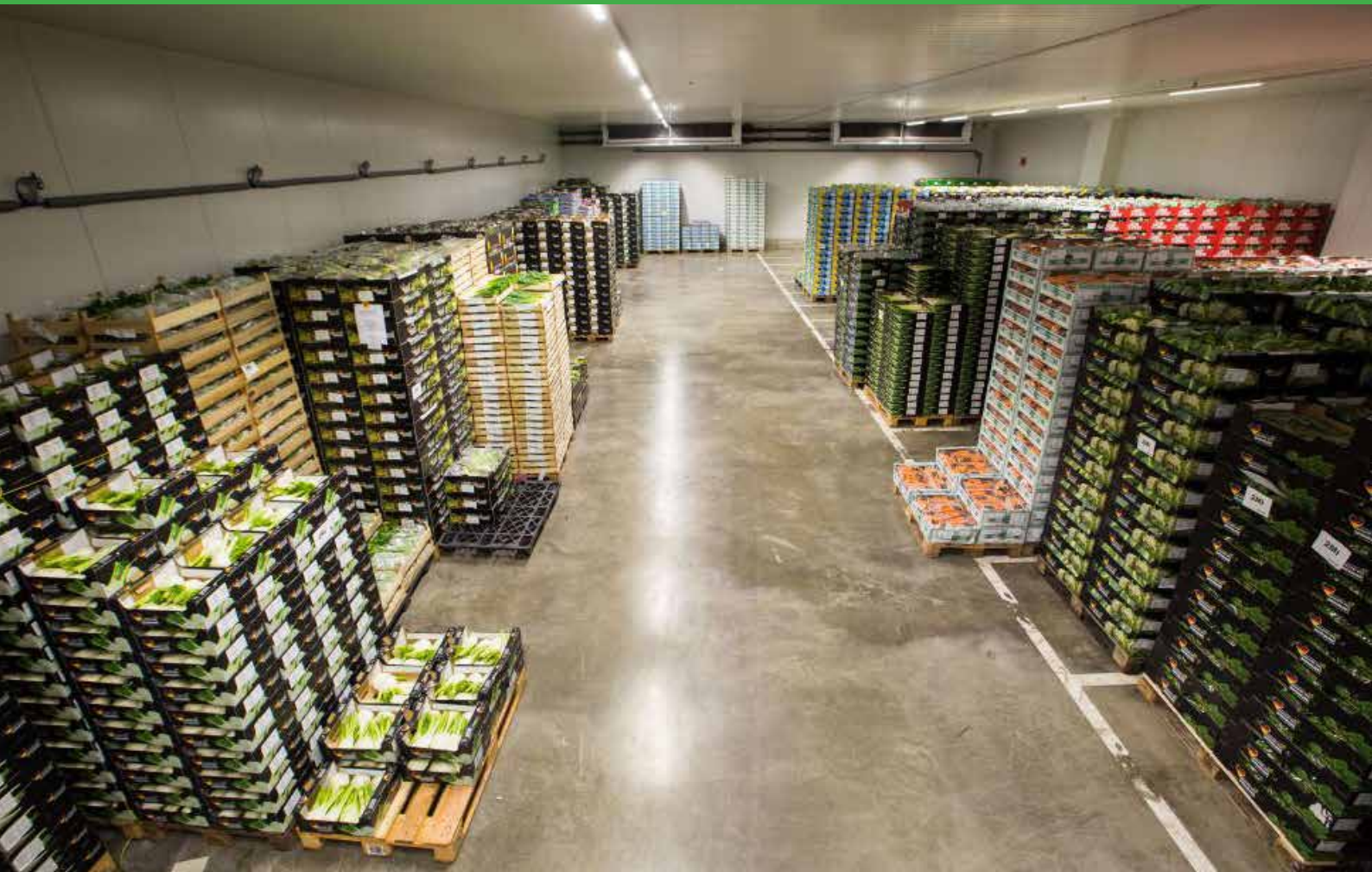




EAST AFRICAN COMMUNITY



East African Community
Post-Harvest Loss Management
Strategy and Action Plan
for the Fruits and Vegetables Value Chain



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List of Acronyms and Abbreviations

AU	African Union
CAADP	Comprehensive Africa Agriculture Development Programme
COMESA	Common Market for Eastern and Southern Africa
EAC	East African Community
FNSAP	Food and Nutrition Security Action Plan
FNSS	Food and Nutrition Security Strategy
F&V	Fruits and Vegetables
GAP	Good Agriculture Practices
GIZ	Deutsche Gesellschaft für Internationale Zusammenarbeit GmbH
GDP	Gross Domestic Product
IPM	Integrated Pest Management
M&E	Monitoring and Evaluation
MDGs	Millennium Development Goals
MEACAs	Ministries of East African Community Affairs
PHLMNFPs	Post-Harvest Loss National Focal Persons
MISMEs	Micro, Small and Medium Enterprises
NEPAD	New Partnership for Africa's Development
NFPs	National Focal Persons
NQFs	National Qualification Frameworks
PHL	Post-Harvest Losses
PHLM	Post-Harvest Loss Management
PPD	Public Private Dialogue
PTSC	Post-harvest Training and Services Centers
R&D	Research and Development
RAIP	Regional Agriculture Investment Plan
RIVA	Regional Industrial Value Addition Project
RPHLMCC	Regional PHLM Coordination Committee
RQFs	Regional Qualification Frameworks
SCTIFI	Sectoral Council on Trade, Industry, Finance and Investment
SDGs	Sustainable Development Goals
SEAMPEC	Support to East African Market-Driven and People-Centered Integration
SPS	Sanitary and Phytosanitary System
SSA	Sub-Saharan Africa
TAHA	Tanzania Horticulture Association
TBT	Technical Barriers to Trade
UN	United Nations
USAID	United States Agency for International Development

Foreword



The East African Community (EAC) has developed and adopted the 'EAC Post-Harvest Loss Management Strategy and Action Plan for the Fruits and Vegetables Value Chain.' It aims at providing strategic and targeted investment along the EAC fruits and vegetable (F&V) sector so as to reduce the sector's post-harvest losses from the current 40% to 20% on average, by 2030.

Fruits and vegetables sub-sector in the region plays a significant role in the economic development of EAC Partner States' economies, variably contributing between 20 per cent and 30 per cent of agricultural Gross Domestic Product (GDP) on average. Despite this contribution, the F&V sector in the EAC, is beset by significant levels of post-harvest losses that make it difficult for the region to optimally reap the opportunities in the sector. Depending on the situation, country and crop in question, the post-harvest losses in the EAC region may reach 35-60%. Research conducted in the EAC over the years, has established and documented that post-harvest losses occur throughout the F&V value chain. The relevance of post-harvest loss management (PHLM) stems from the fact that it is central to poverty reduction, improvement of livelihood through sustainable food security, increased confidence of farmers, economic development and environmental sustainability.

Some of the factors that lead to post-harvest losses include lack of local availability of post-harvest tools, limited technical know-how in handling prac-

tices that can reduce losses, poor transportation systems including rural roads and poor market infrastructure among others. Partner States across the region have not invested in substantive programs to monitor and systematically evaluate losses at the pre-harvest stage. This strategy, therefore, focuses on interventions in cultivation, agricultural extension services and pest management systems.

To counter the above challenges, the Action Plan proposes various interventions amongst them; promotion of good production practices to address pre-harvest losses; strengthening of research and development (R&D) and policy frameworks.

The EAC Secretariat remains committed to ensuring the reduction in post-harvest losses, and in this context, welcomes key stakeholders and development partners to support its efforts. The successful implementation of the Strategy and Action Plan requires the concerted effort of all EAC Partner States and a multi-sectoral approach, including national ministries of agriculture, industry, trade and finance, as well as national academic and research institutions, private sector players, non-state actors and international development partners. In view of the importance of the sub-sector to East Africans and its contribution to agricultural and industrial development, I urge all the stakeholders to support appropriate measures as outlined in the strategy for its successful implementation.

Hon. (Dr.) Peter Mutuku Mathuki
Secretary General
East African Community

Acknowledgment



The adoption of the EAC Post-harvest Loss Management Strategy and Action Plan for the Fruits and Vegetables Value Chain comes at a time when the world is tackling the global challenge of how to ensure food security for a world growing population while ensuring long-term sus-

tainable development. Achieving zero hunger by 2030 will require that no more food is lost or wasted. According to the Food Agriculture Organization (FAO) food, production will need to grow by 70% to feed world population, which will reach 9 billion by 2050. Further trends like increasing urban population, shift of lifestyle and diet patterns of the rising middle class in emerging economies along with climate change put considerable pressure on the planet's resources, declining freshwater resources and biodiversity, loss of fertile land among others..This document has been developed by a consultancy team comprising a regional consultant and EAC Partner States national post-harvest loss management focal persons and was guided by technical and policy inputs by various national, regional and international stakeholders.

It is in this regards that the EAC Secretariat wishes to acknowledge the participation, contribution and dedication of the EAC Partner States participating during national consultative workshops, interviews and focus group discussions. Key national stakeholders were drawn from private sector, Fruits and vegetables Growers, Exporters & Processors, National Ministries responsible for Industrial Development, Agriculture and East African Community Affairs, National Horticultural Associations, National Manufacturing Associations, National Agriculture and Food Authorities, National Research Institutes and Orga-

nizations, Agricultural Research organizations, National Bureaus of Standards, Small Industries Development Organizations, Private sector Foundations, Academia among others.

The invaluable technical and financial support provided by the Federal Republic of Germany, through Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) under the GIZ-EAC Support to East African Market-Driven and People Centered Integration Programme (SEAMPEC) implemented by the Regional Industrial Value Addition Project (RIVA) is highly acknowledged and appreciated. Finally, yet importantly, the Secretariat wishes to recognise the tireless efforts of the EAC staff from the productive sectors on the successful stewardship of the development of this strategy.

In conclusion, I wish to emphasize that the Secretariat will ensure a coordinated and collaborative approach by all the relevant departments of the EAC Secretariat (Agriculture, Industry and Trade), Partner States' national ministries and institutions, fruits and vegetables processing associations, as well as development partners, to successfully implement this document. This coordination will seek to synergize and harness existing national, regional and international initiatives, towards strengthening value addition in the fruits and vegetables sub-sector. The EAC Secretariat will take the lead responsibility in mobilizing and optimally deploying the necessary resources, including personnel, for the successful implementation of the strategy, while the Partner States will drive the implementation in their respective countries through their internal mechanisms.

Hon. Christophe Bazivamo
Deputy Secretary General
(Productive and Social Sectors)
East African Community

Executive Summary

This document presents a Revised Report for the EAC Post-harvest Loss Management Strategy and Action Plan for the Fruits and Vegetables Value Chain.” The assignment was undertaken as part of implementation of the recommendations of the 37th Extra Ordinary Sectoral Council on Trade, Industry, Finance and Investment (SCTIFI) meeting, during which the EAC Secretariat was directed to develop a regional F&V post-harvest loss management (PHLM) strategy for the sector.¹

The role of the F&V sub-sector in the EAC

The F&V sector plays a significant role in the EAC economies. Due to its growing importance, the sector is of strategic importance to the socioeconomic development of region. The F&V sector represents between 20 per cent and 36 percent of GDP on average. The sector has a huge transformation potential and provides a promising economic opportunity for reducing rural poverty in the EAC. The most direct contribution is through generating higher incomes for farmers. Studies have found that farmers engaging in F&Vs earn significantly higher incomes than farmers producing other products, because horticulture products are high value products.

The F&V sector is of prime interest to all EAC national governments because it is a labour-intensive sector as compared to staple food production. The sector provides potential for addressing employment challenges, especially among youth and women. Significant employment opportunities are created through crop growth periods, (planting, weeding and harvesting), approximately twice the labour input per hectare of cereals and more off-farm jobs in processing, grading, packaging, delivery to exporters’ factories or collection centres and marketing. Most of the off-farm employment opportunities accrue in the value-added processing activities up the value chain.² Additionally, as many of the F&V products are new to farmers, they get an opportunity to learn and upgrade their agricultural skills (like irrigation and farming methods) but also through technology transfer to the wider community on the construction of greenhouses, boreholes or irrigation systems for example.³

The indigenous vegetables have been part of the food systems in the EAC for generations. They are the most affordable source of vitamins and minerals

required for good health. The traditional fruits and vegetables found in many parts of East Africa have significant medicinal and curative potential.⁴ The F&V sector plays an important role in promoting the EAC industrialization agenda. The processed fruits market in the EAC is among the most promising ones, with sector maturity still far off into the foreseeable future.⁵

The Relevance of Post-harvest Loss Management

The relevance of post-harvest loss management (PHLM) stems from the fact that it is central to poverty reduction and improvement of livelihood through sustainable food security. Food supply chains are constrained by global population growth, hence the need for serious efforts to minimise food waste.⁶ The issue of food losses is of great importance in the efforts to combat hunger, raise incomes and improve food security in the world’s poorest countries. Food losses have an impact on food security for poor people, on food quality and safety, on economic development and on the environment.⁷ These challenges are all evident in the EAC.

Post-harvest losses in F&Vs, challenge the lives of poor farmers in the EAC. High levels of losses contribute to childhood malnutrition and the chronic issue of vitamin deficiencies among poor households. In addition, women often receive low prices for the food they produce, since marketing intermediaries know that what they purchase from growers will lose a lot of volume and value before they can be sold to consumers. Most small farmers must sell their F&Vs immediately after harvest, because they have no access to storage or processing options to extend shelf-life. This means that they receive low prices because their produce is often available at the same time as that of other local farmers producing the same crop, leading to gluts of certain types of fresh produce in the marketplace.⁸

Post-harvest losses minimize the opportunities for processing and value addition, which could subsequently promote backward linkages in the F&V sector. At the moment, the linkages are lacking throughout the region. Increased investment in F&V processing could also promote vertical integration.

Lack of vertical integration is a common feature in East African industries in almost all sectors. In the F&V sector, this feature is quite significant in almost all Partner States, due to the prevailing initial development process of industrializations in the region.⁹

In summary, PHLM will ensure sustainable food security; promote productivity, value addition and agro-processing; increase cross-border trade and supply of agricultural commodities and, ultimately enhance competitiveness of the F&V sub-sector.

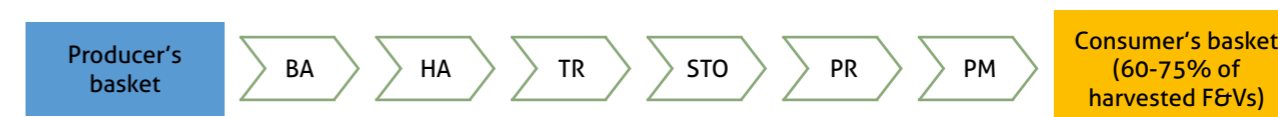
Inclusion of pre-harvest loss component

Studies and experience from the field have shown that prior to embarking into Post-harvest Loss Management (PHLM) Strategies, it is important to consider other primary factors which influence the post-harvest losses. These are generally termed as “pre-harvest” losses.

One of the crucial and significant factors for ensuring a successful food production among smallholder farmers are the pre-harvesting practices and procedures. Due to their impact on the amount of food loss and waste, pre-harvesting should be approached as the first step in post-production interventions and management systems. In actual sense, it is the last step in agronomy that ushers in food harvesting.¹⁰

The above consideration, is premised on the fact that the final market value of F&V products and acceptance by the consumers, depends upon the grower’s ability to apply best practice pre-harvest techniques.¹¹ In reality, a lot of waste occurs well before the F&Vs are harvested from the field.

Post-harvest Losses throughout the F&V Value Chain



Key: BA=Biological Agents; HA=Harvesting; TR=Transportation; STO=Storage; PR=Processing; PM=Packaging and Marketing
Source: Compiled from secondary literature review, July 2021

⁹ Most of the factories are either established in order to substitute imports of processed fruit juice in order to increase value addition to raw materials without taking into account the inter dependence of various segments of the sector.
¹⁰ The pre-harvest factors influencing post-harvest quality are frequency of irrigation, husbandry practices e.g. use of fertilizers, pest control, and growth regulators), climatic conditions (like wet and windy weather conditions), natural climate (such as hailing, high wind velocity, heavy rainfall), and tree conditions (age, training pruning, light penetration, etc.). All these factors influence the overall F&V quality and suitability for marketing
¹¹ These are followed by harvesting and then applying best practice post-harvest handling practices.

Such waste needs to be addressed upfront, due to their spill-over and trickle-down effects. In other words, successful post-harvest loss management interventions should start with pre-harvest loss managements. Once pre-harvest losses are taken into account, it is then possible to propose a more holistic, inclusive and impactful PHLM Strategy.

Against this background, pre-harvest losses have been considered as part and parcel for developing the Post-Harvest Loss Management Strategy and Action Plan for the F&V value chain in the EAC.

Status of Post-Harvest Losses in the EAC Region

The F&V sector in the EAC, is beset by significant levels of post-harvest losses. This makes it difficult for the region to optimally reap the opportunities in the sector. While considerable attention is directed toward increasing food production by 50–70%, one important and complementary factor that is often forgotten, is reducing food loss and food waste.¹² Depending on the situation, country and the crop in question, the post-harvest loss in the EAC region may reach 35-60%.

Critical post-harvest loss points in the F&V value chain

Research conducted in the EAC over the years, has established and documented that post-harvest losses occur throughout the F&V value chain. The quantum differs by stage and by level of sophistication and efforts designed to reduce post-harvest losses. The figure below typically represents the stages through which losses can and do occur from production to consumption.

¹² Hodges, Buzby, & Bennett, 2011: Unpacking Post-harvest Losses in Sub-Saharan Africa: A Meta-Analysis

¹ June 2022; (EAC/ExSCTIFI/37/Directive 33)

² World Bank, 2008

³ Ulrich, A. (2014). Export-Oriented Horticultural Production in Laikipia, Kenya: Assessing the Implications for Rural Livelihoods. Sustainability, issue 6(1), pp. 336-347

⁴ Evidence Based Complementary and Alternative Medicine, Volume 2015 ID 807158

⁵ EAC Industrialization Strategy (2012 – 2032)

⁶ International Journal of Logistics Systems and Management, Vol. 27, No. 2, 2017

⁷ FAO, Guidelines on the measurement of harvest and post-harvest losses

⁸ USAID Horticulture Innovation Lab, Post-harvest Extension Pilot Project: Sub-Saharan Africa, 2014

In general, post-harvest losses in the sector are occasioned by: poor transportation systems – e.g., rural roads; poor means of harvest; poor market infrastructure - transport, packaging materials, storage, etc.); hygienic conditions of the local markets and poor sorting and grading. Depending on the situation and the crop in question, the post-harvest loss may reach 40—50%.¹³ In addition, there are specific challenges in each segment of the value chain as presented below.

Specific value chain segment post-harvest loss challenges

Value chain segment	Specific challenges
Input suppliers	Lack of local availability of many of the most needed goods/supplies; and difficulties and high costs for importing needed post-harvest tools packages, goods, and supplies. The agro-input shops rarely sell post-harvest-related goods. The import taxes and customs issues create disincentives for agri-businesses.
Farmers	Lack of technical know-how on handling practices that can reduce losses; lack of access to improved containers, post-harvest tools, education, credit; lack of market information; low prices during periods of high production and lack of knowledge about market options. Lack of proper storage facilities.
Traders	High fuel prices and high transport costs (can limit market options), lack of access to cool storage facilities for temporary holding of unsold produce.
Transporters	Huge, heavy containers; high fuel prices; poor feeder roads (contributing to vehicle and tire damage); lack of access to refrigerated vehicles; and lack of knowledge on best practices for loading/unloading vehicles.
Marketers	Produce exposed to weather, sun, with subsequent high losses; lack of cool storage for unsold produce and lack of access to facilities, power, and equipment for temperature management.
Extension services	high costs for travel, lack of proper accommodation; lack of suitable teaching materials on appropriate post-harvest technologies; lack of information on local cost/benefits of best practices; lack of working equipment for local travel (e.g., bicycles, motorcycles) and lack of extension kits, field guides, etc.

Source: Compiled from secondary literature review, July, 2021

Assessment of Pre-harvest Losses Status in the Partner States

In the F&V subsector, Partner States across the region have not invested in substantive programs to monitor and systematically evaluate losses at the pre-harvest stage.¹⁴ In general, there are no adequate interventions focusing on cultivation, agricultural extension services and pest management systems. This has made it difficult to access secondary literature and reliable hard data on the magnitude of pre-harvest losses in some Partner States. In situations where this is the case, the information presented in this report will only cover results from stakeholder interviews. However, stakeholders throughout the region, admit the presence of significant pre-harvest losses in F&Vs subsector. They also acknowledge that Partner States have generally made some progress in achieving reduced food loss at pre-harvesting phase.

The Strategy

To counter the above challenges, the EAC Post-harvest Loss Management Strategy and Action Plan propose eight (8) strategies as follows:

1. Promote good production practices to address pre-harvest losses.
2. Strengthen R&D, innovation and technologies.
3. Strengthen market systems and infrastructure.
4. Improve safety and quality infrastructure.
5. Incorporate climate change management systems.
6. Build local skills and knowledge base.
7. Strengthen partnership, coordination, institutional and policy framework.

Implementation budget

The successful implementation of the PHLM Strategy and Action Plan for F&Vs subsector requires substantial financial resources, estimated at USD 33,830,000. It is expected that at the start of each phase, a detailed activity-based budget will be developed as part of the evaluation of the implementation progress of the plan.

Quick wins

To jumpstart the strategy, it is important for the EAC to implement a selective set of “quick-wins” activities, which are estimated to cost around USD 9,720,000 herewith attached as Annex and discussed in chapter 10.

¹³ Tanzania Horticulture Association (TAHA) 2019

¹⁴ Pre harvest losses in this report refers the losses occurring after crop maturity up to harvesting stage. The losses in some cases are referred as yield losses.



1. Introduction

This document presents a Revised Draft Report for the EAC Post-harvest Loss Management Strategy and Action Plan for the Fruits and Vegetables Value Chain. The assignment was undertaken as part of implementation of the recommendations of the 37th Extra Ordinary Sectoral Council on Trade, Industry, Finance and Investment (SCTIFI) meeting, during which the EAC Secretariat was directed to develop a regional F&V post-harvest loss management (PHLM) strategy for the sector.¹⁵

1.1 Assignment rationale

The intervention is proposed against the background that during the preparation of the EAC Fruits and Vegetables Value Chain Strategy and Action Plan 2021-2031, post-harvest losses (PHL) were identified as being a major critical factor impeding the competitiveness of the subsector. The intervention was also identified during the 1st EAC Regional Fruits and Vegetables Forum held from 18th to 19th December 2019. Following the adoption of the Strategy and Action Plan by the SCTIFI, the region has set a target to reduce post-harvest losses from 40% to 20% in the Fruits and Vegetables sector.

1.1 Inclusion of pre-harvest loss component

Studies and experience from the field have shown that prior to embarking into Post-harvest Loss Management (PHLM) Strategies, it is important to consider other primary factors which influence the post-harvest losses. These are generally termed as “pre-harvest” losses.

One of the crucial and significant factors for ensuring successful food production among smallholder farmers, are the pre-harvesting practices and procedures. Due to their impact on the amount of food loss and waste, pre-harvesting should be approached as the first step in post-production interventions and management systems. In actual sense, it is the last step in agronomy that ushers in food harvesting.¹⁶

The consideration above is premised on the fact that the final market value of F&V products and acceptance by the consumers depends upon the grower’s ability to apply best practice pre-harvest techniques.¹⁷ In reality, a lot of waste happens well before the F&V s are harvested from the field. Such waste needs to be addressed upfront due to their spill-over and trickle-down effects. In other words, successful post-harvest loss management interventions should start with pre-harvest loss management. Once pre-harvest losses are taken into account, it is then possible to propose a more holistic, inclusive and impactful PHLM Strategy.

Against this background, pre-harvest losses have been considered as part and parcel for developing the Post-Harvest Loss Management Strategy and Action Plan for the F&V value chain in the EAC.

16 The pre-harvest factors influencing post-harvest quality are frequency of irrigation, husbandry practices e.g. use of fertilizers, pest control, and growth regulators), climatic conditions (like wet and windy weather conditions), natural climate (such as hailing, high wind velocity, heavy rainfall), and tree conditions (age, training pruning, light penetration, etc.). All these factors influence the overall F&V quality and suitability for marketing

17 These are followed by harvesting and then applying best practice post-harvest handling practices.

15 June 2022; (EAC/ExSCTIFI/37/Directive 33)

2. PHLM - Key Concepts

This section presents an overview of the available body of knowledge on the concept of PHLM. It laid the foundation for the analytical agenda, which was used in developing the PHLM Strategy and Action Plan for F&V value chain in the EAC region.

