

REVIEW

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Postharvest food loss reduction and agriculture policy framework in Tanzania: status and way forward

Evodius Waziri Rutta^{1*}

Abstract

In 2014, Tanzania became a signatory of the African Union Postharvest Loss Management Strategy (AU-PHLMS) under the Malabo Declaration, a policy framework of the African Union aimed at reducing the continent's postharvest food losses by 50 percent by 2025. Though Tanzania has several agriculture development policies, very little research exists on to what extent the postharvest food loss agenda is reflected and integrated into Tanzania's agriculture policy framework, making it difficult to assess Tanzania's commitment and progress made to realize these ambitious targets in 2025. Using a scoping review method, this study reviews agriculture-food security policies and programs enacted by the government of Tanzania from the 1990s to 2022. Findings reveal that despite high postharvest food losses, policies, and agriculture development programs in favor of increasing food production remain the central focus of the government, while interventions to eliminate food loss and waste have not been prioritized. Results also show that with nearly half of the food produced not reaching consumers, Tanzania's ambitions to be food secure may only be realized if policy measures to increase crop productivity go hand in hand with preventing postharvest food losses. The study calls for full policy integration of postharvest management programs and more investment in farmer-focused interventions to reduce food loss and waste in Tanzania.

Keywords Tanzania, Agriculture policy, Postharvest food loss, Food security, Small-scale farmers

Introduction

The quest to reduce postharvest food losses in Africa has become an international development agenda. This comes as estimates from the Food and Agriculture Organization (FAO) show that annually, countries in sub-Saharan Africa (SSA) waste about 20% of all the cereals produced in the region due to poor postharvest management [1–3]. Similar to FAO estimates, the African Postharvest Losses Information System (APHLIS) reports that farmers in SSA lose up to 25% of rice and maize due

to mishandling of crops and lack of proper storage facilities to avoid such losses [1, 3]. On the other hand, for perishable crops, especially fruits and vegetables, losses could be up to 40%, attributed to poor storage conditions that lead to spoilage before they are delivered to markets and consumers [1, 4, 5]. As a significant volume of food produced does not reach consumers, cutting down food loss and waste has been widely recognized as the most effective and sustainable means to end hunger in Africa [2, 3]. More importantly, crop losses have a serious impact on the livelihoods of the continent's small-scale farmers, with evidence showing that uncontrolled postharvest food loss problem could derail Africa's progress to attain food security and push many rural smallholders into the cycle of poverty [1, 6, 7]. Furthermore, by producing food that will not be eaten, African countries may

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be forced to expand crop production to compensate for food lost. This, however, could lead to serious environmental consequences such as intensive use of chemical fertilizers and deforestation [4, 5].

To limit excessive food losses in Africa, regional and global policy actions have been put forward. At the global level, the need to reduce postharvest food losses is emphasized in the United Nations Sustainable Development Goals (SDGs)—SDG 1 and 2 and several others, including SDG 12 [2, 3]. Similarly, in June 2014, under the African Union Malabo Declaration, African governments unanimously agreed to cut down current levels of postharvest food loss by 50% before 2025 [8]. Following the ratification of the Malabo Declaration, the African Union Postharvest Loss Management Strategy (AU-PHLMS) was adopted as a continent policy framework to accelerate African governments' efforts to curb food losses [8]. As a result of increased global attention to the food loss and waste problem, food loss prevention programs have slowly become a policy agenda, pushing African governments to be more proactive in tackling the problem [2, 9]. Since 2018, the governments of Kenya, Zambia, Zimbabwe, and recently Tanzania began taking policy measures to tackle the postharvest food loss problem with the development of national postharvest management strategies [8, 10].

The development of these national policy strategies is an important step on Africa's path to eliminating food losses because government policies play a greater role in shaping programs and influencing better postharvest management practices that will lead to less food waste. Despite this policy development, since the passing of the African Union (AU) Malabo Declaration, there is limited understanding of the progress made concerning the implementation of national postharvest management strategies in countries where such policies have been adopted. To fill this knowledge gap, this study examines policy implementation status focusing on Tanzania, which passed its national postharvest management strategy in 2019.

