2020年1月20日～21日	<u>研修教材策定 WS</u> 場所：Rwamagana 郡 参加者：RAB 職員 25 名	・ Iron Beans、Sweet Orange Potato、Bio-fortified Irish potato Soybean、Vegetables および Fruits (Avocado、tree tomato、passion fruit、papaya) の研修教材策定 ・ 8作物別の第1稿の研修教材の完成
2020年3月19日	日本人専門家の帰国	日本人専門家2名は COVID-19 感染拡大の影響により帰国
2020年3月～4月	研修教材の最終化	・ 栽培技術研修および料理講習会を実施した成果・教訓を反映し、関係 RAB 職員とのメール等のやり取りにより、各研修教材内容をレビューして最終化した。
2021年4月～6月	RAB の正式研修教材承認の確認 研修教材およびパンフレットの印刷・配布	・ MINAGRI PS、RAB DDG との協議の結果、栄養研修教材の公式教材としての活用の承認。 ・ 研修教材の配布 栄養研修教材：2,200部（Kinyarwanda 語）、100部（英語） 栄養改善教材パンフレット：2,200部（Kinyarwanda 語）

出典：プロジェクトチーム（2021）

(2) 栄養研修教材の構成

次表に示す通り、栄養研修教材は栄養強化作物および高栄養作物 6 項目、果樹および栄養作物普及・啓発および料理メニューの 2 項目を加えた 8 項目から成る。

表 4.2.2 研修教材の項目

研修教材項目	担当部署	備考
鉄強化マメ	マメ類および油料作物プログラム	栄養強化作物
大豆		高栄養作物
スイートオレンジポテト	根菜類プログラム	栄養強化作物
ジャガイモ		栄養強化作物
キャッサバ		栄養強化作物
RAB-SMAP 活動で得られた収益を活用した栄養改善活動の推進	園芸作物プログラム	SMAP 研修教材に以下のタイトルで追加 (Promotion to Reduce Malnutrition utilizing Profit created by RAB-SMAP Activities)
果樹		Avocado, tree tomato, passion fruit, papaya, mango
栄養作物普及・啓発および調理レシピの紹介	食品品質・栄養摂取プログラム	料理メニューは上記栄養強化作物、高栄養作物が対象

出典：プロジェクトチーム（2021）

(3) 栄養研修教材の承認

2021 年 4 月に、RAB DG および MINAGRI PS と協議を行い、教材作成の過程で各プログラムの RAB 職員が関わっていたため、栄養教材の承認に関するワークショップ等を改めて実施する必要はない旨、合意した。なお、MINAGRI および RAB で公式に承認された栄養研修教材「SMAP Technical Manual for Nutrition Dense Crops」は、当プロジェクトの成果品（事業完了報告書）の別冊として取りまとめた。

(4) 栄養研修教材の印刷・配布

次表に示す通り、栄養改善研修教材およびそのパンフレットを RAB および支援対象 12 郡に 2021 年 4 月から 6 月にかけて配布した。パンフレットは Annex 8 に示す。なお、JICA による野菜種子支援プロジェクトでは種子や SMAP 栽培技術教材の配布と共に、プロジェクトで作成した栄養パンフレットを配布した。

表 4.2.3 栄養研修教材、パンフレット配布先リスト

配布先	栄養研修教材		栄養パンフレット	データ形式 (教材・パンフレット)
	ル語版	英語版	ル語版	英語版・ル語版
Ngoma 郡事務所	100 部	-	100 部	1 個
Ngororero 郡事務所	100 部	-	100 部	1 個
Gakenke 郡事務所	100 部	-	100 部	1 個
Nyamagabe 郡事務所	100 部	-	100 部	1 個
Rutsiro 郡事務所	100 部	--	100 部	1 個
Nyaruguru 郡事務所	100 部	-	100 部	1 個
Rubavu 郡事務所	100 部	-	100 部	1 個
Burera 郡事務所	100 部	-	100 部	1 個
Nyamasheke 郡事務所	100 部	-	100 部	1 個
Gisagara 郡事務所	100 部	-	100 部	1 個
Gicumbi 郡事務所	100 部	-	100 部	1 個
Musanze 郡事務所	100 部	-	100 部	1 個
RAB	1,000 部	100 部	1,000 部	10 個
合計	2,200 部	100 部	2,200 部	22 個

出典：プロジェクトチーム（2021）

4.3 広報活動

プロジェクト活動における広報活動としては、①週報（Weekly Activity Report）の発出、②Facebook および Twitter でのプロジェクト活動に関する記事の投稿等を行った。また、以下に示す栄養教材紹介ビデオの作成や栄養教材データのウェブ掲載を行った。

(1) 栄養研修教材の紹介ビデオ作成

栄養研修教材紹介のためのワークショップを計画していたが、COVID-19 感染拡大の影響により、多人数での集会在禁止され、ワークショップ開催は困難となった。そのため、栄養研修教材の作成に携わった RAB 職員による教材の紹介や使い方を説明するプレゼンテーションを撮影したビデオ資料を作成し、関係者（ワークショップに参加する予定であった MINAGRI、RAB、対象郡の農業・保健関係者、他ドナー等）に配布することとなった¹。

ビデオの各トピックおよびその説明担当者を表 4.3.1 の通り決定した。栄養教材紹介ビデオの長さは1時間程度とした。この他、テレビやラジオ放送で活用できる短い時間（5分～10分程度）の動画（音声のみも）を作成した。

表 4.3.1 栄養教材紹介ビデオにおける各トピックおよびその説明担当者

No.	Topic	Name	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

出典：プロジェクトチーム（2021）

(2) 栄養研修教材のウェブ掲載

MINAGRI、RAB の各ウェブサイトにも栄養研修教材を掲載する了承を得た。また、栄養教材だけでなく SMAP の関連教材の掲載についても了承を得た。プロジェクトは次表の各機関の担当者と調整して栄養教材のウェブ掲載を行った。

¹ RAB DG との協議により、YouTube 等での配信も検討されたが、2021年6月時点では配信はされていない。

表 4.3.2 栄養教材のウェブ掲載にかかる MINAGRI、RAB の担当者

氏名	役職／所属	サイト URL
Mr. NEZERWA Martin	Chief Digital Officer/ MINAGRI	https://www.minagri.gov.rw/publications/extension-materials
Mr. KARANGWA Janvier	Marketing and Communication Specialist/ RAB HQ in Rubona	調整中 (2021 年 6 月時点)

出典：プロジェクトチーム (2021)

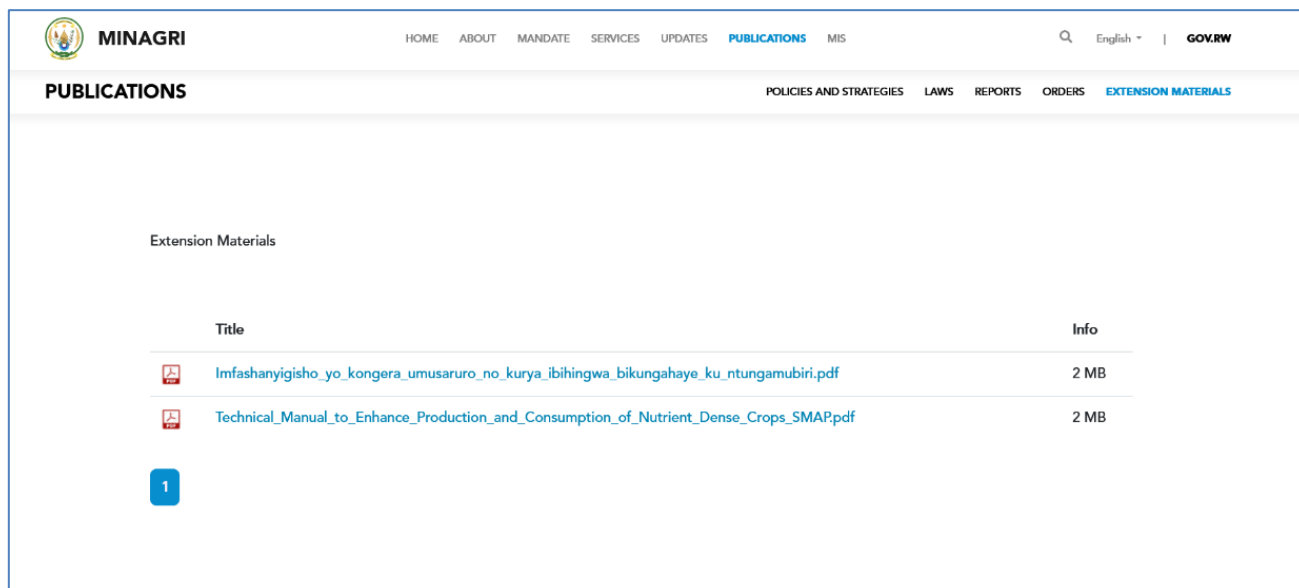


図 4.3.1 MINAGRI の HP に掲載された栄養改善パンフレット (キニアルワンダ語版、英語版)
(URL : <https://www.minagri.gov.rw/publications/extension-materials>)

第5章 成果・教訓および提言

5.1 成果・教訓

(1) 栄養改善活動普及実施体制の確立

1) RAB の栄養改善普及実施体制

本プロジェクトで確立した RAB の栄養改善普及実施体制は事業実施調整局およびマメ類・油料作物プログラム、根菜類プログラム、園芸作物プログラムおよび食品品質・栄養摂取プログラムの4つのプログラムから構成された（図 1.3.1 プロジェクトおよび RAB 栄養改善活動実施体制図参照）。このような体制で RAB 職員が連携して事業を実施することは、RAB 内でも初めての試みであった。また、関係者が一同に会して 2020/2021 年の栄養改善活動に係る実施計画および事業予算、栄養研修教材の作成や対象郡での研修講師を行うことも初めての経験であり、各プログラム職員間の情報共有や普及方法の改善が図られ、団結力が強化された。

なお、プロジェクトチームが中心となり、一連のワークショップの実施や研修実施支援を事業実施調整局と協力しながら行った。栄養借款事業終了後も事業実施調整局はこれらの任を担う中心的な部署となり栄養改善活動を実施することは RAB の基本方針であり、各プログラム職員の協力が一層求められる。今後、栄養改善活動の対象作物に新たな作物が加えられることも予測されるが、基本的には現状の4つのプログラムで担当できると考えられる。ただし、他のプログラムが参加する必要性が生じた場合は、RAB の DG/DDG の承認が必要となる。

2) 郡レベルでの栄養改善普及実施体制

本プロジェクトで確立した郡レベルでの栄養改善活動の実施体制は、郡農業・天然資源局（ANRU）、郡保健・衛生局（HU）、セクターやセルの栄養関連職員および対象組合や農民グループから構成された。栄養研修を通じて、現場レベルでの問題点（ANRU、HU、これらの傘下の組織間の調停・協力体制、研修参加者の選定、料理講習会会場や栽培技術研修のための展示・研修圃場の特定等）が明確になり、その対処法等を協議する中で、特に郡農務官や保健担当官等、郡で中心となる職員等の能力強化や団結力の強化が図られた（図 1.3.2 RAB-対象郡 栄養改善活動実施体制図参照）。また、今後も、特に各地に配置された RAB ステーションの職員と郡職員の協力体制が構築および強化されることにより、効率的な栄養改善活動の推進が期待される。