2.1 Key definitions

The term “post-harvest loss”(PHL), refers to measurable quantitative and qualitative food loss in the post-harvest system. This system comprises interconnected activities from the time of harvest through crop processing, marketing and food preparation, to the final decision by the consumer to eat or discard the food.¹⁸

Food losses are defined as “the decrease in edible food mass throughout the part of the supply chain that specifically leads to edible food for human consumption¹⁹. Food losses take place at the production, harvesting, primary handling, aggregation, storage, transport, processing, distribution, and consumption segments.²⁰ Food losses occurring on the demand side of the food chain (retail and final consumption) are generally referred to as “food waste”, which relates to retailers’ and consumers’ behaviour.²¹

Post-harvest food loss refers to a decrease in quantity and/ or quality of food mass on the supply side of the food chain. It is defined as ‘measurable qualitative and quantitative food loss along the supply chain’. Consequently, post-harvest is not only multidimensional but multidisciplinary, involving the agriculture sector; agro-processing industry; health and nutrition sector; distribution and manufacturing sectors, among others.²²

Quantitative food loss refers to the decrease in edible food mass available for human consumption. Quantitative food loss is simply defined as the decrease in mass of food. In physical terms, this food removed from the post-harvest supply chain and not consumed due to, among other causes, spillage, consumption by pests and also due to physical changes in temperature, moisture content and chemical changes. The quantity lost would either have deteriorated, rendering it inedible, or be discarded for failure to meet regulated standards to eat as a food, or to use for any other purposes.²³

Qualitative food loss is when food loses its quality attributes, resulting in the deterioration of quality leading to a loss of economic, social and nutritional value. The qualitative loss can occur due to incidence of insect pests, mites, rodents and birds, or from handling, physical changes or chemical changes in fat, carbohydrates and protein, and by contamination of mycotoxins, pesticide residues, insect fragments, or excreta of rodents and birds and their dead bodies. When this qualitative deterioration makes food unfit for human consumption and is rejected, this contributes to food loss. In most cases, the quality deterioration goes along with a significant loss of nutritional value, which might affect the health and nutrition status of the whole community. Qualitative food loss is simply defined as the decrease of quality attributes of food.²⁴

18 Action Contre la Faim (ACF),2014

19 FAO (2011), Global Food Losses and Food Waste – Extent, Causes and Prevention. Rome, <http://www.fao.org/docrep/014/mb060e/mb060e.pdf>

20 FAO (2014), Global Initiative on Food Loss and Waste Reduction Definitional framework of food loss, Working Paper, 27 February 2014

21 In the FAO 2014 Definitional Framework of Food Loss working paper, ‘food loss’ is simply defined as the decrease in quantity or quality of food.

22 Aulakh et al, 2013, Post-harvest Losses of Agricultural Produce

23 FAO (1980), Assessment and Collection of Data on Post-harvest Good Grain Losses, FAO Economic and Social Development Paper 13. Rome. http://www.fao.org/fileadmin/templates/ess/ess_test_folder/World_Census_Agriculture/Publications/FAO_ESDP/ESDP_13_Assesment_and_collection_of_data_on_post-harvest_foodgrain_losses.pdf

24 -ibid-

In the context of the F&V Sector in the EAC region, the concept of post-harvest loss management therefore describes an integrated approach to dealing with post-harvest losses. As defined in some of the terms above, post-harvest loss management is about bringing together all possible forms of approaches across the entire value chain that together contribute to reduced levels of losses occurring during and post-harvesting of fruits and vegetables.

2.2 Principal causes of post-harvest losses and poor quality

The most common causes of post-harvest loss in developing countries, continues to be rough handling and inadequate cooling and temperature maintenance. The lack of sorting to eliminate defects before storage and the use of inadequate packaging materials further add to the problem. In general, minimizing rough handling, sorting to remove damaged and diseased produce and effective temperature management, will help considerably toward maintaining a quality product and reducing storage losses. Storage life will be enhanced if the temperature during the post-harvest period is kept as close to the optimum as feasible for a given commodity.

Table 1: Principal causes of PHL and poor quality of Fruits and vegetables

Group	Examples	Principal Causes of Post-harvest Losses and Poor Quality (in Order of Importance)
Root vegetables	Carrots, Beets, Onions, Garlic, Potato, Sweet Potato	Mechanical injuries, Improper curing, Sprouting and rooting, Water loss (shrivelling), Decay, Chilling injury (subtropical and tropical root crops)
Leafy vegetables	Lettuce, Chard, Spinach, Cabbage, Green onions	Water loss (wilting), Loss of green colour (yellowing), Mechanical injuries, relatively high respiration rates, Decay,
Flower vegetables	Artichokes, Broccoli, Cauliflower,	Mechanical injuries, Yellowing and other discolorations, Abscission of florets, Decay
Immature-fruit vegetables	Cucumbers, Squash, Eggplant, Peppers, Okra, Snap beans	Over-maturity at harvest, Water loss (shrivelling), Bruising and other mechanical injuries, Chilling injury, Decay
Mature-fruit vegetables and fruits	Tomato, Melons, Citrus, Bananas, Mangoes, Apples, Grapes, Stone fruits	Bruising, Over-ripeness and excessive softening at harvest, Water loss, Chilling injury (chilling sensitive fruits), Compositional changes, Decay, Pest and diseases damage.

Source: Small Scale Post-harvest Handling Practices: A Manual for Horticultural Crops (4th edition).

2.3 Relative perishability and storage life of fresh produce

Fresh horticultural crops are classified according to their relative perishability and potential storage life in air at near optimum temperature and relative humidity.

Table 2: Relative perishability and storage life of fresh horticulture produce

Relative Perishability	Potential Storage Life (Weeks)	Commodities
Very high	< 2	Apricot, blackberry, blueberry, cherry, fig, raspberry, strawberry; asparagus, bean sprouts, broccoli, cauliflower, green onion, leaf lettuce, mushroom, muskmelon, pea, spinach, sweet corn, tomato (ripe); most cut flowers and foliage; minimally processed fruits and vegetables.
High	2-4	Avocado, banana, grape (without SO ₂ treatment), guava, loquat, mandarin, mango, melons (honeydew, crenshaw, Persian), nectarine, papaya, peach, plum; artichoke, green beans, Brussels sprouts, cabbage, celery, eggplant, head lettuce, okra, pepper, summer squash, tomato (partially ripe).
Moderate	4- 8	Apple and pear (some cultivars), grape (SO ₂ -treated), orange, grapefruit, lime, kiwifruit, persimmon, pomegranate; table beet, carrot, radish, potato (immature).
Low	8-16	Apple and pear (some cultivars), lemon; potato (mature), dry onion, garlic, pumpkin, winter squash, sweet potato, taro, yam; bulbs and other propagules of ornamental plants.
Very low	>16	Tree nuts, dried fruits and vegetables

Source: Kader, A.A, 1993. Post-harvest Handling. In: Preece, J.E. and Read, P.E., The Biology of Horticulture- An Introductory Textbook. New York: John Wiley & Sons. pp. 353- 377



3. Background and context

3.1 The role of F&V sub-sector in the EAC

The F&V sector plays a significant role in the EAC economies. Due to its growing importance, the sector is of strategic importance to the socioeconomic development of region. The F&V sector represents 36 percent of GDP on average. The sector has enormous transformational potential and offers promising economic opportunities for reducing rural poverty in the EAC. The most direct contribution is through the generation of higher incomes for farmers. Studies have found that farmers engaging in F&Vs earn significantly higher incomes than farmers producing other products, because horticulture products are high value products.

The F&V sector is of prime interest to all EAC national governments, because it is a labour-intensive sector as compared to staple food production. The sector provides potential for addressing employment challenges, especially among youth and women. Significant employment opportunities are created through crop growth periods, (planting, weeding and harvesting), approximately twice the labour input per hectare of cereals and more off-farm jobs in processing, grading, packaging, delivery to exporters 'factories or collection centres and marketing. Most of the off-farm employment opportunities are accrued in the value-added processing activities up the value chain.²⁵ Additionally, as many of the F&V products are new to farmers, they have an opportunity to learn and upgrade their agricultural skills (such as, irrigation and farming methods), but also through technology transfer to the wider community, for example, on the construction of greenhouses, boreholes or irrigation systems.²⁶

The indigenous vegetables have been part of the food systems in the EAC for generations. They are the most affordable source of vitamins and minerals required for good health. The traditional fruits and vegetables found in many parts of East Africa have

significant medicinal and curative potential.²⁷ The F&V sector plays a significant role in promoting the EAC industrialization agenda. The processed fruits market in the EAC is among the most promising, with sector maturity still far off into the foreseeable future.²⁸

3.2 The Relevance of Post-harvest Loss Management

The relevance of post-harvest loss management (PHLM), stems from the fact that it is central to poverty reduction and improvement of livelihood through sustainable food security. Food supply chains are constrained by global population growth, hence a need for serious efforts to minimise food waste.²⁹ The issue of food loss is of great importance in the efforts to combat hunger, raise incomes and improve food security in the world's poorest countries. Food loss has an impact on food security for poor people, on food quality and safety, on economic development and on the environment.³⁰ All these challenges are also evident in the EAC.

Post-harvest losses in F&Vs challenge the lives of poor farmers in the EAC. High levels of losses contribute to childhood malnutrition and the chronic issue of vitamin deficiencies among poor households. In addition, women often receive low prices for the foods they produce, since marketing intermediaries know that what they purchase from growers will lose a lot of volume and value before they can be sold to consumers. Most small farmers must sell their F&Vs immediately after harvest, because they have no access to storage or processing option to extend shelf-life.

²⁷ Evidence Based Complementary and Alternative Medicine, Volume 2015 ID 807158

²⁸ EAC Industrialization Strategy (2012 – 2032)

²⁹ International Journal of Logistics Systems and Management, Vol. 27, No. 2, 2017

³⁰ FAO, Guidelines on the measurement of harvest and post-harvest losses

This means that they receive low prices, because their produce is often available at the same time as that of other local farmers producing the same crop, leading to gluts of certain types of fresh produce in the marketplace.³¹

Post-harvest losses minimize the opportunities for processing and value addition, which could subsequently promote backward linkages in the F&V sector. Currently, these linkages are lacking throughout the region. Increased investment in F&V processing could also promote vertical integration. Lack of vertical integration is a common feature in East African industries in almost all sectors. In the F&V sector, this feature is quite significant in almost all Partner States, due to the prevailing initial development process of industrializations in the region.³²

In summary, PHLM will ensure sustainable food security; promote productivity, value addition and agro-processing; increase cross-border trade and supply of agricultural commodities and ultimately enhance competitiveness of the F&V sub-sector.

3.3 Alignment with the existing EAC, continental and global policies and strategies

The proposed EAC Post-harvest Loss Management Strategy and Action Plan for the fruits and vegetables value chain, is aligned with the existing regional strategies and initiatives in the agriculture sector value chains. These are briefly highlighted below.

3.3.1 EAC Regional Food and Nutrition Security Strategy (FNSS) and Action Plan (FNSAP):

The Strategy and Action Plan seeks to contribute to the elimination of hunger, malnutrition, and extreme poverty in the East African region by the year 2024, and to strengthen resilience among households, communities and livelihood systems and uptake of disaster risk reduction with enhanced post-harvest value addition.

The FVPHLMSAP is well aligned with the FNSS/FNSAP in that it contributes to the attainment of its Objective 1: which focuses on improving sustainable and inclusive agricultural production, productivity and trade of crops. Sustainable production, productivity and trade can only be achieved if post-harvest loss is reduced. The Strategy and Action Plan will thus be of

³¹ USAID Horticulture Innovation Lab, Post-harvest Extension Pilot Project: Sub-Saharan Africa, 2014

³² Most of the factories are either established in order to substitute imports of processed fruit juice in order to increase value addition to raw materials without taking into account the inter dependence of various segments of the sector.

big value addition in promoting food and nutrition security.

3.3.2 EAC Industrialization Policy and Strategy 2012-2032

The overall objective of the EAC Industrialization Policy (2012-2032), is to enhance industrial production and productivity and to accelerate the structural transformation of economies of the EAC region through value addition, in order to enable sustainable wealth creation, improved incomes, and a higher standard of living for the Community.

The transformation of agriculture, and in particular the fruits and vegetables subsector, requires strategic efforts to minimising pre- and post-harvest losses. This will ensure the regional agro-processing industry is able to improve its supply capacity and consolidate the ability to create sustainable wealth to the value chain actors and improve their standards of living.

Reduction of post-harvest losses will also contribute to the achievement of the following key targets of the policy:

- Diversifying the manufacturing base and raising local value-added content of manufactured exports to at least 40% from the currently estimated value of 8.62% by 2032.
- Expanding trade in manufactured products by: (i) increasing share of manufactured exports to the region relative to imports from the current 5% to about 25%; and (ii) growing the share of manufactured exports relative to total merchandise export to 60% from an average of 20%. Transforming micro, small and medium enterprises (MISMEs) into viable and sustainable business entities capable of contributing at least 50% of manufacturing GDP from 20% base rate.

3.3.3 The 6th EAC Development Strategy

The overall Goal of the EAC 6th Development Strategy (2021/22– 2025/26), is "To Transform the East African Community into a Stable, Competitive and Sustainable Lower-middle Income Region by 2030". The overarching theme is "Building momentum towards post-COVID19 recovery and accelerating regional adaptation to the dynamic socio-economic environment".

²⁵ World Bank, 2008

²⁶ Ulrich, A. (2014). Export-Oriented Horticultural Production in Laikipia, Kenya: Assessing the Implications for Rural Livelihoods. Sustainability, issue 6(1), pp. 336-347



The F&V - PHLMSAP is strongly aligned with the 6th EAC Development Strategy in particular, the Key Priority Area 3: “Strengthening the productive and social sectors to improve production and productivity, increase value addition, and domesticate regional commitments to improve the welfare of East Africans”. The production, productivity and value addition parameters in this priority area requires targeted efforts in addressing post-harvest losses. Furthermore, the resilience of the sector and the promotion of food safety and security hinges on the ability to minimize the post-harvest losses.

The 6th EAC Development Strategy explores alternative new approaches to doing business at regional and global levels, including building local manufacturing capacities where potential exists to reduce logistics challenges, occasioned in part by COVID-19. In this regard, the F&V-PHLMSAP will foster the achievement of this objective through “targeted” and “strategic” interventions for building the manufacturing capacities during and after the pandemic. The interventions will be reoriented in line with potential effects of the pandemic, in order to ensure minimum interruptions in the supply capacity. Specific interventions will also be incorporated to spur investment and re-orient the economies back on their long-term growth path.

3.3.4 The Regional Agriculture Investment Plan (RAIP) 2017-2015

RAIP is a regional plan, which focuses on five thematic areas which expand on strategies for unlocking the growth potential of the region’s commodities and deepening intra-regional trade and competitiveness in the global markets.³³ One of the priority investment areas for RAIP is the reduction of post-harvest losses. The intervention is premised on the fact that poor post-harvest management compromises the quantity and quality standards of food, thereby reducing food availability and safety. One of the major interventions for reducing post-harvest losses under RAIP is “increased investment in new innovative technologies to reduce PHLs and increase value addition of agriculture commodities.”

At the continental and global level, the EAC Post-harvest Loss Management (PHLM) Strategy and Action Plan is aligned with:

3.3.5 Comprehensive Africa Agriculture Development Programme (CAADP)

The Comprehensive Africa Agriculture Development Programme (CAADP) is an ambitious and comprehensive agricultural reform effort initiative of the African Union (AU) and New Partnership for Africa’s Development (NEPAD). It represents a fundamental shift toward development, that is fully owned and led by African governments. It reflects African governments’ recognition of agriculture as being central to the alleviation of poverty and hunger and hence, for reaching the Millennium Development Goals (MDGs). CAADP focuses on improving food security, nutrition, and increasing incomes in Africa’s largely farming-based economies. It aims to achieve this by raising agricultural productivity and increasing public investment in agriculture.

3.3.6 UN Sustainable Development Goals (SDGs) - Goal Number 2: Zero Hunger

The SDGs aims to end all forms of hunger and malnutrition by 2030, making sure all people, especially children, have sufficient and nutritious food all year. This involves promoting sustainable agriculture, supporting small-scale farmers and equal access to land, technology and markets. It also requires international cooperation to ensure investment in infrastructure and technology to improve agricultural productivity.³⁴

4. The Approach

The methodology for conducting the assignment involved a combination of desk reviews and extensive stakeholder consultations. As part of the secondary literature review, efforts were made to collect relevant information at Partner States and regional level including: sector policies and strategies; existing studies conducted at national and regional levels, as well as other relevant industry document and literature.

Findings from the secondary literature review were complemented by international literature, in order to incorporate lessons learned from the international best practice. All information collected from secondary sources was synthesized and summarized in order to delineate their strategic implications to the assignment.

To complement the findings of literature review, key stakeholders were consulted with a view to assessing the dynamics on the ground, as well as validating some of the findings. This included information from Partner States and in-depth expert interviews. This information was collected by respective National Focal Persons through Structured Questionnaires Guide.

Information from field interviews and secondary literature was subsequently grouped together; synthesized and key findings clustered into their respective thematic areas. The information collected was used to prepare national reports, which were ultimately consolidated into the regional Post-harvest Loss Management Strategy and Action Plan for fruits and vegetables value chain.

To promote buy-in and ownership from the stakeholders, the Consultants facilitated relevant mandatory meetings at appropriate stages. These included: an inception meeting, national consultative meetings, and a regional validation meeting.

A team of consultants was mobilized, comprising of a Lead Consultant and the National Focal Persons (NFPs). The NFPs were selected from the Partner States’ Ministries responsible for Agriculture and EAC Affairs (MEACA). The Lead Consultant coordinated the assignment at regional level and maintained the overall technical management of the assignment. The general framework for the NFPs role was to own the process, coordinate and give technical assistance to the lead consultant on development issues being promoted in the F&V PHLM.

Throughout the assignment, the team worked closely with the Directorate of Productive Sectors and, more specifically, the Departments of Industrial Development and Agriculture, Food Security and Rural Development, which provided necessary technical guidance. The team ensured compliance with EAC procedures, i.e., by facilitating an inception meeting, national consultative meetings and a regional validation meeting. The Consultant reported to the Director of Productive Sectors through the Departments of Industrial Development and Agriculture, Food Security and Rural Development.

³³ These include catalytic investments aimed at increasing agricultural productivity, enhancing food utilization, promoting agribusiness, enhancing sustainable natural resource use and strengthening capacities of agricultural institutions.

³⁴ The Sustainable Development Goals are the blueprint to achieve a better and more sustainable future for all. They address the major global challenges including those related to poverty, inequality, climate change, environmental degradation, peace and justice. The Sustainable Development Goals (SDGs), also known as the Global Goals, were adopted by the United Nations in 2015 as a universal call to action to end poverty, protect the planet, and ensure that by 2030 all people enjoy peace and prosperity.



5. Situational Analysis of the PHL in the F&V Sub-Sector

5.1 Global and Sub-Saharan Africa

Food loss and waste is a global phenomenon and is not restricted to the African continent. Approximately one-third of the food produced in the world for human consumption gets wasted. Food losses and waste amount to roughly USD 680 billion in industrialized countries and USD 310 billion in developing countries. Total quantitative food loss in sub-Saharan Africa has been estimated at a 100 million metric tonnes per year.³⁵

A conservative estimate of PHL in tomatoes across SSA is around 10%, which translates to a value of approximately USD 20 million

A number of international studies have been conducted globally to measure the magnitude of Post-Harvest Losses (PHL). The resulting estimates for horticultural crops from these widely dispersed studies vary somewhat, and differ by region, country, crop and season. The most widely quoted PHL figure ranges between 30-50%.³⁶ Along with roots and tubers, fruits and vegetables have the highest wastage rates of all food products. Almost half (45%) of all fruits and vegetables produced globally are wasted.³⁷

While post-harvest losses for fruits and vegetable crops are reported to be 45% of the total global production by weight,³⁸ these losses have been measured in Sub-Saharan Africa (SSA) for many crops to be at even higher levels of 40% to 80%.³⁹ In addition to physical losses, problems with food quality, safety and nutritional value in SSA have been well documented in recent studies.⁴⁰ The table below presents the magnitude of PHL for F&Vs in selected developing countries.

Table 3: Post-harvest losses of fruits and vegetables in selected developing countries

Country	Commodity	PHL
Benin	Tomatoes	28% in volume; 40% in economic value in 5 days
Kenya	Banana (imported from Uganda)	18.2 –45.8%
	Dessert Banana	11.2% physical losses; 30-50% reduced market value
	Plantains	4.6% physical losses; 20-30% reduced market value
Niger	Dried onions and tomatoes	15% discarded; 65% sold with high levels of quality losses
Tanzania	Sweet potato	32.5-35.8%
Sri Lanka	Tomatoes	54% cumulative (measured at wholesale market)

Source: Post-harvest Education Foundation, White Paper 15-02, September 2015

³⁵ FAO, Global Food Losses and Food Waste – Extent, Causes and Prevention. Rome, 2011.

³⁶ This is the range quoted by most of the international development authorities (e.g. the UNFAO, the World Bank and USAID) and journal article authors.

³⁷ Post-Harvest Education Foundation; Measuring post-harvest losses of fresh fruits and vegetables in developing countries, 2015

³⁸ Lipinski, B.; Hanson, C.; Lomax, J.; Kitinoja, L.; Waite, R.; Searchinger, T. Creating a Sustainable Food Future—Reducing Food Loss and Waste; WRI Working Paper 39p; World Resources Institute: Washington, DC, USA, 2013

³⁹ Kitinoja, L.; Al Hassan, H.A. Identification of appropriate post-harvest technologies for improving market access and incomes for small horticultural farmers in Sub-Saharan Africa and South Asia. Part 1: Post-harvest losses and quality assessments. Acta Hort. 2012, 934, 31–40.

⁴⁰ USAID Horticulture Innovation Lab, Post-harvest Extension Pilot Project: Sub-Saharan Africa, 2014

Post-harvest losses differ by locations in the value chain as shown below:

Table 4: Estimated Post-harvest Losses (%) of Fresh Produce

Locations	Developed Countries		Developing Countries	
	Range	Mean	Range	Mean
From production to retail sites	2-23	12	5-50	22
At retail, foodservice, and consumer sites	5 - 30	20	2-20	10
Cumulative total	3.5-26.5	32	3.5-35	32

Source: USAID Horticulture Innovation Lab-Post-harvest Technology Center

The main factors that are most consistently related to higher levels of post-harvest losses include rough handling, use of poor-quality packages, high post-harvest handling temperatures and delays in marketing.⁴¹

5.2 Status of Post-Harvest Losses in the EAC Region

5.2.1 Overview

The F&V sector in the EAC is beset by significant levels of post-harvest losses. This makes it difficult for the region to maximise its potential in the sector. While considerable attention is directed toward increasing food production by 50–70%, one important and complementary factor that is often forgotten is reducing food loss and food waste.⁴² Depending on the situation, country and the crop in question, the post-harvest loss in the EAC region may reach 35-60%.

The PHLs in the EAC can be categorized into two (2) broad categories, i.e. quantitative and qualitative losses. Quantitative losses occur for many reasons, such as adverse weather, pests and disease, spillage, mechanical damage, limited storage capacity or poor handling. Qualitative losses occur when crops lose value because of decline in quality or condition as perceived/required by the buyer, nutrient content has been compromised and decay, contamination, or adulteration has made the product unfit for its intended use.

Understanding both quantitative and qualitative losses is important so that post-harvest technologies can be used to control PHLs. However, studies have shown that qualitative losses, such as loss in edibility, nutritional quality, caloric value, and consumer acceptability of the products, are much more difficult to assess than quantitative losses.⁴³ The specific causes of PHL vary widely, depending on crop type, region, culture, weather, technology and farmers' incomes.⁴⁴ Within the EAC, there are four (4) types of post-harvest losses as summarized below.

Table 5: Types of post-harvest losses in East Africa

Post-harvest loss	Underlying causes / manifestation
Biological	Pest and diseases
Chemical	Visible external contamination with pesticides and chemical products, toxics and unpleasant flavour produced by pathogens etc
Mechanical	Injuries, cuts, bruises, grazes, drops, scrapings, shatters during harvesting etc
Physical	Heating, cooling, freezing, water loss
Physiological	Sprouting, rooting, senescence and changes caused by transport and respiration

Source: Compiled from secondary literature review, July 2021

⁴¹ KITINOJA, L. and Cantwell, M. 2010. Identification of Appropriate Post-harvest Technologies for Improving Market Access and Incomes for Small Horticultural Farmers in Sub-Saharan Africa and South Asia, 2010

⁴² Hodges, Buzby, & Bennett, 2011: Unpacking Post-harvest Losses in Sub-Saharan Africa: A Meta-Analysis

⁴³ Kader, A.A. (2005) 'Increasing food availability by reducing post-harvest losses of fresh produce', Acta Hort., Vol. 682, Proc. 5th Int. Post-harvest Symp., pp.2168–2175

⁴⁴ US Department of State (2013) Post-harvest Loss Challenges, Discussion Paper, 2013

5.2.2 Critical post-harvest loss points in the F&V value chain

Over the years, research conducted in the EAC, have established and documented that post-harvest losses occur throughout the F&V value chain. The quantum differs by stage and by level of sophistication and efforts designed to reduce post-harvest losses. Figure 1 typically represents the stages through which losses can and do occur from production to consumption.

Figure 1: Post-harvest Losses throughout the F&V Value Chain



Key: BA=Biological Agents; HA=Harvesting; TR=Transportation; STO=Storage; PR=Processing; PM=Packaging and Marketing
Source: Compiled from secondary literature review, July 2021

In general, post-harvest losses in the sector are occasioned by: poor transportation systems – e.g., rural roads; poor means of harvest; poor market infrastructure - transport, packaging materials, storage, etc.); hygienic conditions of the local markets and poor sorting and grading. Depending on the situation and the crop in question, the post-harvest loss may reach 40—50%.⁴⁵In addition, there are specific challenges in each segment of the value chain as presented below.

Table 6: Specific value chain segment post-harvest loss challenges

Value chain segment	Specific challenges
Input suppliers	Lack of local availability of many of the most needed goods/supplies; and difficulties and high costs for importing needed post-harvest tools packages, goods, and supplies. The agro input shops rarely sell post-harvest-related goods. The import taxes and customs issues create disincentives for agri-businesses.
Farmers	Lack of technical know-how on handling practices that can reduce losses; lack of access to improved containers, post-harvest tools, education, credit; lack of market information; low prices during periods of high production and lack of knowledge about market options. Lack of proper storage facilities
Traders	High fuel prices and high transport costs (can limit market options), lack of access to cool storage facilities for temporary holding of unsold produce
Transporters	Huge, heavy containers; high fuel prices; poor feeder roads (contributing to vehicle and tire damage); lack of access to refrigerated vehicles; and lack of knowledge on best practices for loading/unloading vehicles
Marketers	Produce exposed to weather, sun, with subsequent high losses; lack of cool storage for unsold produce and lack of access to facilities, power, and equipment for temperature management
Extension services	high costs for travel, lack of proper accommodation; lack of suitable teaching materials on appropriate post-harvest technologies; lack of information on local cost/benefits of best practices; lack of working equipment for local travel (e.g., bicycles, motorcycles) and lack of extension kits, field guides, etc.

