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MINISTRY OF AGRICULTURE



Postharvest Management Strategy of Ethiopia (PHMSE)



THE FEDERAL DEMOCRATIC REPUBLIC OF ETHIOPIA

MINISTRY OF AGRICULTURE

POSTHARVEST MANAGEMENT STRATEGY OF ETHIOPIA (PHMSE)

(Grains, Horticultural Crops and Animal Source Foods)

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MESSAGE FROM THE MINISTER

Ethiopia is in the process of building an inclusive economic system that aims to ensure the prosperity of its people. The Government plays a crucial role in achieving this by facilitating the fair distribution of wealth and intervening in strategic areas while adhering to the principles of a market-led economy. One of the key objectives of the Government's strategic plan is to industrialize the nation's agriculture, making it less reliant on traditional practices focused on exports and reducing imports. This approach places particular emphasis on generating employment opportunities, enhancing food and nutrition security, and promoting agro-industrial development. To achieve these goals, the sector has developed new sectorial policies, ten in-ten programs and flagship initiatives.

Up until now, our primary focus has been on increasing the production and productivity of agri-food products, but with less attention given to postharvest management (PHM) compared to pre-harvest practices, however, it is essential to address the issue of postharvest losses (PHLs) to a greater extent. The leading causes of PHLs reported are inadequate infrastructure and logistics, high water content in produce, and improper PHM. Studies indicate that PHL in grains ranges from 20% - to 30%, while for horticultural products, it is substantially higher, reaching (30%-to 50%). Milk and meat losses are around 30% and 40% respectively. These have significant implications for our nation's economy, society, and environment.

To tackle these challenges effectively, it is necessary to strategically design interventions aimed at reducing postharvest losses (PHLs) along the value chain of agricultural food commodities. Consequently, Ethiopia developed its first strategy in 2018, called the Postharvest Management Strategy of Grains in Ethiopia. However, this strategy was not comprehensive enough and did not adequately address other commodities such as fruits, vegetables, roots, tubers, flowers, spices, tea, coffee, meat, milk, honey, and fish. Therefore, there is a pressing need to create a more comprehensive postharvest management strategy that identifies key interventions to reduce PHLs across all relevant commodities value chains.

The Ministry of Agriculture, in collaboration with distinguished professionals from universities, research institutions, FAO, SAA, professional associations, NGOs, and other essential stakeholders, has developed this National Postharvest Management Strategy of Ethiopia (PHMSE). This strategy is designed to be implemented over seven years and will primarily focus on agri-food commodities, including cereals, fruits and vegetables, roots and tubers, and animal food products. The strategy offers significant interventions to mitigate postharvest losses and address the country's food deficits.

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Minister for Agriculture

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Mrs. Alemtehay Sergawi
Head, Food and Nutrition Office
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LIST OF ACRONYMS AND ABBREVIATIONS

AGDP	Agricultural Gross Domestic Product
AGP	Agriculture Growth Program
AGRA	Alliance for a Green Revolution in Africa
AI	Artificial Intelligence
ARARI	Amhara Regional Agricultural Research Institute
ATVETs	Agricultural Technical Vocational Education Technical Centers
AUC	African Union Commission
CBE	Commercial Bank of Ethiopia
CPHMSE	Comprehensive National Postharvest Management Strategy
CSA	Central Statistical Agency
DAAD	German Agency for International Cooperation
DAs	Development Agents
DOC	Day Old Chicks
ECC	Ethiopian Cooperatives Commission
EDB	Ethiopian Development Bank
EIAR	Ethiopian Institute of Agricultural Research
EIC	Ethiopian Investment Commission
FAO	Food and Agriculture Organization of the United Nations
FCC	Federal Cooperative Commission
FDI	Foreign Direct Investment
FFS	Farmers Field School
FTC	Farmer Training Center
GDP	Gross Domestic Product
GIZ	Gesellschaft für International Zusammenarbeit
PHM	Postharvest Management
GoE	Government of Ethiopia
GTP	Growth and Transformation Program
IAIP	Integrated Agro-Industrial Park
ICT	Information communication Technology
IGAD	Intergovernmental Authority for Development
IMF	International Monetary Fund
IMS	Information Management Institute
LLPs	Losses in Livestock Products
LMP	Livestock Master Plan
M&E	Monitoring and Evaluation

MinT	Ministry of innovation and Technology
MOA	Ministry of Agriculture
MoE	Ministry of Education
MoIT	Ministry of industry and Trade
MoT	Ministry of Transport
MoTRI	Ministry of Trade and Regional Integration
MoWE	Ministry of Water and Energy
NBE	National Bank of Ethiopia
NGO	Non-Government Organization
NNP	National Nutrition Program
NSA	Nutrition sensitive Agriculture strategy
OARI	Oromia Agricultural Research Institute
PHL	Post-harvest Loss
PHLM	Postharvest loss Management
PHT	Postharvest Technology
PIF	Policy and Investment Framework
PFS	Pastoral Field School
PTC	Pastoral Training Center
RAB	Regional Agricultural Bureaus
SAA	Sasakawa Africa Association
SARI	Southern Agricultural Research Institute
SDC	Swiss Development Cooperation
SDG	Sustainable Development Goals
SMSE	Small and Medium-Scale Enterprises
SNNPR	Southern Nations Nationalities People Region
SWOT	Strength Weakness Opportunities and Threats
TARI	Tigray Agricultural Research Institute
TVET	Technical Vocational Education Technical Centers
UN	United Nations
UNDP	United Nations Development Program
USAID	United States Agency for International Development
USD	United States Dollar
VAT	Value Added Tax
WRI	World Resource Institute

TECHNICAL DEFINITION

This technical definition aims to assist novice readers in understanding the basic terminologies used in the PHMSE.

- **Agri-food commodities:** These encompass plant and animal products and their by-products, including cereals, fruits, vegetables, roots, tubers, fish, poultry, meat, milk, etc.
- **Crop value chain :** The entire lifecycle of a product or process, starting from material sourcing, production, consumption, and disposal/recycling processes.
- **Grain crops:** Any of the crop plants belonging to the grass family (Poaceae or Gramineae) that are generally grown for their edible starchy seeds example, wheat, rice, corn (maize), barley, rye, oats, sorghum, and millet.
- **Harvesting:** The operation of gathering the valuable part or parts of the plant and is carried out at the time when all the nutrients have developed and the edible parts have reached the appropriate degree of maturity.
- **Horticultural crops:** These include fruits, vegetables, roots, tubers, and medicinal, aromatic, and ornamental plants.
- **Postharvest handling** is the stage of crop production immediately following harvest, including cooling, cleaning, sorting, and packing.
- **Postharvest loss (PHL):** Measurable quantitative and qualitative losses along the food supply chain from the production site to where the food product is prepared for processing or consumption.
- **Quantitative loss:** Refers to decreased edible food mass available for human consumption.
- **Qualitative loss:** Occurs when food loses its quality attributes, resulting in a loss of economic, social, and nutritional value.
- **Postharvest management:** A system of handling, storing, and transporting agricultural commodities after harvest.
- **Value chain actors:** The various actors involving in transacting a particular product as it moves through the value chain, including input suppliers (e.g., seed suppliers), farmers, traders, processors, transporters, wholesalers, retailers, and final consumers

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EXECUTIVE SUMMARY

The Government of Ethiopia (GoE) attributes the improved use of inputs and advisory services to enhance agricultural production, increase productivity, ensure food and nutrition security, sustain a raw material supply for the agro-industry, improve exports, and create more employment opportunities for its citizens. However, the high magnitude of postharvest losses (PHL) and other socioeconomic problems contribute to the nation's continued food and nutrition insecurity. In response to this issue, the MoA has developed the National Postharvest Management Strategy (PHMSE) to be implemented from 2023 to 2030, focusing on three commodity groups: grain crops, horticulture crops, and animal source foods. The strategy comprises six strategic objectives with critical interventions aimed at reducing PHL and mitigating the prevailing food shortage in the country. It was developed as comprehensive unlike to the earlier Postharvest Management Strategy of Grains in Ethiopia. The strategy aligns with the National Food and Nutrition Policy, National Food and Nutrition Strategy, and the Ten Years Perspective Plan of the country, demonstrating thoughtful consideration in its development. Additionally, the PHMSE is designed to support Ethiopia's efforts in achieving the goals of the African Union's Malabo Commitment. The Malabo Commitment, adopted by the African Union Heads of State and Government in June 2014, aims to eliminate hunger in Africa by 2025, with Target 3b specifically aiming to halve the current levels of PHL by 2025. The strategy's contribution lies in assisting the GoE in fulfilling the African Union Malabo Commitment of halving postharvest losses by 2025. Moreover, the PHMSE aligns with the United Nations General Assembly for Sustainable Development Goal of 12.3 is to reduce per capita global food waste at the retail and consumer levels and reduce food losses along production and supply chains by 2030. To ensure joint ownership of the strategy and seamless coordination among the various actors and stakeholders, the PHMSE has been designed with a participatory approach, involving diverse stakeholders. The effective execution of this strategy, with the cooperation and commitment of all relevant parties, will reduce PHL, sufficiently contribute to national food and nutrition security, and promote the inclusive economic development of the entire nation.

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1. INTRODUCTION

1.1. Backgrounds

Ethiopia, with a population of approximately 123 million people as of 2022, is the second most populous country in Africa, following Nigeria (World Bank, 2022). It has a growth rate of 2.6% and maintains the title of the fastest-growing economy in the region, experiencing a growth rate of 6.3% in the fiscal year 2020/21. Over the past 15 years, Ethiopia has consistently been one of the world's fastest-growing economies, averaging a growth rate of 9.5% per year. The agricultural sector contributes significantly to Ethiopia's economy, accounting for 38% of the GDP, over 85% of foreign earnings, and playing a vital role in food and nutrition security as well as overall economic development (World Bank, 2022). Despite the notable growth in manufacturing, agriculture remains the primary source of export earnings. In fact, 80% of the country's export revenues and 21% of total government revenues are derived from agricultural exports. However, it is worth noting that the majority of agricultural exports are in an unprocessed form, with only one percent being processed. Unprocessed commodities dominate the agricultural export sector, while processed food imports are growing at a faster rate than exports (Heinz, 2021).

To date, the Government of Ethiopia's main focus is on increasing production and productivity of agricultural produce. However, there is a lack of attention given to postharvest management compared to pre-harvest practices. It is important for postharvest policies, strategies, and guidelines to consider technical suitability

ity, economic viability, social acceptance, and environmental sustainability. The key challenges in postharvest management in Ethiopia include a lack of emphasis on postharvest management in policies and strategies, inadequate infrastructure, logistics, and market systems, limited adoption of postharvest management technologies and practices, limited access to financial resources, absence of a comprehensive database and information system for postharvest management, weak regulatory systems for enforcing quality standards, and limited capacity for postharvest management among other issues.

Improper postharvest management systems contribute to grain crop losses across various stages of the postharvest chain, from harvest to consumption. Studies conducted by different researchers have demonstrated that crop losses from maturity to consumption or sale are significantly high. The estimated range of postharvest losses in grains is between 20% and 30%, although the specific extent varies depending on the commodity. Critical points where losses occur include harvesting, drying, threshing/winnowing, and storage. In comparison, postharvest losses in horticultural crops are even higher, ranging from 30% to 50% (FAO, 2023). The main factors driving these losses include the high-water content of the produce, inadequate postharvest management practices, and the lack of developed infrastructure and logistics.

Livestock production plays a crucial role in the livelihoods of millions of smallholder farmers, agro-pastoralists, and pastoralists in Ethiopia. The country boasts the largest livestock population in Africa, with approximately 70.29 million cattle, 52.46 million goats, 42.92 million sheep, 8.15 million camels, 6.99 million colo-

nies/hives, and 57 million poultry (MoA, 2015). Additionally, Ethiopia has significant potential for fish production, estimated at 94,500 tons per year from natural water bodies, as well as ample opportunities for aquaculture. Consequently, the country's production of meat, milk, eggs, fish, and honey amounts to approximately 400,000 tons, 7.3 million liters, 1.5 million eggs, 73,000 tons of fish, and 142,000 tons of honey (MoA, 2015). Livestock is a vital component of Ethiopia's economy, contributing 26% to the GDP, supporting the livelihoods of 70% of the population, and generating around 8% of annual export earnings. The livestock sub-sector not only adds value and creates employment but also contributes to national income, supplies inputs to agro-processing and leather industries, and provides a source of protein for balanced nutrition.

Livestock and its products in Ethiopia experience significant postharvest losses due to their perishable nature and inadequate postharvest management practices across the value chain. In the country, approximately 40% of red meat produced is lost during various postharvest activities such as handling, transportation, marketing of live animals (cattle, sheep, goats, and camels), butchering, and retailing. This amounts to around 175 thousand tons of red meat lost annually (CSA, 2021). Similarly, the postharvest loss for milk is estimated to be 40% (CSA, 2021). These high levels of postharvest loss pose a significant challenge in meeting the growing demand for animal-origin food products. Moreover, they have a detrimental impact on food and nutrition security, as well as on the socioeconomic and environmental aspects of the country.

In a nutshell, the underlying causes exacerbating the postharvest losses in agri-

cultural commodities are the lack of supportive policies, strategies, and programs to reduce these losses, gaps in human resource capacity, absence of processing technologies, lack of standardized processing regulations, inefficient extension systems, outdated storage systems, poor infrastructure, and insufficient development of postharvest handling and marketing systems. The Ethiopian government has mainly focused on increasing production and productivity, neglecting the importance of postharvest aspects. However, it is clear that addressing these challenges and ensuring food and nutrition security requires a focus on postharvest strategies and collaboration among different stakeholders.

