

SUPPLEMENTARY FILE 1

Study Questionnaire

Post-Harvest Losses of Perishable Vegetables and Their Contribution to Household Dietary Gaps in Kamonyi District, Rwanda

Study Site:	Kamonyi District, Southern Province, Rwanda
Study Period:	November 2025 - January 2026
Target Population:	Smallholder vegetable farmers
Language:	Administered in Kinyarwanda (translated from English)

INSTRUCTIONS FOR ENUMERATORS

1. Obtain informed consent before beginning the interview.
2. Complete all sections in order. Mark N/A if a question is not applicable.
3. For multiple choice questions, tick (☑) the appropriate box(es).
4. Record all quantities in the units specified (kg, %, RWF).

IDENTIFICATION

Questionnaire ID:	_____
Sector:	_____
Cell (Akagari):	_____
Village (Umudugudu):	_____
Date of Interview:	____/____/____ (DD/MM/YYYY)
Enumerator Name:	_____
Start Time:	____:____ (HH:MM)
End Time:	____:____ (HH:MM)

MODULE 1: SOCIO-DEMOGRAPHIC CHARACTERISTICS

No.	Question	Response
1.1	Sex of household head	☐ Male ☐ Female
1.2	Age of household head (years)	_____ years
1.3	Marital status	☐ Single ☐ Married ☐ Divorced/Separated ☐ Widowed
1.4	Highest education level completed	☐ None ☐ Primary ☐ Secondary ☐ Tertiary/University
1.5	Total number of household members	_____ persons
1.6	Number of children under 5 years	_____ children
1.7	Number of children 5-18 years	_____ children

1.8	Primary occupation of household head	☐ Farming ☐ Trading ☐ Employed ☐ Self-employed ☐ Other: _____
1.9	Years of farming experience	_____ years
1.10	Total land area owned (hectares)	_____ hectares
1.11	Land area allocated to vegetable farming (hectares)	_____ hectares
1.12	Estimated monthly household income (RWF)	☐ <50,000 ☐ 50,000-100,000 ☐ 100,001-200,000 ☐ >200,000
1.13	Member of farmer cooperative/group?	☐ Yes ☐ No
1.14	Distance to nearest market (km)	_____ km
1.15	Access to agricultural extension services?	☐ Yes ☐ No

MODULE 2: VEGETABLE PRODUCTION AND POST-HARVEST HANDLING PRACTICES

Section 2A: Vegetable Production

No.	Question	Response
2.1	Which vegetables do you grow? (Tick all that apply)	☐ Tomatoes ☐ Leafy greens (amaranth/nightshade) ☐ Carrots ☐ Cabbage ☐ Onions ☐ Other: _____
2.2	Which is your primary/main vegetable crop?	☐ Tomatoes ☐ Leafy greens ☐ Carrots ☐ Other: _____
2.3	How many growing seasons per year?	☐ 1 ☐ 2 ☐ 3 ☐ Year-round
2.4	Source of irrigation water	☐ Rain-fed only ☐ River/stream ☐ Well/borehole ☐ Pond ☐ Other: _____
2.5	Do you use improved/certified seeds?	☐ Yes ☐ No ☐ Sometimes

2.6 Production quantities in the last harvest season:

Crop	Area planted (ha)	Total harvest (kg)	Variety used
Tomatoes	_____	_____	_____
Leafy greens	_____	_____	_____
Carrots	_____	_____	_____

Section 2B: Harvesting Practices

No.	Question	Response
2.7	Time of day you usually harvest	☐ Early morning ☐ Mid-morning ☐ Afternoon ☐ Any time
2.8	How do you determine harvest maturity?	☐ Color change ☐ Size ☐ Days after planting ☐ Market demand ☐ Other: _____
2.9	Harvesting method used	☐ Hand picking ☐ Cutting tools ☐ Pulling/uprooting ☐ Other: _____

2.10	Containers used during harvest	☐ Plastic crates ☐ Woven baskets ☐ Sacks ☐ Buckets ☐ Other: _____
2.11	Do you sort/grade produce after harvest?	☐ Yes ☐ No
2.12	If yes, grading criteria used	☐ Size ☐ Color ☐ Damage ☐ Ripeness ☐ Other: _____

Section 2C: Storage and Preservation

No.	Question	Response
2.13	Do you store vegetables before selling?	☐ Yes ☐ No (Skip to 2.17)
2.14	Average storage duration (days)	_____ days
2.15	Storage facility/method used	☐ Open air/shade ☐ Room in house ☐ Dedicated store ☐ Cold storage ☐ Other: _____
2.16	Do you use any preservation techniques?	☐ None ☐ Drying ☐ Coating/waxing ☐ Cooling ☐ Other: _____
2.17	Have you heard of aloe vera coating for preservation?	☐ Yes ☐ No
2.18	Would you be willing to try natural preservation methods?	☐ Yes ☐ No ☐ Need more information