Source: Compiled from secondary literature review, July, 2021

5.2.3 Assessment of PHL Status in the Partner States

Post-harvest losses in F&Vs varies depending on crop. There are a limited number of studies on PHL in the EAC for horticultural crops in general. Nonetheless, few studies have been conducted across specific value chains. The percentages of losses differ in stages along the segments from production to market. The table below present average post-harvest losses for specific F&Vs at farm level.

Table 7: Post-harvest losses for specific F&Vs value chains in the EAC

Country	Value chain	PHL
Kenya	Mango	39-52%
	Cabbage,	4%
	Kale	9.70%
	Indigenous vegetables	10%
	Banana	4.50%
	Pawpaw	15.80%
	Watermelons	25-30%
Tanzania	Mangoes	43.8%,
	Oranges	50%
	Avocado – local varieties	41%
	Tomatoes	32%
	Water melon	60%
	Sweet pepper, carrots and onions	20%
	Cabbage	30%
Rwanda	Chili	42%
	Tomato	40%
	Orange Fleshed Sweet Potato (OFSP)	18%
	Green banana	30%
Uganda	Leafy vegetables- Nakati (Solanaceae spp), Amaranth, Cow peas, Cabbages	40-100%
	Tomato, Green Pepper, Egg plants Avocado	20-60%
	Passion fruits, Oranges, Pawpaw, Mango, Watermelon & Plantains	15-40%

⁴⁵ Tanzania Horticulture Association (TAHA) 2019

Country	Value chain	PHL
Burundi	Banana	40%
	Mango	60%
	Avocado	65%
	Citrus fruits	55%
	Watermelon	30%
	Pineapple, banana,	40%
	Mango	60%
	Avocado	65%
	Carrot	40%
	Leek	30%
	Cabbage	20%
	Sweet paper	25%
	Tomato	70%
	French beans	30%
Onion	35%	
South Sudan ⁴⁶	Melons	15-20%
	Dates	50%
	Potato	30%
	Assorted leafy vegetables	80-100%

Note: PHL figures are taken as average at farm level
Source: Authors compilation from various secondary sources and Field Interview Notes, July 2021

5.3 Assessment of Pre-harvest Losses Status in the Partner States

Caveat⁴⁶

In the F&V subsector, Partner States across the region have not invested in substantive programs that monitor and systematically evaluate losses at the pre-harvest stage.⁴⁷ In general, there are no adequate interventions focusing on cultivation, agricultural extension services and pest management systems. This has made it difficult to access secondary literature and reliable hard data on the magnitude of pre-harvest losses in some Partner States. In situations where this is the case, the information presented in this report will only cover results from stakeholder interviews. However, stakeholders throughout the region, admit the presence of significant pre-harvest losses in F&Vs subsector. They also acknowledge that Partner States have generally made some progress in achieving reduced food loss at pre-harvesting phase. The pre-harvest loss situation in individual Partner States is presented below.

⁴⁶ Source: Hind A. Elbashir and Mohamed A. Imam. 2010. Status Report on Fruits and Vegetables Production and Processing Industry in Sudan
⁴⁷ Pre harvest losses in this report refers the losses occurring after crop maturity up to harvesting stage. The losses in some cases are referred as yield losses.

5.3.1 Burundi

In Burundi, there are no quantities officially declared or found in the country's national statistics on pre-harvest losses for F&Vs, but figures can be estimated at between 60 and 80% of total production.

The main causes of pre-harvest losses are:

- Diseases and pests that attack plants, fruits and vegetables.
- Lack of irrigation system, bad quality of seeds, lack of technical services,...
- The need of quick money: producers are harvesting before commercial maturity.
- Ignorance of optimum harvest periods: In general, producers are not readily aware on optimum harvesting periods for key products such as cabbage, lettuce, and fruits that do not change colour when ripe, etc.
- Safety factors: Because of instability, there has been increasing incidences crop stealing almost everywhere in the country.
- Exposure to excessive sunlight leads to loss of all nutrients in general, and vitamins in particular.

Major challenges of addressing pre-harvest losses are lack of sufficient technical skill for treatment of diseases and pests, lack of adequate infrastructures and farmers' knowledge.

5.3.2 Kenya

According to stakeholders, the major causes of pre-harvest losses in fruits and vegetables are as follows:

- Weeds: they compete with crops plants for water, nutrients, space and light. They affect plant growth.
- Pests (insects, rodents & birds): cause injury to plants when they lay eggs into plant tissue. Heavy oviposition into stems can cause death or die back of stems or branches on the plant.
- Diseases: fungal, viral and bacterial disease affecting plant growth, leaves, flower and fruits.
- Poor quality of propagation from disease source and unhealthy plants

- Insufficient soil nutrients and moisture, fluctuating atmospheric temperature effects plant growth, flowering and fruiting.
- Inappropriate application of pest control products impacting the quality of produce

The stakeholder's perceptions are generally in line with available general literature. Studies have shown that pre-harvest loss may be due to infestations by insects, weeds and rusts. A number of agronomical factors also contribute to the losses. These include the choice of crop varieties for production, fertilization and/or nutrient management, water management, pest and disease management, drainage system, staking, transport preparations and bagging. Biological factors and environmental factors in the pre-harvest period can also lead to failure in attaining desirable quality during crop production, which may lead to a high percentage of food losses.⁴⁸

5.3.3 Rwanda

Time series data of pre-harvest losses for F&V in Rwanda were not available. However, all respondents interviewed, revealed that pre-harvest losses for F&V are huge. For example, pre-harvest losses in mango are high due to prevalence of fruit fly that lay eggs under mango fruit skin; the eggs are hatched into maggots that cause damage to the edible part (the flesh). The losses occasioned by this pest sometimes reach 100% in the absence of pheromone traps which are not easily obtained. Mango mealybugs, powdery mildew and anthracnose also occasion serious pre-harvest losses.

Yields for citrus and mangoes have reduced drastically compared to previous years, due to attack of pests and diseases. Major infestations are caused by: powdery mildew (on mango) mango mealybugs (on mango & citrus) and cescospora fruit and leaf spots (on citrus). Mango powdery mildew causes premature drop of flowers, which affects the ultimate number of fruits per tree. Mealybugs on mango and citrus trees have caused damage by sucking the plant and releasing a honeydew substance, which in turn, attracts saprophytic fungi (sooty mould) covering all plant parts and affecting plant photosynthetic capacity.

Due to high incidences of collar rot diseases, plants have been reported to collapse even before the fruits reach harvestable stage. There are also high

⁴⁸ The Effects of Pre-harvest Practices on Food Loss in Gucha Sub-County, Kisii County, Kenya; International Journal of Social Sciences and Management Research Vol. 3 No. 8 2017

incidences of pre-harvest losses in strawberry fields as a result of insects, birds and anthracnose diseases. The bravura varieties are particularly susceptible to anthracnose disease. Pests and diseases that occasion heavy pre-harvest losses are *Tuta absoluta* on tomato, false codling moth on peppers, mango fruit fly and powdery mildew, mango mealybugs on mango, citrus and goyava, thrips on avocado, tomato and banana, as well as sweet potato weevils among others.

In some areas (e.g., Rutsiro District), there are serious issues of wild animals, particularly Jackals, that come overnight and eat almost all ripe strawberry fruits, causing over 70 % of losses. High incidences or pre-harvest losses in Rwanda are also the result of climate change that have led to the emergence of new pests and diseases and even increase the virulence of pre-existing ones.

Other causes of pre-harvest losses in Rwanda are:

- Use of varieties that are susceptible to biotic (pests & diseases) & abiotic stresses.
- Poor irrigation/watering systems.
- Soil erosion.
- Mixed maturities at harvest time.
- Poor crop management (e.g. poor pruning etc).
- Delay in harvesting.
- Inappropriate use of pesticides.
- Dry season (climate change).
- Abnormal dropping of fruits.
- Lack of us for stakes by some farmers, causing plants to fall prematurely (e.g., bananas) falling of banana bunches.
- Farmers usually pick fruits (e.g., tomatoes) only when they are ripe, reducing their already short shelf-life.
- Poor quality seed and planting materials - some farmers use their own seeds saved for many generations.

5.3.4 South Sudan

- The magnitude of preharvest losses in F&Vs, in both Sudan and South Sudan, are generally huge ranging between 30%-40%. Poor preharvest practices have had negative impact on the national economy.⁴⁹ The main causes of pre-harvest losses in South Sudan are:
- *Cultural practices*: Farmers generally rely on their inherited traditional techniques and skills of cultivation and harvesting resulting into observed high pre-harvest losses and the subsequent losses in market value. For this reason, the overall quality and condition of fresh F&Vs cannot be improved after harvest. In addition, the final potential freshness and market value of F&Vs depends on field conditions and time of planting as well as the subsequent cultivating and harvesting practices. The prevailing culture practices do not provide sufficient scope for improvement in product quality and market value
- *Mechanical damage (physical injury)*: Careless handling of fresh fruits and vegetables, which is the common practice amongst the fruit and vegetable producers, causes internal bruising, physiological damage or splitting and skin breaks, all of which increase rapid water loss and the rate physiological breakdown. Skin breaks also provide sites for infection by disease organisms causing decay and un-estimated huge quantities of fruits and vegetables refuses.
- *Diseases and pests*: Fresh fruits and vegetables are prone to infestations by parasites or infection by diseases before (pre-harvest) or after harvest (post-harvest) damage. This is the major cause of losses which ultimately leads to poor marketability.
- *Physiological deterioration*: South Sudan is generally a high temperature country. Under high temperature, low atmospheric humidity and physical injury, the rate of loss of normal physiological changes in F&Vs increases. When fresh produce are subjected to extremes of temperature, atmospheric modification or of contamination; they develop unpalatable flavours and fail to ripen or cause changes in the living processes of the produce, making them unfit for use.

⁴⁹ HS, 2003. Annual report of Horticultural Sector, Ministry of Agriculture and Forests, Khartoum

- *Poor traditional methods and techniques of harvesting fruits and vegetables*: This is another major factor accounting for high levels of preharvest losses.

5.3.5 Tanzania

In Tanzania, as in many other countries, the rates of pre-harvest losses are relatively higher in high production season than in low season.⁵⁰ The largest amount of pre-harvest losses (yield losses) occur mostly after fruit maturity and ripening in fruity vegetables (e.g., tomato) and after maturity in fruits like pawpaw, oranges and avocado. The following are the main causes of pre harvest losses.

Insect pest and diseases at crop maturity stage: Insect pest damage and diseases, account for 45% of total loss in pre harvest loss. In oranges for example, fruit flies cause 50% of total loss and microbial spoilage cause 45%. In mandarin, fruit fly infestations are reported to cause as much 14.6% loss.⁵¹ Farmers interviewed reported that insect pest and disease causes up to 50% loss. Information on specific crops indicated that pre-harvest losses in tomatoes range from 20% to 40 % in Northern part of Tanzania (Moshi and Arusha). The loss could be even higher during new pest outbreak (*tuta absoluta*) famous as *Kantangaze*. The losses were reported to have reached up to 50% in 2019.^{52,53} It has been further reported that the extent of losses due to insect pests differs by region. For example, in the Coast region, fruit flies cause losses in mango up to 50%,⁵⁴ and watermelon 20%. In pawpaw mealy bug, millipedes, vermin (birds) and other pest cause loss up 40% of pre harvest losses.⁵⁵

Delayed harvesting: Studies conducted for mandarin in Tanga and Morogoro, indicated 43.8% fruit loss due to delayed harvesting.⁵⁶

Crop variety: Preharvest losses differ according to crop variety. For example, new avocado variety (Hass) has a long shelf life and hence low pre-harvest losses (less than 1%) while in the local varieties, the losses reach up 15%.

⁵⁰ The Ministry of Agriculture does not have official database which captures the magnitude of pre-harvest losses. The information presented is only captured from few technical studies on specific value chains; the experience of value chain actors and extension officers.

⁵¹ Msogoya et al: Assessment and management of post-harvest losses of fresh mango under small-scale business in Morogoro, Tanzania; Journal of Animal & Plant Sciences, 2011. Vol. 11, Issue 1: 1358-1363

⁵² Tanzania Smallholder Horticulture Empowerment and Promotion- (TANSHEP), 2019

⁵³ Field Survey, 2021

⁵⁴ Tanzania Mango Growers Association, Coast region, 2021

⁵⁵ Field Interview Notes, 2021

⁵⁶ Ng'atigwa et al: Empowering Youth to Reduce Horticulture Post-Harvest Losses in Tanzania, 2019

Lack of knowledge of good agriculture practices (GAP): Lack of knowledge in harvesting stage and harvesting method, causes significant losses mostly in fruits. For example, poor agronomic practices in onion, especially in local varieties, reduce bulb size quality by 15%.⁵⁷

Poor quality seeds: Use of poor-quality seeds, which are not resistant or tolerant to prevailing insect pest and diseases, leads to poor yield (pre-harvest losses)

Climate change - causes unpredictable weather and affect crop produce: Climate change affects production plan, leading to pre-harvest losses. For example, in 2020, onions in Uchira (Moshi area) were affected by unpredicted rain during harvesting, causing quality loss of about 40%, due to onion rot caused by wet weather.

5.3.6 Uganda

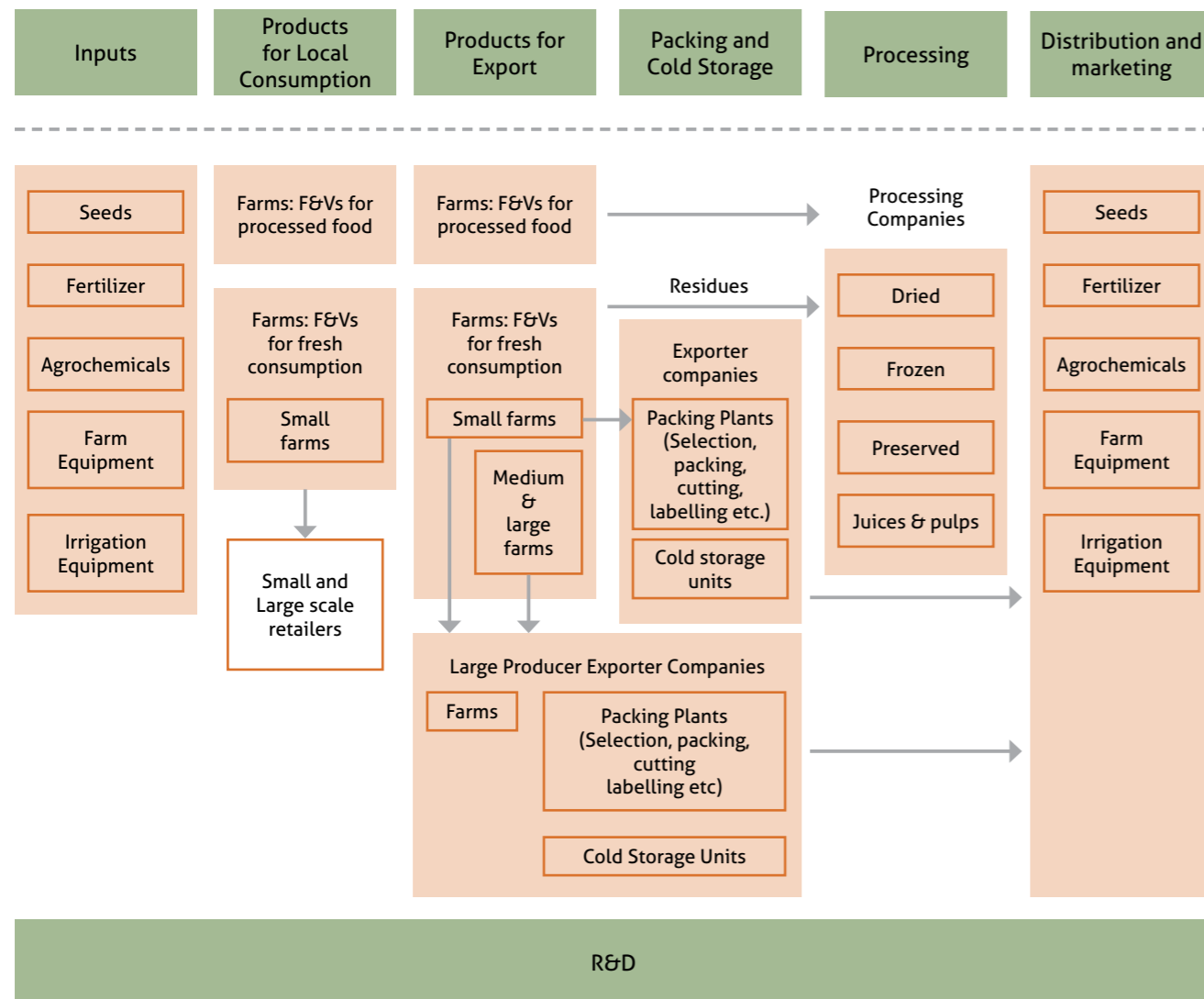
Results from field surveys show that pre-harvest losses account for 10% to 12% of total annual produce. The main causes of pre-harvest loss in Uganda are: pests and diseases; lack of good quality planting materials; poor agronomic practices; lack of enforcement of quality standards; weak sensitization on good agriculture practices (GAP); lack of established production and harvesting manuals and inadequate knowledge on pre-harvest qualities. Three major reasons account for the inability to address preharvest losses in Uganda namely: limited awareness on pre-harvest losses by farmers; lack of funds to secure appropriate tools to prevent pre-harvest losses and lack of quality standards to guide the pre-harvest processes.

⁵⁷ Tanzania Smallholder Horticulture Empowerment and Promotion- TANSHEP Field Expert Interview, 2021



6. Structure of the EAC Fruits and Vegetable Value Chain

The F&V Value Chain (CTA) can be grouped into six (6) general interlinked stages and / or segments as shown in the Figure below. The intermediary stages range from input suppliers at production stage to the distribution and marketing at the consumption stage. However, the complexity of the value chain differs between domestic trade and processed fruits and vegetables trade.



7. SWOT Analysis

In concluding the Situational Analysis for the Pre- and Post-Harvest Loss situation for the F&V sector in the EAC region, an attempt has been made to develop a SWOT analysis to provide a quick snapshot of the subsector in terms of its Strengths, Weaknesses, Opportunities and Threats. This has been reached through the examination of how the subsector operates and the associated dynamics in the context of the pre- and post-harvest loss management. The key assumption behind the analysis, is that both the internal factors (Strengths and Weaknesses) as well as external factors (Opportunities and Threats) in their totality, will have a bearing on the scope for achieving the intended objective of fostering the competitiveness of the East African F&V subsector. The analysis is presented below.

Table 8: SWOT Analysis for F&Vs Pre- and Post-Harvest Loss Management

Strengths	Weaknesses
Strong political will: Partner States have made commitments to reduce pre-and post-harvest losses as part of national development strategies and also achieve Sustainable Development Goals (SDGs)	Weak enforcement and implementation of existing policies and strategies
Priority sector status for most governments	Low budgetary support for addressing pre-and post-harvest losses at national level – including funding on research and extension
Existing national policies and strategies to support horticulture development	Lack of harmonized standards and certification standards
Ongoing capacity development efforts on PHL management through PPPs at national level	Weak extension systems
Availability of various alternatives for end-markets (domestic, cross-border, international) for fruits and vegetables reduce marketing risks	Lack of quality planting material and seed systems
Abundant availability of arable land suitable for F&V production	Weak capacity to implement and comply to standards
Suitable climatic conditions for continuous production	Poor market linkages, small market share, weak info systems, low level of service provision in the sector, large number of intermediaries along the chain
Existence of the technologies in the Partner States that can easily be adapted for addressing pre-and post-harvest losses	Limited availability of local expertise for commercial production of F&Vs - insufficient local skills and knowledge base



8. The EAC F&V Post-Harvest Loss Management Strategy

This section presents the EAC F&V Post-harvest Loss Management (PHLM) Strategy, building on the findings of the analysis on the global scene, the dynamics of the EAC region in general and individual Partner States in particular. The strategy document elaborates “strategic” and “targeted” interventions relevant to each stage of the value chain.⁵⁸ It is premised on the collective commitment of the EAC Partner States to fast track equitable and sustainable development of the region, or the benefit of the people of East Africa. Implementation of the Strategy holds the key to unlocking the region’s overall economic potential, through structural transformation and diversification of the regional economy and development of high potential industrial value chains.

8.1 The Vision, Mission, Objectives and Outcomes/Targets

8.1.1 The Vision

The Vision is “*To be a regionally and internationally competitive fruits and vegetable industry, sustainably contributing to the socio-economic development and transformation of the EAC region, through increased reduction of pre-and post-harvest losses.*”

8.1.2 The Mission

The Mission is “*To provide strategic and targeted investment along the EAC fruits and vegetable sector, capable of reducing the post-harvest losses from the current 40% to 20% by 2030.*”

8.1.3 The Overall Objective

The overall objective of the Strategy is “*to transform*

⁵⁸ Research conducted over the years have established and documented that post-harvest losses occur throughout the F&V value chain. There are specific challenges in each segment of the value chain. The quantum differs by stage and by level of sophistication and efforts designed to reduce post-harvest losses

and develop the EAC fruits and vegetable sector from the current nascent, domestic focused to a robust industry capable of exporting fresh and processed (value added) products of sufficient quantities and quality.”

8.2 Strategic Objectives

The Key Strategic Objectives for achieving the Vision, Mission and the Goal of the PHLM for the F&V subsector are summarized below.

- **Strategic Objective 1:** Promote good production practices to address pre-harvest losses.
- **Strategic Objective 2:** Strengthen R&D, innovation and technologies.
- **Strategic Objective 3:** Strengthen market systems and infrastructure.
- **Strategic Objective 4:** Improve safety and quality infrastructure.
- **Strategic Objective 5:** Incorporate climate change management systems.
- **Strategic Objective 6:** Build local skills and knowledge base.
- **Strategic Objective 7:** Strengthen the coordination, institutional and policy framework.

8.3 Good production practices to address pre-harvest losses

The first line of defence against post-harvest loss management, is the management of pre-harvest losses. One of the crucial and significant factors for ensuring a successful production, particularly among

Strengths	Weaknesses
Presence of national standards for fruits and vegetables	Low availability of supportive market and infrastructural facilities (store rooms, cooling houses, refrigerated trucks etc.) – leading to product deterioration
Short production cycles (for vegetables)	Limited compliance to market standards and requirements
Minimal entry barriers and business start-up procedures	Limited access to the information and data necessary for making informed decisions
Many support organizations active in the sector	Irregular supply of necessary inputs, lack of access to capital for investment
Availability of labour	Poor subsector coordination – e.g., inadequately developed linkages between R&D organizations and industry
Bilateral and multilateral trade agreements with key markets	International competition
Support from the Development partners at national level	Termination of preferential treatments
Growing interest of private sector investment in PHLM	Strong seasonal and annual price fluctuations for fruits and vegetables
Emerging and increasing private certification standards	Labour migration to urban areas seeking better employment opportunities
Increasing urban population and income levels and changing consumption patterns leading to increased local demand	Emerging new pests and diseases
Opening of global markets - new market destinations are emerging and expanding - leading to increased demand	Climate change
Availability of advanced processing facilities in some Partner States can easily absorb F&Vs produced in other countries	Declining soil fertility.
Established industrial base for production of supporting equipment, e.g., packaging industry	COVID-19 pandemic can significantly lower the demand for fruit & vegetables
Many F&Vs can be grown in the EAC region, offering vast potential for agro-processing activities	Absence of collaborative effort within the value chain

smallholder farmers, is pre-harvesting procedures. Pre-harvesting is considered the last step in agronomy that ushers in food harvesting, and should be approached as the first one in the post-production system, due to its impact on the amount of food loss and waste. In most rural areas of the world, little focus has been devoted towards understanding how household food-resource handling procedures contribute to incidences of food insecurity.⁵⁹In this regard, pre-harvest phase will help in understanding the level of preparedness of the F&V smallholder farmer in the next step, which is harvesting. If pre-harvesting is done well before the actual harvest, and farmers have knowledge on how to avoid pre-harvest losses, less F&V will be lost at harvest thus countering the severity of PHLs.

There are no wide coverage studies in the EAC, which have undertaken detailed analysis of the magnitudes of preharvest losses.⁶⁰The available information is limited to a few studies conducted in some Partner States, and the experience of actor's industry experts. For example, in Uganda, respondents estimated post-harvest losses in F&V to account for 10% to 12%, 23% up to 40% of total annual produce. In Tanzania, pre-harvest losses were reported to reach up to 35% in selected fruits and vegetables. The magnitude of pre-harvest losses in Sudan combined with South Sudan, are generally huge ranging between 30% - 40%. Other countries did not report the magnitude of pre-harvest losses.

In general, the main causes of pre-harvest losses in the EAC are poor planting materials, agronomic practices, pests, insects⁶¹ and diseases (e.g. fungal diseases), human and animal damage/contamination to both the soils and produce; use of inappropriate farm inputs, poor yielding seed varieties, climate and weather conditions, inappropriate use of pest control products, insufficient soil nutrients and moisture, fluctuating atmospheric temperature effects plant growth, flowering and fruiting and weeds.⁶²

Despite the lack of availability of data on pre-harvest losses, stakeholders interviewed in all partner States admitted that the losses are huge in different fruits and vegetables. This presents the case for intervention as presented below.

59 Peter Gutwa Oino et al, The Effects of Pre-harvest Practices on Food Loss in Gucha Sub-County, Kisii County, Kenya

60 This is proposed as one potential area of future research by the EAC Secretariat.

61 Pests and insects cause injury to plants when they lay eggs into plant tissue. Heavy oviposition into stems can cause death or dieback of stems or branches on the plant.