3) RAB と RBC や郡事務所の料理講習会実施の調整や連携の欠如

本来、料理講習会は保健省の管轄であり、この傘下のルワンダ生物医学センター（RBC）は、保健所や村において、保健ボランティアを通じた住民への料理講習会を推奨している。しかしながら、RAB と RBC や郡事務所の活動の間の調整や連携を図る場、システムが存在しないため、本プロジェクト期間内では RAB は RBC との料理講習会の連携はできなかった。早急の改善が必要である。

なお、中央レベルでは国家保育庁（National Child Development Agency、NCDA）が、地方レベルでは郡事務所が、栄養改善にかかる異なるセクター間の活動調整の職務を負っている。RAB の計画策定時にはこれらの機関を通じた RBC との調整が必要となるため、NCDA の調整能力の強化が必要である。

(2) RAB 栄養研修教材の策定

今回作成した栄養研修教材は、RAB の4つのプログラムからなり、高栄養作物や果樹の栽培技術、これらの作物・果樹の普及・栄養啓発、これらを食材とした調理レシピから構成され、RAB の栄養改善に係る啓発・普及内容を包括的にとりまとめたものである。MINAGRI や RAB で公式に研修教材として認められた。今後、他ドナー、NGOs や郡レベルでも有効に活用されることが期待できる。

(3) RAB の栄養改善活動に係る 2020/2021 年実施計画および予算策定支援

新たに構築した事業実施調整局が主体となり、上記4つのプログラムの代表の協力のもとに、2020/2021 年の RAB 栄養改善活動計画および予算案は策定された。予算申請は、個別プログラムが各々行った訳ではなく、事業実施調整局が各プログラムによって作成された活動計画や予算を取りまとめ、RAB 内での申請手続きを行った。ルワンダの縦割り行政システムの中で、このような横断的な事業実施体制は初めての試みであった。今後、栄養借款事業後の RAB の栄養改善活動においても、RAB が毎年の実施計画や予算の策定を行っていく上でのモデルとなった。

なお、栄養改善に係る事業に関し、RAB や郡職員の日当・宿泊費等が事業費の6割以上を占める結果となった。この予算を縮小し、現場レベルでの活動費に振り分ける必要がある。例えば、研修地近傍の RAB ステーション職員やセクター農務官を講師として活用し、これらの経費を削減すべきである。

(4) 栄養改善啓発・料理講習会

1) 研修教材の内容

料理講習会の実施は参加者の高評価を受けた。しかし、料理講習会ではガスボンベを燃料として用いたが、村落レベルでの料理用の燃料は薪が殆どであること、参加者にとっては資機材、材料が高価すぎて、メニューの再現が難しい、参加者が多すぎる、講習会の時間に対してメニューが多すぎて理解が追いつかない等の指摘があった。今後の料理講習会を通じてこれら問題点を明確にし、料理講習会で取り上げる調理レシピを改善する必要がある。

2) 料理講習会の参加者について

料理講習会では、Community Health Workers、Caretakers at the Home Grown Early Childhood Development Center 等、住民ボランティアおよび会場近くに居住する子どもが栄養不良状態にある母子が、住民代表として参加した。住民ボランティアは、概して、参加意欲が高く、野菜の下処理や洗い物も進んで取り組んでいたが、一方で、子どもが栄養不良状態にある母子は、気後れもあるのか、自分からは積極的に動かない人もいた。今後、料理講習会の実施では、参加者のグループ分け等を行い、社会・経済的な階層をなるべく均質化することで、参加者の誰もが参加しやすくなる工夫が必要である。

(5) 高栄養作物の栽培技術研修

1) 栽培技術の改善

参加者は高栄養作物、栄養強化作物、果樹に対して適切な栽培方法や種子、苗木、微生物資材や DAP 等の肥料の入手方法や使い方等を理解し、栽培技術の改善が図られた。

2) RAB と NCDA における家庭菜園普及の調整

栽培技術研修終了時の研修内容の振り返りの時間に、野菜や果樹が栄養改善に対し有効であることを参加者は理解し、自宅周辺での家庭菜園を行いたい等の発言が多くみられた（第3章 3.3.2 (1)2)を参照）。家庭菜園の普及活動は RAB から NCDA に移管されているが、今後、研修を通じて家庭菜園を行う参加者が増えることが予測されるため、NCDA との情報共有が必要となる。

また、RAB、NCDA および RBC 間の活動の重複を避けるべく、例えば、RAB は高栄養作物・栄養強化作物の栽培指導の対象者に対し、これら作物の料理講習会を実施する。NCDA は Home-based ECD Centre において、その Caretakers に対し家庭菜園と料理講習会を実施する。そして RBC は保健所や保健ポストの利用者や CHW のサービス受益者に対し料理講習会を実施する等、機関ごとに活動の対象者と目的を明確に分けることも必要である。

3) セクター農務官のリーダーシップ

展示・研修圃場での農民による持続的な栽培には、当該地区を担当するセクターの農務官の強力なリーダーシップが鍵となる。セクター農務官は RAB や郡の農協関連職員との調整、研修対象農民の動員、展示・研修圃場の整地指導や営農指導等を担う。このため、研修等の実施には当該セクター農務官を招聘し、将来、彼らが研修講師として研修を実施出来るように技術移転を行う必要がある。今後、対象組合やグループを選定する際には、これらのセクター農務官のリーダーシップも考慮すべきである。

4) 栽培技術研修への小・中学校の巻き込

展示・研修圃場の隣接の小学校の教師からの要請により、数名の教師が栽培技術研修に参加し、同学校では高栄養作物の栽培が実施された（第3章 3.3.3(6)を参照）。RAB や対象郡との協議の上、プロジェクトチームからは、研修で使用した農具や苗の一部を同学校に提供した。栄養改善は教育分野とも関係が深いため、今後、研修の対象に学校を含める事とし、教育カリキュラムに高栄養作物の栽培技術を加える事を提案する。

5.2 提言

(1) MINECOFIN からの確実な予算の配分

SMAP の市場志向型農業事業でも問題点として指摘したが、2018/2019 年の園芸分野事業に係る予算は、申請予算の 20%しか MINECOFIN から送金されなかった事や、四半期毎の送金が遅れたことにより普及活動が停滞した。本プロジェクトでは、栄養借款事業における 2020/2021 年 RAB 栄養改善事業実施計画の予算として約 Rwf 21.2 億を計上したが、COVID-19 の影響のため、MINECOFIN からの予算は殆ど配分されなかった。予算不足・配分の遅れは今後も十分に危惧されるが、この問題は RAB 職員のモチベーションを大きく低下させる。MINAGRI や RAB は MINECOFIN に対して、予算配分の改善を強く要請すべきである。

(2) RAB 栄養改善活動に係る計画予算決定の過程の明確化

2020/2021 年の栄養改善事業計画および予算は、2019 年 12 月に RAB から MINECOFIN に提出された。その後、MINECOFIN で、どのような過程を経て RAB が申請した予算が決定されたのかは明確ではなかった。MINECOFIN は、栄養借款事業に関して、JICA や事業実施機関である MINAGRI、RAB、NCDA、RBC に対して予算をどのように決定し、配分したのか明確にすべきである。

(3) 事業実施機関の連携

栄養借款事業では MINAGRI、RAB、NCDA および RBC の4 機関が事業実施機関である。RAB は本事業において、家庭菜園の促進や料理講習会を実施している。本事業の枠組みの下、NCDA も家庭菜園の推進を、また、RBC も料理講習会の実施を担っているが、事業実施に際しては相互の連携がない。郡レベルにおいて、これら実施機関の情報共有を図り、重複を避けてより効率的に事業展開を図るシステムを、郡が中心となり構築されるべきである。

【中央レベル】

現 NCDA (旧 NECDP) が、中央レベルの栄養にかかる関係機関の調整役を担うことになっていた。しかし、NECDP は、ジェンダー・家族推進省の傘下の1 部署でしかなく、行政機能的には RBC や RAB の方が NECDP よりはレベルが上ということで、各機関の調整が難しかった。栄養に対するマルチセクターアプローチを機能させるために、一番望ましいのは、大統領府の直属として各機関を調整するための常設部署を設置することを提案する。このことにより、セクター省庁よりも1 レベル上の機関が調整役を担うことで、セクター省庁も活動が円滑に行いやすくなる。

【郡レベル】

郡レベルではマルチセクターで作成される DPEM (District Plans to Eliminate Malnutrition, 郡の栄養不良解消計画) が重要になる。この DPEM 作成には、中央省庁 (NCDA、RBC や RAB 等) からの支援についても明記され、これら中央省庁からのインプットの調整が図られることが重要だと考えられる。新年度が7月に始まり各省予算が確定した段階で、郡長主導で関係省庁と郡の栄養改善関連部署との調整のための会議が設定されることが望ましい。なお、DPEM の策定は各郡の HU (保健・衛生部) が担うのではなく、郡長や副郡長主導で、郡の計画部・予算部がその作成、とりまとめを担う方が良い。このことにより、異なるセクターが参加しやすくなり、調整もしやすくなると思われる (Kirehe 郡の例)。

また、ECD センター、農業普及員、CHW、学校教員間など、異なるセクター間の連携、調整は、郡事務所の役割とされているため¹、郡事務所の調整機能の強化が必要である。具体的には、マルチセクターによる共通目標達成のための活動計画・予算の共同策定を郡が実施することが有効だと考えられる。各郡は栄養改善のための優先地域や優先事項をデータに基づいて絞り込み、その目標達成のために、各セクターが展開する活動を DPEM に記載する (セクターごとの活動計画・予算にも同じ活動が記載される) 仕組みが作れば、郡庁の調整機能が強化される。

(4) 栄養改善研修教材の有効活用と持続的な改善

本プロジェクトで作成した栄養研修教材は、今後も RAB や郡事務所の栄養改善普及活動に寄与するものである。本プロジェクトでは対象12 郡に研修教材を配布したが、今後は、RAB が13 のステーション事務所を通じて、他の郡にもこれを配布し、栄養改善普及活動の拡大を図るべきである。また、今後も新たな高栄養作物、栄養強化作物の導入や新たな栽培技術の開発等が行われることが予測されるため、RAB は3~4 年に一度は栄養研修教材を改定すべきである。

¹ 参照: '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	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	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
	S/Total Food Quality and Nutrition														381,982,480	
	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 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	0	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 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 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	Management of the nursery	8,100,000	16,200,000	16,200,000	16,200,000	16,200,000	64,800,000	Fuel & lubricants: 64,800,000	
Number of Farmer field demonstrations conducted			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	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 workshops sessions will be conducted on season analysis	Workshop on season evaluation and report writing					1,159,000				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	
S/Total Fruits														231,776,000		