Section 2D: Transportation and Marketing

No.	Question	Response
2.19	Primary market for your vegetables	☐ Local market ☐ District market ☐ Kigali ☐ Middlemen ☐ Direct to consumers ☐ Other: _____
2.20	Mode of transport to market	☐ Head load ☐ Bicycle ☐ Motorcycle ☐ Vehicle ☐ Other: _____
2.21	Packaging used for transport	☐ Plastic crates ☐ Woven baskets ☐ Sacks ☐ Cardboard boxes ☐ Other: _____
2.22	Average time from harvest to market (hours)	_____ hours
2.23	Road condition to market	☐ Good (paved) ☐ Fair (murrum) ☐ Poor (rough) ☐ Very poor

MODULE 3: POST-HARVEST LOSS ASSESSMENT**Section 3A: Loss Quantification by Value Chain Stage**

3.1 For your last complete harvest, estimate the quantities at each stage (in kg):

TOMATOES:

Value Chain Stage	Quantity (kg)	Main causes of loss
Total harvested	_____	N/A

Lost at field/harvest	_____	☐ Over-ripe ☐ Mechanical damage ☐ Pests ☐ Disease ☐ Other: _____
Lost during transport	_____	☐ Crushing ☐ Heat damage ☐ Spillage ☐ Other: _____
Lost during storage	_____	☐ Rotting ☐ Drying/shriveling ☐ Pests ☐ Other: _____
Lost at market	_____	☐ Unsold/spoiled ☐ Rejected ☐ Theft ☐ Other: _____
Total sold	_____	N/A
Consumed at home	_____	N/A
Given away/gifted	_____	N/A

LEAFY GREENS (Amaranth/Nightshade):

Value Chain Stage	Quantity (kg)	Main causes of loss
Total harvested	_____	N/A
Lost at field/harvest	_____	☐ Wilting ☐ Mechanical damage ☐ Pests ☐ Disease ☐ Other: _____
Lost during transport	_____	☐ Wilting ☐ Crushing ☐ Heat damage ☐ Other: _____
Lost during storage	_____	☐ Wilting ☐ Yellowing ☐ Rotting ☐ Other: _____
Lost at market	_____	☐ Unsold/spoiled ☐ Rejected ☐ Other: _____
Total sold	_____	N/A
Consumed at home	_____	N/A
Given away/gifted	_____	N/A

CARROTS:

Value Chain Stage	Quantity (kg)	Main causes of loss
Total harvested	_____	N/A
Lost at field/harvest	_____	☐ Cracking ☐ Mechanical damage ☐ Pests ☐ Disease ☐ Other: _____
Lost during transport	_____	☐ Breakage ☐ Bruising ☐ Other: _____
Lost during storage	_____	☐ Rotting ☐ Drying ☐ Sprouting ☐ Other: _____

Lost at market	_____	☐ Unsold/spoiled ☐ Rejected ☐ Other: _____
Total sold	_____	N/A
Consumed at home	_____	N/A
Given away/gifted	_____	N/A

Section 3B: Price and Economic Loss Assessment

No.	Question	Response
3.2	Average selling price during peak harvest (RWF/kg) - Tomatoes	_____ RWF/kg
3.3	Average selling price during off-season (RWF/kg) - Tomatoes	_____ RWF/kg
3.4	Average selling price during peak harvest (RWF/kg) - Leafy greens	_____ RWF/kg
3.5	Average selling price during off-season (RWF/kg) - Leafy greens	_____ RWF/kg
3.6	Average selling price during peak harvest (RWF/kg) - Carrots	_____ RWF/kg
3.7	Average selling price during off-season (RWF/kg) - Carrots	_____ RWF/kg
3.8	Did prices drop significantly during peak harvest?	☐ Yes ☐ No If yes, estimated drop: _____%
3.9	Did you ever discard produce due to low prices?	☐ Yes ☐ No If yes, approximate quantity: _____ kg

Section 3C: Perceived Challenges and Constraints

No.	Question	Response
3.10	What are the main challenges causing post-harvest losses? (Rank top 3: 1=most important)	___ Lack of storage facilities ___ Poor road conditions ___ Lack of market information ___ Insufficient packaging ___ Price fluctuations ___ Lack of preservation knowledge ___ Other: _____
3.11	Have you received any training on post-harvest handling?	☐ Yes ☐ No
3.12	If yes, from which organization?	☐ Government extension ☐ NGO ☐ Cooperative ☐ Other: _____
3.13	What support would help reduce your losses? (Tick all that apply)	☐ Training ☐ Storage facilities ☐ Better packaging ☐ Market linkages ☐ Credit/loans ☐ Other: _____

MODULE 4: HOUSEHOLD DIETARY DIVERSITY ASSESSMENT

Section 4A: 24-Hour Dietary Recall (Household Dietary Diversity Score - HDDS)

Ask: "Now I would like to ask you about the types of foods that you or anyone else in your household ate yesterday during the day and at night at home or outside the home. Please think about all foods and drinks consumed by any household member."