62 Weeds compete with crops plants for water, nutrients, space and light. They affect plant growth

8.3.1 Facilitate access to quality productive inputs

The program actively seeks to improve the accessibility, availability, and affordability of quality farm inputs across the EAC region. F&V production requires consistent access to quality inputs, (seeds, fertilizers, agrochemicals, and biological control agents).

The key actions for this program are outlined below:

(a) Facilitate the establishment of certified seed and planting materials nurseries: This action seeks to facilitate the establishment of "certified" nurseries, to ensure the availability of good quality seed and planting material in the EAC. Nurseries in the EAC will be supplied with disease free, high yielding seed and planting material cultivars that are demanded in the international market.

The existing public orchards within the Partner States, will be strengthened and maintained as sources of quality planting materials. Private nurseries supplying quality planting materials, should also be identified, promoted, guided, and regulated to ensure that farmers are receiving quality planting materials. Likewise, current seed sources and research efforts will be reoriented to suit the dynamic needs of the industry.

NB: Nurseries are certified by accredited bodies. For example, if a particular business entity wants to certify a seedling nursery with GLOBALG.A.P, it needs to find a company that is accredited by GLOBALG.A.P to audit the nursery. The same company will provide certification.

(b) Strengthen the extension services: The action seeks to improve yields of F&V in the EAC. The activity will ensure that producers apply Good Agronomic Practices (GAP) to minimize post-harvest losses and optimize output per unit area of land. The intervention is particularly relevant, given the small and fragmented nature of F&V production, where an average smallholder farmer owns less than two (2) acres of land. There should be a continuous capacity building, including exposure learning to Public and Private Sector Extension Agents, especially in the area of Good Agriculture Practices (GAP), Integrated Pest Management (IPM), Sanitary and Phytosanitary System (SPS) Inspectorate, etc. to cope with the industry dynamics. Options for the digitization of extension services should also be considered, with particular attention to options for reducing Preharvest losses.

8.3.2 Promote pesticide use compliance to international standards

This program activity seeks to incorporate new international regulations on pesticide use and ensure compliance at regional level. It specifically focuses on the use of radiation as part of measures to be added to ISPM 18 standards. The standard provides technical guidance on the specific procedures for the application of ionizing radiation as a phytosanitary treatment for regulated pests or articles.⁶³

The key action for this program is outlined below:

(c) Use of ionizing radiation (irradiation) for pest risk management: This action seeks to promote treatment of F&V s with ionizing radiation (irradiation⁶⁴), as a measure for pest risk management. It is premised on the growing commercial use of ionising radiation as a post-harvest phytosanitary measure to overcome trade restrictions on fresh food commodities globally.⁶⁵

In order to operationalise the initiative in the Partner States, National plant protection organizations (NPPOs) should be assured that the efficacy of the treatment is scientifically demonstrated for the regulated pest(s) of concern and the required response. Application of the treatment requires dosimetry and dose mapping to ensure that the treatment is effective in particular facilities and with specific commodity configurations. The NPPO will be responsible for ensuring that facilities are appropriately designed for phytosanitary treatments. Procedures should be in place to ensure that the treatment can be conducted properly and commodity lots are handled, stored and identified to ensure that phytosanitary security is maintained. Record-keeping by the treatment facility and documentation requirements for the facility and NPPO are required, and should include a compliance agreement between facility operator and the NPPO stipulating in particular, the specific requirements for phytosanitary measures.

8.3.3 Control transboundary pest and diseases

The spread of transboundary plant pests and diseases has increased dramatically in recent years. Globalization, trade and climate change, as well as reduced resilience in production systems due

63 This does not include treatments used for: - the production of sterile organisms for pest control - sanitary treatments (food safety and animal health) - the preservation or improvement of commodity quality (e.g., shelf-life extension), or - inducing mutagenesis.

64 Irradiation is a procedure that kills pests while leaving the fruit intact.

65 Food irradiation involves gamma, electron beam or X ray irradiation to doses of less than 1 kGy to prevent insects from being able to reproduce and establish in new areas. It is a chemical-free way of enabling trade that would otherwise be restricted due to risk-based pest controls on shipments such as fresh fruits and vegetables.

to decades of agricultural intensification, have all played a part. Transboundary plant pests and diseases can easily spread to several countries and reach epidemic proportions. Outbreaks and upsurges can cause huge losses to crops and pastures, threatening the livelihoods of vulnerable farmers and the food and nutrition security of millions at a time.

The key action for this program is shown below.

(d) Strengthen the system for forecasting and management of F&V pests and diseases: This action focuses on establishing a system for the forecasting and management of pests and diseases expected, especially pests of concern which may negatively affect trade and industry e.g. mealybugs (*predococcidae*), whitefly, *Tuta absoluta*, false codling moth (*Tiumatotibia leucotreta*) thrips, fruit fly among others. Part of the intervention is to develop appropriate control and mitigating measures

8.4 Promote Technology, Research and Innovation

This Strategy Objective seeks to promote low-cost PHLM research and technology solutions to the F&V subsector in the EAC region. The interventions presented, considers both large commercial operations as well as small-scale producers. This is to ensure a holistic approach. Large scale entities have a role to play, particularly in commercializing the sector and bring it to scale. They facilitate inclusion of international best practice in production, processing and quality control, packaging, transportation and delivery of products to the final consumers. These are all key requirements for reducing PHLs.

Research has shown that, while large scale operations may benefit from investing in costly handling machinery and high-tech post-harvest treatments, these options often may not be necessarily practical for small-scale handlers who comprise the majority of the value chain actors. Instead, simple, low-cost technologies often can be more appropriate for small volume, limited resource commercial operations, farmers involved in direct marketing, suppliers and exporters.⁶⁶ This situation is true for the fruits and vegetable subsector EAC region.

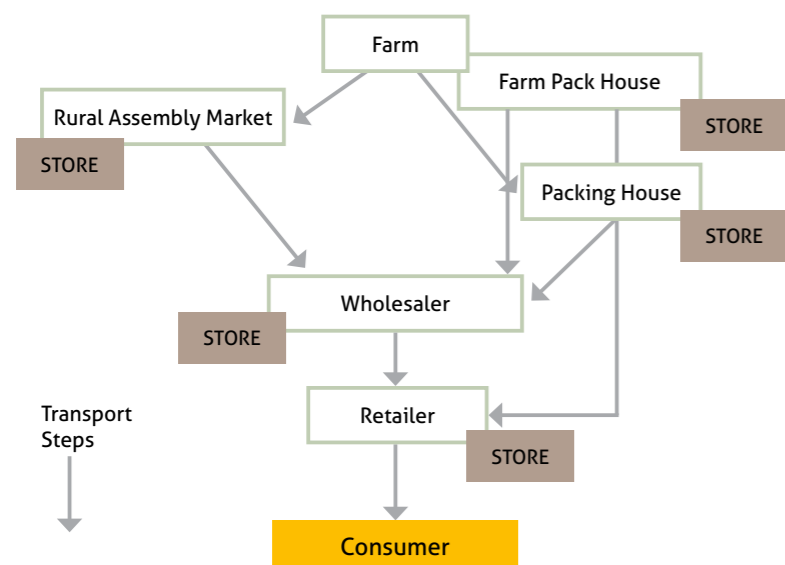
66 Post-harvest Horticulture Series No. 8E, Lisa Kitinoja et, al 2003

In view of above, the interventions presented provide room for “organic-graduation” from simple, small-scale technologies to sophisticated technology solutions, ideal for large and high-tech operations. The intervention is premised on the understanding that effective management during the post-harvest period is the key in reaching the desired objectives, rather than the level of sophistication of any given technology.⁶⁷

NB: It should be noted however that the proposed technology solutions are not “panaceas” for all the PHLM challenges across EAC Partner States. As such, interventions will need to be tailored to address the needs of individual countries.

There are several interacting steps involved in any post-harvest systems and the produce is often handed by different people and passes through different processes.⁶⁸ In order to optimize the impact of the proposed technological solutions, it is important to distinguish technologies relevant to each segment of the value chain.

Figure 2: Post-harvest handling steps for a typical F&V commodity



The interventions proposed below are organized in line with the interacting stages presented above.

8.4.1 Technology and innovation

8.4.1.1 Harvesting and preparation for market

Fruits and vegetable producers are faced with options to either harvest earlier, when vegetables are more delicate and valuable; harvest later, when fruits are at a riper, more flavourful stage; or harvest more often (taking advantage of multiple harvests to gather produce at its optimum stage of maturity). All these options can lead to higher profits, due to the higher value of the produce they have to offer for sale. The most important thing is to ensure none of these options expose the harvested produce to excessive levels of post-harvest losses. Producers across the region need some level of support to address this potential pitfall.

⁶⁷ There is a wide range of simple post-harvest technologies from which to choose. Many of these have the potential of meeting the special needs of small-scale food handlers and marketers. Many of the practices proposed here have successfully been used to reduce losses and maintain produce quality of horticultural crops in various parts of the world for many years.

⁶⁸ Such as picking, transportation and stored repeatedly between harvest and consumption

The key actions for this Program Activity are shown below:

(a) Use of maturity index to assess crop maturity: This action seeks to identify and develop maturity indices, relevant to the F&V subsector in the EAC. The indices are principles dictating at which stage of maturity a fruit or vegetable should be harvested. Producers across the region will be trained on how to use the indices in their local context. The indices should be calibrated to standard parameters such as: skin colour; optical methods⁶⁹, shape, size, aroma, fruit opening, leaf changes, abscission, firmness: etc. The intervention is premised on the fact that maturity indices are crucial to the subsequent storage and marketable life and quality of F&Vs.⁷⁰

(b) Conduct field packing (in-situ-packing): This action seeks to ensure that packing activities are conducted right at the farm level. It is premised on the fact that any practice that reduces the number of times the produce is handled will help reduce losses. Field packing (selection, sorting, trimming and packaging of produce at the time of harvest) can greatly reduce the number of handling steps the produce must undergo before marketing. To this end, simple technologies, such as small carts or small mobile field packing stations, can be designed to be moved along with the packers and to provide shade for packing operations.

(c) Measures to reduce mechanical damages: This action seeks to reduce mechanical damages during harvesting. In particular, harvesters will be equipped with requisite skills and “best-practices” for using maturity indices to guide their harvesting activities. Manual harvesters will be trained in the correct way to: harvest the crop to minimize damage and waste and recognize the proper maturity stage for the produce they are handling. Pickers will be trained on how to harvest with care, by snapping, cutting or pulling the fruit or vegetable from the plant in the least damaging manner.

There are a number of other best practices relevant to the F&V subsector in the EAC. For example, the tips of harvesting knives should be rounded to

⁶⁹ Light transmission properties can be used to measure the degree of maturity of fruits. These methods are based on the chlorophyll content of the fruit, which is reduced during maturation. The fruit is exposed to a bright light, which is then switched off so that the fruit is in total darkness. Next, a sensor measures the amount of light emitted from the fruit, which is proportional to its chlorophyll content and thus its maturity.

⁷⁰ Post-harvest physiologists distinguish three stages in the life span of fruits and vegetables: maturation, ripening, and senescence. Maturation is indicative of the fruit being ready for harvest. At this point, the edible part of the fruit or vegetable is fully developed in size, although it may not be ready for immediate consumption. Ripening follows or overlaps maturation, rendering the produce edible, as indicated by taste. Senescence is the last stage, characterized by natural degradation of the fruit or vegetable, as in loss of texture, flavor, etc. (senescence ends at the death of the tissue of the fruit).

minimize inadvertent gouges and excess damage to perennial plants. Knives and clippers should always be well sharpened. Pickers should empty their picking bags and/or baskets with care, never dumping or throwing produce into field containers. If harvesters pick directly into large bulk bins, produce can be protected from bruising by the use of adequately accelerating chute fashioned from canvas. Also, vented, stackable field containers should be kept clean and smooth. Other interventions include: use of field bins and shades; time of harvesting⁷¹; and produce handling during preparation to market.⁷²

(d) Apply international best practice harvesting practices and procedures: This action will focus on promoting best harvesting practices, with a view to causing as little mechanical damage to produce as possible. There are a number of international best practice harvesting procedures relevant to the F&V subsector in the EAC region. These include: gentle digging, picking and handling; picking carefully to avoid damage; grasping the product firmly but gently and pulling upward; wearing cotton gloves, and removing jewellery such as rings and bracelets. Other best practices include: use of appropriate harvesting containers, harvesting tools⁷³; and field curing systems. Harvesters across the EAC region will be trained on these “simple” but “fundamental” practices for reducing post-harvest losses in F&V subsector.

8.4.1.2 Packhouse operations

This Program Activity focuses on incorporating “targeted” post-harvest loss management practices across the packhouse operations. It is proposed against the backdrop that as the size and complexity of the packinghouse increases, more operations and workers need to be trained in specific tasks on post-harvest loss management.

The key actions for this Program Activity are outlined below:

(a) Apply appropriate dumping techniques: Actors will be trained on best practice for undertaking

⁷¹ For example, citrus fruits should not be harvested early in the morning when turgid because of their greater susceptibility to the release of essential oils from the flavedo oil glands that cause oil spotting (green spots on yellow and orange citrus fruits after de-greening)

⁷² For example, rough handling during preparation for market will increase bruising and mechanical damage and limit the benefits of cooling. Roads between the field and the packing house should be graded and free from large ruts, bumps and holes. Field boxes must be well-secured during transport and, if stacked, not overfilled. Transport speeds must be suited to the quality and conditions of the roads, and truck and/or trailer suspensions kept in good repair. Reduced tire air pressure on transport vehicles will reduce the amount of motion transmitted to the produce.

⁷³ For example, pruning shears that cut and hold onto the stem of the cut product allows the picker to harvest without a catching bag and without dropping fruits.

“dumping” i.e., the process of removing produce from the field bin or harvesting container and moved through the packinghouse. In principle, dumping must be done gently, whether using water assisted methods or dry dumping. Studies have shown that wet dumping can decrease bruising and abrasions by using moving, chlorinated (100-150ppm) water to carry delicate produce.⁷⁴ In the context of this action, specific emphasis will focus on processes that can reduce injuries to produce (e.g., dry dumping, padded, slope ramps or moving conveyor belts).

(b) Apply appropriate pre-sorting techniques: This action will focus on equipping actors with skills to undertake pre-sorting produce to eliminate injured, decayed, or otherwise defective produce (culls), before cooling or additional handling. Pre-sorting will save energy as culls will not be handled. Removing decaying produce items will limit the spread of infection to other units, especially if post-harvest pesticides are not being used.

(c) Apply appropriate cleaning techniques: Actors need skills specific for cleaning different produce. The choice of brushing and/or washing will depend up on both the type of commodity and the type of contamination.⁷⁵ This action will place specific emphasis on sanitation, which is essential both to control the spread of disease from one item to another, and to limit spore build-up in wash water or in the packinghouse air.

(d) Apply appropriate waxing techniques: Actors will be trained in the use of food grade waxes to replace some of the natural waxes removed in washing and cleaning operations. This can subsequently help reduce water loss during handling and marketing. Waxing of immature fruit and vegetables, such as cucumbers and summer squash; mature fruit vegetables such as eggplant, peppers and tomatoes; and fruits such as apples and peaches, is common. If produce is waxed, the wax coating must be allowed to dry thoroughly before further handling. These are simple but necessary procedures to reduce post-harvest losses.

(e) Apply appropriate sizing techniques: This action seeks to optimize opportunities for getting higher prices for selected size grades of F&Vs. In most low-input packinghouses, manual sizing is still commonly practiced. Warehouse operators in the EAC region will be trained in selecting the size desired and to either directly pack the items into containers or place the selected produce gently into

74 Lisa Kitinjoja et al, 2003

75 For example, in some commodities, such as kiwifruits and avocados, dry brushing may be sufficient to clean the produce. Other commodities, however, such as bananas and carrots, require washing.

a bin for packing further down the line. Sizing can be done subjectively (visually), with the use of standard size gauges. Examples of the smallest and largest acceptable sizes for each product can be placed within view of the operator for easy reference. Hand held sizers are used for a variety of products. Many products have established grades and standards in selected “premium” markets that can assist packers in sorting and sizing produce to address those markets.⁷⁶

(f) Deploy efficient packinghouse layout options: This action seeks to build the capacity of actors to deploy efficient packhouse layout options. It is premised on the fact that packing operations undertaken in an unsystematic manner can cause delays, add costs or affect produce quality. Operators in the EAC region can save time and money by laying out the packing shed in an organized, step-by-step system.

(g) Choice of packing and packaging materials: Actors will be trained on the choice of proper packing materials relevant to their local circumstances. Specific information regarding the characteristics of different kinds of ingredients used to make packing materials will be provided as part of the program.⁷⁷ In addition, the training will include the types of typical mechanical damage and their effect on packaging containers such as: impact damage through dropping, compression damage through high stacking; vibration; snagging, tearing, tear strength and hook damage. Other areas of coverage include factors to consider in choosing a container type. In view of the fact that choosing a container can often be a complex decision, actors will be helped to analyse the trade-offs to consider with respect to price, durability, reusability and protection.

8.4.1.3 Decay and insect control

This program activity focuses on various methods of treating produce to control insects or decay-causing organisms. There are a number of reasons why it is important to manage produce decay and insect control. For example, while high humidity in the storage environment is important for maintenance of high-quality produce, any free water on the surface of commodities can enhance germination and

76 Several types of mechanical sizers are available for small scale operations. One type is composed of a long-slanted tray with a series of openings which converge (largest at the top, smallest at the bottom). This type of sizer works best with round commodities. Other sizers are designed as conveyors fitted with chain or plastic belts with various sized openings, and are useful for sizing most commodities. Another simple method for mechanical sizing is to use a set of diverging bar rollers where the smallest sized produce falls through the rollers first to assorting belt or bin, and larger sized produce falls between successively more divergent rollers.

77 For the case of sacks, characteristics to be considered include: tearing and snagging, impact, protection against moisture absorption, insect invasion and contamination

penetration by pathogens. When cold commodities are removed from storage and left at higher ambient temperatures, moisture from the surrounding warm air condenses on the colder product’s surfaces causing pathogen infestation.

The key actions for this Program Activity are outlined below:

(a) Put in place appropriate chemical controls: Actors will be exposed to the use of different chemicals to prevent produce decay. These include: washing produce with chlorinated water⁷⁸, hypochlorite solution, sulphur dioxide⁷⁹; sodium or potassium bisulphite;⁸⁰ bicarbonate salts⁸¹; lime powder and fungicides.⁸²

(b) Use of cold treatments to control produce deterioration: This action seeks to impart actors with requisite knowledge for using cold treatments in controlling produce deterioration. Research has shown that certain fungi and bacteria are susceptible to cold in their germination phase, and infections can be reduced by treating produce with a few days of storage at the coldest temperature the commodity can withstand, without incurring damage. Cold treatments can also serve to control some insect pests, and are currently allowed for the control of fruit flies, the false codling moth, melon fly, and pecan weevil and lychee fruit borer.⁸³

(c) Use of heat treatments: Actors will be trained in the use of hot water dips or heated air for direct control of post-harvest insects. Brief hot water dips or forced-air heating can be effective for disease control, especially for reducing the microbial load for crops such as plums, peaches, papaya, cantaloupe and stone fruits⁸⁴ sweet potatoes and tomatoes.⁸⁵

78 Washing produce with chlorinated water can prevent decay caused by bacteria, mould and yeasts on the surface of produce. Calcium hypochlorite (powder) and sodium hypochlorite (liquid) are inexpensive and widely available.

79 SO₂ is used as a fumigant (with a 10-ppm residue tolerance) on grapes to control *Botrytis*, *Rhizopus* and *Aspergillus* fungi

80 Bisulfites are usually contained within a paper or plastic pad that can be placed inside a carton to release SO₂ for control of molds on grapes during transportation and storage.

81 Bicarbonate salts for prevention of post-harvest decay have been used on fresh peppers, melons, potatoes, carrots and citrus fruits. These salts are very inexpensive, safe to use, readily available and accepted as “certified organic” and “chemical free” for marketing purposes.

82 When fruit is packed for export, fungicides are often applied to meet the requirements of international quality standards and to reduce deterioration during transport

83 Mitcham, E.J., S. Zhou and A.A. Kader. 1997. Potential for CA for post-harvest insect control in fresh horticultural perishables: an update of summary tables compiled by Keand Kader, 1992. pp. 78-90 In: Thompson, J.F. and Mitcham, E.J. (eds) *CA'97 Proceedings Volume 1: CA Technology and Disinfestation Studies*. Department of Pomology Post-harvest Hort Series No. 15.

84 Shewfelt, R.L. 1990. Quality of Fruits and Vegetables. A Scientific Status Summary by the Institute of Food Technologists' Expert Panel on Food Safety and Nutrition. Institute of Food Technologists, 221 North LaSalle Street, Chicago, Illinois 60601.

85 Barkai-Golan, R. and Phillips, D.J. 1991. Post-harvest treatments of fresh fruits and vegetables for decay control. *Plant Disease* (Nov): 1085-1089.

(d) Biological control and plant growth regulators: This action focuses on promoting an integrated pest management system as a complementary tool (to chemical and/or heat treatments) for the management of post-harvest decays. Specific attention will be placed in the identification of commercially available biological control materials and plant growth regulators (PGR) registered as post-harvest treatments relevant to the context of the EAC region.

8.4.1.4 Temperature and humidity control

This program activity seeks to train actors on simple practices useful for cooling and enhancing storage systems. It is premised on the fact that throughout the period between harvest and consumption, temperature control has been found to be the most important factor in maintaining product quality. A key aspect to consider when handling F&Vs is the relative humidity of the storage environment. Loss of water from produce is often associated with a loss of quality, as visual changes such as wilting or shrivelling and textural changes can take place.

Key actions for this Program Activity are summarized below.

(a) Use of room cooling options: Room cooling is a relatively low cost, but very slow method of cooling when electricity for mechanical refrigeration is available. When using room cooling, produce is simply loaded into a cold room, and cold air is allowed to circulate among the cartons, sacks, bins or bulk load. This cooling method is best suited to less perishable commodities, such as potatoes, onions, apples, sweet potatoes and citrus fruits, since more highly perishable crops will deteriorate too much before being adequately cooled. Research has shown that room cooling may be all that is needed to handle chilling sensitive crops which need to be cooled from early morning harvest temperatures to storage temperatures of 10 to 13 °C (50-55 °F). The design and operation of cold rooms are fairly simple and no special equipment is required.

(b) Use of forced-air cooling techniques: Forced-air cooling pulls or pushes air through the storage containers themselves, greatly speeding the cooling rate of any type of produce. Many types of forced-air-coolers can be designed to move cold moist air over the commodities. These include: portable forced-air coolers, cold wall, and cold wall forced-air coolers.

(c) Use of hydro-cooling techniques: This provides fast, uniform cooling for some commodities, particularly those which are tolerant of wetting. The simplest version of a hydro-cooler is a tank of cold

water in which produce is immersed. Others include: hydro-cooling shower and batch-type hydro-cooler.

(d) Apply evaporative cooling mechanisms: These packinghouses are made from natural materials that can be moistened with water. Evaporative coolers can be constructed to cool the air in an entire storage structure, or just a few containers of produce.⁸⁶ Water is collected in a tray at the base of the unit and recirculated. An evaporative cooler can be combined with a forced air cooler for small lots of produce. Air is cooled by passing through the wet pad before it passes through the packages and around the produce. The air can be cooled to within a few degrees of the wet bulb temperature of ambient air.

8.4.1.5 Storage of F&Vs

This Program Activity focuses on temperature management during storage. A number of capacity building actions for value chain actors will be implemented as follows:

(a) Construct appropriate storage buildings: Type and construction of building has an important bearing on temperature management during storage. Research has shown that constructing square rather than rectangular buildings can support temperature management. Rectangular buildings have more wall area per square feet of storage space, so more heat is conducted across the walls, making them more expensive to cool. Temperature management can also be aided by shading buildings, painting storehouses white to help reflect the sun's rays, or by using sprinkler systems on the roof of a building for evaporative cooling.⁸⁷ Actors will also be trained on the construction of low-cost cold rooms, using concrete for floors and polyurethane foam as insulation materials.

(b) Apply storage temperature principles: There is a recommended storage temperature for different F&Vs. Actor will be aided to develop an understanding of how this principle applies to the individual crops of their own contexts.

(c) Apply appropriate storage practices: This action will impart knowledge on routine inspection of stored produce and cleaning storage structures on a regular basis, to reduce losses by minimizing the build-up of pests and discouraging the spread of diseases. Storage facilities should be protected from rodents by keeping the immediate area clean, free from trash and weeds. Rat guards can be made

from simple materials such as old tin cans or pieces of sheet metal fashioned to fit the extended legs of storage structures. If desired, more elaborate technologies can be used, depending on the circumstances of individual Partner States. Concrete floors will help prevent rodent entry, as will screens on windows, vents and drains.⁸⁸

(d) Use of appropriate ventilation methods and tools in storage facilities: Storage facilities require adequate ventilation in order to help extend shelf life and maintain produce quality. Actors will be trained on how to use the three types of fans found in common use, namely centrifugal, axial flow, and propeller/expeller. The training will also include the type of ventilation and insulation required in storage structures and how these could be improved to suit the dynamics of specific locations.⁸⁹

8.4.1.6 Transportation of F&Vs

This program Activity will focus on temperature management during long distance transport, to avoid damage to produce. In order to achieve this objective, value chain actors will be provided with knowledge on the following areas.

(a) Use of appropriate transportation systems: Standard practice recommends simple but effective transportation systems. In general, bulk loads of produce should be carefully loaded to avoid causing mechanical damage. Vehicles can be padded or lined with a thick layer of straw. Woven mats or sacks can be used in the beds of small vehicles. Other loads should not be placed on top of the bulk commodity. An open-air vehicle can be loaded in such a way that air can pass through the load, and provide some cooling of the produce as the vehicle moves. Actors will also be trained on how to handle cartons of various sizes when loaded together on a vehicle.