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
	S/Total Vegetables													253,074,000	
	Number of sites identified.	10	32	Identification and selection of target group farmers/cooperatives for training					435,000	3,480,000	3,480,000	3,480,000	3,480,000	13,920,000	Domestic Per Diems: 13,920,000
									420,000	3,360,000	3,360,000	3,360,000	3,360,000	13,440,000	Transportation cost for domestic business travel (airplane, bus, train, taxi): 13,440,000
									375,000	3,000,000	3,000,000	3,000,000	3,000,000	12,000,000	Agricultural and Veterinary Supplies: 12,000,000
									100,000	300,000	300,000	300,000	300,000	1,200,000	Internet cost: 1,200,000
									500,000	2,500,000				2,500,000	Acquisition of Laptop: 2,500,000
									400,000	1,200,000				1,200,000	Acquisition of Printer: 1,200,000
									51,687	413,496	413,496	413,496	413,496	1,653,984	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)					1,950,000	15,600,000	15,600,000	15,600,000	15,600,000	62,400,000	Domestic Per Diems: 62,400,000
									1,218,000	9,744,000	9,744,000	9,744,000	9,744,000	38,976,000	Transportation cost for domestic business travel (airplane, bus, train, taxi): 38,976,000
									675,000	5,400,000	5,400,000	5,400,000	5,400,000	21,600,000	Other transport costs: 21,600,000
									387,500	3,100,000	3,100,000	3,100,000	3,100,000	12,400,000	Meetings and Special Assembly Costs: 12,400,000
									310,000	2,480,000	2,480,000	2,480,000	2,480,000	9,920,000	Training consumables: 9,920,000
									324,000	2,592,000	2,592,000	2,592,000	2,592,000	10,368,000	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)					300,000	2,400,000	2,400,000	2,400,000	2,400,000	9,600,000	Domestic Per Diems: 9,600,000
									84,000	672,000	672,000	672,000	672,000	2,688,000	Transportation cost for domestic business travel (airplane, bus, train, taxi): 2,688,000
									387,500	3,100,000	3,100,000	3,100,000	3,100,000	12,400,000	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					648,000	5,184,000	5,184,000	5,184,000	5,184,000	20,736,000	Domestic Per Diems: 20,736,000
									432,000	3,456,000	3,456,000	3,456,000	3,456,000	13,824,000	Transportation cost for domestic business travel (airplane, bus, train, taxi): 13,824,000
									413,500	3,308,000	3,308,000	3,308,000	3,308,000	13,232,000	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					510,000	4,080,000	4,080,000	4,080,000	4,080,000	16,320,000	Domestic Per Diems: 16,320,000
									210,000	1,680,000	1,680,000	1,680,000	1,680,000	6,720,000	Transportation cost for domestic business travel (airplane, bus, train, taxi): 6,720,000
	TOTAL Soybeans													297,097,984	

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		
	S/Total Sweet													293,729,220			

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
	S/Total Cassava									48,522,000	28,272,000	15,408,000	28,186,460	120,388,460	
	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
	S/Total Irish Potatoes													256,825,000	
Grand Total														2,116,005,560	

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

Site 1: 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, <i>Rukira</i> 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
Site 2: 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. RUKUMBERI, 2. Sake, 3. Karemba, 4. Jarama, 5. Gashanda, 6. Mugesera, 7. Zaza
DT-Farm: Cooperative Farm Land

b. Summary of Cooking Place

Site 1: Kibungo HC, Kibungo Sector, Cyasemakamba 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
Site 2: 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

Site 1: 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
Site 2: Jyambere Muhinzi, Kibeho Sector, Mubuga Cell, Rwoganyoni 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

Site 1: 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
Site 2: 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

Site 1: 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
Site 2: 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
Site 3: 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

Site 1: 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
Site 2: 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

Site 1: 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
Site 2: 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

Site 1: 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
Site 2: 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

Site 1: 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
Site 2: 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

Site 1: 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
Site 2: 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

Site 1: 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. COKO , 2. Minazi, 3. Ruli, 4, Muhondo, 5. Muyongwe, 6. Rushashi
DT-Farm: Farm Land of Seed multiplier
Site 2: 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

Site 1: 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
Site 2: 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 1st Cycle Cooking Demonstration Schedule (Feb. 2nd to Feb. 21st, 2020)

Month	Day	Activities	Accommodation	
Feb	Mon	3	Preparation of the week	
	Tue	4	Moving from Kigali/ Rubona to Ngoma 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 Gakenke Preparation in Home Based ECD at Kivuruga Sector, Gakenke	Musanze
	Fri	7	Demonstration in Kivuruga Sector, Gakenke Returning to Kigali/ Rubona	Kigali/ Rubona
	Sat	8		
	Sun	9		Musanze
	Mon	10	Preparation of the week	Kigali/ Rubona
	Tue	11	Moving from Kigali/ Rubona to Ngororero Preparation of Ngororero Sector, Ngororero	Ngororero
	Wed	12	Demonstration in Ngororero Sector, Ngororero, Moving to from Ngororero to Rutsiro	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 Kigali/ Rubona	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 Nyaruguru	Huye
	Wed	19	Demonstration in Home Based ECD at Kibehe Sector in Nyaruguru	Huye
	Thu	20	Preparation in Home Based ECD at Cyanika Sector, Nyamagabe	Huye
	Fri	21	Demonstration in Home Based ECD at Cyanika Sector, Nyamagabe Returning to Kigali/ Rubona	Kigali/ Rubona

Annex 3.3 2nd Cycle Cooking Demonstration Schedule (Mar. 9th to Mar. 27th, 2020)

Month	Day	Activities	Accommodation	
March	Mon	9	Preparation of the week	Kigali/Rubona
	Tue	10	Moving from Kigali/ Rubona to Ngororero/Nyange , Preparation in Home Based ECD at Nyange Sector, Gaseke Cell, Gaseke Village, Ngororero	Muhanga
	Wed	11	Demonstration in Home Based ECD at Nyange Sector, Gaseke Cell, Gaseke Village, Ngororero , Moving from Nyange to Karongi	Karongi
	Thu	12	Preparation in Home Based ECD at Kigeyo Sector, Buhindure Cell, Nturo Village, Rutsiro	Karongi
	Fri	13	Demonstration in Home Based ECD at Kigeyo Sector, Buhindure Cell, Nturo Village, Rutsiro , Returning to Kigali/ Rubona	Kigali/ Rubona
	Sat	14		
	Sun	15	Preparation of the week	
	Mon	16	Validation WS	Rwamagana
	Tue	17	Validation WS Moving from Rwamagana to Ngoma , Preparation in ZAZA Health Centre, Zaza Sector, Ruhembe Cell, Kabeza Village, Ngoma	Ngoma
	Wed	18	Demonstration in Zaza HC, Zaza Sector, Ruhembe Cell, Kabeza Village, Ngoma Moving from Zaza to Kigali	Kigali
	Thu	19	Moving from Kigali to Gakenke , Preparation in Home Based ECD Minazi Sector, Murambi Cell, Kabuga Village, Gakenke	Musanze
	Fri	20	Demonstration in Home Based ECD Minazi Sector, Murambi Cell, Kabuga Village, Gakenke , Returning to Kigali/ Rubona	Kigali/ Rubona
	Sat	21		
	Sun	22		
	Mon	23	Preparation of the week	Kigali/Rubona
	Tue	24	Moving from Kigali/Rubona to Huye , Preparation in Home Based ECD at Kaduha Sector, Kavumu Cell, Bamba Village, Nyamagabe	Huye
	Wed	25	Demonstration in Home Based ECD at Kaduha Sector, Kavumu Cell, Bamba Village, Nyamagabe	Huye
	Thu	26	Preparation in Home Based ECD at Rusenge Sector, Gikunzi Cell, Rwabujogi Village in Nyaruguru	Huye
	Fri	27	Demonstration in Home Based ECD at Rusenge Sector, Gikunzi Cell, Rwabujogi Village, Nyaruguru , Returning to Kigali/Rubona	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
Total (Rwf)						1,473,600

Annex 3.5 Cooking Ingredient and Condiments List for a Cookind Demonstration

N ^o	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
Total (Rwf)				49,150

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
Health Workers	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
Government Officers	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	
Others	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
Project (Others)	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
Total				48			58			57			59			47			60

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
- 2) Mr. Boniface KAGIRANEZA Program Leader/ Horticulture Program-RAB
- 3) Mr. Augustin MUSONI Program Leader/Pulses and Oils Crops Program-RAB
- 4) Dr. Marguerite NIYIBITURONSA Program Leader/ Nutrition and Food Quality Program-RAB
- 5) Dr. Athanase NDUWUMUREMYI Orange Sweet Potato Subprogram Leader/ RAB
- 6) Dr. Edouard RURANGWA Cassava Subprogram Leader/ RAB
- 7) Ms. Floride MUKAMUHIRWA Soybeans Sub Program Leader/ RAB
Researcher/ Pulses and Oils Crops Program-RAB
- 8) Mr. Martin BUSOBOZI Research Assistant Fellow / Horticulture Program-RAB
- 9) Mr. Firmin UWIZERWA Research Technician/ Horticulture Program -RAB
- 10) Mr. Jean Chrysostome MUHIGIRWA Research Assistant Fellow/ Horticulture Program-RAB
- 11) Ms. Christine UZAYISENGA Research Technician /Horticulture Program-RAB
- 12) Mr. Edouard MURWANASHYAKA Research Technician/Pulses and Oils Crops Program-RAB
- 13) Mr. Martin NIZEYIMANA Research Technician/ Pulses and Oils Crops Program-RAB
- 14) Ms. Agnes AYINKAMIYE Research Technician / Pulses and Oils Crops Program-RAB
- 15) Mr. Martin KIMENYI Research Technician/ Pulses and Oils Crops Program-RAB
- 16) Mr. Severin NTIVUGURUZWA Research Technician/ Roots and Tubes Program-RAB
- 17) Mr. Elias MUNYANKERA Research Technician/ Roots and Tubes Program-RAB
- 18) Mr. Claire KANYANGE Researcher/ Roots and Tubes Program-RAB
- 19) Ms. Lydie KANKUNDIYE Researcher/ Roots and Tubes Program-RAB
- 20) 20) Mr. Anastasie MUSABYEMUNGU Research Technician/ Roots and Tubes Program-RAB
- 21) Dr. Jean NDIRIGWE Senior Research Fellow / Roots and Tubes Program-RAB
- 22) Ms. Lea NDILU Research Technician/ Nutrition and Food Quality Program-RAB
- 23) Mr. Jean Bosco SHINGIRO Researcher/ Nutrition and Food Quality Program-RAB
- 24) Ms. Gerardine NYIRAHANGANYAMUNSI Research Technician/Nutrition and Food Quality Program-RAB

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			RAB/ Musanze station
Bio-Fortified Irish Potato	40kg	420	
	50 trees	600	RAB/ Rubona station
Fruits	50 trees	600	RAB/ Rubona station
	7 trees	1,300	RAB/ Rubona station
Orange Sweet Potato	7 trees	1,300	RAB/ Rubona station
	600 cuttings	25	RAB/ Kigali station
Vegetables	1.5 cans	3,500	Supplier
	1.5 cans	3,000	
Zucchini	1.5 cans	3,000	
Beetroots	1.5 cans	3,000	
Carrots	1.5 packages	6,000	Green farm, Ltd. in Kigali
Cabbages	1.5 Packages	2,000	
Dodo	0.25 package	6,000	
Watermelon			

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

[Nutrition]
Dr. Marguerite Niyibituronsa, Food Quality & Nutrition Program leader

[Cultivation]

Ms. Agnès Mukayiranga, Research & Technology Transfer Specialist

◊ Pulse & Oil Crops Program Leader:

Mr. Augustin MUSONI

◊ Roots & Tubers Program Leader:

Dr. Placide RUKUNDO

◊ Horticulture Program Leader:

Mr. Boniface KAGIRANEZA

Rwanda Agriculture Development Board

Po Box 5016 Rubona, Huye District Huye-Rwanda.

Mobile: +259788385312

Toll free: 4675, E-mail: infos@rab.gov.rw

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.