Tackling food loss in Tanzania: past and current policy response

Like elsewhere in the continent, postharvest food loss (PHL) is a major food security challenge in Tanzania. About 50% of fresh fruits and vegetables perish before being delivered to the markets, and almost 25% of rice and maize are lost due to a lack of proper postharvest infrastructure [10]. The PHL problem in Tanzania has been linked to several factors, including inadequate government investment in storage facilities and poor extension services, leaving rural farmers to rely on traditional and inefficient postharvest facilities [11–14]. As a result,

farmers waste a significant volume of food crops because they lack the facilities to keep them while waiting for reliable markets [13, 14]. In 2017, a study in northern Tanzania revealed that a lack of proper storage facilities to extend the shelf life of fresh fruits and vegetables before transportation and sales was a leading cause of spoilage and losses experienced by most vegetable farmers [11]. Due to their high perishability, farmers and food suppliers in fruits and vegetable value chains in Tanzania tend to experience much higher spoilage, with losses for some of these crops reported to be 20% (banana), 30% (mango), 40% (orange), and 50% (tomato) [15]. These food losses have serious implications for agricultural growth, food security, and the livelihoods of many people in the country, especially those in rural areas. Additionally, it has been observed that uncontrolled postharvest food losses have adverse consequences for Tanzania's economic growth because its economy is still largely dependent on farming [13, 16, 17].

Given these challenges, the government of Tanzania has also expressed concerns over the economic impact of postharvest food loss, particularly to the rural communities whose livelihoods are centered on small-scale farming. Several agriculture policies and programs have been put in place to enhance national food security and address the PHL problem. Though such policies and programs exist and are implemented, little is known about how the PHL reduction agenda has been featured in agriculture development programs and policy implementation. For instance, despite the passing of the National Postharvest Management Strategy (NPHMS) by the Ministry of Agriculture (MOA) in 2019, there is a lack of understanding of the extent to which postharvest management issues have been featured in the implementation of past and current active agriculture and food security policies.

Furthermore, as a signatory of the Malabo Declaration and the SDGs, Tanzania has pledged to take bold policy measures to reduce crop losses after harvest by 2025 [10]. However, concerns have been raised regarding the government's continued policy focus on expanding food production through ongoing agriculture development programs such as the Southern Agricultural Growth Corridor of Tanzania (SAGCOT) that prioritizes increasing food productivity and less emphasis on improving postharvest extension services for small-scale farmers [16, 18, 19]. It is also unclear how PHL reduction has been integrated into SAGCOT and several other programs promoted by the government of Tanzania as a pathway to food security. To fill this knowledge gap, the objectives of this paper are: (1) assess how the postharvest food loss problem has been incorporated into existing agriculture-food security policies and programs in Tanzania; (2)

establish policy gaps and provide recommendations for better integration of postharvest management issues in the implementation agriculture-food security policies. As Tanzania's NPHMS marks four years since its launch, addressing these knowledge gaps is critical to guide and inform policymakers on future areas that need to be incorporated.

Method

Search strategy

A review of relevant agricultural development policies, strategies, and programs was guided by a Scoping Review approach to identify and select the most relevant policy documents that respond to the primary objective of this study. In a scoping review, the researcher's interest is to establish gaps and findings from a wide range of selected literature [20]. A scoping review also provides a broad overview of existing knowledge gaps in an area that has been least investigated or emerging [21]. Doing so ensures a "comprehensiveness in literature search", which helps the reviewer identify and recommend future potential research areas [21–23]. Additionally, due to the nature of the scoping review process, which focuses on offering a descriptive overview of the literature searched without critiquing evidence from specific studies, hence less biased [24]. These methodological strengths made scoping review an ideal research method for this paper because evidence shows that not enough research exists regarding the integration of the PHL agenda in agriculture development policies and programs implemented by the government of Tanzania [25].

Despite these known strengths, the use of Scoping review has also been criticized in terms of its lack of structured and pre-defined processes to answer specific research questions but rather giving a descriptive overview of searched literature, with some scholars stating that its findings may be too broad [23]. As such, other alternative research methods, such as systematic review that employs a more structured approach in conducting literature reviews, have been recommended [26]. In this paper, a search strategy was limited to specific government policies and programs implemented since 1990. The specific nature of what to include and not include in the search for literature scan (policy review process) addressed this shortcoming, making scoping review an appropriate research method for this study.

Inclusion and exclusion criteria

Since, over the years, Tanzania has implemented several agriculture development programs and policies, the search and selection of policy documents were mainly restricted to agricultural policy documents, government-led agricultural development programs, and strategies

put forward and implemented solely by the government of Tanzania (Ministry of Agriculture) from 1990 to 2022. The decision to start a literature search in 1990 was made because some of the government policies enacted in the 1990s are still active and being implemented. In terms of exclusion criteria, agriculture policies or programs were not included in the review if they did not meet one of the following criteria:

- i. if the implementation of policy or program (s) period has phased out.
- ii. did not focus on agriculture development, food security, or nutrition issues.
- iii. was not government-led or purely private-led agricultural development programs such as food security programs implemented by non-governmental organizations (NGOs).
- iv. was not implemented or did not take place in Tanzania.
- v. was only implemented as a pilot project or program by the government.