8.4.1.7 Handling at destination

This Program Activity will expose the actors to techniques for handling produce at their destinations. The overall objective is to avoid rough handling, minimize the number of handling steps, and maintain the lowest feasible temperature. If produce is to be stored before sale, then wholesale and retail markets need clean, well-insulated storage rooms.

Key actions for this Program Activity are summarized below.

(a) Apply appropriate unloading techniques: This action focuses on the techniques to ease the work associated with handling produce at destination. Specific emphasis will be placed on how to transfer containers more rapidly and with less bending and lifting. Appropriate devices for easing the work of unloading transport vehicles will also be considered depending on particular circumstances.⁹⁰

(b) Hold produce at temporary storage temperatures: Actors will be trained on how to hold the produce at destination for a short time before marketing. The objective is to ensure that the handler is able to help maintain quality and reduce losses by storing commodities at their most suitable temperatures. Methods relevant for specific produce will be explored.

(b) Apply appropriate sorting/repacking techniques: Some produce may require washing, trimming, bunching or sorting at the wholesale or retail market level. The actors will be trained on how to organize the layout of the work station used for handling produce at destination, to minimize non-productive movements. Also, the actors e.g., wholesalers and retailers, will be trained on how some produce may have to be repacked due to changes in quality or uneven ripening.

(c) Apply proper display techniques: Actors will be trained on appropriate methods of displaying their produce at the marketing level. For example, use of wooden display tables designed to be used for commodities such as cruciferous crops or leafy green vegetables that tolerate cooling with ice and how to insulate the display trays to minimize ice needs. Other necessary display skills include: (i) the use single or double layers of produce to protect the commodities from compression damage and over-handling by the consumers; (ii) maintaining high relative humidity during display by misting leafy vegetables and water tolerant crops with clean, cold water; (iii) cleaning and sanitizing displays and storage areas; and (iv) how to trim wasted and bruised product remaining in displays - these can be a source of decay, odour and ethylene.

8.4.1.8 Processing of F&Vs

This Program Activity will focus on different methods of processing F&Vs, particularly when conditions are

not suitable for storage or immediate marketing of fresh Produce. This necessitates using simple technologies to process the produce. It is important to note that post-harvest handling, transport and marketing of processed products can be much simpler and less costly than for fresh products, since refrigeration is unnecessary. Dried products take up much less space than their fresh equivalents, further reducing transport and storage costs.

Key actions for this Program Activity are summarized below.

(a) Utilise different options for processing equipment: Actors will have the opportunity to view to different catalogues of post-harvest processing equipment, available locally or within the EAC region and beyond. These include: driers, storage containers, cleaners, hand mills, power mills, shellers, decorticators (seed removers), oil processing equipment, fruit presses, and root crop cutters/graters.

(b) Specific preparation for processing: Some produce requires blanching before freezing or drying. Blanching by boiling water bath or in steam, ends certain enzymatic reactions in the product and helps retain colour and flavour after processing. Actors will be trained on different methods for blanching, depending on their particular circumstances. This includes blanching times for different commodities. Some fruit commodities such as apples, pears, peaches and apricots are sometimes treated with sulphur being dried. Other commodities can be solar dried while others require forced-air dehydrators, oil-burning dehydrators, electric dehydrators, oven drying, canning, juicing, freezing, acidification, and fermentation. Actors will be given access to different methods of processing, depending on which is suitable for their particular circumstances.

8.4.2 PHLM Research

This Program Activity seeks to strengthen the Research and Development (R&D) institutions to address issues related to PHLM in the region. Research work has developed a multitude of technologies and methods used to reduce post-harvest losses in the region. However, some are inefficient/ineffective in curbing the losses. In some cases, technologies, which are potentially effective, are constrained by high prices of spare parts and limited knowledge in adapting their adaptation. Furthermore, information on particular technologies and methods are scattered and/or unknown outside the group/ cohort of users. It is therefore, important that effort is made to increase the "utility" of research on PHLM across the EAC region.

⁸⁶ These coolers are best suited to lower humidity regions, since the degree of cooling is limited to 1 to 2 C (2 to 4 F) above the wet bulb temperature.

⁸⁷ Kader, AA (ed). 2002. Post-harvest Technology of Horticultural Crops (3rd Edition). UC Publication 3311. University of California, Division of Agriculture and Natural Resources, Oakland, California 94608. 535 pp

⁸⁸ FAO. 1985. Prevention of Post-Harvest Food Losses: A Training Manual. Rome: UNFAO. 120 pp.

⁸⁹ Any type of building or facility used for storage of horticultural crops should be insulated for maximum effectiveness. A well-insulated refrigerated building will require less electricity to keep produce cool.

⁹⁰ For example, a simple set of stairs can be constructed to ease the work of loading and unloading produce. Using a ramp is a simple and safe method for unloading produce. The ramp should be wide enough to prevent accidents and strong enough to carry the full weight of the handler plus the package she/he is carrying. Providing hand-trucks or small carts can also ease the work associated with unloading.

Against this background, the following actions are proposed:

(a) Support R&D Institutions in the F&V sub-sector: This Action will build the capacity of R&D institutions to incorporate PLHM issues in a wider research agenda. More specifically, the intervention will help researchers to come up with “practical” solutions, which could help the EAC region to produce globally competitive F&V products through efficient production, processing, and marketing processes.

(b) Establish PHLM research database: It is important for research information to be assembled into a single database, to enable ease of access for users in their quest to promote practical solutions to PHLM. This action seeks to take stock of available/existing technologies as well as new ones coming into the market, test their efficacy and disseminate the successful ones to producers, processors, relevant actors along the respective value chain. This will require establishment of database management system on PHM in the region, conduct research to introduce new and innovative technologies, as well as undertaking verification exercise of existing technologies on PHLM.

(c) Use R&D to increase the commercialization rate of processed F&V products: Research and development efforts can play a big role in this area, through building the in-house capacity to support end-to-end PHLM product development and commercialization, through strong partnerships with other institutions and service providers to address both the technical and commercial needs of the industry.

(d) Commercialize appropriate PHLM innovations into business opportunities: This action can be achieved through the promotion of initiatives aimed at developing vibrant industry “clusters”⁹¹ where the targeted PHLM products and technologies can be quickly converted into business opportunities and utilized by the targeted clientele and/or markets. This proposal is based on the fact that the utility of innovative products for managing post-harvest losses depends on the degree to which the innovations are converted to business opportunities and, in particular, their ability to attract a critical mass of consumers, both in the local and international markets. This also includes premium consumers in the niche markets.

⁹¹ Clusters are geographic concentrations of interconnected companies, specialized suppliers, service providers, and associated institutions in a particular field that are present in a nation or region. In other words, a cluster is a system of interconnection between private and public sector entities. It usually comprises a group of companies, suppliers, service providers, and associated institutions in a particular field, linked by externalities and complementarities. Clustering is internationally recognized as the best way to pro-actively address sector development and stimulate economic development.

(e) Enhance technology transfer: Scientific and technological developments on PHLM will be made accessible to a wider range of users, who can then further develop and exploit the technology into new products, processes, applications, materials, or services. Technology transfer will: increase access to information on new technologies and innovations in the industry; increase the linkage between these institutions and industry; establish long-term mutually beneficial partnerships, and contribute to increased human resource skills base for industry development in the region.⁹²

To achieve the objectives of investing in PHLM product development, partnerships between R&D selected institutions and related service providers needs to be engaged: The partnerships should involve the following actors: major Industrial Research Institute in each EAC Partner State; academic institutions with a strong history and reputation for supporting agro-food industry development; government agencies from each Partner State, involved in product and technology development and/or IP registration; specialized BDS providers with interest and capacity to support entrepreneurs in the commercialization of agro-processing business ventures; selected commodity-specific business associations and/or multi-stakeholder platforms.

Given the fact that research in technology development is a support function, investments in enhancing the contribution of these institutions must leverage investments by the private sector and other partners, especially those seeking to increase access to regional and international markets, where value-added products can find an outlet and have a stronger imperative to compete.

(f) Establish PHLM regional technology and innovation laboratories that meets international standards: The laboratories will offer key diagnostic services in the region, including plant health diagnosis, soil, and water testing, etc. The intervention will reduce the cost of accessing these services where samples are sent to other countries for testing and diagnosis. In this way, services will be more available to small-scale farmers. Options for upgrading some existing laboratories to internationally accredited status will also be explored.

⁹² Technology transfer (TT) refers to the process of conveying results stemming from scientific and technological research to the market place and to wider society, along with associated skills and procedures, and is as such an intrinsic part of the technological innovation process.

8.4.3 Use of technology, innovation and creativity to attract youth in PHLM

This program activity seeks to address the fundamental challenge of promoting youth-based horticulture enterprises in the EAC. It is based on fact that the agriculture sector in general, is not perceived to be “attractive” to the youth. The emerging F&V subsector sector will not be able to meet its potential for growth if it cannot increase its productivity and create opportunities for young people to integrate into existing initiatives. To address this situation, the project will roll out ‘strategic’ and ‘targeted’ efforts within the horticulture sector to make it attractive to the youth. Against this background, the following action will be undertaken:

(a) Promote application of ICT solutions in F&Vs: The rapid development of Information Communication Technology (ICT) has exposed rural youth to a fast moving world, even those who wish to engage in horticulture would want to practice modern systems that use more technical skills and less energy to produce. The development of telecommunication sector has, over a short period of time, changed every aspect of young people’s lives, even in rural areas of the Partner States. For example, the mobile financing service is widely used by young people in rural and urban areas. They can track and transmit important information for sector.

There are several other ICT applications relevant to the F&V sub-sector for example:

- The collection and compilation of geo spatial data for use in addressing PHLs.
- Mapping out the various actors in the value chain and develop individual profiles which can subsequently be used as basis for accessing essential services such as bank loans, insurance service etc.
- Call centres for provision of “real” time PHLM information between local actors and big global actors.
- ICT mechanisms for stock tracking in the input distribution systems.

The above models are the kind of innovations youth would like to see applied in the F&V sub-sector for them to practice as an exciting and potential career (job), to make living even in rural areas. Against this background, the Strategy should continuously consider scope to embed ICT based PHLM interventions, which can attract more youth in the sector, but most importantly, provide a reliable

source of revenue. The intervention will ultimately become a “game changer” in the industry, because the youth population will become “future” actors in the value chain, hence contribution to the sustainability of key interventions being proposed under the Strategy. In summary, the youth population will take the PHLM interventions to the next frontier. Youth based interventions can also focus on providing PHLM technical assistance, business development skills and services in specialized crops like flowers, spices (e.g., chillies, vanilla, ginger) and processed fruits (e.g., mangoes, pineapples etc) in adding value addition to these crops.

8.5 Strengthen Markets and Market infrastructure

This Strategic Objective focuses on facilitating more market outlets. Essentially, this implies addressing the “demand side” of the various F&V products produced in the EAC. In particular, it focuses on expanding the market share of these products at local, regional, and international markets. The interventions proposed under this Strategic Objective, will promote business-to-business relationships between producers and consumers. It will ensure that products reach the markets in a timely and consistent manner. The Strategic Objective is proposed in line with the assumption that if large volumes of produce is offloaded in various markets, (local and exports), there will be less incidence of post-harvest losses. At the moment, less than 20% of F&Vs produced in the EAC are exported. The rest are consumed locally, and the bulk of them end up rotting in the field.

The following program activities are proposed:

8.5.1 Promote market linkages

Market linkages refer to the establishment of business-to-business relationships between producers and consumers. The objective of this program activity is to link farmers and off-takers dealing with various F&V products in the EAC with reliable and premium markets. It seeks to ensure that products reach the markets in a timely and consistent manner. A major assumption is that the linkages will ultimately reduce the incidence of post-harvest loss, occasioned by the inability of farmers to offload products to the market

The key areas of focus for this program activity are presented below:

(a) Promote contract farming model: Research has shown that contract farming in SSA increases farmers’ income and reduces post-harvest losses, especially

when applied to the value chains of high-value, high-margin crops including fruits and vegetables.⁹³ These value chains offer good incentives for the significant capital investment required by off-takers. The large agricultural businesses engaged in contract farming, typically operate collection centres for the organized aggregation of produce, and ensure appropriate handling, storage, and transportation practices, as they must adhere to strict process and product quality requirements imposed by their buyers. Most of the time, these types of arrangements are for crops destined for the export market such as F&Vs. Reproducing this model for domestic markets could decrease PHL, while potentially improving the income of farmers and increasing availability of nutritious food for domestic consumers.

Essentially, contract farming seeks to link smallholder farmers to large commercial entities. This initiative will address the current challenge of inadequate linkages between the small-scale production sector and those of large commercial activities. It is also expected to address the problem of “informality” characterized by the existence of relatively small formal marketing channels in parallel to a large informal one. The initiative will allow the majority of small-scale farmers to connect to the regional and international markets and therefore increase their chances to conduct export business themselves. It is an important step towards reducing post-harvest losses.

(b) Establish terminal wholesale markets: The initiative involves the creation of an alternative marketing structure, through the establishment of terminal wholesale market that operates parallel to, and in addition to, the present system of a multitude of wholesale markets common in the EAC. At present, the F&V supply chain has multi-layered marketing channels and lacks market infrastructure. The intervention will provide essential infrastructural services, including product distribution; cold storage; grading, sorting, adequate quantity, and quality products; and proper integration of post-harvest technology into marketing supply chain. These embedded services have a great potential to reduce post-harvest losses.

The facilities will also introduce a transparent and efficient platform for the sale and purchase of products, by connecting growers through Growers’ Associations, with farmers and wholesale buyers in various markets across the EAC. They will also provide incentives for improved quality and productivity, thereby improving farmers’ income. Through this approach, an increased integration is expected

between growers, wholesalers, and retailers into the market system.

A single gateway to the markets will save time and improve efficiency. Vertical coordination of farmers through cooperatives, contract farming, and retail chains, would facilitate better delivery of output, reduce market risks, provide better infrastructure, attract more public investment, acquire better extension services, and would create awareness regarding prevailing and new technologies. Its multiplier effect would help in increasing income, output, and employment. The terminal market will also have an auction facility through clock auction; backward linkage through farmer associations; and forward linkage in the form of cash and carry semi-wholesale and retail stores.

(c) Promote digital marketing: Market linkages can be promoted through the establishment of “digital marketing platforms”. This proposal is based on the fact that in the current digital age, developing know-like-and-trust relationships with clients, is more likely than ever to happen online. A healthy website, with a strong social media presence, is a dynamic way of promoting market linkages. A user-friendly and technically sound website helps attract more potential clients. This business model can make a significant difference in reducing post-harvest losses, due to its ability to link produce to markets in a speedy manner. Many clients and prospective customers have already seen the positive impact an effective Internet plan can bring to other industries, particularly those which target mass consumers e.g., food distribution systems. This can also be replicated in the F&V sector.

(d) Promote cross-border trade: This action is premised on the fact that farmers can use cross border trade as a way to take advantage of seasonal fluctuations in the supply and demand of F&Vs in different Partner States. There are a number of incidences where there are surplus F&Vs in one country and deficits in another country. If the surplus produce cannot be offloaded in other countries with deficits, then products end up deteriorating.

There are significant opportunities for cross-border trade in the F&V value chain. This is particularly the case for small-scale producers, who at the moment, struggle to sell high-value highly perishable products as soon as they are harvested. It has been observed across the region, that the tendency for localization of markets for perishable products, such as fruits and vegetables, is a common phenomenon. Currently, prospects of increasing regional trade in commercially produced fruits and vegetables are only limited to large-scale commercial producers.

This intervention, therefore, seeks to empower small-scale farmers to participate in the regional markets.

There is already a window of opportunity within the region, that can be used as a “springboard” to promote cross-border trade in F&V’s. In particular, the recently established One-Stop Border Post (OSBP) within the EAC Partner States is likely to improve formal cross-border EAC trade for F&V products. There are already ongoing efforts to promote free trade in general and significant efforts have been made by the EAC to guide the rules and regulations for conducting cross-border trade. The formalization and customization of the rules and regulations, in the context of the fruits and vegetable trade, is now required.

Smallholder producers and traders will need to be empowered to participate in the trade. Specifically, for the F&V sector, there is a need for a comprehensive information pack (Simplified Guide/Tool), that can provide up-to-date and relevant information on the existing policies, procedures, requirements, rules of origin, taxes, tariffs, exemptions, and facilities available to cross-border traders, such that they can more easily trade within the region. This guide should provide information on key EAC trade rules, regulations and procedures, related to trade within the EAC (intra-EAC trade), in a simplified and user-friendly manner, as well as relevant government institutions.

8.5.2 Strengthen market information system

This Program Activity seeks to ensure that information reaches a critical mass of actors within the F&V value chain for timely decision-making. It is proposed, against the background that the lack of market research results and information is a major problem facing the augmentation of marketing efficiency in the East African F&V sector and hence high incidences of post-harvest losses. Below are the actions for this program activity.

(a) Improve PHLM market intelligence and dissemination across the whole value chain: This intervention seeks to build the capacity of value chain actors⁹⁴, in undertaking value chain studies and market research. It is based on the fact that data collection and analysis are crucial to building an accessible pool of knowledge for the F&V sector. To increase its utility, the information has to be made “user friendly” and readily available by more traditional means, as well as electronically. This sharing of information will include promotional campaigns, both at international and domestic levels.

⁹⁴ Key target actors are Government ministry officials, producer and processor associations, industry experts and advisors.

(b) Develop a standard methodology for collecting data and estimating PHL in the EAC: There has been various research conducted on PHLs across the EAC region. The available data is shown to vary, depending to the nature of the crop commodity and the stages of the value chain. Researchers use different methods to assess levels of PHLs and there is no common agreed methodology of post-harvest loss assessment. There is a need to harmonise the methodologies to optimise the “utility” of the research information across the region.

8.5.3 Improve logistical infrastructure

Improvement of the logistical infrastructure in the EAC region, not only ensures the lowering of costs of doing business, but also promotes regional trade competitiveness and integration. Accelerated access to growth markets for F&Vs is a key driver of investment in the horticulture industry. Increased access to growth markets has huge potential for reducing post-harvest losses.

The actions proposed to improve the logistical infrastructure are outlined below:

(a) Strengthen post handling systems in the transport infrastructure: Railways, posts, airfreight services to cater to the needs of perishable F&Vs: For example, cold storage facilities, cold rooms for transit goods, and “green” belts to fast-track clearance at the ports, will ensure quick transit time (speed to market); safe products, and adequate volumes at destination points. The shorter the transit time, the lower the incidence of post-harvest losses.

(b) Improve transport and communication infrastructure in the major EPZs and production corridors: The production corridors will provide a critical mass of products, hence enabling EAC to deliver increased quantities of F&V in the export markets and ultimately reduce post-harvest losses. Improved communication systems in these corridors will lower the cost of delivering the goods to the destination markets

(c) Establish service-oriented collection centres/satellite collection centres and packhouses: This intervention seeks to build a supply sub-sector, that will guarantee a consistent and continuous supply of fresh F&Vs. The intervention will ultimately increase scope for reducing post-harvest losses. The main services provided by the centres, will include information dissemination cooling, grading, and sorting. Capital services, such as pick-up and delivery, will also be provided.⁹⁵ The latter

⁹⁵ Information on: price, quantities needed, quality, transport availability. These can be provided through mobile phones;

⁹³ Deloitte & Touche, Reducing Food Loss Along African Agricultural Value Chains, 2015

would enable farmers to meet customers' quality requirements and allow appropriate planning for planting. The grading services will create and enforce strict quality standards on all produce agreed to with the buyers. Finance and admin support services will also be offered.

The centres will also provide a series of "embedded" services to value chain operators. These will come on stream after the pilot service centres have consolidated the core portfolio/primary functions. The expanded services could include marketing of produce; training for farmers on quality and management; information collection and dissemination; finance/credit lines and collateral provision; common sourcing of supplies; bulk buying of inputs; seeds and packaging and engaging technical (national/regional/international) consultants in the field of growing and post-harvest handling. The longer-term functions may include: Increase overall volume and integrate independent farmers, empower farmer community bargaining skills, maximize efficiency by working together and sourcing commonly, share market and buyer demand information, encourage first stage food processing, etc.

The proposed centres will be run on a commercial basis to ensure sustainability. Ideally, the centres should be managed by farmer associations and/or a private sector operator.

8.5.4 Support creation of a critical mass of off-takers

The F&V sector currently has few off-takers, hence the bulk of produce is left in the field to deteriorate. Not many actors in the private sector have been attracted to: engaging in the purchase of products from the production areas; transportation services, packaging, processor, or marketing activities. The sector has suffered from a lack of service providers and/or actors across the entire value chain spectrum. This challenge has had a cumulative effect on increasing post-harvest losses.

The following action is proposed:

(a) Integrated solutions to attract off-takers: The initiative involves a series of interrelated interventions in the value chain. These include mapping out and identification of the most potential crop varieties (industry priority crops) with the highest potential in the market. In order for them to be engaged, off-takers need to be assured of adequate production and productivity of potential crops in any given area. These can be marketed and branded to attract more players in the industry, particularly the private sector. The branding efforts

should target all stages of the value chain (i.e., from production, transportation, processing, packaging, and marketing). Other interventions may include:

- Improving the certification infrastructure through selecting and appointing qualified local certification agents. Fast-tracking the certification system will eventually attract more players in the sector.
- Contract farming models can also be used as a way of attracting off-takers, because of the assured volume of supply.
- Fast-tracking input registration systems to ensure more players are attracted to the industry.
- Development of central collection centres, and or satellite collection centres.
- Statistical modelling used to project yields and expected value of market

8.6 Improve Food Safety and Quality Infrastructure

This Strategy Objective focuses on addressing numerous concerns about food safety when handling fresh F&Vs witnessed in recent years. For example, recent outbreaks of food-borne disease have been associated with berries, tomatoes, leafy greens and cut fruits. Wholesale buyers and consumers across the world, are increasingly interested in the use of handling practices that will ensure food safety.

Assuring food safety throughout the post-harvest handling chain, is critical to successful marketing of produce, particularly to the export market. Food safety for F&Vs demands special attention, since they are often consumed raw or with minimal preparation and there are no effective intervention strategies that can completely eliminate food safety risks of uncooked produce.⁹⁶ Retailers, such as large supermarket chains, are demanding compliance with food safety practices from their suppliers. Today, it is almost impossible to export produce to Europe or the U.S. without documenting its safe handling from the farm to the market.

The guiding principle for addressing this challenge, is to prevent contamination of fresh produce with human pathogens, dangerous levels of chemical residues, or physical contaminants. Prevention is much more reliable and less expensive than interceding with corrective action once contamination

⁹⁶ Bracket 1999; Kitinoja and Gorny 1999

has occurred.⁹⁷ Common-sense practices during production, harvesting, packaging and marketing provide the best prevention measures. These post-harvest practices combine to provide layers of protection at successive steps in the handling system and any breaches in their application can lead to cross-contamination, resulting in an unsafe produce. The EAC needs to be cognizant of these, in order to optimize opportunities in the destination markets.

Against this background, the following interrelated program activities proposed:

8.6.1 Food safety at farm level

This Program Activity seeks to address challenges related to produce contamination at farm level. F&Vs have a high susceptibility to contamination by infected fieldworkers, use of contaminated irrigation water, contact with contaminated soil, use of inadequately composted manure, or careless harvest and/or post-harvest handling.

Key actions for this Program Activity are summarized below:

(a) Apply appropriate practices to ensure clean soil: F&V producers will be trained on a number of important topics such as: avoiding the improper use of manure; treatment of compost manure to kill pathogens; strategies for keeping keep domestic and wild animals out of fields to reduce the risk of faecal contamination; preventing run-off or drift from animal operations from entering produce fields; and the proper timing of harvest after manure application.

(b) Apply appropriate practices to promote water sanitation/clear water: Producers will be trained on: (i) how to test surface water used for irrigation, for faecal pathogens on a regular basis, especially if water passes close to a sewage treatment or livestock area; (ii) keeping livestock away from the active recharge area for well-water that will be used for irrigation; (iii) keeping chemicals away from the active recharge area for well-water that will be used for irrigation; (iv) filtering or use settling ponds to improve water quality; (iv) where feasible, use of drip irrigation to reduce crop wetting and minimize risks; and, (v) use potable water for making up chemical pest management sprays.

(a) Maintaining clean surfaces: This action relates to the tools and containers used in the field. Producers will be trained on how to keep them clean at all times. This includes washing and sanitizing these items before each use.

⁹⁷ US Food and Drug Administration, 1988,

(b) Promote hand sanitization practices: Workers harvesting produce in the field, will be trained on appropriate methods of keeping their hands clean when handling produce. Specific emphasis will be placed on the importance washing hands after using the toilet, using soaps, clean water and single-use towels in the field.

8.6.2 Food safety at harvest

This Program Activity focuses on minimizing pathogen contamination during harvest. It is premised on the fact that during harvesting operations, field personnel may contaminate fresh F&V by simply touching them with an unclean hand or knife blade.

Key actions for this Program Activity are summarized below:

(a) Establish hand wash stations: Field practitioners will be trained on establishing hand wash stations for use by all harvest crew members. Monitoring and enforcement of field worker personnel hygiene practices, such as washing hands after using the latrine, should be mandatory to reduce the risk of human pathogen contamination. Workers who are ill, or who have symptoms of nausea, vomiting or diarrhoea, should not be assigned to harvest fresh produce.

(b) Use of field tools and containers: This action focuses on procedures for cleaning field harvesting tools. Specific emphasis will be put on ensuring that they are not placed directly in contact with soil. Other interventions will seek to ensure that field containers should be cleaned and sanitized on a regular basis, as well as being free of contaminants such as mud, industrial lubricants, metal fasteners or splinters. Workers should not be allowed to stand in field bins during harvest to reduce pathogen spread by shoes.