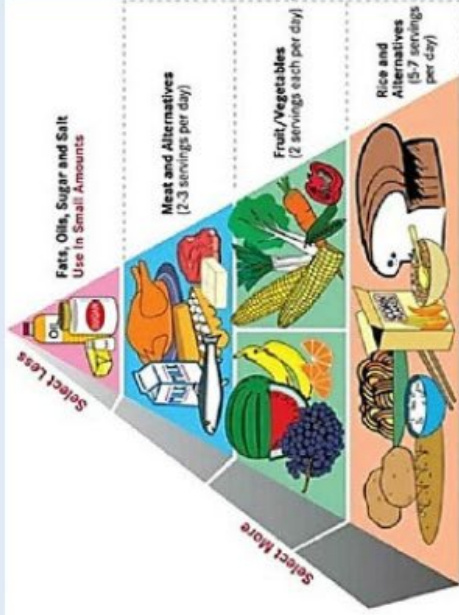
What does malnutrition bring about?

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
Iron beans,



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

A. RAB Officers

1) Dr. Placide RUKUNDO	Program Leader/ Roots and Tubes Program-RAB
2) Mr. Boniface KAGIRANEZA	Program Leader/ Horticulture Program-RAB
3) Mr. Augustin MUSONI	Program Leader/ Pulses and Oils Crops Program-RAB
4) Dr. Marguerite NIYIBITURONSA	Program Leader/ Nutrition and Food Quality Program-RAB
5) Dr. Athanase NDUWUMUREMYI	Cassava Subprogram Leader/ RAB
6) Dr. Damien SHUMBUSHA	Orange Sweet Potato Subprogram Leader/ RAB
7) Dr. Edouard RURANGWA	Soybeans Sub Program Leader/ RAB
8) Ms. Agnès Mukayiranga	Research & Technology Transfer Specialist
9) Ms. Floride MUKAMUHIRWA	Researcher/ Pulses and Oils Crops Program-RAB
10) Mr. Martin BUSOBOZI	Research Assistant Fellow / Horticulture Program-RAB
11) Mr. Firmin UWIZERWA	Research Technician/ Horticulture Program -RAB
12) Mr. Jean Chrysostome MUHIGIRWA	Research Assistant Fellow/ Horticulture Program-RAB
13) Ms. Christine UZAYISENGA	Research Technician /Horticulture Program-RAB
14) Mr. Edouard MURWANASHYAKA	Research Technician/Pulses and Oils Crops Program-RAB
15) Mr. Martin NIZEYIMANA	Research Technician/ Pulses and Oils Crops Program-RAB
16) Ms. Agnes AYINKAMIYE	Research Technician / Pulses and Oils Crops Program-RAB
17) Mr. Martin KIMENYI	Research Technician/ Pulses and Oils Crops Program-RAB
18) Mr. Severin NTIVUGURUZWA	Research Technician/ Roots and Tubes Program-RAB
19) Mr. Elias MUNYANKERA	Research Technician/ Roots and Tubes Program-RAB
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23) Dr. Jean NDIRIGWE	Senior Research Fellow / Roots and Tubes Program-RAB
24) Ms. Lea NDILU	Research Technician/ Nutrition and Food Quality Program-RAB
25) Mr. Jean Bosco SHINGIRO	Researcher/ Nutrition and Food Quality Program-RAB
26) Ms. Gerardine NYIRAHANGANYAMUNSI	Research Technician/Nutrition and Food Quality Program-RAB

B. SMAP PROJECT TEAM

JICA Experts

1) Mr. Goto MICHIO	Team Leader
2) Dr. Yoshinao ADACHI	Horticulture/ Monitoring
3) Ms. Hiroko YASHIKI	Nutrition Expert (1)
4) Ms. Nana MORITA	Agriculture & Marketing/ Coordinator/ Nutrition Expert (2)

Local Staff

1) Mr. Valens NTEZIREMBO	Project Operational Coordinator
2) Mr. Benoit GATEBUKA	Senior Agronomist & Horticulture Expert
3) Ms. Gisele KARANGWA	Nutrition Expert (3)
4) Mr. Didier SEMANYENZI	Coordinator/Translator



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



Soybean Cultivation Technics



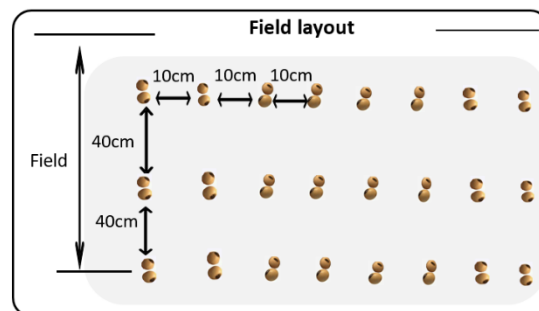
Manual Number: SMAP-NDC-01

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

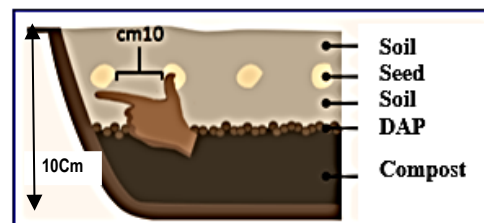
After addressing the crop rotation, seeding rate, row spacing, other conditions such as planting time, seeds preparation, water requirements, seed depth and cropping system should be considered before sowing.

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"> ● It reduces the acidity of the soil and slowly releases nutrient supply. ● It helps increase the nutrient holding capacity to increase the yield.
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"> ● It contributes to the improvement of soil fertility. ● It improves the water holding capacity of the soil. ● It increases the air and water permeability of the soil. ● It increases the number of beneficial microorganisms in the soil and the nutrient-holding capacity of the soil.
DAP	Planting time	1Kg per 1Are	<ul style="list-style-type: none"> ● As a basal dressing, it enhances the formation of roots, plant, foliage, and pods development by holding necessary nutrients.

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

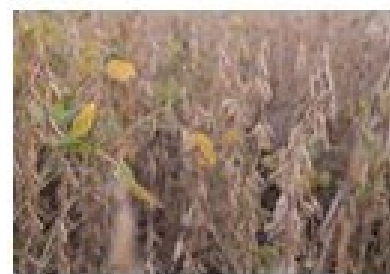
Earthing up

- 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>Rust Cause: fungus known as <i>Phakopsora pachyrhizi</i></p> <ul style="list-style-type: none"> Symptoms are small and water-soaked lesions on the underside of leaves. 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. 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. 	<ul style="list-style-type: none"> Use of certified seeds. Use of resistant varieties. Use of appropriate chemicals: <ul style="list-style-type: none"> ➤ Azoxystrobin 25% SC: 10ml/ 20 Liters of water; ➤ Tebuconazole 25% EC: 20ml / 20 Liters of water; ➤ Copper hydroxide: 30 mg / 20 Liters of water.
<p>Soybean mosaic Cause: Virus usually transmitted by insects</p> <ul style="list-style-type: none"> Characterized by leaf deformation, infected plants can be stunted with shortened petioles and internodes. Seed mottling may occur and the seed germination rate may be reduced. 	<ul style="list-style-type: none"> Use of certified seeds. Application of crop rotation. Remove the infected plants as soon as found and bury them in the ground. 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"> ➤ Lambda-Cyhalothrin: 1ml / 1 liter of water; ➤ Cypermethrin: 1ml / 1 liter of water;
<p>Leaf roller Cause: Insect (Moth is known as <i>Lamprosema indicata</i>)</p> <ul style="list-style-type: none"> The adult moth is creamy yellow to light brown. After one week of hatching, young larvae eat the epidermal layer of the leaves. 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. 	<ul style="list-style-type: none"> On-time planting helps to escape diseases. Eradicate the weeds and voluntary plants in the vicinity of the soybean farms as they act as host agents of soybean diseases. Use appropriate chemicals: <ul style="list-style-type: none"> ➤ Lambda-cyhalothrin 5% EC: 1ml / 1 liter of water; ➤ Azadiractin 0.3% EC: 1ml / 1 liter of water; ➤ Acetameprid 1.8 % EC: 10ml / 20 liters of water;
<p>Aphids Cause: Insect</p> <ul style="list-style-type: none"> Aphids suck sap from the soybean leaves and feed gregariously on plants. The aphids parasitize young leaves and stems as well as flowers. Aphids are the vectors of many viruses and diseases. Eggs overwinter on the buds and leaves. Thus, the leaves are and suffocated. 	<ul style="list-style-type: none"> On-time planting helps to escape diseases. Cultivate at the appropriate distance and respect the recommended quantities of seeds. Application of sufficient amount of fertilizer and practice all techniques learned. Use appropriate chemicals: <ul style="list-style-type: none"> ➤ Lambda-cyhalothrin 5% EC: 1ml / 1 liter of water; ➤ Azadiractin 0.3% EC: 1ml / 1 liter of water;

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

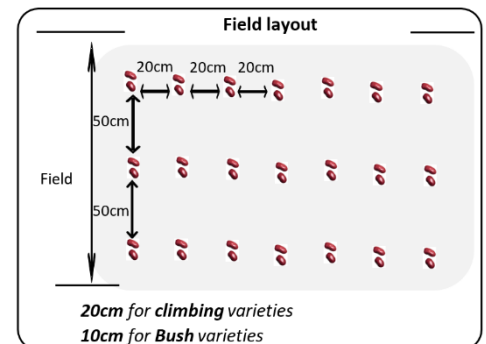
- At the selection of land for High-Iron beans cultivation, farmers have to think about crop rotation. Avoid a field where any variety of beans, such as French bean, Soybean, and Peas, was cultivated in order to keep the land fertile and to avoid diseases that could spread among the plants of the same 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"> Improvement of water holding capacity and physical property of the soil by increasing soil nutrient. Increase air and water permeability. Compost makes an essential contribution to maintaining and increasing soil fertility. Increase the helpful microorganisms and holding of nutrients.
DAP	Planting time (Basal fertilizer)	0.5-1 Kg	<ul style="list-style-type: none"> As basal fertilizer, it enhances plant growth, foliage, and pod development by holding nutrients.
NPK	Planting time (Basal fertilizer)	2 - 3 Kg	<ul style="list-style-type: none"> As basal fertilizer, it is effective for leaves and stems development when DAP is not applied.
UREA	Earthing - up time (Top dressing)	0.5-1 Kg	<ul style="list-style-type: none"> It enhances plant development.