Search process and policy review process

After establishing inclusion and exclusion criteria, a step-by-step process (Fig. 1) was employed to synthesize and extract information from potential policy documents to be selected for the review. In Step 1, policy documents that met one of the inclusion criteria were scanned and collected from government websites and other sources. Then, they were read several times to extract passages that relate to food and nutrition security, postharvest management, food loss, and waste. In this step, the search process resulted in the selection of twenty ($n=20$) previous and current agricultural and food security policy documents that were identified and considered for full review. In Step 2, a second comprehensive review of selected policy documents was done, which included a full-text review and reading sections and passages of the policy documents several times, including policy statements and strategic objectives, to understand policy goals and establish similarities and differences between these policy documents. Twelve ($n=12$) policy documents that met the inclusion criteria were then selected for the next review (Step 3), which was restricted to active agriculture development policies and programs currently being implemented by different agencies such as the Ministry of Agriculture (MOA). In Steps 3 and 4, as the search focused more on current agricultural policies and programs, six ($n=6$) agriculture development policies, strategies, and programs were finally selected and included for the full review (Table 1). The selection of these final policy documents ($n=6$) considered policy

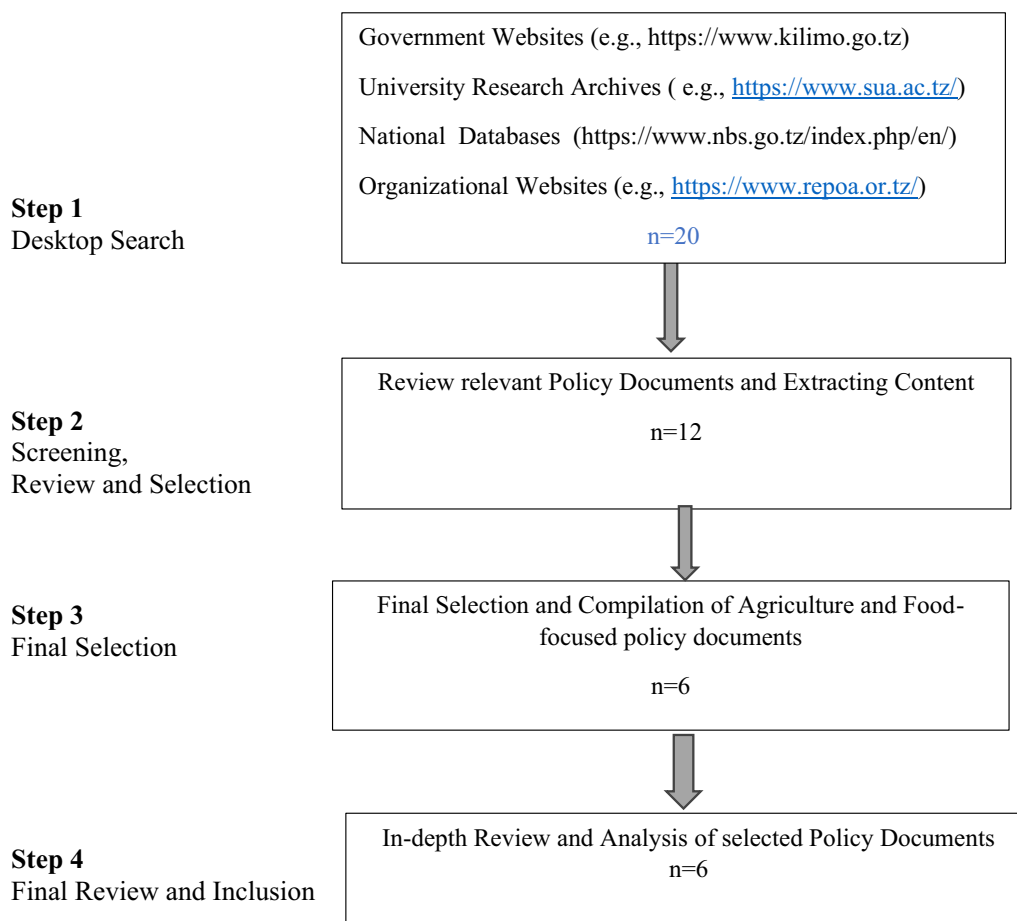


Fig. 1 Postharvest food loss and agri-food policies in Tanzania (policy review process)

goals, implementation status mentioning postharvest intervention or reduction, and how findings from this evaluation will aid the ongoing policy implementation process. Gaps found, and major findings from this process are summarized (Table 1) and further discussed in Sects. 3 and 4 of this paper.