(c) Use of containers: Field workers should be trained on the correct use of plastic field bins instead of wooden containers, since plastic surfaces are easier to clean and sanitize, which should be done after every use. The main assumption is that if containers are not cleaned and sanitized after every use, they may become contaminated and then contaminate the next products which are placed in the container. Actors should be made aware that wooden containers are almost impossible to sanitize, since they have a porous surface and wooden or metals fasteners, such as nails from wooden containers, may accidentally be introduced into produce. Cardboard field bins, if reused, should be visually inspected for cleanliness and lined with a polymeric plastic bag before

reuse, to prevent the risk of cross contamination. All these are simple fundamentals which should be communicated to actors.

Depending upon the commodity, actors should be trained on how produce may be field packaged in containers that will go all the way to the destination market, or be temporarily placed in bulk bins, baskets or bags, which will be transported to a packing shed. Emphasis should be made that people, equipment, cold storage facilities, packaging materials and any water which will be contacting the harvested produce, must be kept clean and sanitary to prevent contamination.

8.6.3 Food safety at post-harvest

This Program Activity seeks to institute measures to minimize pathogen contamination during post-harvest handling. It addresses issues related to personal hygiene, equipment, and packaging materials.

Key actions for this Program Activity are summarized below:

(a) Promote employee hygiene: This action focuses on maintaining the cleanliness of employees handling produce at all stages. The objective is to ensure that production and handling must be managed to minimize the risk of contamination. Adequate bathroom facilities and handwash stations must be provided and used properly, to prevent contamination of produce by packinghouse employees. Shoe or boot cleaning stations may also be in place, to reduce the amount of field dirt and contamination which enters the packing shed from field operations. Employee training regarding sanitary food handling practices should be done when an employee is hired and reviewed before they begin work each season.

(b) Apply best practice for care of equipment: Value chain actors will be trained in appropriate methods for cleaning and sanitizing food contact surfaces on conveyor belts, dump tanks etc. on a regular scheduled basis, with food contact surface approved cleaning compounds.⁹⁸ For example, best practice requires that sanitizers should be used only after thorough cleaning with abrasion to remove organic materials such as dirt or plant materials. Use of steam to clean equipment should be avoided, since steam may actually cake organic materials and form a biofilm, which renders equipment almost impossible to sanitize. Steam may also aerosolize bacteria into the air and actually spread contamination throughout

the packing house facility.⁹⁹ These are the kinds of hands-on skills that this action will seek to equip the actors with.

(c) Apply best practices for handling packaging materials: This action focuses on equipping the actors with skills to make packaging materials out of food contact grade materials, to assure that toxic compounds in the packaging materials do not leach out of the package and into the produce. Toxic chemical residues may be present in some packaging materials due to use of recycled base materials. Empty packages, such as boxes and plastic bags, should be stored in an enclosed storage area to protect them from insects, rodents, dust, dirt and other potential sources of contamination. These actions protect, not only against the potential loss of valuable materials, but also the integrity and safety of these materials.

(d) Promote use of refrigerated Transport: Produce is best shipped in temperature controlled refrigerated trucks. Actors will be shown techniques to pre-cool the vehicles prior to loading. Also ensuring they understand the fact that perishables maintained below 5°C (41° F), even while being transported to destination markets, will extend shelf-life and significantly reduce the growth rate of microbes, including human pathogens. Temperatures used for transporting chilled sensitive produce will not protect against the growth of most pathogens. Trucks used during transportation, should be cleaned and sanitized on a regular basis. Trucks which have been used to transport live animals, animal products or toxic materials, should never be used to transport produce. These are examples of practical skills which will be imparted to actors for the purposes of promoting food safety at post-harvest level.

(e) Sanitizing field containers, tools and packhouse surfaces: Actors will be trained on different methods for sanitizing all crop containers tools and packhouse surfaces, prior to each day's harvest. The emphasis is to ensure that sanitizers are used only after thorough cleaning with abrasion to remove organic materials such as dirt or plant materials. Selection of the sanitizer to use, depends upon the surface to be cleaned, hardness of the water, application equipment available, effectiveness under ambient conditions and cost. All require extreme care when handled as either compressed gas, powders, or concentrated liquids. Standard tables should be used to assist in the selection of appropriate sanitizers for particular operations.

⁹⁹ Gorny, J.R. Small-Scale Post-harvest Technology: Economic Opportunities, Quality and Food Safety. Post-harvest Horticulture Series No.21, Department of Pomology, University of California, Davis

8.6.4 Traceability

The ability to identify the source of any fresh produce product is an essential part of managing post-harvest losses. This is especially important whenever several growers are contributing to a single load, or when produce is being exported by one grower from several different fields.

This Program activity will focus on the following actions:

- Develop procedures to track produce from the farm to the packer, distributor and retailer.
- Documentation to indicate the source of the product (farm identification and the field where it was produced), the date of harvest, and who handled the produce.

NB: Growers, packers and shippers should partner with transporters, distributors and retailers to develop management tools to facilitate the trace back process.

8.6.5 Capacity to conform to trade related policies on safety and quality

This Program Activity seeks to move the EAC region forward, with respect to removing technical barriers to trade (TBT) for greater intra and inter-regional trade and investments. It is based on the assumption that conformity to the international trade standards will promote more exports and hence reduce post-harvest losses.

Most of the outstanding challenges revolve around: farmer's knowledge of market standards and how to interpret them; enterprises knowledge on trade policy requirements and how to interpret them into actions; adequate availability of accredited laboratories and certification bodies for F&Vs; as well as developing appropriate institutional mechanisms and frameworks to oversee the implementation of various safety and quality requirements.

The following actions are proposed:

(a) Build the capacity of farmers and enterprises to comply with international standards and market requirements: There are a number of market standards, which govern the international trade in food products. A clear understanding of these standards will allow producers of F&V to participate in the international markets. In particular, exporting enterprises have to meet buyer and/or market requirements based on internationally accepted

good practices and/or standards, where they have to: (i) manage food safety (based on guidelines and standards like GAP GHP, GMP, HACCP, ISO 22,000, and other Private Standards); (ii) Manage quality (based on standards like ISO 9001 Quality Management System); (iii) manage environmental impact (based on standards like ISO 14001) and (iv) meet social accountability requirements (SA 8000, Fairtrade), and more recently resource sustainability requirements e.g. Carbon Labelling.

In order to overcome barriers to trade, F&V enterprises must, not only comply with standards, but also technical regulations¹⁰⁰ and conformity assessment procedures and certification mechanisms throughout the supply chain, in order to protect consumers, producers, and the environment.

(b) Harmonize the technical requirements across the region, and in the export markets: This action includes: (i) further harmonization of technical regulations, (ii) establishing more robust systems for notification of new technical regulations, (iii) enhanced standardization of Food Standards within the EAC, Africa region (through the ARSO¹⁰¹ harmonization structure), and internationally.

(c) Refurbish and upgrade chemical and microbiological laboratories: This action proposes the urgent upgrading of selected laboratories in the region. The Partner States have to identify testing facilities to be upgraded for food control purposes. This will enable competent authorities to designate national laboratories for specific functions.

(d) Strengthen the certification and guarantee systems: Improvement in the certification and guarantee systems will ensure that EAC is able to cope with the large and increasing number of management and food safety standards adopted in the fresh F&V industry. This is against the background that food safety is a top priority in all European food sectors. It is, therefore, logical to expect most buyers to request extra guarantees in the form of certification. All actors in the supply chain, such as traders, food processors and retailers, require the implementation of food safety.

The certification initiatives and processes across the EAC, face a number of challenges including: unstructured producer and marketing systems – the

¹⁰⁰ Technical regulations include the following aspects: product and process characteristics, product dimensions, product design and performance criteria, packaging, marking and labelling requirements, process and production methods, and administrative provisions for procedures like inspection, testing, certification, and approvals

¹⁰¹ African Organization for Standardization

majority being SMEs and not unified; Inadequate skills for development and implementation of effective quality assurance systems; costs of certification; availability of certification bodies; lack funds for certification process; compliance cost due to foreign certification bodies; and limited skills and professionals in certification.

(e) Capacity building of actors in complying with the standard certification and guarantee systems: This action will provide specialized training programs to SMEs, for the purpose of implementation of effective quality assurance systems. These include, but are not limited to: GLOBALG. A.P; BRC: and IFS, SQF, FSSC 22000. Part of this initiative will involve: developing structured producer marketing systems; unifying the SMES (through for example development of effective producer organizations); development of quality assurance systems.

8.7 Incorporate Climate Change Management Systems

This Strategic Objective seeks to cushion the F&V industry against the negative effects of climate change and other related factors. Climate change, usually manifesting in extreme and volatile weather forms (drought, floods, increased pest, and disease infestation, etc.), has become a very serious concern for the F&V sector in the region, and has been documented as arising from increased unsustainable human exploitation and consuming of fossil fuels, deforestation, heavy unsafe crop farming practices, and industrial livestock farming, among others, that adds enormous amounts of greenhouse gases to those naturally occurring in the atmosphere, increasing the greenhouse effect and global warming.

Among impacts, there are unpredictable extreme and volatile weather conditions that lead to premature vegetables and fruit senescence with suboptimal biomass accumulation, increase in vulnerability to pests and diseases, and reduced and irregular harvests and delivery of raw material to the processors. As a result, climate change translates into higher costs for F&V processors (capacity utilization and adaptation costs), among other impacts in upstream and end-stream value chain sections

As a result, this program activity seeks to equip value chain actors, particularly the smallholder farmers, with necessary measures to safeguard their livelihoods and business operations against unforeseen events and natural disasters (including floods, drought, and other adverse weather conditions); increase in the incidence of pests and diseases and health-related conditions. All these factors increase financial losses for value chain

actors. Going forward, value chain actors need some degree of protection against these incidences. The intervention is based on the fact that a competitive F&V industry in the EAC is a function of stable households, firms, and business entities that are engaged in various activities along the value chain.

The key actions for this Strategic Objective are shown below.

(a) Develop and mainstream sectoral climate change adaptation and mitigation strategy: Efforts must focus on reducing the scale of climate change through mitigation and adaptation measures. While mitigation is about preparing the sector to absorb climate change variability and thus reduce the shock, adaptation to climate change is also a countermeasure against climate change. It consists mainly of helping communities and ecosystems to cope with changing climate conditions and impacts (damages and losses).

i) Mitigation:

These are countermeasures that the F&V sector adopts to reduce the scale and rate and absorb the impacts of climate change. Mitigation measures for the agricultural sector include the improvement of field production practices through improved irrigation (micro-irrigation), fertilization control, climate-smart agriculture, protected production systems, innovative management of crop and animal wastes, and carbon sequestration measures, among others. Some of the best-practice strategies for climate change mitigation, involve developing relevant policy programs and appropriate portfolio approaches using a policy mix, including:

- Economic: policies that utilize market mechanisms, such as charges, carbon tax, emission trading scheme, and subsidy;
- Regulatory: Examples include emission cap, chemical fertilizer spraying standard, manure, and liquid fertilizer spraying standard, and breeding density regulations;
- Voluntary agreements: non-regulatory policy measures such as Good Agricultural Practices (GAP) and voluntary development of resource-recycling villages by growers and processors.
- Research and development.
- Information dissemination and promotion of public awareness.

ii) Adaptation:

Climate change adaptation (IPCC, 2007) is defined as "adjustment in natural and human systems in response to actual or expected climatic stimuli and their effects." UNFCCC defines adaptation as "regulating process of ecological and socioeconomic systems to reduce possible damages from actual and expected climate change, that is, actions are taken to help communities and ecosystems cope with changing climate conditions".

Adaptation contributes to reducing the negative risks of climate change and provides opportunities to use climate change for positive effects, it plays an important role in mitigating the impacts of climate change. Adaptation includes both actions taken to directly mitigate the damages from the climate and enhance the future adaptive capacity and actions to contribute to indirectly mitigating the damages from climate change. Climate change adaptation strategies to consider are:

- Research and development (crop development, meteorological and climate information system, resource management innovation),
- National government programs and insurance (agricultural subsidies, private insurance, resource management program),
- Agricultural production techniques (agricultural production, land utilization, irrigation, cultivation time control), and
- Financial management for farm households (crop insurance, crop future trading, income stabilization program, household income).

(b) Establish crop insurance schemes: Insurance schemes are important, due to the perishable nature of horticulture products. Without an insurance system, their degree of vulnerability¹⁰² increases significantly. The design of appropriate insurance schemes will differ from country to country and will be on a case-by-case basis, but generally, it will seek to address the following demand and supply barriers.

Table 9: Demand- and supply-side barriers to the uptake of agricultural insurance

Demand-side barriers	Supply-side barriers
Low awareness of insurance	Insurance services for smallholder farmers can be costly and complicated to design
Low trust in the provider and the chance of receiving a pay-out	Distribution and operations: smallholder farmers are expensive customers to acquire and serve
Poor understanding of how insurance works	Low profitability potential due to low premiums
High cost of premiums and lack of government subsidy	Difficult to provide some policies without government support and subsidies
Difficult to register and claim, which requires extensive traveling to a point of service offered	
The insurance cover on offer is not needs-specific	

¹⁰² "Vulnerability" is the inherent fragility of poor people's livelihoods, which makes them unable to cope with stress and less able to manipulate or influence their environment to reduce those stresses (or benefit) even when trends move in the right direction. This definition establishes three criteria for household vulnerability namely: poor ability to cope with stress and shocks; less ability to influence the environment to reduce stresses; and inability to take advantage of an improvement in environmental conditions.

(c) Develop an integrated approach to microfinancing, climate change, and food security: Transforming the F&V sector, requires dedicated funding for significant productivity improvements that will motivate mid-stream investment (processing). This requires an integrated multi-sectoral approach that enhances investment in productive technologies, micro-financial management training, and climate-smart agriculture. Included in the approach is the inclusion of the private sector to connect growers to markets and financial services.

Strategic facilitation of partnerships among microfinance service providers and other institutions, can ensure scaling up of financial literacy and continuing to foster national- and private sector-led ownership, improving F&V sector initiatives that connect climate-smart agriculture, microfinancing, and food and nutrition technical assistance.

8.8 Promote Awareness, Strengthen Skills and Knowledge Base

This Strategic Objective seeks to promote actors' awareness of the causes, impact and appropriate solutions for post-harvest losses. Awareness triggers action to address the causes of loss and could be the least expensive way to reduce loss. In addition, the uniqueness of the horticulture industry implies a need for sufficient specific skills related to post-harvest losses at local level. The industry is high tech, knowledge intensive and focuses on high value crops. There is, therefore, a need to develop local capacity skills in these areas.

Against this background, the following interrelated program activities proposed.

8.8.1 Implement communication strategies

The objective of this Program Activity is to raise awareness of food loss causes and impact. The following actions are proposed:

(a) Establishment of post-harvest training and services centres.

Post-harvest Training and Services Centers (PTSC) will provide training on specialized skills needed for reducing post-harvest losses in F&Vs. The training location will be identified from strategic locations of critical mass of actors. They will provide potential users with a complete package of post-harvest training, supplies, services, and support activities.

The PTSC will serve as a site for extension workers and local post-harvest trainers, to meet with growers and others working along the value chains, to provide

training to improve local capacity and knowledge on improved produce handling, harvesting, sorting/grading, packing, cooling, storage, food safety, processing, and marketing practices. They can also be a training venue with permanent demonstrations for observing improved, cost-effective small-scale post-harvest handling practices, facilities, and equipment.

Local private companies can also demonstrate and explain the benefits of their goods and services related to improved post-harvest handling, processing, or storage. The centres could also accommodate a retail shop with post-harvest tools and supplies, packages, plastic crates, and other goods that can be purchased locally at reasonable prices.

The Centres are expected to serve as one-stop-shop, a place where people can come to ask questions or get advice on how to use improved post-harvest practices, learn about costs and benefits and marketing options. Growers or traders can also pay a small fee for services, such as having their produce packed in improved containers, cooled and/or stored for a few days before marketing, leasing of a small, insulated transport vehicle, using a solar dryer to produce dried fruits or vegetable snack products, etc.

8.8.2 Human skills development

This Program Activity focuses on accelerating the absorption, utilization, and maintenance of post-harvest loss management technologies. Based on current experiences in human skills challenges within the industry, together with the unfolding opportunities in the region and beyond, the following actions are being proposed.

(a) Conduct curriculum review for local institutions:

The reviews will capture the fast-changing dynamics of the industry e.g., production and marketing systems to cater for incorporation of specialized skills on post-harvest loss management and in particular to cater for the needs of the emerging middle class in the region and beyond.¹⁰³ This will provide the region with "job ready" graduates from the existing institutions. Once the curriculum review has been completed, the institutions can conduct regular refresher trainings – on job training, particularly to the government extension services. These should ensure that the personnel have a continuous access to new developments in post-harvest loss management technology and mechanisms. Development of awareness creation materials and programmes on

¹⁰³ The growing middle class in the urban centers have new consumption patterns which ultimately dictates the way the F&V industry should be structured. Among the key concerns of the middle class are product quality issues

the application of GAP and Good Hygienic Practices and Standards along the value chain, should also be part of the new curriculum. In addition to technical skills, it is also important to equip the graduates with managerial and business skills in post-harvest loss management.

(b) Enhance the capacity of the TVET system

The capacity of TVET system can be enhanced through: (i) promoting collaboration and coordination between industry and the education and research institutions; (ii) accountability and responsiveness to the needs of the industry; (iii) addressing any gaps in the National Qualification Frameworks, especially with respect to wider certification, quality assurance, standardization; and, (iv) creating flexibility in enforcing capabilities of the mandated institutions.

(c) Invest in proven models of technology transfer and skills development in the region

This intervention should target equipping the lower-level cadre (e.g., undergraduate, higher diploma) with practical skills based on post-harvest loss management. Based on the design of this model, the impact can reach the entire supply chain of companies, impact the education institution's curricula, including generation of research papers for academics, enhance the sponsorship opportunities for the graduates, establish technology transfer infrastructure between industry, academia, and research and industrial training institutions, which becomes the basis for further collaboration.

(d) Invest in selected higher-level specialized PHLM skills in partnership with centres of excellence

This area covers high level analysts and researchers who can provide "thought leadership" to the industry. These will require high level academic degree (PhD and MSc) in specialized areas relevant to PHLM, such as: waste management, biotechnology, industrial and process engineering, microbiology, and computer-aided design and manufacture.

(e) Develop strategic linkages with private sector

The governments should promote entrepreneurship and innovation activities focused on PHLM, through direct linkages to the private sector. These may include, for example: industrial attachments; internship programs; youth incubation schemes; technology-based incubation centres, and apprenticeships schemes.

(f) Develop regional wide skill development policies

There should be region-wise policy response to incorporate requirements for mandatory certification of PHLM practitioners on key technical areas, such as quality assurance and standardization. Appropriate policy instruments should be developed and linked to the National Qualification Frameworks (NQFs), as well as the Regional Qualification Frameworks (RQFs). However, it should be noted that the implementation of these frameworks requires strong TVET systems. There is, therefore, a need to equip the TVET systems with requisite skills to monitor, assess, and share knowledge on how these policies are working. Currently, this is widely recognized as a key challenge across the EAC. Efforts should also be made to create appropriate policy incentives on these institutions to ensure PHLM skills development initiatives are aligned with skills allocation and utilization in industry.

8.8.3 Knowledge Management

This program activity seeks to generate the necessary data and information on PHLs. It is based on the fact that EAC region has a multitude of technologies and methods used in reducing post-harvest losses. The information on these technologies and methods is scattered and/or unknown outside the group/ cohort of users.

The lack of reliable data on the extent and impact of PHLs has been identified as one reason for a slow and ad hoc response to effective PHLM interventions in the region. Data collection and PHL measurement have been identified as critical components that are invariably missing and not adequately addressed in PHLM across the region. The reasons for this, are lack of appreciation of the importance of PHL data and the lack of resources, lack of technical skills, and organizational capacities for data collection

To address the above challenge, the following actions are proposed.

(a) Establish a single database for PHLM information

This action seeks to mobilize the available information into a single database, to enable ease of access to users in their quest to promote PHLM in the region. It is also imperative that efforts are made to take stock of available/existing technologies, as well as new ones coming into the market, test their efficacy and disseminate the successful ones to producers, processors, relevant actors along the value chain. This will require establishment of a database management system on PHLM in the region

(b) Develop a standard methodology for collecting data and estimating PHL in the region

Researchers in the EAC use different methods to assess levels of PHLs. There is no common agreed methodology and hence, the reported figures vary widely across the region. This makes it difficult to come up with regional wide cost effective and efficient measures to address the challenges.

This intervention seeks to develop a common methodology for PHL assessment in the region. This will be achieved by reviewing the current methodologies and developing a consensus on the most relevant methodology, considering the dynamics of individual Partner States. This will ultimately lead to a uniform approach in addressing PHL challenges, as well as sharing information on successes, challenges and best practices. To support PHL management, data must be collected consistently, at a relevant geographical scale, and a proper sampling strategy should be implemented at critical points of supply chains.

(c) Improve PHL research capacity across the whole value chain

This action seeks to build the capacity of researchers in the region to undertake “targeted” PHLM studies. It is based on the need to have a pool of knowledge in the region, which can be mobilized to address specific challenges related to PHLM, in a timely and cost-effective manner.¹⁰⁴ To increase the utility of this intervention, efforts should be made to ensure that such information reaches a critical mass of actors within the F&V value chain for timely decision making. Furthermore, the information has to be made “user friendly” and readily available by more traditional means, as well as electronically.

8.9 Strengthen partnership, coordination, institutional and policy framework

The success of the PHLM Strategy will require strong partnerships, coordination, institutional and policy framework at national and regional level, to ensure that program activities are well entrenched within the overall PHLM Strategy. As a result of this, the following interrelated program activities proposed.

8.9.1 Promote financing and private sector participation

This Program Activity seeks to address the twin challenges of poor financing and weak private sector participation in PHLM.¹⁰⁵ It is premised on the fact

¹⁰⁴ The lack of research results and information on PHLM is a major problem facing the East African F&V sector.

¹⁰⁵ Although reducing food losses may positively impact the company's

that currently, PHLM suffers from inadequate public financing relatively more than other nodes of the agriculture value chains in the region. Also, most financial institutions continue to view agriculture lending as a risky business. In view of this, the PHLM Strategy should strive to identify targeted options to increase public funding and strengthen the existing and introduce new, innovative and friendly financial mechanisms, products and instruments to finance PHLM interventions in the F&V sector.

It should also be noted that the private sector across the region, has generally been excluded in PHLM policy formulation, yet it is acknowledged that interventions that impact PHLs are implemented at the firm and individual levels.¹⁰⁶ Driven by profits, the value of PHLs should be of interest to the private sector. Operators along food value chains have an incentive to implement measures to reduce food losses if the financial benefits outweigh the cost. Also, efforts to reduce food loss and waste involve costs, which rational individuals and entities are willing to bear if the benefit is higher than the cost. However, the size and costs necessary to address the problem of PHLs and the scope of investments required, are largely insufficient or unknown for PHLM practices, technologies, and services.

The information gap hinders the engagement of private sector actors in PHLM activities. Besides, appropriate financial products and services tailored for boosting investments in PHLM are mostly absent.¹⁰⁷ Therefore, there is need to involve the private sector in identifying information gaps and how to address them as well as developing appropriate investment schemes and dialogue mechanisms to be promoted and supported.

The following key actions are proposed:

(a) Increased public financing

This action calls for Partner States to fund the PHL initiatives from “own” sources. Currently, governments in the region depend on donor funding for most of the development projects. However, this is not a sustainable way of addressing the PHLs, which is a key impediment to promoting the competitiveness of the F&V subsector. The success of PHLM Strategy would

profits, the financial incentives for a private company to reduce food losses may be weak. Even where the business case for food loss reduction is evident, stakeholders may be unable to implement the necessary actions because of financial constraints and costs due to lack of credit, inadequate infrastructure, and policies that discourage private sector participation.

¹⁰⁶ It is the responsibility of partner States to ensure that the private sector has a role to play and that the infrastructure, institutions, and policies that support private sector activities are in place and coherent. Public interventions that allow private actors to overcome financial or other barriers that stop them from undertaking food loss reduction decisions can convince private actors that there is a business case for food loss reduction.

¹⁰⁷ The Bellagio post-harvest Management Statement 5 of September 2017

largely depend on the extent to which individual governments are able to fund the various initiatives. At the minimum, Partner States should allocate at least 10% of their budgets to the agriculture sector, in order to have meaningful PHLM interventions.¹⁰⁸

In addition to increased public funding, there are a number of other “innovative” options which can be used to attract investment within the value chain itself. These are presented below:

(b) Introduce a “catalytic” fund / endowment fund

This approach entails earmarking and/or ring-fencing, a certain proportion of proceeds accruing from different levels of value addition in F&V subsector as a “special levy” to cater for the required investment in PHLM. The model is especially relevant for F&V value chain, owing to the intrinsic opportunities (i.e., incremental benefits) for value addition. The approach to this proposal may differ from country to country and as such, should be adapted on a case-by-case basis.

The proposal requires Partner States to carry out an in-depth analysis of practical possibilities in their local contexts. They should then develop regulations, which require a “fixed” proportion of money received by national governments (through the Treasury), to be ploughed back to the industry for the purpose of funding PHLM initiatives.