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 1st 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>Anthraxnose Cause: Funguses (Seed borne and seed transmitted disease)</p> <ul style="list-style-type: none"> For symptoms, dark red to black lesions develop on the whole plant, including the pods. On stems and pods, the lesions are sunken. Anthraxnose especially occurs in a cool and humid climate. 	<ul style="list-style-type: none"> Practice crop rotation. Use of certified seeds and resistant varieties. Desinfect seeds before planting by using fungicides like Benomyl (1 gr / 1kg of seeds). Remove the infected plants as soon as it is found and bury them in the ground. Application of fungicides; <ul style="list-style-type: none"> ➤ Benlate: 50g / 20L of water (once/ 2weeks) ➤ Dithane M45: 50g/ 20L of water (once/ week)
<p>Bean Mosaic Virus Cause: Virus</p> <ul style="list-style-type: none"> Leaves may have considerable puckering, stunting, malformation and/or downward curling. Early infected bean plants are usually yellowish and dwarfed. The growth of the plant may be reduced. Infected seeds may spread the angular leaf spot 	<ul style="list-style-type: none"> Reinforce the prevention by using crop rotation or by planting disease-free seeds and resistant varieties. Remove the infected plants as soon as it is found and bury them in the ground. 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"> ➤ Superimetrine: 20 ml/ 20 liters of water ➤ Rocket: 20 ml/ 20 liters of water
<p>Angular leaf spot Cause: Fungal disease</p> <ul style="list-style-type: none"> 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. The lesions are the first grey and then become dark brown in color. Infected bean debris may spread the angular leaf spot 	<ul style="list-style-type: none"> Plant disease-free seeds and disinfected them. Use resistant varieties. Use appropriate chemicals; <ul style="list-style-type: none"> ➤ Benlate: 50g / 20 liters of water (once/ 2weeks) ➤ Dithane M45: 50g/ 20 liters of water (once/ week)
<p>Ascochyta blight Cause: Fungal (Ascochyta Phaseoli) disease</p> <ul style="list-style-type: none"> Symptoms are black or brown concentric lesions on the leaves and pods. Stems can show black nodes. 	<ul style="list-style-type: none"> Use the certified and disease-free seeds. Use resistant varieties. Avoid using compost from bean debris. Seed treatment before planting by using fungicides like Benomyl + Thiram(2 gr each / 1kg of seeds). Use appropriate chemicals; <ul style="list-style-type: none"> ➤ Benlate: 50g / 20L of water (once/ 2weeks) ➤ Dithane M45: 50g/ 20L of water (once/ week)
<p>Halo Blight Cause: Bacteria</p> <ul style="list-style-type: none"> 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. As enlarging the area of disease, the whole leaf surface changes brown color, and the plant dies. 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. The disease development is favored in humid and cloudy conditions. 	<ul style="list-style-type: none"> Use certified seeds. Use resistant varieties. Practice crop rotation. Avoid using compost from bean debris.

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

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



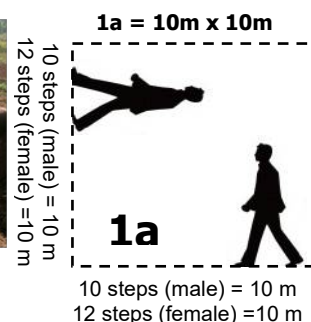
Manual Number: SMAP-NDC-03

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.

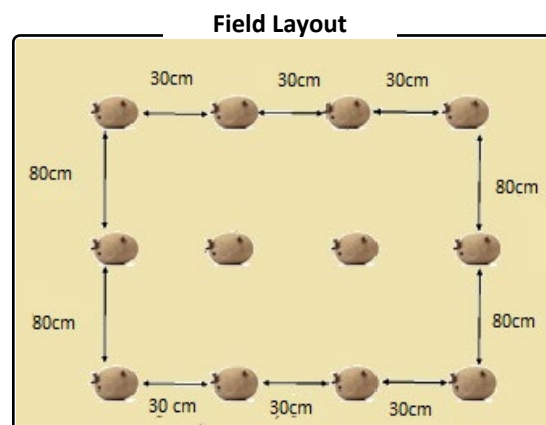


Ploughing the Field



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

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>Mildew <u>Cause:</u> Fungus known as “<i>phytophthora infestans</i>”</p> <ul style="list-style-type: none"> Initially, infected leaves are covered with whitish spore masses resembling soil residues. The disease requires high humidity. Old infected leaves superficially resemble the late blight as leaves turn black, die, and drop from the plant. 	<ul style="list-style-type: none"> Use the disease-free seed potatoes and resistant varieties (late in the rainy season). Remove and destroy any potato debris. Burn-off the foliage 3 weeks before harvesting and harvest mature roots. Apply sorting by removing rotten, diseased, infected and cut tubers before storage. 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.
<p>Early Blight <u>Cause:</u> Fungus known as “<i>Alternaria solani</i>”.</p> <ul style="list-style-type: none"> Early blight is also known as target spot. It affects older leaves first, and spots are rarely found on young and vigorously growing plants. 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. Brown lesions appear first on older, lower leaves, then spread upward. 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. 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). Tubers get irregular spots that are dark and circular. The sunken lesions on the tubers are often surrounded by a purplish raised border. 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. 	<ul style="list-style-type: none"> Use the disease-resistant varieties or late-maturing varieties, which are more resistant than early maturing varieties. Watering at the base of the plant in the morning by avoiding overhead irrigation. Keep plants healthy with proper watering and fertilizer application to prevent the disease. Avoid crop rotation with solanaceous plants such as tomatoes, pepper, eggplant, etc., since the disease is common among them. Avoid bruising seed tubers and mature tubers when harvesting. Application fungicides such as Mancozeb, chlorothalonil, and copper with approximately 7-10 days intervals. Spraying should commence at the first sign of disease or immediately after bloom.
<p>Common scab <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"> It thrives in soil with a pH greater than 5.2 or under drought conditions. 	<ul style="list-style-type: none"> Use the certified seed potatoes and disease-resistant varieties. Practice crop rotation. Try to plant potatoes in the same field only once every 3 to 4 years. Use acid-type fertilizer if the soil has a high pH. Do not use animal manure, wood ashes, or lime in the field. Keep potato plants well-watered, especially during the tuber growth initiation. However, avoid excess watering.

Name & characteristics	Control methods
<ul style="list-style-type: none"> ● The tubers are most susceptible but stems and roots may be infected only occasionally. ● Scab is carried by wind and water from infected seed tubers. It can also be transmitted by manure that is not well composted. ● No above-ground symptoms are apparent on infected potato plants, and scab does not adversely affect potato tubers in storage. ● 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. 	<ul style="list-style-type: none"> ■ Remove and destroy any potato debris and tubers at the end of every season.
<p>Verticillium Wilt</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"> ● The fungi penetrate into plants from roots and spread upwards in the vascular tissues restricting water uptake and infecting stems, petioles and leaves. ● Usually, after flowering, the lower leaves begin to turn yellow between leaf veins. The symptoms then move upwards to younger leaves. ● 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. ● 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. 	<ul style="list-style-type: none"> ■ Carry out a soil analysis to detect the level of Verticillium infestation in the soil. ■ 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. ■ Practice crop rotation by alternating potatoes with non-susceptible cereal crops. ■ Plant certified seed tubers, selecting cultivars that are resistant to wilt. ■ Control host weeds and dispose of infected crop debris. ■ Avoid over-irrigation.
<p>Bacterial soft rot</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"> ● Soft rot brings about rot of tubers during storage accompanied by foul odors. ● It also develops in the harvested tubers, which were infected by blackleg during the growing season. ● 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. ● First, small and moist cream spots appear on the surface of tubers, and they will progress gradually inwards. ● 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. 	<ul style="list-style-type: none"> ■ Planting certified seed potatoes obtained from credible sources and practicing crop rotation. ■ Control weeds like nightshades that harbor the disease organisms. ■ Avoid harvesting under wet conditions and dry wet tubers as quickly as possible. ■ Avoid bruising, and do not wash tubers before storage. ■ Remove vines, clods, and soil adhered to tubers before piling. ■ Sanitize storage facility and eliminate condensation/ moisture during storage. ■ Keep storage well ventilated.



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



Yellow Cassava

Cultivation Technics

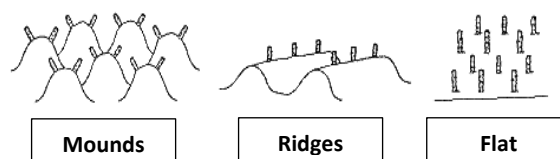


Manual Number: SMAP-NDC-04

Land preparation

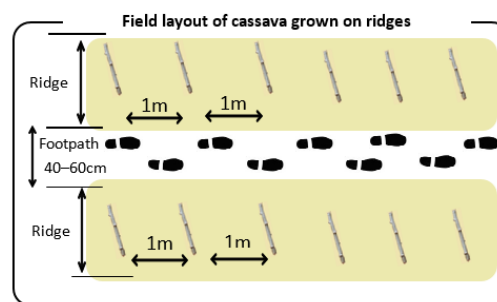
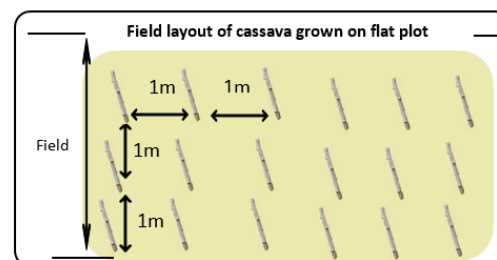
- Cassava is grown in light, deep, and well-drained soil of good texture.
- Cassava is one of the root crops. However, unlike other root crops, it is advisable to cultivate a legume crop as a cover plant during the rest period of cassava cultivation in the intercropping. It is best to plant the cassava 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.

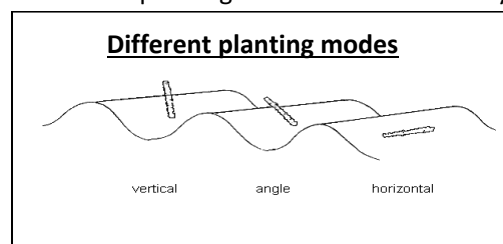


Preparation of planting materials, planting time and planting methods

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>1. Cassava mosaic disease (CMD)</p> <p><i>Cause: Virus</i></p> <p><i>Symptoms</i></p> <ul style="list-style-type: none"> Leaves of recently infected plants are discolored and present pale green or yellow mosaic. 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. 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.  	<ul style="list-style-type: none"> Use the varieties with good tolerance. Use healthy planting materials from the disease-free plants or the plants derived from multiplication farmlands (produced by registered farmers/ companies). Visit the field regularly to check the plants at least once per month. Uproot and burn any infected plants and crop residues. 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. The application of fungicide is not effective, because this is not a fungus disease but a virus disease.
<p>2. Kabore (Cassava brown streak disease - CBSD)</p> <p><i>Cause: Virus</i></p> <p><i>Symptoms</i></p> <ul style="list-style-type: none"> 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. Unlike Cassava mosaic disease, there is no leaf distortion. Brown streaks on cassava stems are observed. In severe cases, there may be leaf drying and shoot dieback. The disease also affects the tuberous roots, which develop a yellow/brown color, dry, corky necrosis within the starch-bearing tissues.  	<ul style="list-style-type: none"> Use the varieties with good tolerance. Use healthy planting materials from the disease-free plants or plants derived from multiplication farmlands (produced by registered farmers/ companies). Visit the field regularly to check the plants at least once per month. Put in quarantine the roots and cuttings from the infected region/ zone. 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. The application of fungicide is not effective, because this is not a fungus disease but a virus disease.



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.