In response to this scenario, the Ethiopian Ministry of Agriculture (MoA) and various stakeholders collaborated to develop this Postharvest Management Strategy of Ethiopia (PHMSE). The PHMSE will be implemented over a period of seven years, focusing on horticultural crops, grains, and animal-source foods. Its purpose is to address the issue of postharvest losses and bridge the food and nutrition gap by providing effective interventions.

1.2. International, regional and National policies, Strategies and Programmes on PHM

Cognizant of Sustainable Development Goal 12, (aims to achieve sustainable consumption and production patterns), which calls for halving per capita food waste at the retail and consumer levels, as well as minimizing food losses throughout the production and supply chains including reducing PHL by 2030 (CSA, 2021). The policies and strategies within regional contexts acknowledge the significance of postharvest management (PHM) in attaining food and nutrition security.

The African Union Heads of State and Government have made a commitment to end hunger by 2025, including a goal to reduce postharvest losses by 50% by that time. The African Union Commission and the Intergovernmental Authority for Development (IGAD) have also developed strategies in 2021 to address postharvest losses in the region. Despite the efforts of the Government of Ethiopia in setting policies and programs, challenges still remain in managing postharvest losses, such as inadequate services, limited infrastructure, and a lack of relevant technologies. The strategy will provide guidance for both the public and private sectors in addressing these issues, taking into account ongoing institutional and policy reforms, as well as the country's new political system and government structure.

Ethiopia has experienced significant economic growth, partly due to the effective policies, plans, and programs implemented by the government. The country has focused on developing the agriculture and livestock sectors through initiatives like the Agricultural Development Led Industrialization (ADLI) and the Plan for Accelerated and Sustained Development to End Poverty (PASDEP). PASDEP, implemented from 2005/06 to 2009/10, recognized the importance of addressing postharvest losses (PHL) and aimed to reduce PHL from 15% in 2006 to 10% by 2010 (CSA, 2021). The plan targeted reducing pre-harvest crop loss to 25% and post-harvest crop loss to 10%, with a goal of achieving a 2% annual reduction of crop loss during the plan period. However, there is a need for sufficient information on the progress made towards these targets. The subsequent Growth and Transformation Plan I (GTP I: 2011-2015) did not explicitly address PHL or set any specific targets. However, the second Agricultural Sector Growth and Transformation Program (GTP II) (2015 - 2020) aimed to significantly reduce overall PHL, setting an

ambitious target of reducing it from the current estimated range of 5-25% to 5% by 2025 (Gashew and Wolff, 2014).

The Ten-Year Economic Development Plan (2020/21-2029/30) in Ethiopia focuses on enhancing agriculture, with a projected annual growth rate of 6.20% (NBE, 2021). The plan aims to increase agricultural export revenues, reduce production costs, and substitute imports. It emphasizes the promotion of postharvest activities, including mechanization, market infrastructure, agro-processing, transportation, and logistics. Postharvest management (PHM) has been recognized as a crucial factor in achieving the ambitious goals of the plan. Specific targets for reducing postharvest losses (PHL) have been set for different agricultural commodities. Additionally, various programs and strategies have been implemented in conjunction with food and nutrition initiatives. These include the Agriculture Growth Program (AGP), the Policy and Investment Framework (PIF), the Nutrition-Sensitive Agriculture Strategy (NSA), the Livestock Master Plan (LMP), and the National Nutrition Program (NNP). The food and nutrition policy and the Food and Nutrition Strategy (FNS) of Ethiopia give special attention to interventions for ensuring food safety and reducing postharvest losses. Postharvest management is one of the three main pillars of intervention in the FNS. Furthermore, a national food safety strategy is being developed, with postharvest management as one of the areas of focus. The Ethiopian Institute of Agricultural Research (EIAR) has developed a national postharvest management strategy that is yet to be implemented.

The Government has initiated a 10-Year Development Plan based on the 2019 Home-Grown Economic Reform Agenda. This plan will be implemented from

2020/21 to 2029/30 and aims to continue the impressive growth achieved in the previous decade under the Growth and Transformation Plans. It also seeks to promote a more private-sector-driven economy, enhance efficiency, and introduce competition in key sectors such as energy, logistics, and telecom. Additionally, the plan aims to improve the business environment, address macroeconomic imbalances, and participate in regional and international initiatives focused on agricultural-led economic development.

1.3. Rationale

The production of food requires a substantial amount of our limited natural resources, such as water, soil, energy, labor, and time. Additionally, it faces various obstacles like diseases, insect pests, and natural disasters. However, the challenges don't stop there, as the food goes through multiple stages of postharvest handling before it reaches the consumer, resulting in losses at each step. These losses, both before and after harvest, are a significant concern for producers, as well as other stakeholders in the supply chain, businesses, industries, and policymakers.

Approximately 1.3 billion metric tons (one-third), of the world's food is lost or wasted. In sub-Saharan Africa alone, it is estimated that 100 million metric tons of food are lost each year. The value of post-harvest losses (PHL) for grains in this region is estimated at USD 4 billion annually, which is enough to feed about 48 million people for a year. This amount exceeds the value of grain imports into Africa and the total food aid received in sub-Saharan Africa over the past decade (Gashew and Wolff, 2014).

The reported figures for post-harvest losses (PHL) in grains, horticultural crops,

and animal-sourced foods (such as fish, milk, meat, and eggs) are concerning, and the Ministry of Agriculture (MoA) in Ethiopia recognizes the significant impact of food loss and waste. While the current policy environment acknowledges the importance of reducing PHL, existing agricultural and sectorial strategies have not given enough attention to post-harvest management (PHM) as a means to achieve national goals of ensuring food and nutrition security, sustainable supply of raw materials to agro-industries, promoting exports, generating employment, and fostering inclusive national development.

Due to their nature, horticultural crops such as fruits, vegetables, root, and tuber crops and animal-sourced commodities like milk, meat, and fish) are highly perishable, making them prone to significant losses throughout their value chains. In the 2020/2021 period, Ethiopia produced a total of 42.13 million tons of grain and horticultural crops (Gashew and Wolff, 2014). Unfortunately, around 12 million tons of this food were lost due to inadequate post-harvest loss (PHL) management practices and systems. This exacerbates the already existing food insecurity in the country, as the lost food could have provided sustenance for approximately 46 million people. It is ironic that Ethiopia had to resort to importing food and relying on aid to feed 8-10 million food-insecure individuals. It is important to consider the impact of these losses on food and nutrition security, economic factors, and the environment.

Despite the severity of the issue, there is a need for increased awareness at various levels about the significant economic, social, and environmental impacts of food loss and waste. Post-harvest losses (PHL) result in the wastage of production

resources, including seeds, water, fertilizer, agrochemicals, land, animal feed, and veterinary drugs. It also leads to the loss of food and income for those involved in the value chain. The reduction of PHL is globally recognized as an opportunity to address food and nutrition insecurity, reduce greenhouse gas emissions, and promote economic development. Therefore, preventing PHL offers triple benefits: saving money for farmers, companies, and households, utilizing resources to feed more people, and lessening the strain on water, land, and the climate. In addition to efforts to increase production and productivity, low-income countries like Ethiopia must ensure that the food produced reaches the intended consumers.

Therefore, it is crucial to have a strategy to mitigate post-harvest losses, building upon existing global and regional initiatives and commitments, such as the Malabo Declaration, to create synergies for progress. For more detailed information, please refer to the situation analysis section.

2. METHODOLOGY

It was crucial to develop a strategy that was widely accepted, comprehensive, feasible, and internally consistent, with clear objectives and well-defined interventions. To achieve this, active participation from various key stakeholders was sought, including value chain actors and experts in crop production, horticulture, animal production, regulation, mechanization, and other relevant fields. The strategy was developed by a thorough review of national, regional, and international strategies, declarations, regulations, guidelines, and project documents related to post-harvest management (PHM) and its associated aspects.

A team of highly skilled experts and professionals from various sectors, including public, private, NGOs, international organizations, cooperatives, unions, professional associations, consumer associations, and financial institutions, were involved in the preparation of the strategy. Recognizing the extensive expertise of these individuals in their respective fields, a series of discussions and consultations were conducted to assess the current situation through a comprehensive SWOT analysis. This analysis served as the foundation for identifying the targets of our Postharvest Management System by 2030 and determining the appropriate approaches to pursue.

In the end, a validation meeting was organized to involve all the stakeholders more deeply and make sure that the strategy accommodates essential components for implementation. The success of the strategy in achieving its goals depends on the extent of consultation, involvement, and subsequent support from policymakers.

3. SCOPE

Unlike the previous postharvest strategy that specifically targeted grain crops, the scope of this strategy is broad. It includes grain crops, horticultural crops, and animal-source foods (milk, meat, fish, honey, and poultry) from production to consumption. This strategy will be endorsed at the national level to guide postharvest loss reduction interventions and activities to be implemented from 2023/24 to 2030.

Specifically, the strategy focuses on the broad areas of priority, the type of interventions needed in these areas, who will be involved in these interventions, and

the level and nature of responsibilities of the players, among others.

4. SITUATION ANALYSIS

Postharvest loss is among the major concern globally. The United Nations general assembly has established 17 sustainable development goals for 2030, with postharvest loss being one of the key focus areas of SDG 12, which aims to “Ensure sustainable consumption and production patterns”.

The Government of Ethiopia prioritized postharvest loss as a major bottleneck to the country’s agricultural and industrial progress, and has therefore implemented various strategic measures to address this issue. However, the strategic directions could be more cohesive and sometimes fail to comprehensively address the entire supply chain. Postharvest losses occur at various stages of the Food Supply Chain (FSC), including production/rearing, harvesting/slaughtering, postharvest handling, processing, distribution, storage, and consumption (MoA, 2022; FAO, 2023). The magnitude of these losses may differ depending on factors such as the type of commodity, country, and stage of the FSC. In physical terms, the food that is removed from the supply chain and goes unconsumed due to various reasons, such as spillage, consumption by pests, and physical changes in temperature, moisture content, and chemical changes. The quantity of food lost during postharvest would have deteriorated, making it unfit for consumption or unable to meet the regulated standards for use as animal feed, resulting in its disposal.

Qualitative loss can arise from various factors such as the presence of insect pests, mites, rodents, and birds, as well as improper handling, physical changes, and chemical changes in the composition of fats, carbohydrates, and proteins. It can

also result from contamination by mycotoxins, pesticide residues, insect fragments, physical impurities, or excreta from rodents and birds, including their dead bodies. In most instances, the deterioration in quality is accompanied by a substantial decrease in nutritional value, which can have implications for the health and nutrition of the entire community (MoA, 2022).

4.1. Status of postharvest loss

Although there is a lack of precise data on the extent of food losses and waste in the global food system, the available evidence suggests that approximately one-third of the food produced is lost or wasted from production to consumption. In the case of Ethiopia, the information on postharvest losses is limited. However, studies conducted by the FAO (Figure 1) indicate that the overall postharvest loss for grain and horticultural crops in the country ranges 10% to 50% (MoA, 2022). Specifically, the postharvest loss of grain crops is estimated to be 5% to 26% from the marketing stage to consumption (FAO, 2017). Additionally, self-reported post-harvest losses of cereals by farmers in selected areas were estimated to be around 24% (MoA, 2022).

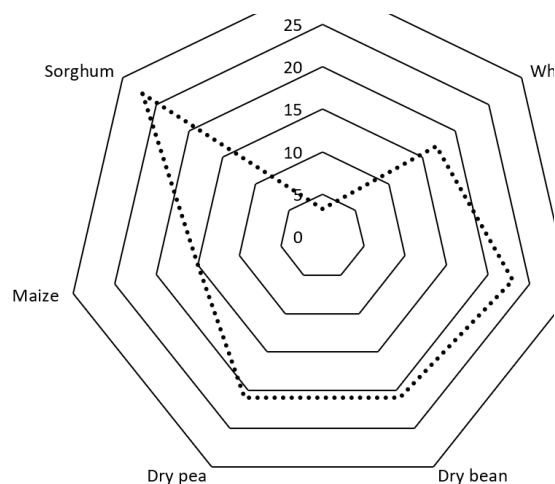


Figure 1: Postharvest loss of different crops (Source: FAO, 2017)

According to the 2018/19 CSA data, horticultural crop production in Ethiopia is estimated to be around 6,259,428 tons on average. However, due to inadequate harvesting and processing technologies, post-harvest losses (PHLs) range from 1,251,886 to 3,129,714 tons on average per year. This means that PHL causes a total loss of 20 to 50 % of the nation’s annual horticultural crop.

According to the Ministry of Agriculture (MoA) 2022 report, the total postharvest loss of red meat in the supply chains is estimated to be approximately 40% in 2022 (Table 1). This is primarily due to moisture loss in retail shops (MoA, 2022). In a study conducted by the Food and Agriculture Organization (FAO) in selected woredas of the Amhara Region, it was found that around 30% of milk is wasted, amounting to 2,217,000 liters (MoA, 2021 unpublished data) of milk lost annually. If the price of one liter of milk is about 40 Ethiopian Birr, then the yearly loss would be 88.68 billion birrs (Table 1). According to FAO’s regional estimate for postharvest loss of milk and dairy products in East African countries (including Ethiopia), the total value exceeds 90 million USD annually (Yilma, 2011 and Felleke, 2010).