Once this model is adopted, the catalytic fund will become a “premier” fund for implementing PHLM in the F&V subsector across the EAC region. It should be considered as sustainable way for funding the sector through value addition processes. This can also be considered as an “embedded” approach for encouraging more value addition activities in the industry. The sustainability element will kick-in since funds will be flowing “cyclically”, thereby building “endowment fund” for the value chains.¹⁰⁹

(c) Establish a “Revolving Fund” for the subsector

This proposal calls for the establishment of a revolving fund, as capital for funding targeted investment activities in PHLM. The revolving fund should be financed by its users - individual firms; Partner States or by both. It should be noted that the fund may take time to become fully established, if it depends on small injections of funds in the form of contributions, savings deposits or phased donor financing. For this reason, Partner States may

¹⁰⁸ This is in line with CAADP requirements

¹⁰⁹ An endowment fund is a financial asset, which contains capital investments and related earnings leveraged to fund a specific mission. In this case, the Post-Harvest Loss Management initiatives in the F&V sector.

consider earmarking a certain percentage of the national budget to cater for the fund. Contribution from the manufacturing firms should be in form of a special “levy”, to be earmarked for the purpose of F&V subsector.¹¹⁰

Under this arrangement, the fund’s resources should circulate between the Fund and the Users, meaning that each group member has the ability to borrow in turn, provided the others have repaid. The repayment of the loan, together with interest, will be used to replenish the fund and make further loans.

The PHLM revolving fund should be established with the intention of it being self-sufficient and sustainable after a certain period. Its capital is expected to remain at a constant level, more or less, without any fresh external financing. The factors that affect the operation of a Revolving Fund are the interest rates (for lending and/or borrowing), levels of premiums; administrative expenses; payments/ repayments and failure to make them; inflation and the liabilities. In order to keep the Revolving Fund self-sufficient and sustainable, appropriate measures would be required to be adopted to effectively appraise and monitor these factors for its improved operations.

Experience shows that the financial involvement of the target group, is a major precondition for successfully achieving the aim of the fund. When setting up a Revolving Fund for the PHLM in the F&V sub-sector, the aim should be to ensure that the target groups are financially involved, either voluntarily or compulsorily. Participation in Revolving Fund by a donor may be in the form of grants, interest-free advances, loans, combinations of any of these, and guarantees. However, dependence on donor funding for PHLM initiatives should be temporary and be gradually phased out. With regard to advances and loans to the Revolving Fund, the multi-year financial prognoses relating to the fund, should indicate when repayment will be possible and the schedule for phasing out guarantees.

There are two possible ways of using a Revolving Fund, namely, ‘making the fund’s capital available to the users’ and the other, ‘making income from the fund available to the users’. In the former case, the availability of fund’s capital to users, depends on lending periodicity and prompt repayments. In the case of the latter, the fund’s capital is not directly available to the users and only yield from the investment of the capital is made available. The capital is not depleted and the interest received by the fund is lent to users and even part of these loans

¹¹⁰ Companies (manufacturing firms) will be encouraged in contributing a certain percentage of their earnings into a common kitty.

is subsequently repaid to the fund. Thus, the fund's capital grows. If the accumulated interest assumes the role of the original capital, the original capital can be repaid to the donors, provided the establishment of Revolving fund is by means of donor financing. The fund itself can provide guarantees to enable local funds to be borrowed. The amount of capital which the fund possess determines the maximum guarantee it can provide.

(d) Promote Public Private Partnership (PPP)

This proposal calls for the joint investment between Public and Private sectors in financing the PHLM in the F&V sector. The proposal is premised on the fact that the private sector can work together with government as business partners. The key principle being that better value for the initiative can be achieved through leveraging public and the private sector financing. This requires identification of 'win-win' opportunities. It should however, be noted that there is no universal norm as to the most appropriate approach to PPP in the context of the F&V sector. That analysis needs to be made on a country-by-country and project-by- project basis.

NB: Partner States are encouraged to share experiences and best practices in financing PHL management. This should be undertaken under subsector coordination platform.

(e) Facilitate private sector investment in PHLM

This action specifically calls for increased investment in PHLM activities within the F&V value chain. This can be achieved by leveraging on prior investments. Considering the nascent stage of the industry, addressing PHLs can be viewed as a lever of change, which can propel the industry to the next level.

Over the years, there has been considerable investment in addressing PHLs in the F&V sub-sector in the EAC, even though it is difficult to quantify. Any initiative to stimulate further investment, needs to explore opportunities for leveraging these existing investments, in order to maximize the returns (financial or social) for the past and future investors. Increased predictability of returns for the horticulture sector, can potentially attract more investors into the PHLM space. It is therefore, important to take stock of these investments and "showcase" their success to potential investors.

It should be noted that potential investors are likely to choose from a narrower set of more predictable investment choices, before embarking on aggressive PHLM options. In the short to medium term, they

will be more concerned with clearer and predictable return on investment as they consolidate their portfolios. Furthermore, increased investment in PHLM requires simultaneous investment in the entire horticulture sector, in order to maximize return on investment, manage risks and also optimize impact. Focusing on the local, regional and international markets, will create more benefits to actors and maximize on the feeder relationships and/or multiplier effects and opportunities emanating from the sector wide investments. This will subsequently attract further investment in PHLM. Other cross-cutting areas, such as human skills development, technology, and R&D, are also important in this regard. These are all pre-requisites for crowding in more investors in the medium to longer term.

8.9.2 Strengthen institutional capacity of PHLM actors

This Program Activity seeks to promote coordination amongst various institutions involved in PHLM initiatives in the region for effective implementation. This will provide an opportunity to share knowledge and experiences as well as avoiding duplication. The activity will ensure effective planning, distribution of resources and, above all, optimize the impacts of such interventions.

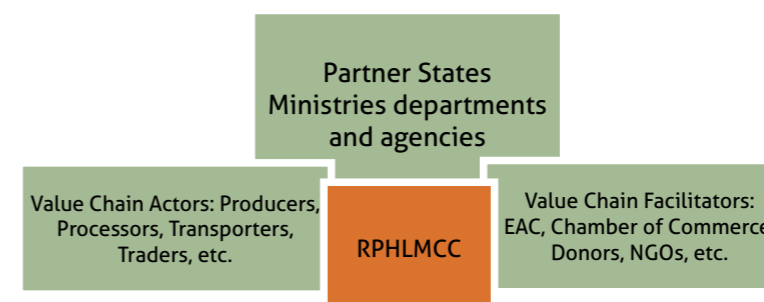
According to international best practice, the institutional framework for value chain development should clearly set out the lead ministries and other key actors (e.g., industry associations or other professional bodies), who will take the overall responsibility for advancing the PHLM development agenda. These are also referred to as "Key Actors" or "Industry Champions". The framework should also clearly spell out the position and role of public and private sectors and the laws guiding them, as well as strategies for achieving maximum impact.

The following actions are proposed:

(a) Establish national and regional sub-sector coordination platform

Furthermore, the platform will encourage buy-in from the respective governments, (particularly policy makers) and other value chain facilitators (including BDS providers). The composition of a typical Committee could be as depicted in the figure below.

Figure 3: Schematic composition of Regional Post-harvest Loss Management Coordination Committee (RPHLMCC)



8.9.3 Strengthen policy frameworks

In order to accelerate the implementation of the PHLM Strategy in the EAC, there is a need to align the PHLM policies at national level to the regional, continental and international policies and frameworks. A number of policies have been developed at national level, that should support development and implementation of the regional Strategy. However, the main challenge is the implementation of such policies. The existing sector policies at national and regional levels need to be translated into action.

In view of the above, the following actions are proposed:

(a) Facilitate and fast-track the implementation of existing policies

The EAC Secretariat and individual Partner States should put in place mechanisms for implementing the policies. An elaborate M&E system should be developed, with appropriate indicators and other results tracking mechanisms. Budget allocation at national level for monitoring policy implementation in the F&V sector is also critical.

(b) Provide capacity building for the implementation of the Strategy

A capacity building program, targeted at Government Ministries and Agencies is required, and various institutions responsible for overseeing the implementation of PHLM Strategy in respective Partner States. The program can also be extended to other institutions responsible for sector policy and strategy formulation, implementation, monitoring and evaluation. It is expected that the program will

accelerate structural changes in respective countries and enable EAC to catch up with the unfolding dynamics in the global F&V industry.

Consideration should be given to ensure that the proposed interventions, first and foremost, contribute to the facilitation of the operationalization of the EAC-wide industrial development policy. The program should also contribute to the achievement of key outputs and outcomes spelled out in the major national policies and strategies.¹¹¹ The key national institutions need a blend of skill set to deliver their mandate. The skill set includes a combination of 'hard' technical skills and 'softer' interpersonal skills.

(c) Specific policy recommendations

There are a number of policy recommendations which need to be considered:

- Greater investment by the Partner States in public goods and infrastructure including electricity, water, roads and transport systems to facilitate the development of post-harvest systems.
- Increased investment into the fabrication of locally produced PHM tools and technologies will contribute to loss reduction as well as generating much needed employment.

¹¹¹ Particularly for those countries which have such policies and strategies in place

- In an effort to increase youth agribusiness opportunities, young people need to be informed of how PHLM provides a significant business opportunity within the F&V sub-sector. Appropriate supporting mechanisms (access to finance, skills training etc.) are required to facilitate their entry into this area.
- Smallholder organizations, aspiring entrepreneurs particularly women and youth need to be supported in accessing finance to enable the acquisition and post-harvest technologies.
- Work is needed to harmonize the benefits of both traditional and modern post-harvest tools and technology.
- Greater research is needed on the consumption patterns of select value chains in the country, fruits and vegetables being one, which shows a trend of low consumption despite an increase in purchasing power.
- Improving the collection of data and reporting of post-harvest loss in the region is vital to the overall monitoring.
- Increasing the budget allocation to the agricultural sector is vital to supporting the overall creation of post-harvest management systems and to reduce food loss in the EAC.

8.9.4 Strengthen the advocacy function

A conducive business environment, stimulated by joint stakeholder efforts, is key to the transition towards higher levels of sector growth and increased competitiveness. The industry support structures should be positioned toward a common cause; particularly the developmental of favourable and supportive regulatory frameworks.

A key action for promoting a conducive business environment is described below:

(a) Incorporate advocacy component in the F&V Strategy

Efforts to implement the PHLM Strategy in the EAC region, require significant advocacy through Public Private Dialogue (PPD) initiatives. This is largely because industries, individual firms and industry clusters, are often faced with a myriad of policy related challenges which impact on their ability to become competitive. These constraints require significant investment in the policy advocacy, over and above the requisite requirements, to manage businesses more effectively and increase efficiency. The successful implementation of Strategy would therefore, require some degree of orientation to policy advocacy for it to have an opportunity to advance these policy challenges through recognized policy advocacy institutions.



9. Action Plan and Implementation Matrix

A detailed description of key actions, together with timelines for implementation and the proposed indicators to track the impact of each Strategic Intervention are presented in Annex 1. For each action, an indicative budget, together with responsible actors, is also indicated.



10. The Implementation Budget

The successful implementation of the PHLM Strategy and Action Plan for F&Vs subsector, requires substantial financial resources estimated at USD 33,830,000. It is expected that at the start of each phase, a detailed activity-based budget will be developed as part of the evaluation of the implementation progress of the plan.

10.1 Quick wins

To jumpstart the strategy, it is important for the EAC to implement a selective set of “quick-win” activities, which are estimated to cost around USD 9,720,000. These are outlined below.

Table 10: Quick win activities

Strategic objective	Activities/Actions	Estimated Cost (USD)
Promote Good production practices to address pre-harvest losses	Facilitate establishment of certified seed nurseries	1,200,000
	Strengthen the extension services	350,000
Promote Technology, Research and Innovation	Identify measures to reduce mechanical damages	300,000
	Apply international best practice harvesting procedures and practices	150,000
	Apply appropriate dumping techniques	250,000
	Apply appropriate waxing techniques	450,000
	Apply appropriate sizing techniques	200,000
	Promote application of ICT solutions in F&Vs:	350,000
Strengthen markets and market infrastructure	Promote contract farming model	450,000

Strategic objective	Activities/Actions	Estimated Cost (USD)
Improve safety and quality infrastructure	Apply appropriate practices to ensure clean soil	600,000
	Apply appropriate practices to promote water sanitation/clear water	250,000
	Maintaining clean surfaces	300,000
	Promote hand sanitization practices	150,000
	Establish hand wash stations	300,000
	Use of field tools and containers:	300,000
	Promote employee hygiene	300,000
	Apply best practice for care of equipment's	300,000
	Apply best practices for handling packaging materials	300,000
	Promote use of refrigerated Transport	500,000
	Sanitizing field containers, tools and packhouse surfaces	550,000
	Build the capacity of enterprises to comply with international standards and market requirements	500,000
Build local skills and knowledge base	Conduct curriculum review for local institutions	300,000
	Enhance the capacity of the TVET system	750,000
	Develop regional wide skill development policies	200,000
Strengthen the coordination, institutional and policy framework	Establish national and regional PHLM Coordination Committee" (RPHLMCC)	150,000
	Facilitate and fast track the implementation of existing policies	270,000
Total cost		9,720,000

NB: Given the fact this is a continuous process, Partner States should ensure sufficient budget allocation at all times.

The budget lines indicated above are estimates only. The primary objectives of these funds are to provide an industry stimulus package to jumpstart the PHLM activities through deliberate strategic actions, as detailed in the implementation matrix.

10.2 Resource Mobilization

Adequate financial, human, and technical resources will be crucial for the successful implementation of the Strategy. The Strategy implementation is largely dependent on several sources; mostly Partner State contributions; receipts from regional and international partners; grants, donations, funds for projects and programs; inputs and programs run by the private sector; private foundations, technical assistance; income earned from Community activities; and other sources, as may be determined by the Council.

It is envisaged that these funding sources, however, may be constrained by the intermittent and ad hoc nature of inflows, particularly with respect to development partner contributions, which are mostly influenced by many factors influencing their economies. Also, potential accumulation of Partner States contribution arrears, due to financial constraints in each Partner States. Lack of coordinated efforts in harmonizing priorities between the regional and national levels, and lack of guiding operating procedures/framework for Technical Assistance; as well as lack of a guiding framework for coordination of sector-specific funding, may potentially influence efforts for optimal resource mobilization for the Strategy.

Given the above, a resource mobilization plan will be prepared by EAC Secretariat in collaboration with the Partner States.

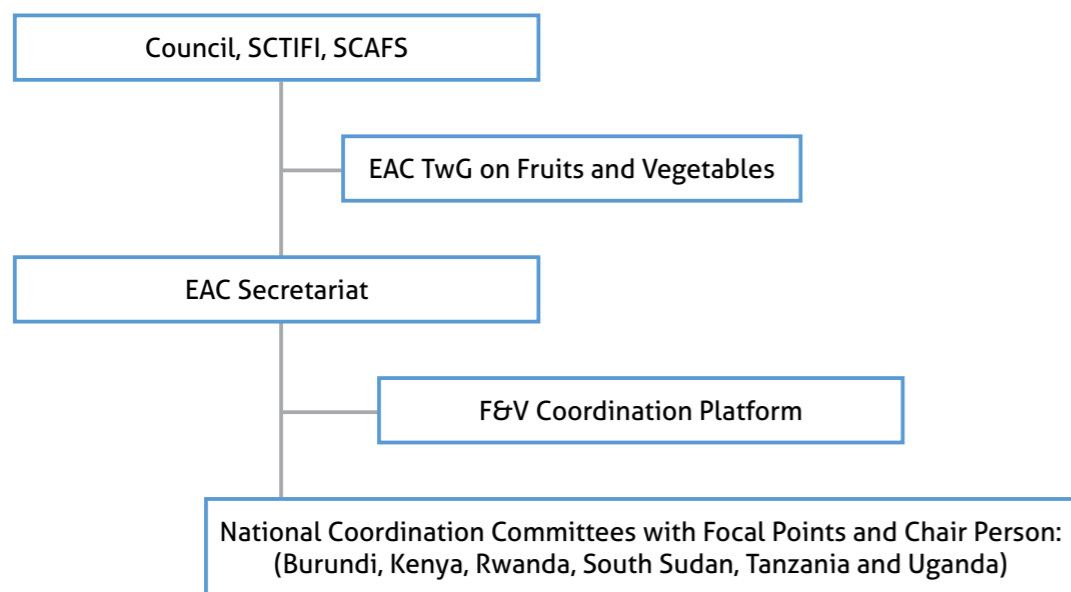


11. Operationalization of the Strategy and Action Plan

11.1 Steering and coordination arrangements

The PHLM Strategy and Action Plan is a regional undertaking that is largely implemented at the national level through a multi-sectorial approach. The steering structure takes into consideration the decision-making process of the EAC organisations and the multiple actors (regional and national), comprising the public and private sectors. The Industrial Development Department and the Ministry of Industry are the focal points at the Secretariat and the Partner States respectively. Figure 4 below, illustrates the steering structure in detail.

Figure 4: Simplified graph of the EAC-Fruits and Vegetables sub-sector steering structure



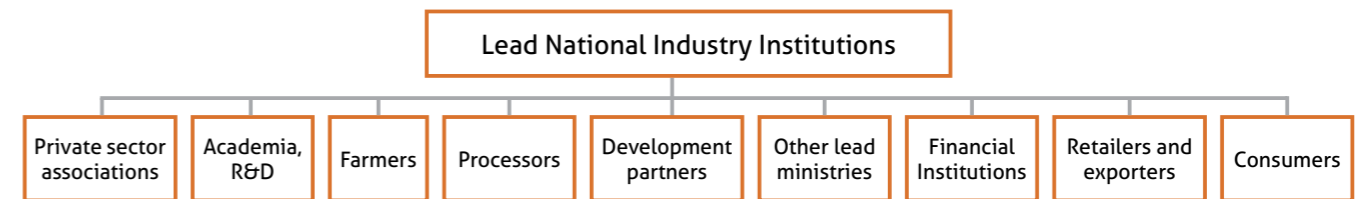
11.1.1 National-level implementation and coordination

For each Partner State, a Lead National Industry Institution will champion the implementation of the Strategy. Focal points should be appointed substantively to these positions. The lead institutions will work closely with all relevant MDAs, including the Ministries of East Africa Community Affairs, Trade and Industry, Agriculture, and Finance. In particular, the institutions will guide relevant MDAs, mainstream the Strategy into their national plans and budgeting processing, and ensure that National F&V policies and strategies are aligned to regional initiatives.

The Lead National Industry Institutions will also coordinate the activities of all other players and actors in the industry. In addition, the association will be charged with facilitating the establishment of the National F&V Sector Platform, comprising all the players as presented below. Through the platform, the Agency will launch implementation of the Strategy, as well as providing the necessary support to the private sector representatives, to play a lead role in implementation and monitoring of the Strategy.

11.1.2 Regional level implementation and coordination

Figure 5: National F&V sector coordination platform



The EAC Secretariat will oversee coordination of the implementation of the Strategy. The Secretariat will also appoint a project implementation officer within the EAC Secretariat Industrial Development Department. The project officer will support the national focal points to develop respective annual operational plans.

Reporting on the Strategy implementation will follow the structures of the EAC regional policy organisation, including the Sectoral Committee for Agriculture and Food Security (SCAFS), EAC Sectoral Committee on Industrialization, EAC Sectoral Council on Trade, Industry, Finance and Investment and the Council of Ministers.

11.2 Pre-requisites for Implementation of the Strategy and Action Plan

Several pre-requisites will have to be in place to ensure the successful implementation of the Strategy. The major ones include political will, commitment and support at all levels; demonstrable ownership of the Strategy by all categories of stakeholders; effective use and management of credible data/information for evidence-based decision making; sustainable use of the natural resource base¹¹²; and enhanced private sector participation. There is also a need for mind-set change, including civic competence and responsibility; and a more widespread sense of "East Africanness", among all categories of stakeholders across the EAC Partner States. The pre-requisites also include: demonstrable preparedness for implementation and effective monitoring and evaluation to support implementation; clarity and internal harmony of roles and responsibilities of actors/stakeholders; effective partnerships and collaboration with non-state actors; human resource capacity and conducive work environment at all levels; as well as effective and efficient resource mobilization and utilization.

11.3 Monitoring, Evaluation, and Learning (MEL)

Monitoring and Evaluation (M&E) has three elements:

- Monitoring and reporting progress against targets: Monitoring will be done after Year One, and will involve several types of activities: setting up data collection and reporting processes, periodic analyses, and assessment of outcomes of the programs outlined in the Strategy against targets (including whether program milestones have been achieved). Evidence-based decision-making will be a critical component of monitoring, complemented by the development of "lessons learned" in implementing the different components of the Strategy.
- Evaluation of achievements and identification of areas for improvement: Evaluation will involve the collection of data, analysis and assessment of data from implementing program activities, to assess progress and whether or not specific results have been achieved. Evaluation of activities will include conducting baseline surveys, mid-point, and end-line surveys. These will be performed by an external consultant (an individual or a firm).
- Learning will comprise regular monitoring, which will allow the incorporation of lessons learned during implementation and any "course correcting".

¹¹² The Strategy will not operate in isolation. Various initiatives will be implemented in conjunction with other units, departments and/or bureaus within the EAC. This will ensure for example, proper environmental managements practices, are used environmental

Annex 1: Implementation matrix

Strategic Object 1: Promote Good production practices to address pre-harvest losses
Outcome 1: A competitive and efficient regional production system for F&Vs

Activities	Inputs	Outputs	Indicators	Means of verification	Timeframe			Responsibilities	Estimated Budget (USD)
					2022-2024	2024-2026	2026-2028		
Facilitate establishment of certified seed nurseries	Technical assistance	Approved F&V seed nurseries in the region	Number of approved seed nursery in each Partner State	Regional F&V road map monitoring report	✓		EAC secretariat, Private sector (e.g., seed distributors), Breeding and Research Institutions, National Ministries, Industry Associations	1,200,000	
Strengthen the extension services	Technical assistance	Good Agronomic Practices applied across the region	Number of capacity building programs for public and private sector extension agents	Capacity building reports	✓		EAC Secretariat, Service providers, Regulatory Agencies, Industry Associations.	350,000	
Use of ionizing radiation (irradiation) for pest risk management:	Technical assistance	International Standards for Phytosanitary Measures, No ISPM 18	Number of companies (actors) using irradiation technology for pest risk management	Capacity building reports		✓	EAC Secretariat, Technology Institutions, Breeding and Research Institutions, National Ministries, Industry Associations	500,000	
Strengthen the system for forecasting and management pests and diseases	Technical assistance	Approved system for forecasting and management of pests and diseases	Forecasting system in place and operational	Capacity building reports			EAC secretariat, Private sector (e.g., seed distributors), Breeding and Research Institutions, National Ministries, Industry Associations	350,000	

Strategic Object 2: Promote Technology, Research and Innovation
Outcome 2: Availability and accessibility to appropriate PHLM Research, Technology and Innovation

Activities	Inputs	Outputs	Indicators	Means of verification	Time frame			Responsibilities	Estimated Budget (USD)
					2022-2024	2024-2026	2026-2028		
Use of maturity indices to assess crop maturity	Capacity building program/ training Technical assistance	The quality of products harvested and put on the market improved through proper assessment of crop maturity levels	Number of producers able to use the indices in their local contexts.	Survey reports Perceptions survey		✓	EAC Secretariat, Service providers, Regulatory Agencies, Industry Associations.	500,000	
Conduct field packing (in-situ-packing):	Capacity building program/ training Technical assistance	Ability to use simple technologies for packing operations	Number of simple technologies developed and applied to facilitate field packing	Survey reports Perceptions survey		✓	EAC Secretariat, service providers, technology development institutions in the Partner States	400,000	
Identify measures to reduce mechanical damages	Capacity building program/ training Technical assistance	Ability of industry to reduce mechanical damages during harvesting	Number of manual harvesters able to apply "best-practices" to reduce mechanical damages	Survey reports Perception's survey		✓	EAC Secretariat, service providers, technology development institutions in the Partner States	300,000	
Apply international best practice harvesting procedures and practices	Capacity building program/ training Technical assistance	Ability to use "simple" but "fundamental" practices for reducing post-harvest losses	Number of harvesters able to apply international best practice harvesting procedures and practices	Survey reports Perceptions survey		✓	EAC Secretariat, service providers, technology development institutions in the Partner States	150,000	
Apply appropriate dumping techniques	Capacity building program/ training Technical assistance	Ability to apply appropriate best practices for undertaking "dumping" i.e., the process of removing produce from the field	Number of actors able to apply best practices for produce dumping	Survey reports Perceptions survey		✓	EAC Secretariat, service providers, technology development institutions in the Partner States	250,000	
Apply appropriate waxing techniques	Capacity building program/ training Technical assistance	Actors' ability to use of food grade waxes to replace some of the natural waxes removed in washing and cleaning operations.	Number of able to use food grade waxes	Survey reports Perceptions survey		✓	EAC Secretariat, service providers, technology development institutions in the Partner States	450,000	

Activities	Inputs	Outputs	Indicators	Means of verification	Time frame			Responsibilities	Estimated Budget (USD)
					2022-2024	2024-2026	2026-2028		
Apply appropriate sizing techniques:	Capacity building program/ training Technical assistance Trainings	Ability to use hand held sizers in sorting and sizing produce to meet the grades and standards required in different markets	Number of actors able to use hand held sizers in sorting and sizing produce to meet the grades and standards required in different markets	Survey reports Road map reports	✓		Partner States, EAC Secretariat, Industry associations, Pack Operators, Processors and manufacturers, Technology development institutions in the Partner States	200,000	
Deploy efficient packhouse layout options:	Technical assistance Exchange programs Specialized training	Ability to deploy efficient packhouse layout options.	Number of actors able to deploy efficient packhouse layout options.	Partnership reports Road map reports	✓		Partner States, EAC Secretariat, Industry associations, Pack Operators, Processors and manufacturers, Technology development institutions in the Partner States	250,000	
Choice of packing and packaging materials	Technical assistance Exchange programs Specialized training	Ability to choose proper parking materials relevant to local circumstances.	Number of actors able to choose proper parking materials relevant to their local circumstances.	Survey reports Road map reports	✓		Partner States, EAC Secretariat, Industry associations, Processors and manufacturers, Technology development institutions in the Partner States	350,000	
Put in place appropriate chemical controls	Technical assistance Exchange programs Specialized training	Improved ability to use different chemicals to prevent produce decay.	Number of actors trained in the use of different chemicals to prevent produce decay.	Survey reports Road map reports		✓	Partner States, EAC Secretariat, Industry associations, Technology development institutions in the Partner States	550,000	
Use of cold treatments to control produce deterioration:	Technical assistance Exchange programs Specialized training	Improved ability to use cold treatments in controlling produce deterioration	Number of actors able to use cold treatments in controlling produce deterioration	Survey reports Road map reports		✓	Partner States, EAC Secretariat, Industry associations, Technology development institutions in the Partner States	350,000	