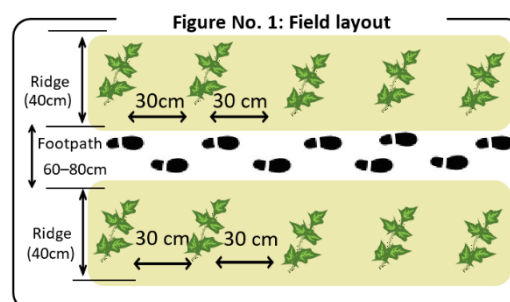


Picture No.1: The ridges provide developing roots to expand to their potential size



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

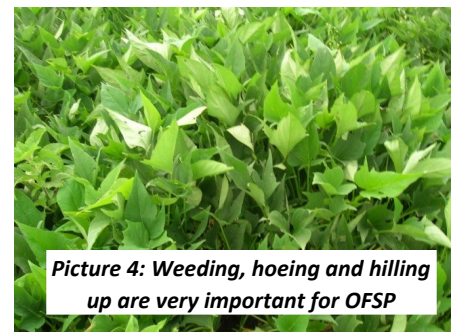
- Low yields can result if the crop is harvested too early or too late. If too early, the storage roots will not have had enough time to develop to their maximum size. If too late, the storage roots may have become fibrous or have been attacked by weevils or root rots. However, other factors such as 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>1. <u>Sweet potato weevils</u></p> <ul style="list-style-type: none"> ● Many weevils found on foliage indicates roots heavily infested ● In vine and roots: Feeding and egg-laying punctures <div style="display: flex; justify-content: space-around;">   </div>	<ul style="list-style-type: none"> ● Use of clean planting materials; ● Hilling up soil around the roots protect them from infestation; ● Crop rotation; ● Field sanitation: Destroying volunteer plants and old plant material; ● Use of natural enemies; ● Timely harvesting; ● Plot separation by planting new crops at a long distance from old crops as OFSP weevils do not fly farther than 500m to 1000m.
<p>2. <u>Sweet potato virus</u></p> <p><u>Cause:</u> one Virus spread by aphids, other by whiteflies.</p> <ul style="list-style-type: none"> ● On infected plants, growth is diminished (stunting); ● Pigmented leaves; ● Reduced production of storage roots. 	<ul style="list-style-type: none"> ● Use clean sweet potato planting materials; ● Destroy any plants showing signs of infection; ● Use resistant varieties; ● Rotate crops by season; ● Plant new crops at a distance from old crops; ● Take cuttings from young plants.



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.

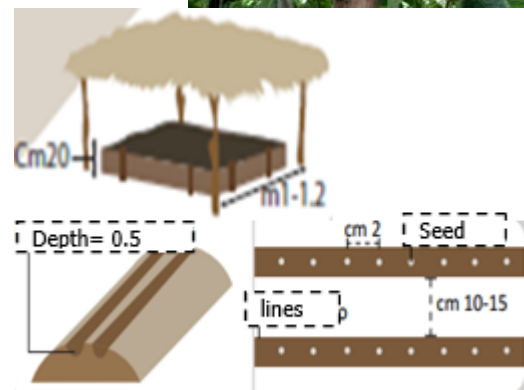


Seedbed preparation

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.

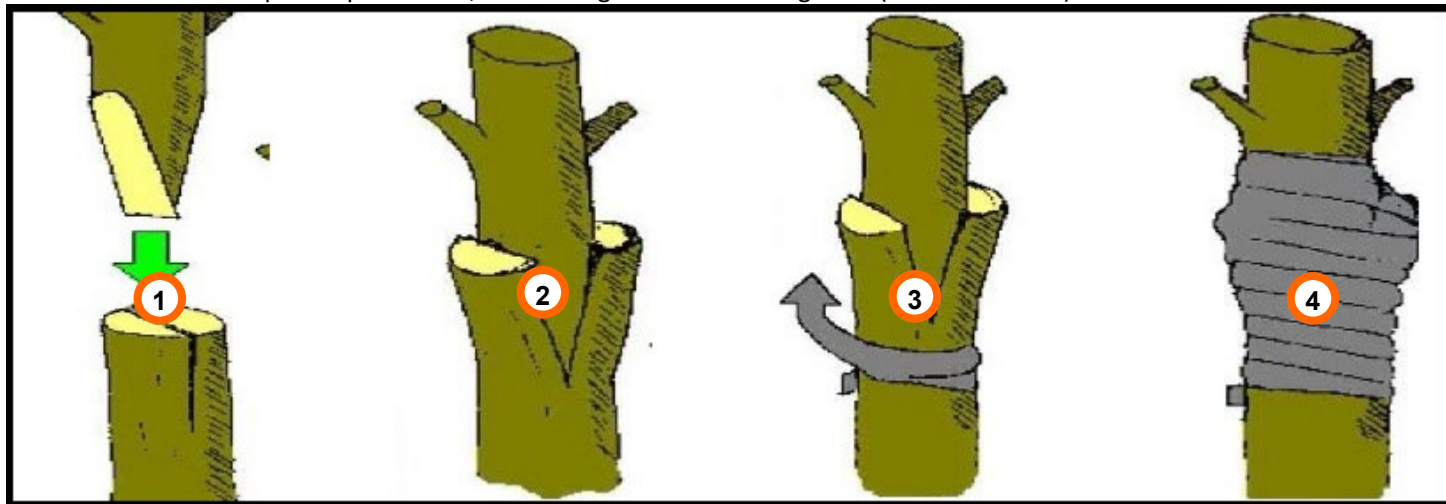
- A nursery bed should be established near a water source to ease watering and near a road to ease seedling transportation.
- After choosing a place where the nursery is established, proceed with the following steps:
 - Level well the nursery place.
 - Measure the land with the width of 1.20 m for the 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

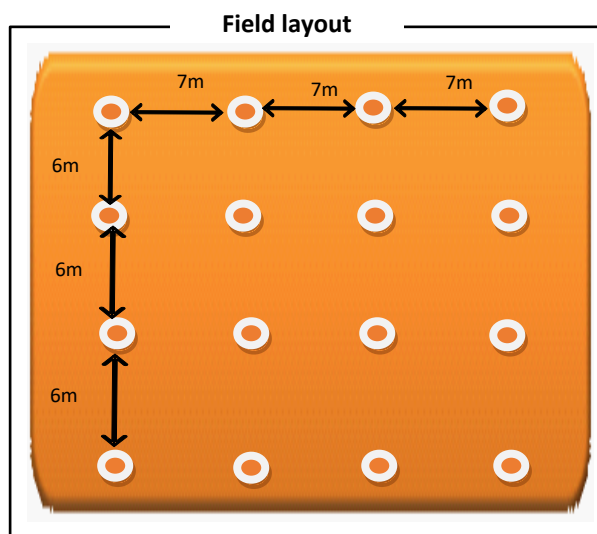
- It is recommended to plant avocado seedlings at the beginning of the rainy periods to ensure they get enough water for root development. It is better to be done in September and October.
- The seedling should be planted early morning or late afternoon to avoid withering caused by direct sunlight.
-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



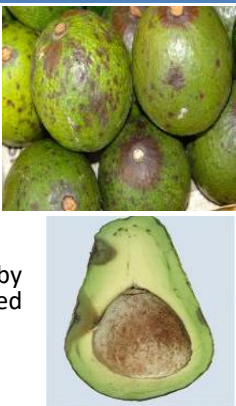


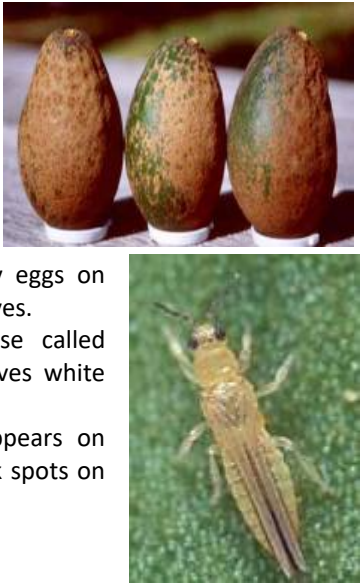
Avocado

Pests and diseases control



Manual Number: SMAP-NDC-06

Major pests and diseases in Rwanda

Name & characteristics	Control methods
<p>Anthracnose</p> <ul style="list-style-type: none"> It is caused by a fungus called <i>Colletotrichum gloeosporioides</i>. It attacks young stems, branches, leaves, and fruits. The symptoms are mainly found on leaves as grey spots. Later, the leaves fall, and the tree is torn. It spreads during the rainy period, by planting infected seeds or by using infected grafts. 	<ul style="list-style-type: none"> Pruning branches to allow sunlight to the tree. Planting grafted and healthy seedlings. Spraying fungicides such as Copper oxychloride/hydroxide, carbendazim or chlorothalonil.
<p>Scab</p> <ul style="list-style-type: none"> It is caused by a fungus called <i>Sphaceloma percae</i>. 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. The fungus attacks mainly the veins of leaves in the upper part of the plant. 	<ul style="list-style-type: none"> Remove all the infected plants from the field. Clean the field by removing the fallen fruits. Apply the fungicides such as Copper oxychloride/hydroxide, carbendazim, or chlorothalonil.
<p>Cercosporiose spots</p> <ul style="list-style-type: none"> It is caused by a fungus called <i>Sphaceloma purpurea</i>. The fungus attack mainly fruits and leaves, and the infected fruits have yellow or brown spots. It spreads during the rainy periods or under high humidity conditions in the field. It also spreads during watering activities. 	<ul style="list-style-type: none"> Apply the fungicides such as Copper oxychloride/hydroxide, carbendazim, or chlorothalonil during flowering periods, fruiting, and after harvesting. Clean the field by removing the fallen avocado fruits.
<p>Thrips</p> <ul style="list-style-type: none"> Thrips have many varieties, and they make fruits turn different colors like white, black or brown. They are spread through agriculture tools. They damage fruits mainly during dry periods. They lay eggs on leaves, and larvae eat the leaves. They can carry virus disease called tospovirus, which makes leaves white and dried. The virus disease mainly appears on branch buds and leaves black spots on flowers. 	<ul style="list-style-type: none"> Visit and observe the field frequently. Weed properly. Keep an appropriate spacing between plants. Apply organic insecticide made from the plants like chili pepper, tobacco or pyrethrum, etc. Spray an insecticide such as UMEME (Lambdacyhalothrin, Imidachloprid (confidor), Aster extrim, cypermethrin, Rocket)



Tamarillo (Tree tomato)

Cultivation Technics

Manual Number: SMAP-NDC-07



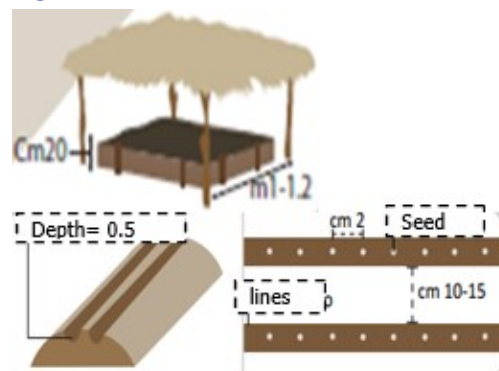
Seed preparation

- 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.



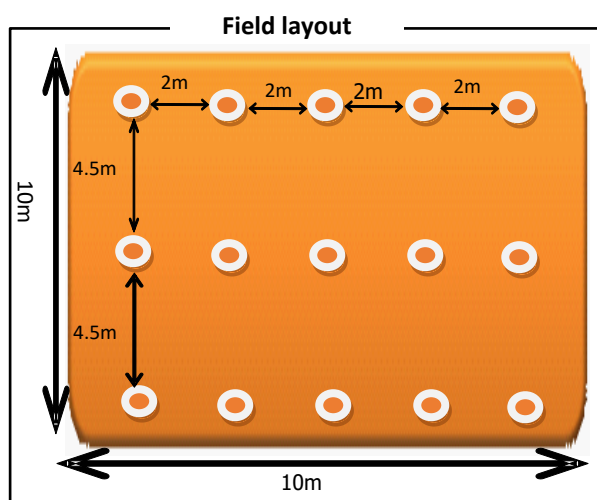
Field layout

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

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

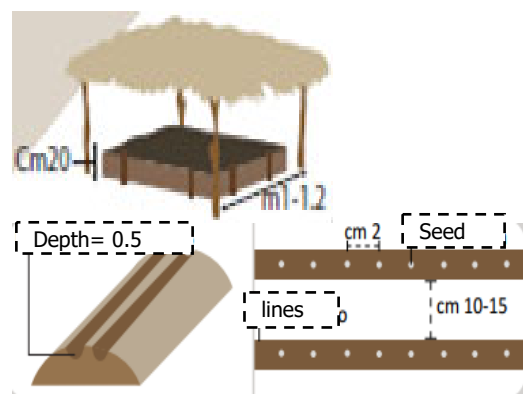
Seed preparation

- 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.