Results

Tanzania’s agri-food policy framework and food loss agenda: gaps and challenges

Food Security and Nutrition Policy (FSN, 1992)

Soon after gaining independence, the government of Tanzania integrated the food security and nutrition agenda into several policies and programs meant to address poverty and other development challenges [27, 28]. In 1992, the Food and Nutrition Policy (FSN) was formulated to combat food shortages and malnutrition facing the country’s rural population. FSN’s goal is to tackle national food and nutrition problems through the involvement of all sectors. Five policy focus areas have been identified to achieve this policy objective: (a) food security, (b) care

for special groups, (c) essential human services, (d) food and nutrition committees, and (e) the role of various sectors in the implementation of food and nutrition policy in Tanzania. On food security, the policy emphasizes that the realization of national food and nutrition security is tied to increased crop yields, efficient food harvesting, preservation and food processing, food availability, distribution and consumption, and better access to quality food and the number of meals. FSN also recognizes that malnutrition problems in Tanzania could be attributed to a high wastage of nutritious food that could feed food-insecure populations [29].

Following FSN’s limited success, in 2011, the National Nutrition Strategy (NNS) was launched, followed by the first National Multisectoral Nutrition Action Plan (NMNAP, 2016–2020), which was recently revised as NMNAP-2 (2021–2025). Both NNS and MNNAP-2 advocate for the inclusion of nutrition issues in agriculture, health, education, and national development plans such as MKUKUTA—National Strategy for Growth and Poverty Reduction [30]. Though after the launch of FSN

Table 1 Selected national food and agriculture policies and programs

Policy	Objective	Integration and consideration of postharvest food loss issues in the policy	Gaps
Food Security and Nutrition Policy (1992)	Coordinate multisectoral policy and programs implementation on food and nutrition activities	Recognizes postharvest food loss prevention as a priority area to enhance food and nutrition security	Has gaps as it emphasizes more on reducing food loss and waste on grains, overlooking losses on fruits, vegetables, and other food products
National Nutritional Strategy (2011)	Ensure national nutritional status is improved through effective nutrition policies, programs, and partnerships	The postharvest food loss problem is recognized as one of the policy priority areas for attaining "Household Food Security."	Focus more on health-related solutions, overlooking the linkage between food loss and food insecurity
National Agricultural Policy 2013 (NAP)	Transform the agriculture sector from subsistence to a modern, efficient, and more profitable sector	Recognizes the postharvest food loss problem and less of an agriculture or food security problem	Emphasizes increasing food productivity but ignores the postharvest management challenges facing the agriculture sector
Agriculture Sector Development Strategy II (ASDS, 2015–2025)	Improve agricultural productivity and profitability through better access to modern technologies such as high-yielding seeds, fertilizers, tractors, etc.	On-farm and off-farm crop losses are recognized as barriers to agricultural growth Vows to support programs that will improve grain storage and processing infrastructure challenges	Policy interventions mentioned largely focus on the improvement of postharvest infrastructure for maize, rice, and other grains and less on other food crops such as fruits, vegetables, and other food products that are more vulnerable to food loss and waste
Agriculture Sector Development Programme II (ASDP, 2017–2028)	Accelerate agriculture sector growth through increased private sector involvement	The postharvest food loss problem is recognized, but more emphasis is given to post-harvest management challenges in the maize and rice value chains	The private sector's role in improving postharvest infrastructure for small-scale farmers is not mentioned or emphasized
National Postharvest Management Strategy (NPHMS, 2019–2029)	Promotes adoption of efficient and affordable postharvest technologies to reduce food loss and waste	Responds to regional and global PHL policy frameworks such as the 2014 African Union-Malabo Declaration and the United Nations Sustainable Development Goals (SDGs)	Overlooks postharvest challenges on fruits, vegetables, and other horticultural crops but focuses more on reducing food loss on maize and other grains

and NNS, some progress has been achieved, hunger and malnutrition are still prevalent, particularly among rural women and children across the country [31, 32]. Many experts argue that the prevalence of malnutrition and food shortages in Tanzania results from policy failures caused by ineffective planning and implementation [29, 32].