Activities	Inputs	Outputs	Indicators	Means of verification	Time frame			Responsibilities	Estimated Budget (USD)
					2022-2024	2024-2026	2026-2028		
Use of heat treatments	Technical assistance Exchange programs Specialized training	Ability to use hot water dips or heated air for direct control of post-harvest insects.	Number of actors trained on the use of hot water dips or heated air for direct control of post-harvest insects.	Road map reports Survey reports		✓	Partner States, EAC Secretariat, Industry associations, Technology development institutions in the Partner States	250,000	
Use of biological control and plant growth regulators	Technical assistance Exchange programs Specialized training	Ability to use of biological control and plant growth regulators	Number of actors able to use of biological control and plant growth regulators	Survey reports Road map reports		✓	Partner States, EAC Secretariat, Industry associations, Technology development institutions in the Partner States	350,000	
Use of room cooling techniques	Technical assistance Exchange programs Specialized training	Ability to deploy room cooling options	Number of packhouse operators able to apply room cooling techniques	Survey reports Road map reports		✓	Partner States, EAC Secretariat, Industry associations, Technology development institutions in the Partner States	200,000	
Use of forced-air cooling techniques	Technical assistance Exchange programs Specialized training	Ability to employ forced air-cooling techniques	Number of packhouse operators able to employ forced air-cooling techniques	Survey reports Road map reports		✓	Partner States, EAC Secretariat, Industry associations, Technology development institutions in the Partner States	350,000	
Use of hydro-cooling techniques	Technical assistance Exchange programs Specialized training	Ability to apply hydrocooling techniques	Number of packhouse operators able to apply hydrocooling techniques	Survey reports Road map reports		✓	Partner States, EAC Secretariat, Industry associations, Technology development institutions in the Partner States	250,000	
Apply evaporative cooling mechanisms	Technical assistance Exchange programs Specialized training	Apply to apply evaporative cooling mechanisms	Number of packhouse operators able to apply evaporative cooling mechanisms	Survey reports Road map reports		✓	Partner States, EAC Secretariat, Industry associations, Technology development institutions in the Partner States	300,000	

Activities	Inputs	Outputs	Indicators	Means of verification	Time frame			Responsibilities	Estimated Budget (USD)
					2022-2024	2024-2026	2026-2028		
Construct appropriate storage buildings	Technical assistance Exchange programs Specialized training	Ability to construct appropriate storage buildings	Number of actors trained in the construction of appropriate storage buildings	Survey reports Road map reports	✓		Partner States, EAC Secretariat, Industry associations, Technology development institutions in the Partner States	250,000	
Apply storage temperature principles	Technical assistance Exchange programs Specialized training	Understanding the principle of temperature control and how it is applied to individual crops.	Number of actors reporting increased understanding of the principle of temperature control and how it is applied to individual crops.	Survey reports Road map reports	✓		Partner States, EAC Secretariat, Industry associations, Technology development institutions in the Partner States	350,000	
Apply appropriate storage practices	Technical assistance Exchange programs Specialized training	Increased knowledge on routine inspection of stored produce and cleaning storage structures on a regular basis	Number of actors trained on routine inspection of stored produce and cleaning storage structures on a regular basis	Survey reports Road map reports	✓		Partner States, EAC Secretariat, Industry associations, Technology development institutions in the Partner States	350,000	
Use of appropriate ventilation methods and tools in storage facilities	Technical assistance Exchange programs Specialized training	Increased awareness of different ventilation methods and tools for storage facilities	Number of actors trained on different ventilation methods and tools for storage facilities	Survey reports Road map reports	✓		Partner States, EAC Secretariat, Industry associations, Technology development institutions in the Partner States	200,000	
Use of appropriate transportation systems	Technical assistance Exchange programs Specialized training	Increased ability to deploy appropriate transportation systems	Number of actors able to deploy appropriate transportation systems	Survey reports Road map reports	✓		Partner States, EAC Secretariat, Industry associations, Technology development institutions in the Partner States	200,000	
Apply appropriate unloading techniques	Technical assistance Exchange programs Specialized training	Increased ability to apply appropriate unloading techniques	Number of actors trained on the use of appropriate unloading techniques	Survey reports Road map reports	✓		Partner States, EAC Secretariat, Industry associations, Technology development institutions in the Partner States	150,000	

Activities	Inputs	Outputs	Indicators	Means of verification	Time frame			Responsibilities	Estimated Budget (USD)
					2022-2024	2024-2026	2026-2028		
Hold produce at temporary storage temperatures	Technical assistance Exchange programs Specialized training	Increased ability to hold produce at temporary storage temperatures	Number of actors trained on techniques for holding produce at temporary storage temperatures	Survey reports Road map reports	✓		Partner States, EAC Secretariat, Industry associations, Technology development institutions in the Partner States	100,000	
Apply appropriate sorting/repacking techniques	Technical assistance Exchange programs Specialized training	Ability to organize the layout of the work station used for handling produce at destination	Number of actors trained on organizing the layout of the work station used for handling produce at destination	Survey reports Road map reports	✓		Partner States, EAC Secretariat, Industry associations, Technology development institutions in the Partner States	150,000	
Apply proper display techniques	Technical assistance Exposure visits Specialized training	Ability to apply proper display techniques	Number of actors trained on proper display techniques	Survey reports Road map reports	✓		Partner States, EAC Secretariat, Industry associations, Technology development institutions in the Partner States	150,000	
Utilise different options for processing equipments	Technical assistance Exposure visits Specialized training	Ability to utilize different options for processing equipment's	Number of actor able to utilize different options for processing equipment's	Survey reports Road map reports	✓		Partner States, EAC Secretariat, Industry associations, Technology development institutions in the Partner States	250,000	
Specific preparation for processing	Technical assistance Exposure visits Specialized training Stakeholder consultation meetings	Ability to apply different methods of preparation for processing	Number of actors trained to apply different methods of preparation for processing	Survey reports Road map reports	✓		Partner States, EAC Secretariat, Industry associations, Technology development institutions in the Partner States	550,000	
Support R&D Institutions in the FBV sub-sector	Technical assistance	Build the capacity of R&D institutions to incorporate PLHM issues in a wider research agenda.	Number of R&D institutions supported in incorporating PLHM issues in a wider research agenda.	Survey reports Road map reports	✓		Partner States, EAC Secretariat, Research Institutions, Technology development institutions in the Partner States	550,000	

Activities	Inputs	Outputs	Indicators	Means of verification	Time frame			Responsibilities	Estimated Budget (USD)
					2022-2024	2024-2026	2026-2028		
Establish PHLM research database	Technical assistance	Mobilise research information into a single database	Research information mobilised into a single database	Survey reports Road map reports	✓		Partner States, EAC Secretariat, Research Institutions, Technology development institutions in the Partner States	350,000	
Use R&D to increase the commercialization rate of processed F&V products	Technical assistance	Ability to commercialize PHLM R&D	Number of end-to-end PHLM products developed and commercialized	Survey reports Road map reports			Partner States, EAC Secretariat, Research Institutions, Technology development institutions in the Partner States	450,000	
Commercialize appropriate PHLM innovations into business opportunities	Technical assistance	Ability to commercialize appropriate PHLM innovations into business opportunities	Number of PHLM innovations commercialized into business opportunities	Survey reports Road map reports		✓	Partner States, EAC Secretariat, Research Institutions, Technology development institutions in the Partner States	250,000	
Enhance technology transfer	Technical assistance	Increased ability to promote technology transfer	Number of actors benefiting from technology transfer	Survey reports Road map reports			Partner States, EAC Secretariat, Research Institutions, Technology development institutions in the Partner States	500,000	
Establish PHLM regional technology and innovation laboratories that meet international standards	Technical assistance	Ability to carry out necessary quality infrastructure tests within the region	Number of technology and innovation laboratories established within the region	Survey reports Road map reports		✓	Partner States, EAC Secretariat, Research Institutions, Technology development institutions in the Partner States	2,000,000	
Promote application of ICT solutions in F&Vs:	Technical assistance Training and capacity building	Enhanced ability to attract youth in the F&V sector	Number of innovative ICT solutions developed and operational	Survey reports Road map reports	✓		Partner States, EAC Secretariat, Research Institutions, Technology development institutions in the Partner States	350,000	

Strategic Object 3: Strengthen markets and market infrastructure
Outcome 3: Ability to discharge products in different markets in a timely manner

Activities	Inputs	Outputs	Indicators	Means of verification	Time frame			Responsibilities	Estimated Budget (USD)
					2020-2023	2023-2026	2026-2030		
Promote contract farming model	Technical assistance Exchange visits Stakeholder consultation meetings	Increased ability to link small holder farmers to large commercial entities	Number of farmers participating in the contract farming Schemes	Survey reports Perceptions survey	✓		Partner States, EAC Secretariat, Industry associations, Commercial farms, International partners	450,000	
Establish terminal wholesale markets	Technical assistance Incentive schemes and awareness Stakeholder consultation meetings	Ability to create alternative marketing structures which can provide essential infrastructural services	Number of terminal whole sale markets established in the region	Survey reports Partnership reports Road map reports		✓	Partner States, EAC Secretariat, Industry associations, Commercial farms, International partners	900,000	
Promote digital marketing	Technical assistance Exchange visits	Ability to establish know-like-and-trust relationships between producers and clients	Volume of products traded through the digital marketing platforms	Partnership reports Road map reports			Partner States, EAC Secretariat, Industry associations, Commercial farms, International partners	300,000	
Promote cross-border trade	Technical assistance Industry networking meetings Matchmaking and brokering	Increased ability for small scale farmers to participate in the regional markets/ increased prospects for increasing regional trade	Number of small-scale farmers engaged in the cross-border trade	Regional F&V Facilitation Committee reports Road map reports		✓	EAC Secretariat, National ministries, Border Post Authorities and Inspection bodies, Industry associations, International partners.	600,000	
Improve PHLM market intelligence and dissemination across the whole value chain	Technical assistance Value chain studies Feasibility studies Promotion campaigns Industry networking meetings Stakeholder consultations	An accessible pool of PHLM knowledge for the F&V sector	Number of actors trained in undertaking market intelligence research and analysis in the region	Market research reports Feasibility study reports Value chain analysis reports Road map reports		✓	EAC Secretariat, Government ministries, Producer and processor associations, Industry experts and advisors, International partners.	300,000	

Activities	Inputs	Outputs	Indicators	Means of verification	Time frame			Responsibilities	Estimated Budget (USD)
					2020-2023	2023-2026	2026-2030		
Develop a standard methodology for collecting data and estimating PHL in the EAC	Technical assistance	A harmonised and standardized system for data collection and estimating PHL across the region	A standardized system for data collection and estimating PHL established and operational	Research reports		✓	EAC Secretariat, Government ministries, Producer and processor associations, Industry experts and advisors, international partners.	300,000	
Strengthen post handling systems in the transport infrastructure	Technical assistance Exposure visits	Accelerated rehabilitation and expansion of transport infrastructure and services to support post handling system	Progress in the expansion, rehabilitation and modernization of transportation infrastructure to support post handling systems	Road map reports EAC reports PPP contracts and reports		✓	EAC Secretariat, Government ministries, Investment Authorities in the Partner States, Port Authorities, International partners	600,000	
Improve transport and communication infrastructure in the major EPZs and production corridors	Technical assistance Exposure visits	Modernized transport and communication infrastructure in the major EPZs and production corridors	Increased efficiency of the transport and communication infrastructure in the major EPZs and production corridors	Road map reports EAC reports PPP contracts and reports		✓	EAC Secretariat, Government ministries, Investment Authorities in the Partner States, Port Authorities, International partners	1,000,000	
Establish service-oriented collection centres/satellite collection centres and packhouses:	Technical assistance Awareness meetings and stakeholder consultations Industry networking meetings Matchmaking and brokering	A sub-sector that can guarantee consistent and continuous supply of fresh fruit and vegetables	Number of service-oriented collection centers / satellite collection centers and packhouses established	Contract reports Partnership reports Road map reports		✓	EAC Secretariat, Industry associations, Local Government Authorities (LGAS) in respective partner States, International partners.	870,000	

Activities	Inputs	Outputs	Indicators	Means of verification	Time frame			Responsibilities	Estimated Budget (USD)
					2020-2023	2023-2026	2026-2030		
Integrated solutions to attract off-takers	Technical assistance Awareness meetings and stakeholder consultations Industry networking meetings Matchmaking and brokering	Increased ability to attract off-takers to engage in purchasing activities:	Increase in the number of off-takers engaging in purchasing activities:	Contract reports Partnership reports Road map reports		✓	EAC Secretariat, Industry associations, Local Government Authorities (LGAS) in respective partner States, International partners.	870,000	

Strategic Object 4: Improve safety and quality infrastructure
Outcome 4: Increased ability to comply to international safety and quality standards for F&V

Activities	Inputs	Outputs	Indicators	Means of verification	Timeframe			Responsibilities	Budget (USD)
					2020-2023	2023-2026	2026-2030		
Apply appropriate practices to ensure clean soil	Technical assistance Trainings Exchange visits	Increased ability to maintain clean soils	-Number of actors complying to practices for maintaining clean soil	Compliance reports Trend reports	✓		EAC Secretariat, National ministries, industry associations, international partners	600,000	
Apply appropriate practices to promote water sanitation/clean water	Technical assistance Meetings and workshops Exchange visits	-Increased ability to comply to standard practices for promoting water sanitation	-Number of actors complying to standard practices for promoting water sanitation	Compliance reports - Trend reports	✓		EAC Secretariat, National ministries, industry associations, international partners	250,000	
Maintaining clean surfaces	Technical assistance Meetings and workshops Exchange visits	Increased ability to comply to standard practices for maintaining clean surfaces	Number of actors complying to standard practices for maintaining clean surfaces	Compliance reports - Trend reports	✓		EAC Secretariat, National ministries, industry associations, international partners	300,000	
Promote hand sanitation practices	Technical assistance Meetings and workshops Exchange visits	Increased ability to comply to standard sanitation practices	Number of actors complying to standard sanitation practices	Compliance reports - Trend reports	✓		EAC Secretariat, National ministries, industry associations, international partners	150,000	
Establish hand wash stations	Technical assistance Meetings and workshops Exchange visits	Ability to promote health practices at harvest level	Number of hand wash stations developed and operational	Compliance reports - Trend reports	✓		EAC Secretariat, National ministries, industry associations, international partners	300,000	
Use of field tools and containers:	Technical assistance Meetings and workshops Exchange visits	Ability to comply to procedures for cleaning field harvesting tools	Number of actors practicing standard procedures for cleaning field harvesting tools	Compliance reports - Trend reports	✓		EAC Secretariat, National ministries, industry associations, international partners	300,000	
Promote employee hygiene	Technical assistance Meetings and workshops Exchange visits	Ability to maintaining the cleanliness of employees handling produce at all stages	Number of enterprises reporting increased ability to maintain cleanliness of employees handling produce at all stages.	Compliance reports - Trend reports	✓		EAC Secretariat, National ministries, industry associations, international partners	300,000	

Activities	Inputs	Outputs	Indicators	Means of verification	Timeframe			Responsibilities	Budget (USD)
					2020-2023	2023-2026	2026-2030		
Apply best practice for care of equipments	Technical assistance Meetings and workshops Exchange visits	Ability to maintaining best practices for care of equipment's	Number of enterprises reporting increased ability to maintain best practices for care of equipment's	Compliance reports - Trend reports	✓		EAC Secretariat, National ministries, industry associations, international partners	300,000	
Apply best practices for handling packaging materials	Technical assistance Meetings and workshops Exchange visits	Ability to apply and maintain the best practices for handling packaging materials	Number of enterprises reporting increased ability to apply and maintain the best practices for handling packaging materials	Compliance reports - Trend reports	✓		EAC Secretariat, National ministries, industry associations, international partners	300,000	
Promote use of refrigerated Transport	Technical assistance Meetings and workshops Exchange visits	Ability to maintaining optimum temperatures appropriate for specific products on transit	Number of enterprises reporting increased ability to maintain optimum temperatures appropriate for specific products on transit	Compliance reports - Trend reports	✓		EAC Secretariat, National ministries, industry associations, international partners	500,000	
Sanitizing field containers, tools and packhouse surfaces	Technical assistance Meetings and workshops Exchange visits	Increased use standard practice for handling sanitizers for cleaning purposes	Number of enterprises reporting increased ability to use standard practice for handling sanitizers for cleaning purposes	Compliance reports - Trend reports	✓		EAC Secretariat, National ministries, industry associations, international partners	550,000	
Build the capacity of enterprises to comply with international standards and market requirements	Technical assistance Exchange programs Quality infrastructure support Trainings	Improved ability of national laboratories to perform internationally-recognized testing and calibrations	-Number of accredited institutions supported to perform internationally-recognized product testing and calibrations -Increased capacity of accreditation institutions to credit laboratories, system certifiers and inspection bodies	-Survey reports -Compliance reports -Road map reports	✓		EAC Secretariat, National ministries, industry associations, international partners EAC Secretariat, National ministries, industry associations, international partners	500,000	

Activities	Inputs	Outputs	Indicators	Means of verification	Timeframe			Responsibilities	Budget (USD)
					2020-2023	2023-2026	2026-2030		
Harmonize the technical requirements across the region, and in the export markets	Technical assistance Exchange programs Quality infrastructure support Trainings	Enhanced ability for EAC to adapt and institutionalize uniform technical requirements and specifications across the region	- Progress in harmonizing technical regulations, -A robust system for notification of new technical regulations established -A standardization system for Food Standards within the EAC, Africa region and internationally	Survey reports -Compliance reports -Road map reports		✓	EAC Secretariat, National ministries, NSBs, NPOs, Food Safety Institutions, EASC), Industry associations, international partners	750,000	
Refurbish and upgrade chemical and microbiological laboratories	Technical assistance Exchange programs Quality infrastructure support Trainings	Increased ability to use competent authorities within the region to perform product quality and safety control	Number of laboratories upgraded and operational	Survey reports Road map reports		✓	EAC Secretariat, National ministries, NSBs, NPOs, Food Safety Institutions, EASC), Industry associations, international partners	950,000	
Strengthen the certification and guarantee systems									
Capacity building of actors in complying with the standard certification and guarantee systems	Technical assistance Training and capacity building programs	Increased ability to cope with management and food safety standards adopted in the fresh F&V industry.	No of actors (i.e. exporters, traders, processors) meeting extra certification and guarantee requirements.	Survey reports -Compliance reports -Road map reports		✓	EAC Secretariat, National ministries, Regulatory agencies, Industry associations, international partners	300,000	

Strategic Object 5: Climate Smart Management Systems
Outcome 5: Enhanced resilience of the F&V sector

Activities	Inputs	Outputs	Indicators	Means of verification	Timeframe			Responsibilities	Budget (USD)
					2020-2023	2023-2026	2026-2030		
Develop and mainstream sectoral climate change adaptation and mitigation strategy	Technical assistance Training and capacity building programs	Increased ability to cope with changing climate conditions and impacts (damages and losses)	No of enterprises reporting use of climate smart agriculture	Trend reports Road map reports		✓	EAC Secretariat, Government Ministries, Local Government Authorities (LGAs), Environmental Management Councils, Regulatory agencies, Industry associations, international partners	450,000	
Establish crop insurance schemes:	Technical assistance Training and capacity building programs	Decreased vulnerability of the F&V sector	No of enterprises ensured	Trend reports Road map reports			EAC Secretariat, Government Ministries, Local Government Authorities (LGAs), Environmental Management Councils, Industry associations, international partners	700,000	
Develop an integrated approach to microfinancing, climate change, and food security	Technical assistance Training and capacity building programs	Enhanced mid-stream investments and partnerships	Number of new partnerships and midstream investments	Trend reports Road map reports		✓	EAC Secretariat, Government Ministries, Local Government Authorities (LGAs), Environmental Management Councils, Industry associations, international partners	350,000	

Strategic Object 6: Build local skills and knowledge base

Outcome 6: Increased ability to develop and maintain sufficient capacity of industry specific skills

Activities	Inputs	Outputs	Indicators	Means of verification	Timeframe			Responsibilities	Budget (USD)
					2020-2023	2023-2026	2026-2030		
Conduct curriculum review for local institutions	Technical assistance Skills gap analysis Consultative meetings Trainings and industrial attachments	Increased ability for local institutions to produce "job ready" graduates	-Gap analysis conducted -Database for key industry specific skills developed -Number of refresher trainings to align the current skill set to industrial requirements	Curriculum review reports	✓		EAC Secretariat, National Ministries, Academia, Technical and Vocational Education (TVEs) Institutions, Industry associations, International partners	300,000	
Enhance the capacity of the TVET system	Technical assistance Consultative meetings	Increased ability of TVET systems to respond to industry needs in PHLM	-Collaboration between the TVET system and the industry, education and research institutions on technical issues related to PHLM -Gaps in the National Qualification Frameworks, addressed with respect PHLM	Collaboration agreements reports -Road map reports	✓		EAC Secretariat, National Ministries, Academia, Technical and Vocational Education (TVEs) Institutions, Industry associations, International partners	750,000	
Invest in proven models of technology transfer and skills development in the region	Technical assistance Consultative meetings Exposure visits and industrial attachments	Enhanced practical skill base for PHLM of lower field practitioners	Increased technological transfer infrastructure between the industry, academia, and research institutions on issues related to PHLM	Collaboration agreements reports -Road map reports		✓	EAC Secretariat, National Ministries, Academia, Technical and Vocational Education (TVEs) Institutions, Industry associations, International partners	450,000	
Invest in selected higher level specialized skills	Technical assistance High level education/ trainings	Promote "thought leadership" on PHLM in the industry	Number of practitioners receiving higher education in specialised PHLM skills and practices	Trend reports Road map reports		✓	EAC Secretariat, National Ministries, Academia, Industry associations, International partners	850,000	
Develop strategic linkages with private sector	Technical assistance Consultative meetings Exposure visits and exchange programs	Increased ability of the industry to address the needs of the private sector	-Number of industrial attachments; internships, incubation and apprenticeships schemes on PHLM	Collaboration agreements reports -Road map reports		✓	EAC Secretariat, National Ministries, Academia, Technical and Vocational Education (TVEs) Institutions, Industry associations, International partners	750,000	

Activities	Inputs	Outputs	Indicators	Means of verification	Timeframe			Responsibilities	Budget (USD)
					2020-2023	2023-2026	2026-2030		
Develop regional wide skill development policies	Technical assistance Consultative meetings	Regional wide skill development policy for PHLM	Skills development policies on PHLM in place at regional level	Policy documents and reports Road map reports	✓		EAC Secretariat, National Ministries, Academia, Technical and Vocational Education (TVEs) Institutions, Industry associations, international partners	200,000	
Establish a single database for PHLM information	Technical assistance	Increased access to PHLM information by the users	Single database established and operational	Road map reports		✓	EAC Secretariat, National Ministries, Academia, Industry associations, international partners	75,000	
Develop a standard methodology for collecting data and estimating PHLM in the region	Technical assistance	A common approach in in data collection, analysis and dissemination	Standard methodology developed and operational	Road map reports			EAC Secretariat, National Ministries, Academia, Industry associations, international partners	75,000	
Improve PHL research capacity across the whole value chain	Technical assistance	A pool of knowledge on PHLM widely available in the region	Number of researchers trained on improved methods of research	Road map reports		✓	EAC Secretariat, National Ministries, Academia, Industry associations, international partners	150,000	

Strategic Object 7: Strengthen Partnership, coordination, institutional and policy framework

Outcome 7: Enhanced industry coordination institutional and policy framework

Activities	Inputs	Outputs	Indicators	Means of verification	Timeframe			Responsibilities	Budget (USD)
					2020-2023	2023-2026	2026-2030		
Introduce a "catalytic" fund / endowment fund	Technical assistance Exposure visits	Enhanced ability for funding targeted investment activities in PHLM	Catalytic fund established and operational	Road map reports Partnership reports		✓		75,000	
Establish a "Revolving Fund" for the sub-sector	Technical assistance Exposure visits	Enhanced ability for funding targeted investment activities in PHLM		Road map reports Partnership reports		✓		55,000	
Promote Public Private Partnership (PPP)	Technical assistance Exposure visits	Increased joint investments in the sector	Number of PPP established and operational	Road map reports		✓		200,000	
Establish national and regional PHLM Coordination Committee" (RPHLMCC)	Stakeholder meetings	Formal mechanism for bringing together various value chain actors to discuss issues of mutual interest.	Regional PHLM Coordination Committee" (RPHLMCC)	Meeting reports	✓		EAC Secretariat, National Ministries, Industry associations, international partners	150,000	
Facilitate and fast-track the implementation of existing policies	Technical assistance Consultative meetings	Increased ability to track policy changes in PHLM	Mechanisms for tracking policy changes established and operational	Policy documents and reports Road map reports	✓		EAC Secretariat, National Ministries, Industry associations, International partners	270,000	
Provide capacity building for the implementation of the PHLM Strategy	Technical assistance Consultative meetings	Increased institutional capacity to oversee the implementation of PHLM Strategy in respective Partner States	Number of training programs in specific areas of competency	Training reports Road map reports		✓	EAC Secretariat, Government Ministries and Agencies, National institutions, Industry associations, International partners	290,000	
Incorporate advocacy component in the PHLM Strategy.	Technical assistance Consultative meetings	Increased ability to advocate policy related PHLM issues in the industry	Public Private Dialogue (PPD) structure in place and operational	PPD reports Road map reports		✓	EAC Secretariat, Government Ministries, Local Government Authorities (LGAs) Industry associations, international partners	150,000	



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