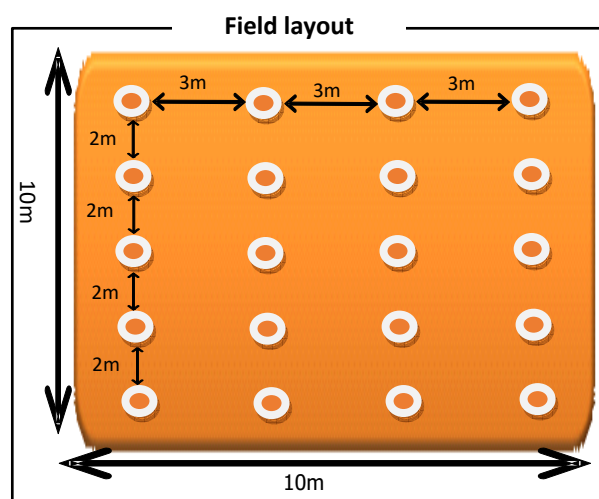
- Fill up into pots a mixture of soil and well-decomposed manure at the ratio of 2:1 (Example: 2 baskets of soil and one basket of manure). Seedling pots have 8-10 cm of diameter and 15 cm of height.
- Put the pots in strip lands between stems of trees surrounding them.
- When seedlings have reached 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.

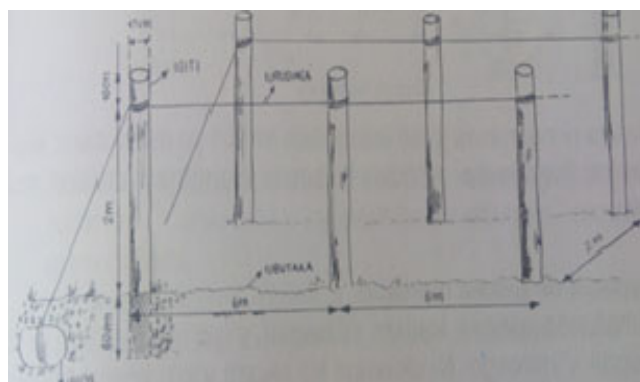
Time for planting

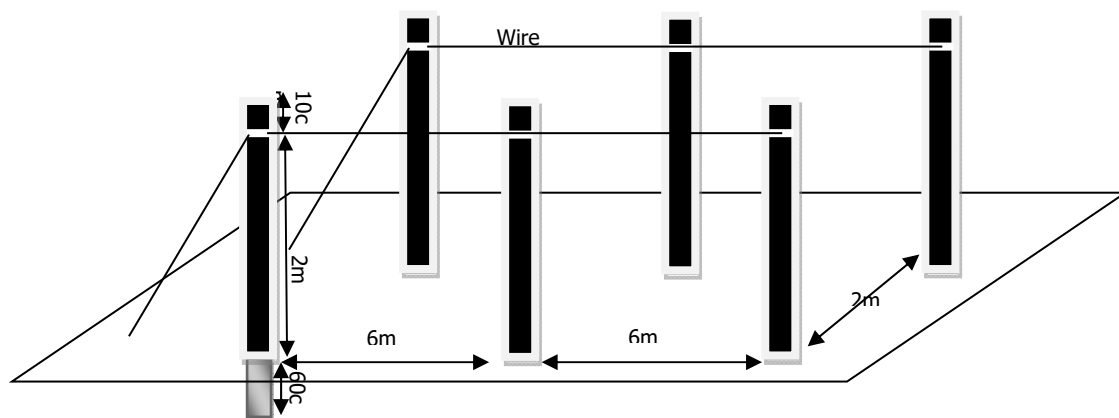
- It is recommended to plant passion fruit seedlings at the beginning of the rainy period to ensure they get enough water for root development. It is better in September and October.
- Seedlings should be planted in the early morning or late afternoon to avoid withering caused by direct sunlight.

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-borne 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)

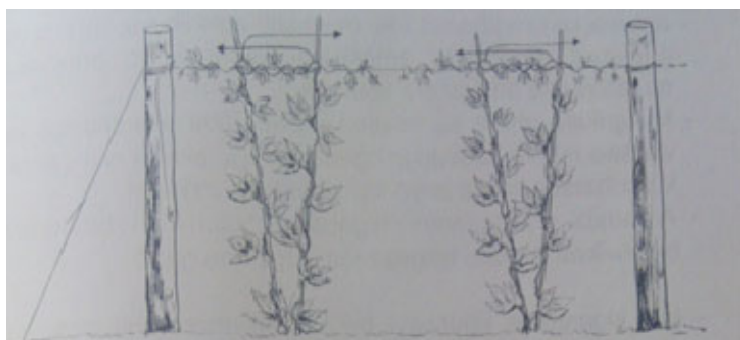
Year	Urea	DAP	Ammonium sulfate	KCl
1	74	52	127.5	266
2	52	104	262.5	625
3	39	156.5	382.5	918

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>Passionfruit woodiness virus</p> <ul style="list-style-type: none"> The leaves are often distorted, puckered, and crinkled. The fruit skin become hard or woody and mottling. The fruits are smaller than normal and juiceless. <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>Prevention:</p> <ul style="list-style-type: none"> Plant healthy seedlings from approved dealers/sellers. Manage aphids that may spread the diseases. Not close the field with the old one. Remove infected plants and burn and bury them in the ground. Remove and bury other remains of crops from and around the field. Other agriculture/ harvesting tools (scatter, knives, machetes, etc.) must be cleaned by chloride or by fire. Make a crop rotation. Weeding and cleaning the field. Pruning regularly to remove the parts of plants where insects hide. <p>Control:</p> <ul style="list-style-type: none"> There are no chemicals to control the virus. Therefore preventive methods are most recommended, like control of aphids which may spread virus.
<p>Cucumber mosaic virus</p> <ul style="list-style-type: none"> Leaves are distorted or deformed, mainly at the upper part of the leaves. Leaves change their normal color to the yellow lesion. The whole plant is stunted. Matured fruits are abnormally ripened, showing up light green or yellow lesions. The virus which spreads this disease is found in numerous plants or weeds which grow in the field (Solanaceae, cucurbits, etc.). 	
<p>Septoria spot</p> <ul style="list-style-type: none"> Brown spots appear on leaves, stems, and fruits. On fruits, the spots enlarge to form one large spot. Fruits are not well ripening, or they rot and provide very bad flavor. Even when the disease is not severe, it causes the fall of leaves and fruits, and the crop prematurely died. It is mainly infected by seeds. The disease symptoms can start in a nursery bed. Infected plants can contaminate other nearby plants because of rain or water for irrigation. Septoria spots are spread in the rainy period but appear in the dry period. This disease becomes severe for plants without staking and pruning or in dense. 	

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

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



Papaya Cultivation Technics



Manual Number: SMAP-NDC-09



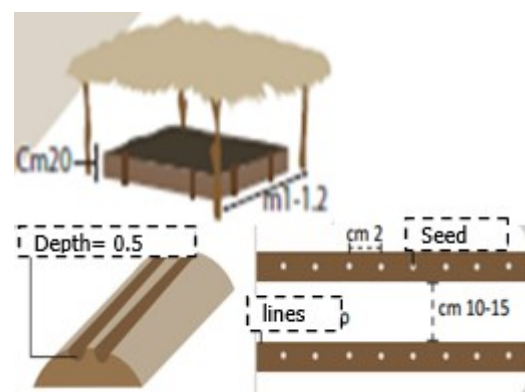
Seed preparation

- 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 1m².
- 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



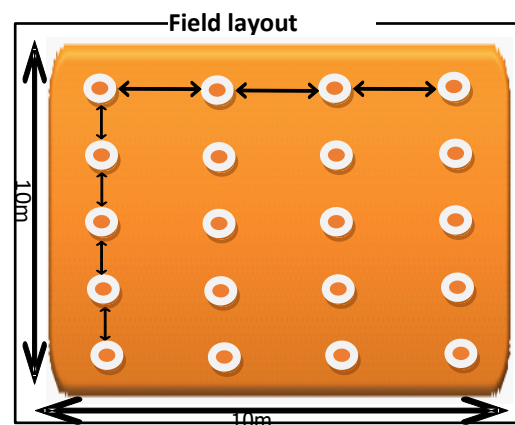
Land preparation and planting seedlings

- 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>Damping-off</p> <p>Cause: Fungus</p> <ul style="list-style-type: none"> ■ Damping-off is common during emergence. ■ It is caused by various soil fungi (including <i>Rhizoctonia solani</i>, <i>Pythium spp.</i>, <i>Phytophthora spp.</i>). ■ The disease is favored by high temperature and humidity. 	<p>Prevention:</p> <ul style="list-style-type: none"> ■ It is prevented by disinfection of the substrate (by moist or chemical heat) and/or water control <p>Control:</p> <ul style="list-style-type: none"> ■ application of fungicides before and after emergence, ■ seed treatment by fungicides (Mancozeb, Thiovit, Chlorotharonil)
<p>Fruits rot</p> <ul style="list-style-type: none"> ■ Fruit rot is mainly caused by <i>Colletotrichum papaya</i>, which causes anthracnose in ripening fruits. 	<ul style="list-style-type: none"> ■ Control consists of preventive sprays of mancozeb and/or appropriate systemic fungicides, for example, Lidomil. ■ Treating the fruit with hot water (49oC, 20 minutes) immediately after harvesting gives good results for protection during transport and storage.
<p>Ringspot virus</p> <ul style="list-style-type: none"> ■ 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. ■ It is non-persistent, transmitted mechanically and by aphids. 	<p>Prevention:</p> <ul style="list-style-type: none"> ■ Planting healthy seedlings. ■ Manage aphids that may spread the diseases. ■ Not close the field with the old one. ■ Remove infected plants and burn and bury them in the ground. ■ Making crop rotation. ■ Weeding and cleaning the field. ■ Pruning regularly to remove the parts of plants where insects hide. <p>Control:</p> <ul style="list-style-type: none"> ■ There are no chemicals to control virus, preventive methods are mostly recommended like control of aphids which may spread virus
<p>Mosaic virus</p> <ul style="list-style-type: none"> ■ Mosaic is caused by several viruses, including papaya mosaic, Potexvirus, PapMV. ■ The first main symptom is the appearance of more or less intense discolored or chlorotic macules on the leaf blades. ■ As a result, the leaves become deformed, the terminal bud ceases to develop and turns yellow and the crown gradually atrophies. ■ Elongated and narrow oily spots appear in an early stage on the petioles and the tender part of the trunk. ■ 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. ■ Viruses are not transmitted by seed. ■ Most of the viruses attacking the papaya tree are found on cucurbits. ■ Damage is variable and can go as far as compromising the entire harvest 	
<p>Aphids</p> <ul style="list-style-type: none"> ■ Several species of insects and mites attack the papaya tree. The most harmful are aphids, vectors of viruses. ■ They take shelter under the leaves and cause lesions, sometimes similar to symptoms of virus. ■ Aphids feed gregariously on plants.  <p>Other insects</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>Prevention:</p> <ul style="list-style-type: none"> ■ Preserve insects known as a natural enemy. ■ Remove infected leaves and allow light in. ■ Use of yellow sticky traps <p>Control:</p> <ul style="list-style-type: none"> ■ Use of following insecticides by alternating; <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><u>Nematodes</u></p> <ul style="list-style-type: none"> Nematodes can cause appreciable damage, which is mainly marked by slower growth, general yellowing, and a sharp drop in production. 	<p>Prevention:</p> <ul style="list-style-type: none"> Crop rotation with groundnut, maize, sorghum, and guinea grass to prevent nematode damage Mix planting or crop rotation with marigold <div style="text-align: right;">  <p>African marigold</p> </div>



Mango Cultivation Technics



Manual Number: SMAP-NDC-10



Seedling preparation

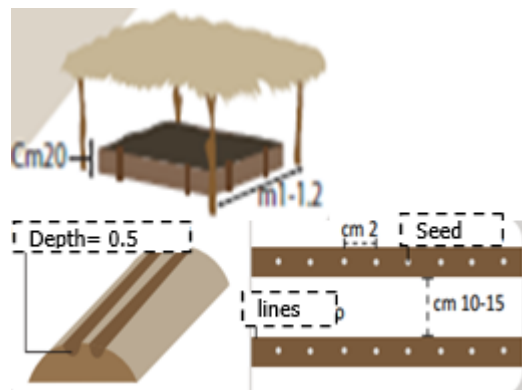
Mango seedlings are prepared in a nursery bed, and they are grafted and then planted in the main field.