On the other hand, while the interconnection between food loss and nutrition security is acknowledged in FSN, NNS, and NMNAP, policy interventions for reducing losses on nutritious food products, such as fruits, vegetables, and others, are not considered in NNS and NMNAP implementation plans. The three policy documents largely focus on the negative health implications of malnutrition overlooking the food loss problem. This lack of recognition of the postharvest food loss problem may affect NNS and NMNAP achievements because a large volume of food produced does not reach consumers due to uncontrolled food loss and waste [33, 34]. At the national level, a significant share of vegetables, fruits, fish, and dairy products spoil and end up in landfills mainly because of poor storage conditions [10, 35]. Studies have also indicated that families and households in Tanzania have limited access to nutritious foods because of postharvest food losses [11, 36]. Despite these facts, neither NNS nor NMNAP mentions specific food loss prevention interventions. Nutrition intervention programs presented by NNS and NMNAP concentrate more on public health solutions such as food supplement provision, water, sanitation, and hygiene (WASH) and give little emphasis on food loss reduction. Additionally, FSN was formulated three decades ago and, therefore, lacks relevance today, underscoring the need for a new food and nutrition policy that reflects the current demographic, food, and nutritional problems in Tanzania.

National Agricultural Policy (NAP, 2013)

The National Agricultural Policy 2013 (NAP) is the policy document that primarily focuses on driving agriculture sector development in Tanzania. The current NAP (2013) is a product of two previous agriculture policies (the Agricultural and Livestock Policies of 1993 and the National Agricultural and Livestock Policy of 1997) that were amended to push forward policy and institutional reforms to modernize the agriculture sector [37–39]. Unlike the two previous agriculture policies, NAP (2013) aims to transform Tanzania's agricultural economy from subsistence to modern, efficient, and commercially profitable [40]. In doing so, research and development, support for private sector engagement, and agricultural mechanization have been widely emphasized by NAP [40].

Under the guidance of the Ministry of Agriculture (MOA), NAP has identified ten policy priorities. These focus areas include (i) agricultural support and technical services; (ii) increasing production, productivity, and profitability; (iii) enhancing national food and nutrition security and production of surplus for export; (iv) improve agricultural processing; (v) enhance the production of quality products to improve competitiveness; (vi) increase foreign exchange earnings from exportation of agricultural products; (vii) strengthen inter-sectoral coordination and linkages to increase efficiency and effectiveness; (viii) provide an enabling environment to attract private sector investment; (ix) strengthen inter-sectoral coordination; (x) protect and promote integrated and sustainable utilization of agricultural lands and (xi) promote the implementation of cross-cutting issues in agricultural undertakings. To transform the sector, NAP believes and considers the private sector a key player. In Chapter 2, item 2.1, NAP calls for more private sector involvement in Tanzania's agriculture economy and seeks to create an enabling policy environment for private actors to thrive and contribute to the agriculture transformation agenda [40].

On the other hand, similar to previous agricultural policies, the Ministry of Agriculture (MOA) continues to focus on interventions for increasing crop yields and gives very little attention to the postharvest food losses confronting the sector and the majority of small-scale farmers. Even though the sector is dominated by small-scale farmers who lack the necessary infrastructure to avoid food loss and waste, NAP prioritizes expanding agricultural yields, overlooking critical postharvest challenges facing most subsistence farmers. Likewise, while NAP acknowledges the need to address the postharvest food loss problem (Chapter 3, item 3.10), no specific postharvest management intervention is pointed out or emphasized in NAP's policy statements and implementation plans. This lack of policy attention regarding the postharvest food loss problem may significantly affect NAP's goal to transform the agriculture sector. It also raises several questions about MOA's commitment to improving national food security and small-scale farmers' livelihoods.

Agriculture Sector Development Strategy II (ASDS, 2015–2025)

Following the passing of NAPs in 1993 and 1997, the Agriculture Sector Development Strategy (ASDS) was put forward to support NAP implementation. The first ASDS was enacted in 2001 and revised in 2015 (ASDS, 2015–2025) for a 10-year implementation till 2025. While the first ASDS focused on institutional reforms, the second ASDS concentrates on accelerating growth

in the agriculture sector through private-led interventions that boost crop productivity and profitability [41]. Under the current ASDS, four strategic areas have been emphasized: (i) expanding sustainable water and land use management; (ii) improving agricultural productivity and profitability; (iii) strengthening and competitive value chain; and (iv) strengthening institutional coordination [41]. Other strategic areas advocated by ASDS include improving access to advanced agriculture technologies (such as seeds, fertilizers, and tractors) for small-scale farmers and removing trade barriers to allow the flow of private capital in agriculture. The implementation of ASDS is also meant to contribute to Tanzania's Development Vision 2025 and National Strategy for Growth and Reduction of Poverty (NSGRP II), also known as MKU-KUTA [41].