Table 1: Postharvest loss of animal source foods

Commodity	Production (ton)	Rate FLW* (%)	Quantity FLW (Lt & tons)	Monetary (Billion Birr)
Meat	794,112.00	23	182,645.76	73.06
Milk	7,390,000.00	30	2,217,000.00	88.68
Total				≈161.74

Sources: Yilma, 2011; Felleke, 2010

The poultry subsector experiences an estimated postharvest loss of 18.9%, 20.0%, 12.6%, and 23.0% respectively for eggs, pullets, live chickens, and day-old chicks annually. In Ethiopia, fragmented postharvest assessment studies on fish indicate losses ranging from 20% to 50%, depending on the species, lake, and assessment method used (UNCSC, 2016). Honey in Ethiopia has an estimated postharvest loss of 20%, while other honeybee products also experience losses (UNCSC, 2016). These varied estimates suggest that there is a wide range of data due to differences in methodology and interpretation, highlighting the need for harmonization.

4.2. Impacts of PHL

The subsequent sections below provide additional details on how postharvest losses (PHL) affect the economy, food and nutrition security, food safety, and the environment.

4.2.1. Economic impact

The economic impact of postharvest losses (PHL) in a specific food supply chain (FSC) are often manifested in terms of the financial impact on the production cost of the lost food volume and the monetary value of the environmental impact caused by the wasted food. Ethiopia relies on imports for all its chemical fertilizers, pesticides, veterinary medicines, animal and plant propagative materials, farm machinery, spare parts, and other materials used in on-farm and off-farm activities for food production, which requires foreign exchange. The consumption of these inputs has significantly increased over the past two decades, leading to higher agricultural production and productivity, which in turn has stimulated other

agricultural and related economic sectors. However, the substantial postharvest losses reported in various studies suggest a significant waste of foreign exchange and local investment due to the loss of agricultural products at different stages of the postharvest supply chain.

There is limited information available on the economic impact of postharvest losses (PHL) in Ethiopia. However, the existing evidence indicates that the total value of PHL for grain and horticultural crops can reach up to USD 6.2 billion, as shown in Table 2. Studies also reveal that smallholder farmers, due to their limited access to storage technologies, are often forced to sell their agricultural produce immediately after harvest at very low prices to local traders. Paradoxically, these farmers then have to purchase food commodities later in the season at significantly higher prices, often with insufficient funds to ensure household food security. As a result, smallholder farmers experience financial losses from selling their products and buying commodities, contributing to a higher level of food insecurity in rural areas (80%) compared to urban areas (20%).

Table 2: Postharvest loss of grains, horticultural crops and root crops

Crop type	Total production (Tons)	FLW (%)	FLW (Ton)	Monetary loss (Billion ETB)
Cereals	30,205,426.08	25	7,551,356.52	211.43
Pulses & Oil crops	3,977,443.28	25	994,360.82	44.75
Fruits	1,419,240.92	38	539,311.55	16.18
Vegetables	906,787.08	38	344,579.09	5.17

Root & Tubers	5,621,681.53	42	2,361,106.24	53.42
Total	42,130,578.89		11,790,714.22	312.93/USD 6.2 Bill.

Source: FAO, 2017-2021 report

Postharvest losses (PHL) also resulted in reduced income for producers as the quality of their produce diminishes, compelling them to sell at lower prices. In Ethiopia, research has revealed that grains contaminated with mold are sold to local cottage beer and spirit producers at half the regular price. PHL contributes to rural poverty by weakening the income-generating capacity of the food value chain. Physical losses during the postharvest stage leads to a decline in product quality throughout the commodity value chains, resulting in substantial price reductions in the market. Consequently, consumers face higher prices due to decreased food availability in the market economy.

The negative impact of PHL on the agriculture sector is causing people to hesitate in investing, as it greatly affects the income and well-being of farmers and the country as a whole. The economic impact of rejected agricultural products from export due to non-compliance with quality and safety standards are significant but often overlooked. For instance, developing countries like Ethiopia often face export barriers such as contamination with high levels of aflatoxin and chemical residues exceeding the permissible standard MRL. In such situations, losses are threefold: the value of the discarded commodity, the cost of shipping the food to and from the export destination, and the tarnished reputation, which makes reentering the same market even more challenging. Some studies have tried to

assess the extent of post-harvest losses (PHL) in livestock and poultry products. In Ethiopia, it is estimated that there was a milk loss of 362 million liters (4.9%) out of the total 7.39 billion liters produced in 2019/2020, which is valued approximately USD 241.55 million. Additionally, around 175 thousand tons (40%) of red meat, including cattle, sheep, goats, and camels, is lost during various stages such as post-harvest handling, transportation, marketing, butchering, and retailing. This loss is equivalent to ETB 87 billion (USD 1.6 billion) annually according to the Ministry of Finance and Economic Development (MoFED, 2010).

Certain animal-based food products are rejected from export due to inadequate post-harvest handling and processing practices, resulting in lower competitiveness. Consequently, these commodities are sold at lower prices in domestic or neighboring countries with less strict quality standards. Additionally, local food processors face limitations in accessing high-quality agricultural products, causing Ethiopian processed agricultural goods to lose value in the global market. As a result, small-scale farmers often have to sell their produce to intermediaries at reduced prices, depriving them of fair compensation for their goods.

In general, according to the production data from the Central Statistical Agency (CSA) for 2020/21, Ethiopia has lost 9.6 billion USD due to insufficient attention given to post-harvest management (PHM). Therefore, taking measures to reduce post-harvest losses (PHL) can bring significant benefits to various stakeholders, including value chain actors, consumers, and the nation as a whole. Decreasing PHL can have a positive impact on overall output, GDP, and employment. If Ethiopia commits to reducing PHL by at least half, the country can save 4.8 billion USD,

which is equivalent to 4.1% of the projected GDP for the years 2023 (117.06 billion USD), 2024 (247.30 billion USD), and 2025 (522.48 billion USD).

4.2.2. Impact on Food and Nutrition Security

Food and nutrition insecurity refers to the inability of individuals to access or afford an adequate amount of food, including nutritious options, which is essential for their overall health and well-being. According to FEWSNET's prediction, up to 73 million people in east and southern Africa, including Ethiopia, are currently experiencing severe food insecurity, including famine, in the first quarter of 2023. Unfortunately, the situation is expected to worsen in the following months for most countries in the region. Adverse weather events, such as droughts and locust invasions, as well as conflicts and global conditions leading to high food prices, further exacerbate food insecurity. Climate change and frequent severe weather events have long-term impacts on agriculture, pastoral livelihoods, and overall food security. The drought experienced in 2022 in Ethiopia, the most severe in four decades, has significantly affected millions of people in the southern and eastern parts of the country. It is estimated that over 20 million individuals are facing chronic food shortages in 2022, according to the World Food Program (WFP, 2022). As of February 2023, the latest estimates indicate that around 22.6 million people in Ethiopia are food insecure due to factors such as drought, conflict, and inflation, as reported by UNICEF in 2022. Additionally, an additional 12 million people are predicted to require food assistance due to significant livelihood losses in areas affected by drought.

The causes of food and nutrition insecurity are complex and are linked to social factors that affect health, such as low income, unemployment, limited access to healthy food, lack of affordable housing, and inadequate healthcare access. Under nutrition, which includes being underweight, wasted, or stunted, can be caused by insufficient nutrient intake over a long or short period of time, as well as by food scarcity or increased disease prevalence. In Ethiopia, there has been a decrease in the prevalence of stunting from 58% in 2000 to 38% in 2016, and a decrease in underweight children from 41% to 24% during the same period. The prevalence of wasting has also decreased from 12% to 10%. These improvements indicate a reduction in chronic malnutrition over the past 15 years (UNICEF, 2022). However, the prevalence of stunting among school-age children in Ethiopia still ranges from 29.2% to 42.7%, and the prevalence of wasting ranges from 8% to 21% (Yisak et al., 2021).

Postharvest losses (PHL) have a significant impact on food security and nutrition by reducing the availability of food and limiting access to it for those involved in various stages of the food supply chain, such as harvesting, slaughtering, transportation, processing, packaging, storage, and retail. This, in turn, affects consumers through a tightening food market and increased food prices. Additionally, PHL contributes to unsustainable use of natural resources, which is crucial for future food production. In Ethiopia, high levels of PHL are a major factor contributing to ongoing food and nutrition insecurity among a significant portion of the population.

In 2010, a joint assessment by the Food and Agriculture Organization (FAO) and the World Food Program (WFP) estimated that Ethiopia experienced postharvest losses of around 2.04 million tons of grain (FAO, 2010). This was a time when the country faced severe food shortages, with approximately 5.2 million people requiring immediate food assistance. At the same time, Ethiopia needed to import 1.16 million tons of food. These figures suggest that if postharvest losses had been reduced by 50% in 2010, Ethiopia could have saved a substantial amount of food and avoided the need for significant imports. Table 2 above demonstrates that if appropriate measures were implemented to reduce postharvest losses, Ethiopia could have had a surplus of approximately 12 million tons of food, which could have been utilized for domestic consumption or exported to foreign markets. Similarly, reducing postharvest losses by half could have a significant impact on food and nutrition security in the country, particularly for livestock products such as milk, eggs, and meat.

Recognizing the significant impact of effective postharvest management, Ethiopia's food and nutrition policy and strategy place great emphasis on reducing losses and ensuring food safety. Specifically, the third pillar of the food and nutrition strategy is dedicated to enhancing postharvest management of agricultural food products. By reducing postharvest losses throughout the value chain of fruits, vegetables, and other crops, there is potential to enhance food and nutrition security by preserving valuable nutrients that would otherwise be lost. This can lead to the creation of profitable, accessible, and affordable diverse diets.

4.2.3. Food safety risks due to poor PHM

Food safety is closely connected to the achievement of Sustainable Development Goals (SDGs), particularly in ending hunger (SDG 2) and promoting good health and well-being (SDG 3). Food and nutrition security is a crucial component of ensuring food safety. In Africa, there is a high incidence of foodborne illnesses, with the continent having the highest per capita cases of such illnesses, estimated at 91 million (Merieux, 2022). Therefore, ensuring food safety is essential for attaining food and nutrition security in Africa. Unsafe food can contain various hazards, such as microbiological, chemical, or physical contaminants, which can cause illness in people. These illnesses can range from acute to chronic, and in severe cases, they can result in death or permanent disability.

In Ethiopia, the food system not only experiences quantitative losses but also faces risks to food safety, which can impact both the quality of food and public health. These food safety risks are concerning because spoilage or contamination may not be easily detectable by human senses, leading to adverse health conditions when consumed. One particular concern is the presence of mycotoxins, which can result in both qualitative and quantitative losses with long-term health effects. Chronic exposure to low levels of aflatoxins, for example, is a known risk factor for liver and esophageal cancers. Aflatoxin is estimated to be a causative factor in 4.6-28.2% of liver cancer cases globally, with a significant number of cases occurring in sub-Saharan Africa, Southeast Asia, and China. In fact, it is responsible for at least 30% of liver cancer cases in Africa. However, it is important to note that by ensuring food safety through appropriate postharvest management, such as

preventing aflatoxin contamination, we have the potential to reduce liver cancer cases by a third. In order to combat the damage caused by insects and rodents to grains, farmers in Ethiopia often resort to using traditional practices and chemical insecticides. However, it is important to be cautious as some of these chemicals, such as DDT and Malathion dust, pose serious safety risks (FAO, 2017).

4.2.4. Impact on environment

There is a growing concern about the environmental consequences of postharvest losses (PHL) and their implications for sustainable development, particularly in light of climate change. These concerns include the loss of water used in food production and the increase in greenhouse gas emissions resulting from the disposal of food in landfills, as well as from the production of food that goes uneaten. The environmental impacts of different food types and segments of the food supply chain were assessed in terms of their carbon footprint, water footprint, and land footprint.

Globally, PHL contributes to approximately 4.4 gigatons of greenhouse gas emissions each year. This includes emissions from on-farm agricultural practices and the energy used in the production, transportation, and storage of food that is ultimately lost. The negative impacts of PHL extend to inefficient water use, an increased carbon footprint, and the wasteful utilization of agricultural inputs and land resources. Ethiopia, being one of the fastest-growing countries in the world with an annual population growth rate of 2.6 percent, faces significant pressure on its land resources. This exacerbates environmental degradation and raises the risk of food shortages (FAO, 2017). Table 3 presents the environmental impact of

estimated postharvest losses of crops during the primary production season in 2020/2021 (FAO, 2022).

Table 3: Impact of PHL on natural resources

Commodities	Wasted Land (ha)	CO ₂ * (mill tons)	Wasted * water (bill m ³)
Cereals, Pulses, Oil crops, Fruits, Vegetables, Root & Tubers	3,762,312.62	150.00	203.00

Reducing postharvest losses offers numerous benefits. Firstly, it helps prevent the expansion of agriculture into remaining natural ecosystems and reduces the strain on already overburdened fisheries. By making better use of the food that is already grown, there is less need to convert additional ecosystems for food production or rely heavily on wild food sources, such as fish. Furthermore, by reducing food wastage, there is a decreased demand for land, water, inputs, and energy, resulting in lower greenhouse gas emissions. These saved natural resources can then be utilized to increase food production or be allocated to other areas within the food system.

Another important aspect is the future need for food and the global demand for increased food supply. By improving the utilization of food that has already been produced, there is less reliance on converting more land, applying excessive amounts of fertilizers, raising more livestock, and consuming energy for the production, processing, transportation, and storage of food. Additionally, diverting food loss and waste away from landfills helps prevent the emission of methane,

a potent greenhouse gas, from decomposing food. Overall, reducing postharvest losses has multiple advantages, including environmental preservation, resource conservation, and meeting future food demands.