No.	Food Group	Consumed? (Yes=1, No=0)	Examples eaten
4.1	CEREALS (e.g., rice, maize, sorghum, millet, bread, pasta)	☐ Yes ☐ No	_____
4.2	ROOTS AND TUBERS (e.g., potatoes, sweet potatoes, cassava, yams)	☐ Yes ☐ No	_____
4.3	VEGETABLES (e.g., tomatoes, carrots, leafy greens, cabbage, onions)	☐ Yes ☐ No	_____
4.4	FRUITS (e.g., mangoes, bananas, oranges, papaya, avocado)	☐ Yes ☐ No	_____
4.5	MEAT AND POULTRY (e.g., beef, goat, chicken, pork)	☐ Yes ☐ No	_____
4.6	EGGS	☐ Yes ☐ No	_____
4.7	FISH AND SEAFOOD (e.g., fresh fish, dried fish, tilapia)	☐ Yes ☐ No	_____
4.8	PULSES, LEGUMES AND NUTS (e.g., beans, lentils, peas, groundnuts)	☐ Yes ☐ No	_____
4.9	MILK AND DAIRY PRODUCTS (e.g., milk, yogurt, cheese)	☐ Yes ☐ No	_____
4.10	OILS AND FATS (e.g., cooking oil, butter, margarine)	☐ Yes ☐ No	_____
4.11	SUGAR AND HONEY (e.g., sugar, honey, sugarcane, sweet drinks)	☐ Yes ☐ No	_____
4.12	MISCELLANEOUS (e.g., spices, condiments, tea, coffee)	☐ Yes ☐ No	_____
	HDDS TOTAL SCORE (sum of Yes responses, max 12)	_____/12	

Section 4B: 7-Day Food Frequency Questionnaire (Vitamin A and C Rich Foods)

Ask: "In the past 7 days, how many days did your household consume the following foods?" (0-7 days)

No.	Food Item	Days consumed (0-7)	Portion size (small/medium/large)
	VITAMIN A RICH FOODS		
4.13	Orange-fleshed sweet potato	_____	☐ S ☐ M ☐ L
4.14	Carrots	_____	☐ S ☐ M ☐ L
4.15	Pumpkin/squash	_____	☐ S ☐ M ☐ L
4.16	Dark green leafy vegetables (amaranth, nightshade, spinach)	_____	☐ S ☐ M ☐ L
4.17	Ripe mangoes/papaya	_____	☐ S ☐ M ☐ L
4.18	Eggs	_____	☐ S ☐ M ☐ L
4.19	Liver or organ meats	_____	☐ S ☐ M ☐ L
	VITAMIN C RICH FOODS		

4.20	Tomatoes (fresh)	_____	☐ S ☐ M ☐ L
4.21	Cabbage	_____	☐ S ☐ M ☐ L
4.22	Green peppers/chili	_____	☐ S ☐ M ☐ L
4.23	Citrus fruits (oranges, lemons)	_____	☐ S ☐ M ☐ L
4.24	Guava	_____	☐ S ☐ M ☐ L
4.25	Pineapple	_____	☐ S ☐ M ☐ L
4.26	Irish/white potatoes	_____	☐ S ☐ M ☐ L

Section 4C: Vegetable Consumption and Post-Harvest Loss Impact

No.	Question	Response
4.27	How often does your household consume vegetables?	☐ Daily ☐ 4-6 times/week ☐ 2-3 times/week ☐ Once/week ☐ Less than weekly
4.28	What is the main source of vegetables for household consumption?	☐ Own production ☐ Market purchase ☐ Both ☐ Gifts/neighbors ☐ Other: _____
4.29	Do post-harvest losses affect the vegetables available for your family?	☐ Yes, significantly ☐ Yes, somewhat ☐ No ☐ Don't know
4.30	During peak harvest, do you eat more vegetables because of abundance?	☐ Yes ☐ No ☐ About the same
4.31	During off-season, is it harder to access vegetables for your family?	☐ Yes ☐ No
4.32	If vegetables are lost/spoiled, what does your household eat instead?	☐ Other vegetables ☐ Staples only (beans/rice) ☐ Reduce meals ☐ Purchase from market ☐ Other: _____
4.33	Has the quality of vegetables you eat declined due to storage?	☐ Yes, often ☐ Yes, sometimes ☐ No ☐ Don't know

END OF QUESTIONNAIRE

Thank you for your participation in this study.

Enumerator's signature: _____	Date: ____/____/____
Supervisor's signature: _____	Date: ____/____/____

Data Entry (Office Use Only):

Data entered by: _____	Date: ____/____/____	Verified by: _____
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