Concerning the postharvest food loss problem, ASDS acknowledges that growth in the agriculture sector cannot be realized if crops harvested are lost before they reach markets and consumers. ASDS highlights that policy efforts to boost crop productivity must be coupled with improving postharvest management infrastructure in rural areas where most farmers experience food losses [41]. Implying this, ASDS strategic objective 3—Strengthened and Competitive Value Chain, has outlined three policy interventions to minimize postharvest food losses. Some of these interventions include the investment in postharvest storage and agro-processing infrastructure, such as *Silos* for grains, and establishing rural marketplaces to connect farmers and traders [41, 42]. ASDS's recognition of postharvest challenges facing Tanzania's agriculture sector is a positive step towards addressing the postharvest food loss problem that was overlooked by previous policies. While building postharvest infrastructure such as *Silos* is critical in reducing crop losses, attention should also be given to training and equipping farmers with better postharvest management skills to help them avoid unnecessary crop losses [10, 42]. Currently, government-led agriculture extension services are underfunded and, in many places, unavailable to farmers. This means investment in extension services is equally important for crop production and the management of crops after harvest.

Agriculture Sector Development Programme II (ASDP, 2017–2028)

To realize ASDS's policy objectives, the Agriculture Sector Development Programme (ASDP) was launched by MOA to facilitate the implementation of interventions outlined in ASDS. Phase one of the ASDP was implemented from 2006 to 2016, focusing on increasing budget allocation for agriculture to at least 10% as recommended by the Comprehensive African Agriculture Development

Programme (CAADP) [37]. In 2016, ASDP was revised, paving the way for the second phase of ASDP from 2017 to 2018, focusing on attracting large-scale investment in Tanzania's agriculture sector [43]. Under ASDP II, several private-led and public–private agribusiness policy programs have been implemented [37]. Some of these programs include the Tanzania Agriculture and Food Security Investment Plan (TAFSIP) and Kilimo Kwanza (KK) Initiative (*Agriculture First Initiative*), Accelerated Food Security Project (AFSP), National Agricultural Input Voucher Scheme (NAIVS), and others [38]. TAFSIP and Kilimo Kwanza (KK) programs have focused on commercializing and privatizing land and other resources to accelerate agriculture growth [37, 44]. For example, under the KK initiative, in 2011, the government of Tanzania launched the Southern Agriculture Growth Corridor of Tanzania (SAGCOT), reserving more than 50,000 hectares of arable land for foreign companies to invest in large-scale agribusiness projects [45, 46]. However, the government's push for private-led agriculture growth has been criticized by several policy experts in and outside Tanzania. Many experts believe SAGCOT and other private-led agriculture development programs would leave rural smallholders with no land for food production, fueling land-use disputes that are already out of control [37, 44, 47]. Nevertheless, many of the SAGCOT targets set almost over a decade ago have not been realized due to poor engagement of local farmers, insufficient foreign capital, and endless land-use conflicts between locals and foreign agribusiness companies [37, 44, 45, 47, 49].

With regard to postharvest food loss management, ASDP-led programs such as KK and SAGCOT largely focus on increasing crop yields for export potential crops through high-tech and modern agriculture technologies overlooking the postharvest food loss problem [43]. Similarly, although under ASDP, MOA has implemented some postharvest food loss management programs, many of these programs focus on maize, rice, and cash crops such as cashew nuts (Table 2). Other crops (such as vegetables and fruits) more vulnerable to food loss and spoilage have not been prioritized [43]. MOA's ambitions to modernize the agriculture sector in Tanzania may not be realized if the postharvest food loss agenda is not prioritized. As the government of Tanzania strives to boost productivity, a comprehensive postharvest management strategy is critical for national food security and the livelihoods of farmers who otherwise would continue to waste even the little they produce.