4.3. Causes of Postharvest losses

Identifying the causes of post-harvest losses (PHL) is crucial in order to find effective solutions and prioritize actions to reduce them. It is important to take a comprehensive view of the entire food supply chain, recognizing that actions at one stage have an impact on the whole chain. Causes of PHL are often interconnected, and a loss or waste at one stage is rarely caused by a single factor. To identify appropriate interventions, it is necessary to analyze the complexity and diversity of causes at the micro, meso, and macro levels (Table 4). Micro-level causes occur at each stage of the food chain where PHL occurs, resulting from the actions or inactions of individual actors in response to external factors. Meso-level causes are secondary or structural causes of PHL, which can be found at different stages of the chain or arise from the organization and relationships between actors, infrastructure conditions, and other factors. Meso-level causes can contribute to the existence of micro-level causes.

Macro-level causes of PHL refer to broader systemic issues that contribute to food losses and waste. These issues may include a dysfunctional food system, inadequate institutional or policy conditions that hinder the coordination of actors, the establishment of secure contractual relationships, and the adoption of good practices. These systemic causes create an environment that allows other causes of PHL, including meso and micro causes, to emerge. Ultimately, these macro-level

causes are a major factor in the global and national extent of PHL.

In Ethiopia, PHL is affected by various factors, including production decisions and practices, internal infrastructure and capacity, the structure of the supply chain, consumer behavior, and food utilization. The level of awareness of PHL among actors IN the chain and the specific product and region also play a role in determining the causes and extent of PHL. Furthermore, the impact of climate change is observed to exacerbate PHL, particularly by affecting the effectiveness of commonly employed postharvest technologies in activities such as harvesting and drying, pest and disease management, and storage.

Table 4: Causes of PHL at micro, meso and macro levels

Levels	Causes of PHL
Micro	<ul style="list-style-type: none"> - Poor harvest scheduling and timing - Rough, careless handling practices, - Inadequate or lack of storage conditions - Poor temperature management - Poor Transport leading to delay between production and consumption - Mechanical & heat injury. - Decrease of nutritional contents. - Poor conditions within the retail outlet (temperature, relative humidity, lighting, gas composition, etc.)

	<ul style="list-style-type: none"> - Poor handling practices - Consumer behaviors - Habits of food buying - Preparation - Consumption, - Time planning - Coordination.
Meso	<ul style="list-style-type: none"> - Lack of equipment and/or of good practices, inadequate organization, - Coordination & communication between food chain actors (e.g. transformation that renders the product useless at a later stage of the chain, etc.), - Inadequate infrastructure - maladapted economic conditions - Pre-harvest/slaughter conditions and actions in the field. - The retailers influence the activities of supply chains by dictating the quality of the produce to be supplied and displayed in their outlets. - Quality standards (as to shape, size, and weight) imposed by the processors, retailers or target markets.

	<ul style="list-style-type: none"> - Inadequate information - Lack of storage capacity and poor storage conditions - Lack of capacity to transport the produce. - Too few and substandard wholesale, supermarket and retail facilities providing suitable storage and sales conditions for food products. - Poor transportation infrastructure. - Lack of implementation of good practices all along the food chain - Confusion arising from the existence and poor understanding of different food date labels
Macro	<ul style="list-style-type: none"> - Absence of a conducive environment to facilitate coordination among stakeholders, investment, and the enhancement of practices. - Inadequate policies and regulatory frameworks.

4.4. Postharvest Initiatives

The SWOT analysis conducted in section 4.5 highlights the existence of various initiatives that directly or indirectly contribute to the ongoing endeavor of reducing post-harvest losses (PHL) in agricultural commodities. Despite these initiatives, the overall effort to reduce PHL has been challenging due to a lack of a strategic approach. The following are the major initiatives: Agricultural sector policy, Ten years perspective plan (ten-in-ten), Cold hub establishment at Mojo dry port, Ethiopian Airline's cold chain systems, Establishment of the nutrition coordination office, Long-term PHM training at different Universities, National postharvest platform, Establishment of ESPHM, Food and nutrition society, crop protection, and other societies, Launch annual PHM week in Ethiopia, Postharvest loss reduction project initiatives of FAO, Introduction of postharvest service provision by SAA, The emergence of hermetic storage bag suppliers, Limited availability of trained artisans to PHTs, Tax exemption guidelines for agricultural and postharvest items, Development of standard postharvest loss measurement protocol for Ethiopia, Agro-industrial parks development and establishment of RTCs and collection centers, Ye Lemat Trufat, Postharvest management strategy for Grains in Ethiopia, Warehouse receipt system, Preparation and incorporation of PHM into ATVET curricula, Initiatives started to establish a regional center for PHM and food safety, Rural road network, Market infrastructure development, Postharvest assessment methodology harmonization and Agro-industry and RTC-related PHM initiatives.

4.5. Key PHM Issues

A thorough SWOT analysis (Table 5) was undertaken to evaluate the existing conditions and evaluate potential opportunities and threats in reducing post-harvest losses (PHL) and food safety risks. This analysis allowed for the identification of significant challenges within the national postharvest system and the development of prioritized issues that require immediate attention if the goal of halving PHL by 2030 is to be achieved. Based on the comprehensive assessment of the current situation, there are nine strategic post-harvest management (PHM) issues that need to be addressed. These are summarized as follows:

- Inadequate coordination among stakeholders involved in postharvest management, leading to limited institutional capacity and minimal involvement of other stakeholders.
- Lack of focused policy attention and a legal framework for postharvest management, as well as poor enforcement of existing regulations and guidelines related to postharvest management and food safety.
- Lack of awareness among value chain actors and policymakers about the extent, causes, and impacts of postharvest losses.
- Insufficient emphasis on training, research, and innovation efforts in post-harvest management.
- Absence of an organized knowledge and data management system, and a scarcity of reliable data on postharvest losses to support informed deci-

sion-making and monitoring progress in reducing losses.

- Limited development of agri-business and value addition (agro-processing) for agricultural commodities.
- Underdeveloped infrastructure, including markets, storage facilities, transportation, roads, and other utilities.
- Limited financing and investment in postharvest management.
- Inadequate attention given to cross-cutting issues such as climate change, gender mainstreaming in postharvest management interventions, and the creation of job opportunities for women and rural youth.

Table 5: SWOT analysis for PHM in Ethiopia

Strength	Weakness
<ul style="list-style-type: none"> - There is a potential for high crop production, both with rain-fed and irrigated methods. - Agro-processing industries are developing to improve the preservation and value of various agricultural products. - Academic institutions have programs focused on postharvest management (PHM). - PHM has been incorporating as a required subject in the curriculum of ATVET colleges. - A strategy for PHM specifically for grain crops has been established. - PHM has been incorporated into the national agricultural extension program. 	<ul style="list-style-type: none"> - Based on current estimates, there is a significant amount of postharvest losses (PHL) in agricultural products. - Ethiopia is experiencing food losses that could have been used to feed millions of people. - The PHL of agricultural products is causing substantial financial losses. - The lack of a cold chain system makes it difficult to handle and preserve horticultural and animal source foods throughout the value chain. - The level of awareness about PHL is unacceptably low at various levels. - There is no comprehensive data on PHL for different agricultural commodities. - There is a lack of nationally harmonized and standardized methods for assessing PHL. - Small-scale agro-processing businesses are either non-existent or very limited in number.

<ul style="list-style-type: none"> - Research institutions are developing various technologies and practices for PHM. - The availability of traditional knowledge and skills related to PHM. - Presence of model farmers can be utilized to promote PHM technologies. - Existence of grain standards to improve the quality and value of produce. - The availability of commodity exchange market with specific quality standards for crops. - Existence of TV and FM radio to disseminate agricultural information prepared by the Ministry of Agriculture. - Availability of SMS and social media platforms to share agricultural information, including PHM practices. 	<ul style="list-style-type: none"> - Coordination for PHM-related responsibilities within and among institutions is weak. - Insufficient attention is given to PHM at all levels, from producers to education, research, and policy-making institutions. - The necessary infrastructure to improve PHM is either lacking or underdeveloped. - Low-quality products are being produced. - Limited standards and a poorly functioning regulatory system contribute to low-quality products in the market. - Existing PHM practices and technologies impose a high burden on women and children, leading to gender imbalances. - Producers, agro-processors, traders, and other market actors have limited access to PHM technologies. - There is a lack of credit and insurance facilities for users of PHM technologies, businesses, and investments. - Weak market linkages and inadequate dissemination of information hinder PHM ventures. - The unregulated role of middlemen creates distortions in the provision of PHM technology services and marketing of agricultural produce.
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Opportunity	Threat
<ul style="list-style-type: none"> - There is significant potential to reduce postharvest losses (PHL) and improve food supply, nutrition security, and monetary savings, while also minimizing environmental impacts. - The agro-processing business has great potential for expansion, with abundant labour, production capacity, and market opportunities. - The diverse agro-ecology in Ethiopia is suitable for producing a wide range of crops, thereby supporting the growth of the agro-processing industry. - Various development partners are dedicated to supporting programs aimed at improving postharvest management (PHM). 	<ul style="list-style-type: none"> - The impacts of climate change are expected to hinder crop production by disrupting rainfall patterns, increasing pest infestations, and changing the suitability of weather conditions for harvesting and postharvest operations. - Cultural and religious beliefs may pose challenges in promoting certain postharvest management technologies, such as harvesting and threshing, due to taboos. - Intense competition in the global market may have a negative impact on the growth of agri-business and the potential for exporting agricultural products. - Limited international market connections may discourage individuals involved in the production, processing, and export of agricultural commodities. - The perishability of products, particularly fruits, vegetables, and livestock, presents a significant challenge in marketing.

<ul style="list-style-type: none"> - The government’s policy of tax exemption for agricultural inputs and machinery creates a favourable environment for implementing PHM improvement interventions. - There is a national platform and society of stakeholders focused on PHM, discussing important issues, designing strategies to address challenges, and advising policymakers on reducing postharvest losses. - The increased capacity for electricity generation ensures a reliable power supply for industrial parks, which play a crucial role in agro-processing. - There is a significant untapped global market demand for agricultural products, which can contribute to the growth of national exports. - The availability of abundant and affordable labour enhances the competitiveness of agricultural export commodities. - Free-trade agreements in Africa and government provisions for foreign direct investment (FDI) further support the growth of the agro-processing sector. - The existing extension service structure, which 	<ul style="list-style-type: none"> - The rising cost of inputs may continue to be a barrier for farmers and private mechanization service providers in adopting postharvest management technologies. - The high cost of certain postharvest technologies may limit the implementation of interventions to reduce postharvest losses.
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<ul style="list-style-type: none"> - The existing extension service structure, which extends from the national to grassroots levels, facilitates the dissemination of information and support for PHM. - The annual dry season, coinciding with the natural cycle of crop maturity, provides favourable conditions for harvesting and postharvest operations. - The government demonstrates an increasing commitment to improving PHM and reducing postharvest losses. - The government’s policy of tax exemption for agricultural inputs and machinery creates a favourable environment for implementing PHM improvement interventions. 	
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5. POSTHARVEST MANAGEMENT STRATEGY

5.1. Vision and Mission

Vision

Ethiopia aspires to achieve under five percent postharvest loss in 2050.

Mission

To improve PHM of agricultural food commodities, thereby reducing PHL and food safety risks by providing policy focus, raising awareness, encouraging agro-processing and value addition, upgrading infrastructure, facilitating financing and investment, and strengthening the capabilities and coordination of strategic post-harvest interventions.

Goal

The goal of the strategy is to halve the PHL of agricultural food commodities by 2030 and contribute to Ethiopia’s food and nutrition security and economy.

5.2. Conceptual Framework

Enhancing the efficiency of the food value chain by reducing losses is crucial in the post-production stage. This involves implementing various strategies to ensure the safe and adequate availability of food throughout the year. These strategies include establishing and enforcing legal frameworks, strengthening institutions and coordination among different sectors, improving research and extension services, developing logistics systems and upgrading infrastructure, facilitating access to finance and investment, and enhancing agribusiness and agro-processing.