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).



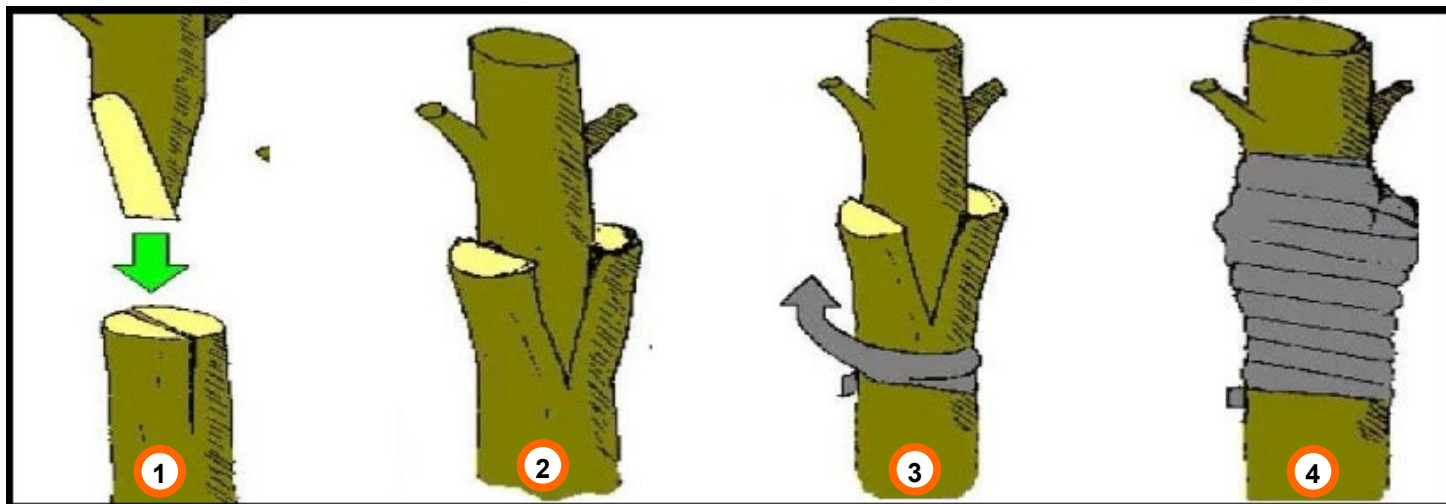
Making a nursery bed, pricking seedlings and management.

- 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.



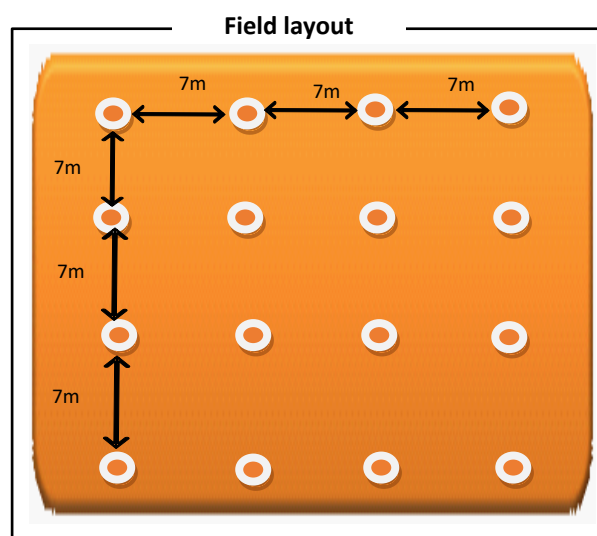
Transplanting seedlings in the main field

- 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 unmatured, 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>Anthraxnose Cause: Fungus</p> <ul style="list-style-type: none"> It appears in the field and in storage as well. It becomes severe on new branches, flowers, and also fruits. It is severe under humid and raining conditions and temperatures between 24 to 32°C. 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. It causes spots on leaves, death of new shoots, and rotting of fruits. On leaves, the lesions are grey to dark grey irregular spots scattered on the leaf, which appear as water-soaked and shattered. Young leaves are mostly infected. This disease causes black dry spots on branches. Infected flowers fall down. 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. 	<p>Prevention</p> <ul style="list-style-type: none"> Respect proper spacing when planting seedlings; Pruning frequently mango trees; Collecting and burning or burring all infected parts; Plant resistant varieties like Tommy atkins, Kent. <p>Control methods:</p> <ul style="list-style-type: none"> Infected leaves, branches, and fruits and burry or burn them. 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. <p>Before harvesting, it is recommended to spray Carbendazim or Chlorothalonil, but it has to be done 14 days before harvesting.</p>
<p>Powdery mildew Cause: Fungus</p> <ul style="list-style-type: none"> It is spread by wind. It is severe under dry and high humidity conditions with cold nights. 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. It is severe in flowering periods. It presents white powder on leaves, flowers, and small new fruits. Infected flowers don't open and fall, which causes a big loss of production. It attacks young leaves while they change from green to light grey color. The white powder appears on both sides of young leaves but more on the bottom side. Small fruits are finally covered by white powder, and they can remain on the tree for a while, then they fall down. When they are not fallen, the skin cracks when the soil contains much water and the surrounding parts hardened. 	<p>Prevention:</p> <ul style="list-style-type: none"> Pruning mango trees frequently so that air and light can pass through and limit trees at a lower height to ease tree management; Collecting and burning or burring all infected parts; Plant resistant varieties like Tommy, Kent, Bire, Zillate, and Van dyke. Avoid mixing mango varieties that are not resistant, like Bolibo, apple mango, and those resistants. Surround the field with a long fence longer than the mango trees to reduce the speed of the wind, which can spread the disease. <p>Control methods:</p> <ul style="list-style-type: none"> Infected leaves, branches, and fruits and burry or burn them. 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.

Name & characteristics	Control methods
<p>Fly and larvae of mangos</p> <ul style="list-style-type: none"> ■ Flies lay eggs The flies lay the eggs which give the larvae which grow and become the flies too. ■ Larvae damage ripe mangoes and reduce production by more than 50%. ■ The fly of the genus Bactrocera and Ceratitis spp are the most dangerous for mangoes. ■ The female fly punches the fruit skin with a stinger on the bottom of his abdomen and lays eggs into small clones. ■ This causes the fruit to lose fleshy juice through holes made by flies which become brown or red color. ■ The eggs give larvae inside the mesocarp and feeding the fleshy thalamus while the epicarp looks healthy. ■ 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. <div style="display: flex; justify-content: space-around;">   </div>	<p>Prevention:</p> <ul style="list-style-type: none"> ■ 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. ■ It is recommended to collect and bury or burn all infected fruits and those fallen down to avoid a reproduction of flies. ■ It is recommended to harvest matured fruits before ripening to avoid flies that lay eggs on fruit. <p>Control methods:</p> <ul style="list-style-type: none"> ■ 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.



Training manual: Nutrition improvement Using nutrients dense foods



**Marguerite Niyibituronsa,
Lea Ndilu, Gerardine Nyirahanganyamunsi,
Jean Bosco Shingiro, Illuminée Kamaraba**

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.

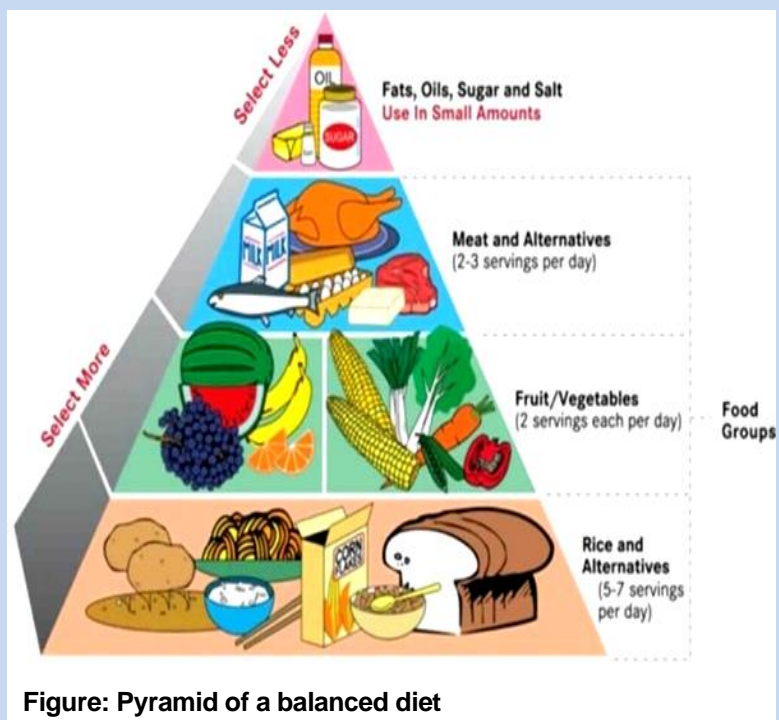


Figure: Pyramid of a balanced diet

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

Nutrient	Proportion (%)
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

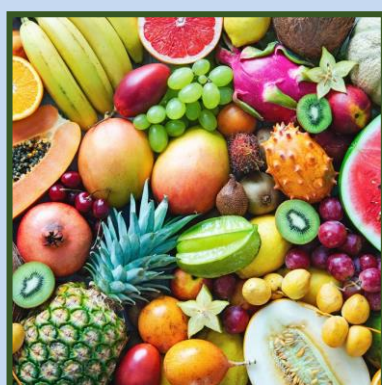
- Vegetable is a part of plant eaten as leaves (Amaranths, spinach), roots (carrots, beet), fruits (eggplant, shallot, green beans), flowers like cauliflower
- Fruits are parts of plants that are eaten when mature
- Fruits and Vegetables are good sources of vitamins, antioxidants, organic acids, minerals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

Nutrient	Nutritional and healthy importance	Main source
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.