National Postharvest Management Strategy (NPHMS, 2019–2029)

After several years of neglect, the postharvest food loss problem caught the attention of agriculture policymakers

Table 2 MOA-ASDP postharvest management programs from 2007 to present

Program	Purpose
Warehouse Receipt System (WRS)	Launched in 2007 to improve access to financing, marketing, and trading conditions in coffee, raw cashew nuts, maize, paddy, sesame, sunflower, pigeon peas, and cotton value chains <i>Status: Ongoing</i>
Tanzania Initiative for Preventing Aflatoxin Contamination (TANIPAC)	Established in 2018 to enhance food safety, postharvest management training, and promote the uptake of technologies reducing aflatoxins and fungal infestation, focusing on maize, groundnuts, and other grains <i>Status: Ongoing</i>
Marketing Infrastructure, Value Addition and Rural Finance Support (MIVARF) Programme	Launched in 2017, focusing on postharvest infrastructure Development and Rural Financing for small-scale producers in rice/paddy, sesame, cashew nuts, and cassava value chains <i>Status: Closed</i>

in Tanzania. In 2019, the National Postharvest Management Strategy (NPHMS) was put forward by MOA in response to the urgent need to reduce food loss and waste and deliver Tanzania's commitment to end hunger echoed in the African Union (AU)-Malabo Declaration of 2014 and SDGs (1, 2 and 12) [3, 10]. Both the Malabo Declaration and the United Nations (UN) SDGs demand that African countries cut down food loss by at least 30% from the current levels [51]. In recognition of past policy failures, NPHMS's vision is to "reduce postharvest losses along the commodity value chains, which adequately reward the actors and sufficiently contribute to national food and nutrition security and the economy" [10]. To realize this vision, NPHMS seeks to provide education and raise awareness about the postharvest food loss problem, improve availability, accessibility, and affordability of food loss reduction facilities, support research and data on food loss, and strengthen institutional capacity to tackle the postharvest food loss problem [10].

The recent passing of NPHMS in Tanzania is indeed significant policy progress toward practical measures to address food losses in Tanzania. While this policy development is commendable, MOA and the government of Tanzania, in general, have continued to advocate for and seem to prioritize agricultural expansion and put very little emphasis on improving postharvest infrastructure [52, 53]. Despite very poor performance in the last decade, SAGCOT and many other agriculture commercialization policies promoted by MOA maintain the same policy stance [52, 54]. Furthermore, according to the NPHMS five-year implementation plan, a significant portion of the NPHMS budget would come from external sources, mainly international development donors and the private sector [10]. MOA's inability to entirely finance NPHMS interventions could seriously affect the coordination and execution of interventions meant to help small-scale farmers

adopt postharvest technologies and avoid food loss. Over the years, due to budget constraints, MOA has failed to meet most policy targets, including delivering extension services to rural subsistence farmers who rely on rudimentary facilities to produce and harvest crops [55–57]. While the passing of NPHMS is a major step, the lack of political will coupled with budget deficiencies may constrain NPHMS implementation, leaving poor farmers without the infrastructure to avoid food loss and waste. As NPHMS is still under implementation, addressing these policy challenges should be MOA's priority going forward.

Discussion

The review of Tanzania's agriculture policy regime reveals that several policies and programs have been put in place over the years to solve the country's agriculture and food security challenges. However, most of these policies and programs enacted by MOA focus on expanding crop yields with little emphasis on the postharvest food loss problem. MOA's desire to transform the agriculture sector can only be realized if postharvest food loss issues are also prioritized in the policy framework. The study highlights several gaps that need the attention of agriculture policymakers in Tanzania. Since most of these policies are currently under implementation, addressing these gaps will be crucial for MOA's efforts to tackle persistent food shortages and attain sustainable food systems.

Over-emphasis on increasing agriculture productivity

At the moment, MOA seems to be more focused on modernizing farming and attracting foreign agribusinesses to Tanzania's agriculture sector, while the

interests of small-scale farmers have not been considered [37, 50, 58]. Furthermore, even though MOA has recently passed the NPHMS (2019–2029), looking at the current administration's policy priorities under President Samia Suluhu, Tanzania seems to pursue the same agriculture policies¹ where private-led agriculture development and programs such as SACGOT are more preferred and advocated despite past failures [25, 45, 50]. Unfortunately, SACGOT and other private-led programs supported by MOA continue to ignore the postharvest food loss problem, which needs urgent interventions. This is evidenced by recent studies by agriculture development scholars in Tanzania who are also concerned with private-led agriculture commercialization policy promoted by the government of Tanzania through programs such as SACGOT, where investment in infrastructure for increasing food production is prioritized than building infrastructure to reduce crop losses in the country [13, 25, 48, 49]. Since programs such as SACGOT² have pledged to inject substantial financial resources into Tanzania's agriculture sector, it is crucial that some of these financial resources are directed to postharvest management programs, especially for small-scale farmers. This means that if food security has to be achieved, increasing food production must go hand in hand with policy measures and interventions to ensure that more food reaches consumers.