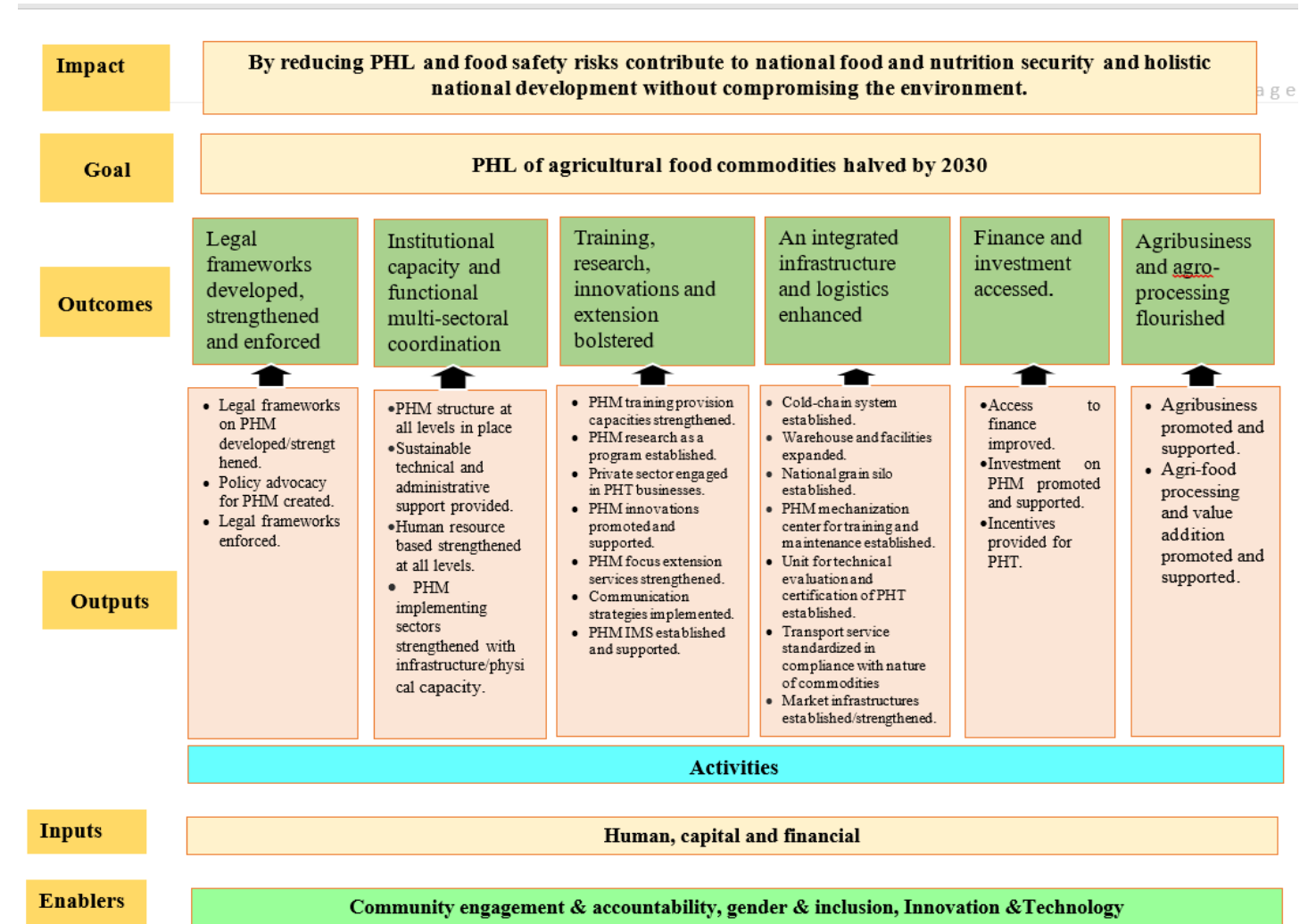


Figure 2: Conceptual frame work of the PHMSE

5.3. Strategic objectives (SO)

5.3.1. Develop/strengthen/enforce legal frameworks (SO1)

Addressing postharvest losses (PHL) in Ethiopia's public programs has been historically unreliable. Previous policies have touched upon postharvest management to some extent. The Plan for Accelerated and Sustained Development to End Poverty (PASDEP) implemented from 2005/06 to 2009/10 recognized the importance of PHL in the national pest management strategy. PASDEP aimed to reduce PHL from an estimated 15% in 2006 to 10% by 2010 (PASDEP, 2010). However, the Growth and Transformation Plan I (GTP I: 2011-2015), which served as the guiding document for national development policies, did not explicitly address PHL or set any targets.

On the other hand, the second Agricultural Sector Growth and Transformation Program (GTP II) (2015-2020) acknowledged the need for overall PHL reduction and set an ambitious target of reducing it from the current estimated range of 5-25% to 5% by 2025. The ten-year agricultural sectorial plan of Ethiopia (2020-2030) emphasizes the promotion of postharvest management, with a specific focus on mechanization, market infrastructure, agro-processing, transport, and logistics. PHM is considered an enabling factor for achieving the ambitious targets of this plan. Although targets have been set for individual commodities, there is a need for more comprehensive guidelines and regulations on postharvest management of agricultural food products to ensure compliance among stakeholders. Moreover, there are limitations in enforcing existing regulations and guidelines

at both the federal and regional levels, which hinders the attainment of required standards and reduction of PHL.

To effectively implement the Postharvest Management Strategy and ensure its success, it is crucial to establish and enforce regulations and guidelines. Therefore, the following interventions are proposed to develop, strengthen, and implement legal frameworks effectively.

Interventions:

- Strengthen/enforce legal frameworks
- Develop legal frameworks on PHM.
- Create policy advocacy for PHM

5.3.2. Establish/Strengthen institution(s) capacity and multi-sectorial coordination (SO2)

The success stories of reducing postharvest losses (PHL) in Ethiopia are not significant due to limited institutional arrangements and lack of coordination among various public, private, and non-governmental institutions operating in the post-harvest value chain. This lack of coordination has resulted in a lack of synergy in reducing PHL for different agricultural commodities along their respective value chains. It is crucial to urgently establish smooth coordination among stakeholders to address postharvest management (PHM) strategies. This objective requires strengthening coordination and partnerships among all sectors responsible for PHM, with the Ministry of Agriculture (MoA) taking the lead and coordinating role. The MoA should have sufficient capacity in terms of human resources, physical

facilities, and other essential resources to effectively carry out its function. Additionally, it is important to build the capacity of other institutions involved in post-harvest value chains. Implementing the following interventions can help establish and strengthen institutional capacity and multi-sectorial coordination.

Interventions:

- Establish PHM governance structure at all levels
- Provide sustainable technical and administrative support to coordination units
- Strengthen human resource base at all levels
- Strengthen infrastructure/physical capacity of implementing sectors

5.3.3. Bolster PHM training, research, innovation and extension (SO3)

Countries in the developed world have successfully reduced postharvest losses by employing trained individuals in postharvest management (PHM) and effectively utilizing postharvest technologies. However, Ethiopia lacks trained personnel and appropriate technologies for PHM. The current postharvest losses of agricultural commodities along various value chains are jeopardizing the country's efforts to achieve food and nutrition security. Additionally, the absence of a database, information management system, and demand-driven PH technology generation hinder the exploration and utilization of PHM knowledge.

Vocational training centers serve as the main training ground for development agents, but the challenge lies in their level of training in postharvest issues. The

current curriculum focuses on production and productivity, with limited emphasis on postharvest training. Effective training programs, both short-term and long-term, are needed to prepare and deploy skilled postharvest professionals. Skill development training provided at ATVETs (Agricultural Technical and Vocational Education Training) should align with market demand and produce competent graduates who can become entrepreneurs or employees in postharvest ventures. Universities also have a crucial role in training professionals, developing postharvest technologies, and disseminating proven technologies to end users, necessitating capacity building of training institutions. To reduce postharvest losses, it is essential to develop new and suitable technologies/methods and strengthen training and research efforts.

Value chain actors require access to information about proven postharvest practices, technologies, and suppliers. Therefore, it is important to consolidate this information into a single database, making it easily accessible for promoting postharvest loss reduction. Efforts should also be made to evaluate available and emerging technologies, test their effectiveness, and disseminate successful ones to producers, processors, and relevant actors along the value chains. This will involve establishing a database management system for PHM, conducting research to introduce new and innovative technologies, and verifying existing technologies for PHM.

The following strategic interventions meant to enhance training, research, innovation, and extension efforts.

Interventions:

- Strengthen PHM-related training provision capacities.
- Establish PHM research programs
- Promote and support PHM innovations
- Engage private sectors in PHT business
- Establish & support PHM IMS
- Strengthen PHM-focused extension services

5.3.4. Develop and strengthen an integrated infrastructure and logistics (SO4)

Ethiopia's infrastructure for reducing postharvest losses is underdeveloped. Apart from the recently opened market in Addis Ababa for fruits and vegetables, food markets in different parts of the country lack essential infrastructure, such as cold chain and storage facilities. The limited infrastructure along the value chain, including harvesting, marketing, and storage facilities, as well as poor fumigation and commodity storage systems, roads, transport, and power infrastructure, contributes to significant food losses.

The lack of marketing structures, weak linkages, and insufficient communication hinder access to marketing information, resulting in high levels of postharvest losses. Reports indicate that the majority of smallholder farmers (95%) require proper storage facilities to store their produce and benefit from better market prices. An inventory conducted by the Ministry of Agriculture's ad-hoc committee revealed

that the existing storage capacity in the public, cooperative, and private sectors for food grains is limited and inadequate to accommodate the current bumper yield of wheat alone. This highlights the urgent need for the Ethiopian government to prioritize and swiftly build national capacity for food reserves, marketing infrastructure, and logistics through the involvement of the private sector, development partners, cooperatives, and other public institutions.

Being a landlocked country, Ethiopia relies on the port of Djibouti or neighboring countries for trade. Additionally, there is a need for a cold hub to aggregate and store perishable produce, as well as a reliable refrigerated transport system to efficiently and safely transport the produce to different destinations. This necessitates the development of sufficient cold hubs at strategic locations and an enhancement of refrigerated transport systems. To address these challenges, the following interventions are proposed:

Interventions:

- Establish & upgrade cold & dry chain systems,
- Expand & upgrade warehouse and relevant facilities,
- Establish a national grain reserve silo,
- Establish & upgrade the PHM Mechanization Center for training & maintenance,
- Establish a unit for technical evaluation & certification of PHT,
- Standardize transport service in compliance with the nature of commodities,
- Establish & strengthen marketing infrastructure.

5.3.5. Improve access to finance and investment (SO5)

Implementing an appropriate system for postharvest management (PHM) has numerous benefits, including reducing hunger, increasing incomes, and improving food security and nutrition. Despite the presence of public and private banks in Ethiopia, obtaining financial support from these institutions to address postharvest losses remains a significant obstacle. The involvement of the private sector in PHM has hindered efforts to reduce losses in the country. One of the challenges in improving PHM is the need for innovative financial services to acquire advanced equipment and tools for PHM and research. As a result, Ethiopian agro-processors have been operating below their full capacity due to a lack of quality raw materials and sufficient financial backing for value chain participants. To address this issue and enhance PHM practices, it is crucial to ease access to finance for harvesting and postharvest activities. The following interventions are proposed to improve access to finance and encourage investment in PHM.

Interventions:

- Improve access to finance
- Promote and support investment
- Provide incentives for PHT

5.3.6. Strengthen agribusiness and agro-processing (SO6)

Agriculture plays a significant role in Ethiopia's economy, employing 80% of the workforce and contributing 32.4% to GDP. It also generates 90% of the country's foreign exchange. However, the majority of agricultural exports are raw materials,

as the agro-business sector faces various challenges and only accounts for 5% of GDP. Additionally, over 40% of the value of agricultural output is lost annually due to limited use of value-addition techniques and insufficient participation in agri-businesses along the value chain.

Therefore, it is crucial to prioritize the development of agro-processing and agri-businesses along the value chain. This will lead to improved food security, safety, and nutrition, as well as the creation of more jobs, economic growth, and environmental sustainability. It is, therefore, timely to strengthen agribusiness and agro-processing.

Interventions:

- Improve the business environment for local PHT manufacturers, distributors, and service providers.
- Improved agro-processing and value addition
- Promote & support industries in the production of food packaging materials

6. IMPLEMENTATION ARRANGEMENTS

Key Implementing Actors

Compared to the former postharvest strategy, which focused exclusively on grain crops, this new strategy includes grain crops, horticultural crops and animal-source foods such as milk, meat, fish, and poultry products in the agriculture sector from production to consumption. The strategy officially approved at the national level and will guide efforts to reduce postharvest losses from 2023 to 2030. The roles

and responsibilities of key stakeholders involved in the different stages of the postharvest value chains.

6.1.1. Ministry of Agriculture (MoA)

The successful development and execution of this strategy require the active involvement of various sectors and stakeholders, working together in harmony. The strategy focuses on three different categories of commodities: grain crops, horticultural crops, and animal-source foods with unique characteristics, there is a shared approach that necessitates proper coordination during implementation.

The Ministry of Agriculture (MoA) will take on the role of the lead sector, overseeing the overall coordination of the strategy. The MoA will be responsible for tasks such as resource mobilization, budgeting, expenditure plans, procurement, monitoring, and evaluation. It will also oversee the operations of thematic working groups that will implement the strategy based on an agreed-upon plan. In fulfilling these functionalities, the MoA will collaborate and form partnerships with other key stakeholders, including the private sector, civil society organizations, community-based organizations, non-state actors, and development partners. This collaborative approach will ensure the effective implementation of the strategy.

In general, the ministry is responsible to:

- Overseas, guide, and coordinate the implementation of the interventions
- Undertake necessary institutional arrangements and alignments in the sub-sector to implement the strategy
- Prepare a detailed action plan and deploy human, financial, and physical

resources to implement the strategy through its identified intervention actions.

- Develop projects and raise funds to address the strategic objective to attain the goal.
- Develop and support legal frameworks, guidelines and directives, etc

6.1.2. Regional Bureaus of Agricultural (RBoA)

The Regional Agricultural Bureaus will be responsible for organizing and overseeing the implementation of intervention activities at both regional and district levels. They will also maintain communication with the Ministry of Agriculture (MoA). At the regional level, specific bureaus will act as focal points to facilitate coordination among key stakeholders, including the private sector, non-governmental actors, and others. Additionally, the bureaus will coordinate the execution of postharvest management activities at the district level by assigning experts from the postharvest management department and other relevant departments. Focal persons at various levels will compile and share lessons learned to support the ongoing implementation of the strategy.

6.1.3. Regional Livestock and Fishery Resource Development Bureaus

Regional bureaus and agencies will work together with federal offices to carry out the strategy. They will coordinate the implementation of intervention activities at the provincial and district levels and maintain communication with the Ministry of Agriculture (MoA). Their primary responsibility is to coordinate the implementation of postharvest management activities for livestock products at the district

level. They are also responsible for compiling and sharing lessons learned to support the ongoing implementation of the strategy.

6.1.4. Private sector and other Technology Developers

The successful implementation of this plan at different levels heavily depends on the active involvement of the private sector. This includes various stakeholders such as PHT manufacturers, distributors, processors, transporters, aggregators, farmers, agro-dealers, traders, and service providers. The Ministry of Agriculture (MoA) supports private organizations with a proven track record to invest in scaling up postharvest technologies and establishing marketing and storage infrastructure. Other private entities will contribute to building capacity and spreading relevant postharvest technologies. Some may participate in consultative meetings and thematic groups. Furthermore, private sectors and technology developers are encouraged to contribute to PHT innovations, adaptation, and replication of successful postharvest technologies from other countries. They also provide technical services like maintenance and training, and collaborate with research institutions and universities to generate innovative solutions to address postharvest challenges.

6.1.5 Livestock Development Institute (LDI)

The institute should actively participate in innovating postharvest technologies (PHT) specifically for livestock products. Additionally, it should develop guidelines for the production and dissemination of these technologies. The institute is also supportive of the establishment of a dedicated department that focuses on gener-

ating technologies to support postharvest handling and storage of livestock products, as well as the agricultural processing industries.

6.1.6 Consultative Group for International Agricultural Research (CGIAR)

The CGIAR, an international organization operating within the country, has the capacity to effectively tackle postharvest management (PHM) issues. It will engage in collaboration with the Ministry of Agriculture (MoA) and other organizations to address postharvest challenges. Additionally, the CGIAR will provide support to the national research system in order to enhance postharvest management practices for livestock products.

6.1.7. Regulatory authorities

Agricultural Authority: Develop guidelines, monitor, and control the compliance of primary agricultural products in collaboration with other stakeholders to improve postharvest handling practices and safety along the value chains.

Ethiopian Standard Institute: Develop and strengthen Ethiopian standards for primary agricultural products and establish a system that checks whether goods and services comply with the required standards. Furthermore, the institute will provide training and technical support to value chain actors along the value chains.

Ethiopia Conformity Assessment Enterprise (ECAE), Ethiopian Accreditation Service (EAS), and Ethiopian Metrology Institute (EMI): The ECAE, EAS, and EMI will provide testing, Inspection, and Certification services to the strategy focus products. They will also be responsible for consumer protection by ensuring that mea-

suring systems result in fair trade transactions of agri-food products.

6.1.8. Ethiopian Grain-Trade Enterprise (EGTE)

Maintain strategic grain reserve and promotes the warehouse receipts system that ensures fair and sustainable market price to producers. It also involves promoting standard warehouse operation and inspection practices.

6.1.9. Academic Institutions

In Ethiopia, there are fifty public universities that provide both long-term and short-term training programs to meet the professional demands of individuals. These universities also offer specialized programs in postharvest management (PHM), including tailor-made training courses. Renowned higher learning institutes such as Jimma, Haramaya, Bahir Dar, Hawassa, Mekelle, and Addis Ababa Universities are actively involved in generating and promoting postharvest technologies of different scales. These universities will further provide customized training to various actors within the value chain, focusing on selected commodities and specific thematic areas.

6.1.10. Ethiopian Institute of Agricultural Research (EIAR) and Regional Agricultural Research Institutes (RARIs)

The Ethiopian Institute of Agricultural Research (EIAR) will be responsible for the development, introduction, adaptation, and promotion of postharvest handling practices and technologies. Furthermore, the Regional Agricultural Research Institutes (RARIs) such as ARARI, TARI, SARI, and OARI will focus on developing post-

harvest technologies specifically for commodities that are of regional importance. These institutes will also offer consultation, training, and technical support to address postharvest management (PHM) issues.

6.1.11. Ethiopian Investment Commission (EIC)

The Ethiopian Investment Commission (EIC) actively encourages both foreign and local investors to explore investment opportunities in the development of postharvest technologies, agro-processing industries, service provision, and technology multiplication. The EIC will also establish and enhance incentive mechanisms to support investors in these areas. Moreover, it will facilitate the registration of technology transfer agreements and non-equity-based collaborations between foreign companies and domestic investors focused on export-oriented initiatives.

6.1.12. Ethiopian Electric Utility:

It is responsible for ensuring the availability of efficient, reliable, and affordable energy supplies to support agro-processing industries, enterprises in technology generation, service providers, and value chain actors to attain the strategic goal.

6.1.13. Financial Institutes and Insurance

The inadequate allocation of financial services to investments in postharvest management poses a significant challenge to the sub-sector in Ethiopia. To overcome the obstacles related to financing and insurance, cooperatives, service providers, and postharvest technology developers must engage with a range of public and private financial institutions, including banks, insurance companies, and microfi-

nance institutions. These institutions are expected to develop financial products specifically tailored to support various actors involved in postharvest management, such as manufacturers, distributors, processors, transporters, aggregators, farmers, agro-dealers, merchants, and service providers. This approach is in line with the requirements of both the service industry and agricultural production.

6.1.14. Ministry of Trade and Regional Integration (MoTRI)

The MoTRI facilitates regional and international trade and develops the marketing of agricultural commodities. They will work aggressively to enhance PHM activities through its regulatory bodies indicated in section 6.1.5.

6.1.15. Ethiopian Cooperative Commission (ECC)

The Ethiopian Cooperatives Commission (ECC) will collaborate closely with both rural and urban populations to address their economic and social challenges and enable them to achieve self-sufficiency. This will be accomplished by organizing different types of cooperatives that align with local resources. The effective implementation of good handling practices for primary agricultural products will be a key strategy in achieving this goal. Primary cooperatives and unions have a crucial role to play in postharvest management (PHM) as they contribute to activities such as product aggregation, sorting and grading, semi-processing, storage, transport, distribution, and marketing of agricultural products.

6.1.16. Development partners (NGO, CSO, UN) and Resource Partners

Various development and resource partners, including FAO, SAA, GIZ, USAID, SDC, WRI, Bill and Melinda Gates, WFP, and others, will collaborate with the MoA on different postharvest interventions. They will offer technical, financial, and resource assistance to ensure the comprehensive strategy is implemented successfully. These partners will contribute to the nation's overarching objectives of eradicating poverty, promoting economic growth, and ensuring food and nutrition security by supporting the strategy.

6.1.17. Ministry of science and technology (MinT)

The Ministry will support studies, research and their dissemination, for the improvement, development indigenous technologies, facilitate the accessibility of technologies in the form of prototypes to stakeholders and the community, encourage and support individuals, professional associations, study and research institutions that contribute significantly for the development of innovations and technologies.

6.1.18. Professional societies and associations

The professional societies such as the Ethiopian Society of Post-Harvest Management (ESPHM) and other societies and associations will facilitate to bring in track the current interdisciplinary research efforts and will recommend ways to stimulate and support relevant research, Follow up the effectiveness of the transformation of innovative ideas, facilitate collaboration of scholars from various fields,

provide a supportive environment to develop and test new skills, provide integrated professional support and technical advice to public and private organizations that seeking special support.

6.1.19. Central statistics service (CSS)

It will provide technical advice and support on capacity building on statistical record and data reporting system, provide services on data collection and arrangement service as the main data collector upon request and collect, compile and disseminate statistical data.

6.1.20. Ethiopian Commodity Exchange (ECX)

Will serve as a marketplace, where buyers and sellers come together to trade, assure quality, delivery and payment, Electronic Trading Session for Identity preserved, provide relevant information related to the selling and buying of agricultural food commodities and establish an automated system to determine the daily price.

7. OPERATIONAL PLAN AND BUDGET

In line with the national ten-year perspective plan and the UN SDG, all the interventions outlined in the PHMSE will be accomplished by 2030. However, it is important to note that this timeline is five years later than the 2025 target set in the Malabo Declaration. The first step after formally adopting the PHMSE is to create a comprehensive work plan, which will include cost estimates for key actions, clear assignment of roles and responsibilities, and specific milestones to be achieved in the short, medium, and long term. To this end, the MoA will collab-

orate with relevant stakeholders to develop an operational plan that will provide detailed information on activities, timelines, and budget allocation.

8. FINANCING THE PHMSE

To ensure the successful execution of the PHMSE, a budget of over 14.3 billion ETB is required. The budget allocation for each strategic objective is outlined below, with the majority of funds dedicated to strengthening training, research, innovations, and extension activities. The second highest allocation is for the development and support of an integrated PHM infrastructure and logistics, as illustrated in Figure 3.

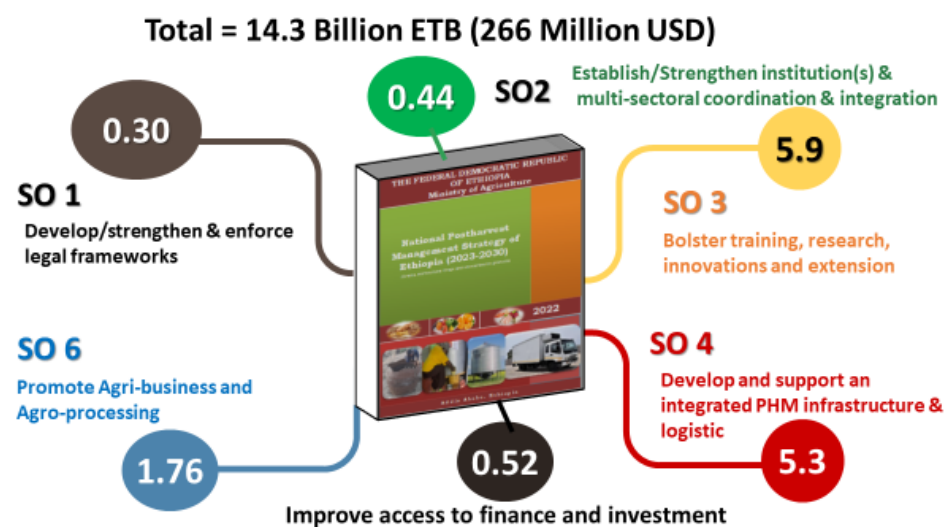


Figure 3: Share of the budget by strategic objective

Similarly, the distribution of the budget over the years indicates that a significant portion of the investment will be made in 2024, followed by 2027, as illustrated in Figure 4. It is anticipated that the private sector will contribute to covering the major share of the budget.

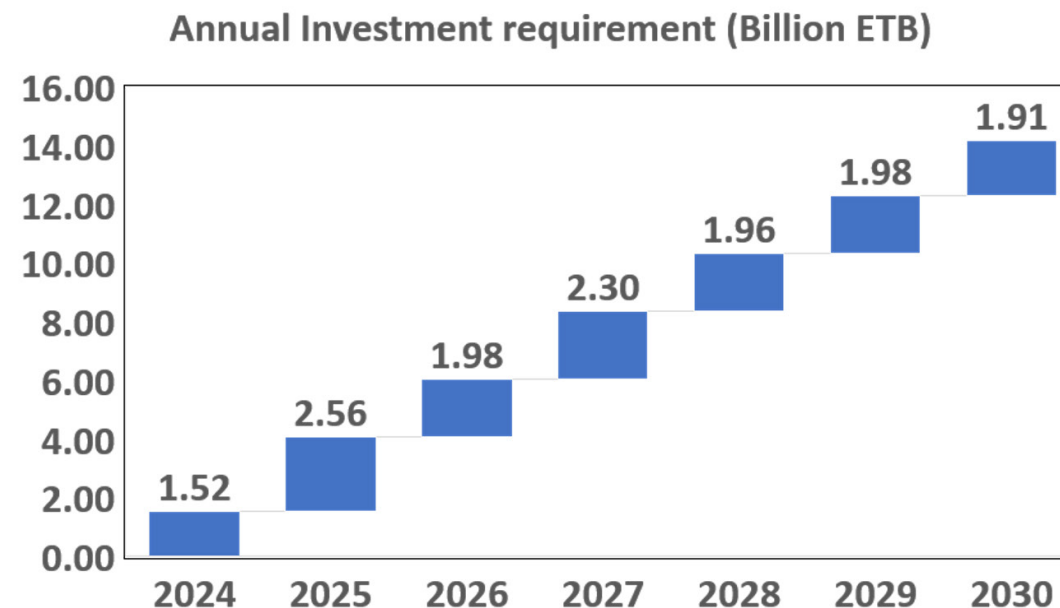


Figure 4: Budget distribution by year

The successful implementation of postharvest management in Ethiopia will rely on financial support from various sources, including the government budget, private sector, international community, and individual contributions. However, it is crucial to adopt an integrated approach and establish a coordinated working system to ensure that these funds are utilized effectively in achieving the objectives outlined in the strategy. The MoA will be responsible for mobilizing funds from different supporting partners for postharvest interventions through special arrangements. In some cases, a common Memorandum of Understanding will be signed between the Government of Ethiopia and Development Partners to establish operational modalities for the Basket Fund, utilizing the government system for disbursement and procurement. Separate budget submissions will be made for direct project funds from other Development Partners, with guidance from

the Treasury. The proposed annual expenditures will serve as the foundation for planning PHMSE basket expenditures to be included in the budget submissions, in collaboration with other sector lead ministries and stakeholders. Based on past experiences, the following funding mechanisms are anticipated.

8.1. National funds:

The primary source of national funds in Ethiopia is the revenue generated through taxes, which are then allocated to Ministries, regional bureaus, departments, and Agencies through their medium-term expenditure framework. These funds are reflected in both recurrent and development budgets, enabling ministries and regional bureaus to implement postharvest interventions. Additionally, domestic funds can be obtained through Public Private Partnerships and local NGOs. These funds can be utilized for the implementation of planned activities by adhering to the established arrangements under these funding sources.

8.2. International funds:

The financing of National Postharvest Management (NPHM) in Ethiopia includes international funds provided by various organizations and countries. These funds include those from the World Bank, International Monetary Fund (IMF), Africa Development Bank (ADB), and Bilateral Funds. Bilateral funds are typically channeled through specialized assistance agencies in donor countries. Additionally, official assistance is provided through multilateral organizations and international non-governmental organizations (NGOs). Some bilateral donors may have a regional focus, while others prefer to work through regional networks such as SADC,

EAC, AU, IGAD, COMESA, NEPAD, and others. It is important to note that certain donors may have specific interests limited to particular aspects of postharvest losses.

8.3. Multilateral Agreement Funds:

These include funds established under the United Nations Frameworks and multilateral agreements to facilitate the implementation of postharvest activities.

8.4. Private Sector Engagement (PSE)

By implementing favorable policies and establishing innovative financing mechanisms, the private sector will play a significant role in promoting sustainable postharvest management (PHM) activities. This involvement will be based on the fundamental principles of shared costs, risks, and benefits.

9. MONITORING AND EVALUATION

The Monitoring and Evaluation (M&E) system of the postharvest management (PHM) strategy will continuously monitor the implementation of planned activities and, if needed, make necessary adjustments to the implementation strategy. The Ministry of Agriculture (MoA) will be responsible for conducting the M&E of the strategy, in collaboration with other key stakeholders, to enhance the credibility and acceptance of the M&E outcomes across the entire value chain. Both internal and external M&E will be carried out, and participatory M&E will be conducted at the mid-term and end of the period.

To ensure the effectiveness of the postharvest management strategy (PHMSE) over its 7-year duration, an external evaluator will assess its implementation ev-

ery three years. This evaluation aims to identify any necessary modifications that could impact the performance of the PHMSE in the remaining years. The monitoring and evaluation (M&E) process will align with the objectives and indicators outlined in the Malabo Declaration. Additionally, the M&E system will undergo an annual review to identify any areas that require revision. The primary purpose of M&E is to compare the planned goals with the actual achievements. It serves as a crucial tool for stakeholders to promptly detect deviations from the target plan and make necessary corrections. The M&E activities will be conducted regularly and systematically, involving the collection, processing, analysis, and reporting of both primary and secondary data to the PHM Steering Committee, relevant forums, and stakeholders.

The main goal of the evaluation is to learn from the experiences gained during the implementation of the management intervention measures and share these lessons with the Ministry of Agriculture (MoA) and other stakeholders. This will help assess the progress and impact of reducing food crop postharvest losses as expected during the implementation period. The monitoring and evaluation (M&E) exercise will specifically encompass the following activities:

- Assessing the realism of the targets set in the postharvest management strategy (PHMS).
- Evaluate whether the implementation of the PHMS is yielding the desired outcomes at various levels, from the federal to kebele level.
- Assess whether sufficient resources, including human resources and funds,

are being mobilized to effectively implement the PHMS.

- Analyze the efficiency and effectiveness of resource utilization
- Evaluate and analyze the factors contributing to the failure of certain agreed-upon activities from being implemented.
- Continuous monitoring and evaluation of the PHMS activities, as well as the organization and promotion of best practices.
- Evaluate the effectiveness of the Ministry of Agriculture (MoA) in leading the implementation of the PHMS

10. REPORTING ARRANGEMENT

The reporting process will follow the usual government channels, starting at the district level and then moving up to the regional PHM office. The district reports will be compiled by the District PHM expert, who will gather information from various government and non-government players at that level. These district reports will then be sent to the regional PHM office, which will compile and forward them to the national-level PHM office, MoA. The PHM Section under MoA will be responsible for analyzing all the regional reports and will store and release the data through the PHM digital information management system. Reports will be submitted quarterly and annually and will include the following:

- A summary of the problems encountered during the implementation of the work plan
- An overview of the expenses related to the distribution of project funds
- A list of the achieved results and a detailed performance framework outlining the goals and accomplishments. The performance targets will remain consistent in each quarterly report.
- Any identified issues will be sent to the relevant thematic working group for resolution. Only issues that require high-level decisions will be brought to the attention of the High-Level Steering Committee for action.

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11. STRATEGIC OBJECTIVE IMPLEMENTATION MATRIX

SO 1: Develop/strengthen & /enforce legal frameworks

S/n	Strategic intervention	Targets	Activities	Responsibility	Performance indicators	Expected outcome
1	Develop/strengthen legal frameworks on PHM.	Develop & review the existing legislations by 2024	<ul style="list-style-type: none"> - Review and identify gaps regarding PHM related legal frameworks - Develop/adapt and validate new & revised voluntary and mandatory legal frameworks. - Get the approval of legal frameworks at various levels - Prepare implementation guideline for legal frameworks - Publish and distribute approved legal frameworks 	<ul style="list-style-type: none"> - Lead (MOA) - Collaborators (Agricultural Authority, ESI, EFDA, Private sectors, Agricultural associations, MoTRI, MOI) 	<ul style="list-style-type: none"> - Number of newly developed/ revised guidelines, laws, regulations, and directives on PHM - Post-harvest issues incorporated into existing legislation 	<ul style="list-style-type: none"> - Improved decision-making on PHM at all levels - Improved performance of PHL reduction
2	Create policy advocacy for PHM	At least 85% of actors capacitated on PHM from 2024-2030	<ul style="list-style-type: none"> - Socialize and promote approved legal frameworks using printed media - Socialize using SMS, social media, TV, and radio - Hold PHM week - Conduct workshops & panel discussions 	<ul style="list-style-type: none"> - Lead (MOA) - Collaborators (development partners, NGO, media, AAE) 	<ul style="list-style-type: none"> - Percentage of actors capacitated on PHM - Number of workshops, panel discussions, TV and Radio talks 	<ul style="list-style-type: none"> - Improved addressing PHM issues - Informed decision-making on PHL and PHT at all levels
3	Enforce legal frameworks	At least 65% of actors practice PHM legal frameworks from 2024-2030	<ul style="list-style-type: none"> - Prepare training manual on legal frameworks related to PHM - ToT to PHM implementers - Cascade the training and create awareness among various stakeholders - Prepare guidelines on monitoring and evaluation of legal framework implementation - Conduct regular M&E for the implementation 	<ul style="list-style-type: none"> - Lead (MoA) - Collaborators (EAA, ESI) 	<ul style="list-style-type: none"> - Number of trained actors on PHM legal frameworks - Numbers of manuals developed - Number of legal frameworks exercised 	<ul style="list-style-type: none"> - PHLs significantly reduced - Regulatory body capacitated

SO 2: Establish/Strengthen institution(s) and multi-sectorial coordination & integration

S/n	Strategic intervention	Targets	Activities	Responsibility	Performance indicators	Expected outcome
1	Establish PHM governance structure at all levels	PHM governance structure established at all levels from 2025-2027	<ul style="list-style-type: none"> - Establish a PHM coordination structure at federal level - Establish a PHM coordination structure along regions - Support established coordination offices - M&E of coordination units - Bench mark and adopt other country experience on PHM institutionalization 	<ul style="list-style-type: none"> - Lead (MoA) - Collaborators (civil service commission, Ministry of plan and development, regional bureaus of agriculture and livestock) 	<ul style="list-style-type: none"> - Number of functional PHM coordination Units established at all levels 	<ul style="list-style-type: none"> - Organizational structure PHM established/ strengthened - Post-harvest losses significantly reduced
2	Provide sustainable technical and administrative support to coordination units	At least 80% of PHM coordination units get sustainable technical and administrative support from 2025-2030	<ul style="list-style-type: none"> - Establish PHM advisory (steering committee) at the federal and regional level - Ensure functionality of the PHM steering committee at the federal and regional level - Establish/strengthen PHM platform at the national level led by MoA - Establish PHM platforms at the regional level led by regional agriculture bureaus - Establish PHM networks at International, national and regional levels led by MoA and regional agricultural bureaus - Conduct quarterly meeting - Conduct biannual network events - Build a database for PHM at federal and regional levels - Stocktaking of professional societies & associations related to PHM - Engage and support associations & societies 	<ul style="list-style-type: none"> - Lead (MoA) - Collaborators (RBoA, Regional Livestock and Fishery Resource Development EIAR Postharvest Society of Ethiopia (PHSE) Development partners/NGO) 	<ul style="list-style-type: none"> - Number of functional PHM advisory groups (steering committees) at the federal and regional level - Number of PHM platforms established /strengthened at the federal and regional level - Number of networks (linkages) established/strengthened - No.of meetings conducted per year - Number of network events conducted per year - Number and type of stakeholders involved in the platform/network <p>Number of professional societies engaged and supported</p>	<ul style="list-style-type: none"> - PHM-related technical and administrative issues improved at all coordination units - PHM database established - Reduced post-harvest losses - Improved professional societies & associations networking on PHM
3	Strengthen human resource base at all levels	At least 95% of actors capacitated on PHM from 2025- 2027	<ul style="list-style-type: none"> - Prepare PHM workforce standards based on the level of competency required for different roles - Deploy PHM and related professionals in all PHM strategy-implementing sectors - Provide continuous PHM professional development 	<ul style="list-style-type: none"> - Lead (MoA) - Collaborators (CSC, academic and research institutions, MoLS) 	<ul style="list-style-type: none"> - Number of trained personnel deployed/assigned at all levels <p>Number of personnel trained and capacitated</p>	<ul style="list-style-type: none"> - Trained workforce on PHM increased - Significant reduction of post-harvest losses

4	Strengthen infrastructure/ physical capacity of PHM implementing sectors	- At least 70% of the implementing sectors will have full PHM infrastructure by 2030	- Establish coordination offices at different levels and equip with required physical facilities - Equip the established offices with up to date ICT facilities - Ensure required transportation facility from federal to regional/zonal agricultural bureau levels	- Lead (MoA) - Collaborators (RBoA) Regional Livestock and Fishery Development partners)	- Number of capacitated offices at all levels	- PHM infrastructure improved - PHM loss reduction
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SO 3: Bolster training, research, innovations and extension

S/n	Strategic intervention	Targets	Activities	Responsibility	Performance indicators	Expected outcome
1	Strengthen PHM training provision capacities	Develop PHM training curricula for grain, horticultural & animal source food by 2024/25	- Assist in offering PHM training need assessment - Support the development of PHM training curricula - Develop training manual on PHM - Offer training to extension workers and stake holders - Revision of existing PHM related curricula - Provide ToT to trainees in academic institutions on PHM - Support with basic materials and equipment required for training	- Lead (MoA) - Collaborators (MoE, universities, EIAR, LDI, ATVET, development partners)	- Number & type of newly developed & revised PHM curricula Number of Universities & ATVETs supported	- PHM training curricula & manuals developed - PHM professionals & extension workers capacitated - Efficiency of performance improved
2	Establish/Strengthen PHM research programs	- At least 80% of training institutions will have PHM research programs 2024-2030 - PHM issues are included in agriculture research themes	- Restructure and integrate PHM research programs - Prioritize & conduct PHM problem solving researches - Develop new and feasible PHT & techniques - Capacitate agricultural research institutes - Promote PHT and practices to small holder and cluster farms - Introduce PHT for perishable agricultural products (horticultural, animal sources and spices) - Establish postharvest research center of excellence with the state of the art lab facilities	- Lead (MoA) - Collaborators (Research institutions & Academia)	- Number of PHM research unit established/ structured at Research & University institutes - Number of PHT generated & adapted	- Improve in quality of problem solving research on PHM issues - Reduced PHLs - PHM center of excellence & state of the art lab facilities established
3	Engage the private sector in PHT business	Increase the private sector in PHT business by 50% from 2024-2030	- Encourage private actors to involve in generation, promotion & fabrication of postharvest and processing technologies - Facilitate business to business linkage between actors - Support & strengthen service systems related to PHT - Promote joint venture in PHT (PPP)	- Lead (MoA) Collaborators (Technology developers, ECC, EIC, Financial & Insurance, PS)	- Number of private institutions involved in PHT generation, promotion & fabrication Number of PHT generated & adapted by the private sector	The private sector institutions engaged in PHT increased

4	Promote and support PHM innovations	PHM innovation increased by 30% from 2024-2030	<ul style="list-style-type: none"> - Establish PHM innovation and incubation centers - Conduct inventory and characterization of PHM technologies - Generate or adapt PHM innovations - Certify, obtainment of property right for innovators of PHM technologies - Validate the suitability and performance of the existing and generated PHM technologies and practices. - identify, test and demonstrate appropriate PHM technologies - Capitalize, modernize and promote innovations on indigenous PHM technologies and practices 	<ul style="list-style-type: none"> - Lead (MoA) - Collaborators (MoIT, EIAR, ATVET, private sectors, development partners, universities) 	<ul style="list-style-type: none"> - Number of innovation and incubation centers established - Number of PHM innovations generated/ adapted 	<ul style="list-style-type: none"> - PHM innovation, generation & adaptation increased
5	Strengthen PHM focused extension service	At least 80% of the stakeholders use informed PHT 2024-30	<ul style="list-style-type: none"> - Create awareness to all stakeholders on the use of PHT and practices along the value chain (manuals, standard operating procedures, media, & printed materials) - Demonstrate proven and feasible PHM technologies for value chain actors. - Capacitate all relevant actors (DAs, SME) - Promote small scale preservation and processing technologies for agricultural food products - Disseminate information on PHM technologies through different media - Facilitate multiplication/dissemination of effective PHM innovations and early warning information on PHM - Create linkage among associations, CSO and partners - Strengthen FTCs& PTC to demonstrate PHT 	<ul style="list-style-type: none"> - Lead (MoA) - Collaborators (MoLS, RBoA, regional Livestock and Fishery Resource Development, NGOs, ATVET) 	<ul style="list-style-type: none"> - Number of actors benefited from awareness - Number of technologies/ innovations demonstrated & adopted <p>Number of training manuals, SOPs & materials prepared & distributed</p>	<ul style="list-style-type: none"> - PHM focused extension service increased - Improved planning & implementing PHL and PHT issues - Significant reduction of post-harvest losses
6	Establish & support PHM information management system (IMS)	PHM information management system (IMS) for grain, horticultural & animal source agri-foods established from 2024-2030	<ul style="list-style-type: none"> - Develop PHM ICT hub - Design and deploy appropriate Mobile applications - Establish PHM database system in collaboration with stakeholders - Conduct sensitization training on PHM data base management information system 	<ul style="list-style-type: none"> - Lead (MoA) - Collaborators (MoIT, RBoA, RBoLs) 	<ul style="list-style-type: none"> - Number of PHM IMS database center established - Number of beneficiaries from IMS - Number of repositories 	<ul style="list-style-type: none"> - PHM IMS hub established - PHM data easily accessed <p>Improved PHL data accuracy & ease of access</p>

SO 4: Develop and support an integrated PHM infrastructure & logistics

S/n	Strategic intervention	Targets	Activities	Responsibility	Performance indicators	Expected outcome
1	Establish cold chain system	Establish cold chain system that accommodates 25% of perishable agri-commodities from 2024-2030	<ul style="list-style-type: none"> - Establish cold hubs at production and aggregation sites - Establish/strengthen cold storage facilities at airport, dry port and sea port for perishable agri-food products - Pre-cooling system at production and collection site - Evaluate and introduce climate smart refrigeration technology (Hydro, solar / solar-wind hybrid powered) - Establish community based solar operated refrigerated pack-house and storage - Engage the private sector in cold storage establishment - Involve the private sector in the provision of refrigerated transport for perishable products - Introduce and promote refrigerated container system (refer containers) 	<ul style="list-style-type: none"> - Lead (MoA) - Collaborators (MoT, MoTRI, MoTL, Ethiopian Shipping Lines (Dry Port, Private sectors, Financial institutions, Ethiopian Airport enterprise, Ethiopian railway corporation) 	<ul style="list-style-type: none"> - Number of cold hubs established - Number of refrigerated transportations - Refrigerated market places 	<ul style="list-style-type: none"> - PHM cold chain & cold-truck system established - reduction of PHLs by 75% - Some storage systems will be fitted with climate smart refrigeration technology (Hydro, solar /solar-wind hybrid powered) <p>Adapted</p> <ul style="list-style-type: none"> - Food safety risks reduced by 50 %
2	Expand warehouse and associated facilities	At least 30 % of the primary cooperatives & unions will have standardized warehouse and associated facilities from 2025-2030	<ul style="list-style-type: none"> - Support establishment of standard warehouses (loading/unloading, fumigation, etc) - Establish community grain warehouse receipt system - Provide backstopping on warehouse receipt system - Provide Capacity building on warehouse management - Establish standard post harvest chemical storage and disposal system 	<ul style="list-style-type: none"> - Lead (MoA) - Collaborators (MoTRI, development partners, private sectors, FCC) 	<ul style="list-style-type: none"> - Number of warehouses established - Number of warehouses that use receipt system <p>Number of trained personnel</p>	<ul style="list-style-type: none"> - Grain loss in storage reduced by 75% <p>Food safety risk reduced by 75%</p>
3	Establish/Strengthen National food & feed reserve system	- National food & feed reserve system increased to	<ul style="list-style-type: none"> - Asses the demand for food & feed reserve system in Ethiopia - Prioritize sites for national grain reserve establishment 	<ul style="list-style-type: none"> - Lead (MoA) - Collaborators (MoTRI, DRMC, development partners, Ethiopian 	<ul style="list-style-type: none"> - Number of food & feed reserve established/ strengthened - Volume of food & feed reserved 	<ul style="list-style-type: none"> - National food & feed reserve increased by 30%

4		30% from 2025-2030	<ul style="list-style-type: none"> - Establish/Strengthen national food and feed reserve capacity in strategic locations - Promote community based food and feed banks in strategic locations - Provide capacity building on food & feed reserve system <p>Conduct regular M&E of the food & feed reserve system</p>	domestic market corporation, ECX, EGTC	<ul style="list-style-type: none"> - Number of community based food reserve established/ strengthened - Number of persons benefited from the reserved food & feed reserve 	Reduce the risk of starvation people & animals due to shortage of food & feed by 30%
5	Establish PHM mechanization center for training & maintenance	One PHT maintenance & training centers at federal & five at selected regions	<ul style="list-style-type: none"> - Establish/ strengthen PHT maintenance & training centers at federal & regional level - Support the manufacturing and distribution of PHT & accessories through PPP - Provide technical backstopping for operation and maintenance staffs - Capacitate selected private enterprises/ youth group for maintenance of PHT - Capacity building training to established centers 	<ul style="list-style-type: none"> - Lead (MoA) - Collaborators (MoLS, RBoA, EIAR, partners, private sectors) 	<ul style="list-style-type: none"> - Number of functional centers established - Number of trained personnel by the center - Number & type of PHT maintained 	<ul style="list-style-type: none"> - Increased efficiency of machinery improved by 25% - At least 90% of service providers attitude, skill & knowledge improved - Reduce PHL due to mechanization misuse by 50% - Number of functional machineries increased by 50%
6	Standardize Transport service in compliance with nature of commodities	At least 80% of agri-food commodities transported with standard transport service in compliance with nature of commodities from 2024-2029	<ul style="list-style-type: none"> - Prepare standards and guidelines referring to commodity specific transportation & handling modalities - Promote the use of appropriate packaging materials - Promote use of appropriate and product specific transportation facilities and services - Regulate the movement of agri-food commodities along the transport route - Regulate the movement of agri-food commodities along the transport route 	<ul style="list-style-type: none"> - Lead (MoA, EAA) - Collaborators (ESI, MOTRI, NAHI) 	<ul style="list-style-type: none"> - Number of standardized transportations means operating per commodity - Number of developed standards & guidelines 	<ul style="list-style-type: none"> - Agri-commodity transport service improved by 60% - reduction of PHL by 30%

7	Establish and strengthen marketing infrastructures	<ul style="list-style-type: none"> - Ten standard market centers at the capital city & one in each region established from 2024-29 - At least 80% of agri-food commodities have a digital marketing platform from 2024-2029 	<ul style="list-style-type: none"> - Develop standards and guidelines for marketing services - Introduce and support digital marketing platform through PPP - Develop and implement product quality standards and grades for price differentiation - Establish infrastructure for the marketplace - Facilitate infrastructure for farm-gate markets - strengthen and create strong linkage between producers and agro-food processors - Support private actors to establish and run sorting grading and packing houses - Support private actors in providing ripening service - Capacity building for service providers at market places (loading, unloading, ripening..) 	<ul style="list-style-type: none"> - Lead (MoA, EAA) - Collaborators (MoTRI, ESI, Regional bureaus - Private sectors) 	<ul style="list-style-type: none"> - Number of standards & guidelines prepared - Number of standard markets, sheds constructed at federal & regional level established/ strengthened - Number of aggregation centers and pack-houses established 	<ul style="list-style-type: none"> - Market access for standard agri-food products improved by 30%
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SO 5: Improve access to finance and investment

S/n	Strategic intervention	Targets	Activities	Responsibility	Performance indicators	Expected outcome
1	Improve access to finance	At least 20% of stakeholders accessed for finance services from 2024-2029	<ul style="list-style-type: none"> - Facilitate credit & insurance services to PHT manufacturers and users - Facilitate lease financing - Develop & apply revolving fund scheme - Arrange matching fund for cost-sharing/recovery arrangements - Provide adequate foreign currency for PHM technology importers - Allocate adequate research fund for PHT generation and demonstration - Establish smart agri-collateral systems 	<ul style="list-style-type: none"> - Lead (MoA) - Financial Collaborators (financial Institutes and Insurance companies FCC) 	<ul style="list-style-type: none"> - Number of PHM actors with access to finance - Number of financial institutions providing financial access to PHT - Amount of hard currency allocated for PHT import - Number of financial institutions funding research and development of PHM - Number of credit accessed through agricultural collateral 	<ul style="list-style-type: none"> - Overall PHM loss reduced by 30%
2	Promote and support investment	<ul style="list-style-type: none"> - 20 Investors supported in the area of PHM from 2024-29 - 50 SME organized in each region from 2024-29 - 100 Farmer cooperatives & unions established in each region from 2024-2029 - Foreign direct investment increased by 50% from 2024-2029 	<ul style="list-style-type: none"> - Conduct inventory & mapping of businesses working on PHM, processing, value-addition and related activities - Facilitate attractive environment for local and FDI to invest in PHL reduction technologies - Develop workable business models for commercialization of PHL reduction technologies / practices / agro-processing - Support and encourage private investors to engage in PHM business - Facilitate technical, financial and administrative support to small and medium agro enterprises, farmers coops and unions - Support and encourage service providers in PHM business - Create market linkage for enterprises - facilitate to attract foreign direct investment in PHM - Provide capacity building training for various stakeholders 	<ul style="list-style-type: none"> - Lead (MoA) - Collaborators (Ethiopian investment commission, Financial and insurance institutions, private sectors) 	<ul style="list-style-type: none"> - Number of documents prepared - Number of incentive packages - Number of investments established in PHM business - Number of developed & Supported small and medium scale agro-enterprises, farmers cooperatives or unions - Number of market linkage created with financial institutions - Number of foreign direct investment attracted 	<ul style="list-style-type: none"> - Investors, SEM, farmer coops & unions in PHM increased by 50% - job opportunity increased - proportion of value added products increased - Foreign direct investment improved

3	Provide incentives for PHT	<ul style="list-style-type: none"> - Three document incentivized on technology generation, innovation & promotion 	<ul style="list-style-type: none"> - Revise and update tax exemption scheme for PHTs (produced & imported) - Prepare implementation guidelines for tax exemption PHM technologies - Create awareness on tax exempted PH technologies - Encourage entrepreneurs (investors, youth groups, Coops, etc) for investment in PHM enterprises 	<ul style="list-style-type: none"> ✓ - Lead (MoA) ✓ Collaborators (MoF, MoIT, MoLS ECC, MoPD, private sectors) 	<ul style="list-style-type: none"> - Number of technologies exempted from Tax - Number of beneficiaries from tax exemption - Number of reports 	<ul style="list-style-type: none"> - Utilization of PHTs increased by 50% - Job opportunity increased
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SO 6: Promote Agribusiness and Agro-processing

S/n	Strategic intervention	Targets	Activities	Responsibility	Performance indicators	Expected outcome
1	Improve business environment for local PHT manufacturers, distributors and service providers	<ul style="list-style-type: none"> - 105 local manufacturers equipment and machinery supported - 28 local manufacturers and distributors of pesticide and insecticides supported 	<ul style="list-style-type: none"> - Promote the development of an effective service industry - Promote coordinated, integrated and targeted smart subsidies for the agricultural input supplier manufacturers to effectively reduce costs for the postharvest enterprises - Capacitate PHT business actors 	<ul style="list-style-type: none"> - Lead (MoA) - Collaborators (MoLS,- Private sectors, Ethiopian Agricultural Industrial Park, EFDA) 	<ul style="list-style-type: none"> - Number of functional PHM service providers - Number of Beneficiaries - Number of Youth and women engaged in agri-business - Proportion of processed & value added products 	<ul style="list-style-type: none"> - Income of actors engaged in agri-business increased by 50% - Job creation in PHM business increased by 50% -
2	Improved agro-processing and value addition	<ul style="list-style-type: none"> - At least 70 cooperatives/unions linked to processing industry from 2024-29 - At least 70 cooperatives started processing and value addition - At least 5,000 youth and women organized and started processing and value-adding - At least 10,000 farmers and value chain actors increased their awareness on value addition 	<ul style="list-style-type: none"> - Promote the partnering of agro-processing and the farming enterprises to develop strong supply links - Promote processing and value addition by cooperatives and unions - Organize women and youth to engage in processing and value-addition - Create awareness and promote the desire for quality differentiation through value addition for the benefit of the value chain actors, particularly farmers. 	<ul style="list-style-type: none"> - Lead (MoA) - Collaborators (Investment Commission, IPDC, LDI (Livestock Development Institute), EFBPI (Ethiopian food, beverage & Pharmaceutical Institute), Private sector/associations 	<ul style="list-style-type: none"> - Number of micro, small, medium and large scale agro processing industries established - Number of SML agri-food processing enterprises, cooperatives and Unions that received technical support - Number of Rural Transformation Centers supported 	<ul style="list-style-type: none"> - Significant increase in the shelf life of agri-food products - Year-round availability of diversified processed foods - Increased convenience for consumption -

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