Little emphasis on food loss reduction on non-traditional crops

MOA's postharvest management programs, such as WRS, mainly focus on maize rice and export valuable crops, rarely include fruits or vegetables. A major policy shift is needed to create a supportive policy environment for other crop value chains, particularly horticultural crops. The horticultural sector, which includes the production of vegetables, fruits, flowers, and spices, is one of the lucrative agribusinesses in Tanzania [35]. Data from the Tanzania Horticultural Association (TAHA) indicate that over one million people are employed in the production of horticultural products [59]. However, due to their high perishability combined with inappropriate post-harvesting practices, horticultural producers in Tanzania experience a high rate of postharvest losses [35, 59]. Many rely on traditional postharvest management practices that are unreliable and inefficient, which lead to significant spoilage and losses of up to 40% [37,

60]. The inability to control spoilage has also left many fruit and vegetable producers in Tanzania unable to supply high-quality fresh produce needed by international markets [61, 62]. To unlock the sector's economic contribution, NPHMS implementation should prioritize non-traditional crops that have often been and continue to be neglected. Policy interventions such as training farmers on proper handling of fresh produce and funding the establishment of essential infrastructure, including cold storage facilities near production areas, will be crucial in reducing losses on perishable fruits and vegetables. MOA should also ensure farmers are connected to reliable markets prior to the start of production season to minimize losses that tend to occur due to market challenges.

Budget deficiencies hinder agriculture development efforts

This study reveals that MOA continues to rely on donors and development partners for funding to implement some of its agriculture policies and programs. Currently, significant funding for major programs such as SACGOT and NPHMS is expected to come from external sources [10, 44, 46]. MOA's inability to fund its policies and programs could derail Tanzania's efforts to address postharvest infrastructure challenges facing small-scale farmers that are critical in transforming the agriculture sector in Tanzania. While external financial resources can complement government policy efforts, history has shown that donor-funding policy implementation is unsustainable and leads to limited impact due to a lack of financial continuity and ownership [63, 64]. For years, Africa's reliance on external donors to run development policies and programs has been found to be ineffective and with limited success due to the unsustainability of programs when development aid phases and shift in donor priorities [65, 66]. Highlighting the bigger problem of donor dependency in Africa, Eicher (2003) states that, "donor aid can only provide a fraction of the resources needed to get African agriculture moving. The political leadership and the bulk of the needed funding will have to come from within Africa" [67]. To achieve many of its policy goals, MOA must commit adequate financial resources and limit its dependency on development partners. A sufficient national budget should be allocated and directed to agriculture development programs, particularly rural postharvest extension services, to equip farmers with knowledge and enhance access to essential facilities for preventing food losses.

Engage the private sector beyond food production

Though the need for private sector engagement is widely emphasized in major agriculture programs such as KK, TAFSIP, and SACGOT, the private sector's contribution

¹ <https://www.tanzaniainvest.com/agriculture/president-samia-orders-establishment-of-agricultural-development-fund>

² <https://sagcot.co.tz/index.php/en/what-we-do/sagcot-partnership/about-sagcot-partnership>

to the postharvest food loss agenda has not been mentioned in existing and past policies. Like in crop production, local and foreign private actors, including food processors, marketers, and financial institutions, can play a significant role in building postharvest infrastructure and supplying facilities to eliminate postharvest food losses. This is also important because most postharvest infrastructure and facilities, such as silos and food processing facilities essential to cut down food losses, require substantial capital; hence private sector investment will be critical in solving postharvest food loss in Tanzania. The government of Tanzania has a history of working with the private sector in postharvest management issues in Tanzania. To address postharvest storage challenges, in 2005, the Warehouse Receipt System (WRS) was launched by Tanzania's Ministry of Trade and Industry in collaboration with private enterprises, including banks, food exporters, and processors focusing on cashew nuts, beans, rice, maize, sesame and other value chains [68, 69]. Under Warehouse Receipts Act No. 10 of 2005, small-scale farmers involved in selected value chains keep harvested crop commodities in a private licensed warehouse facility and use warehouse receipts as collateral to secure loans in banks and other financial institutions, enabling them to sell quality commodities to reliable buyers [69, 70]. Under this arrangement, WRS intends to solve two critical postharvest problems: storage losses and lack of reliable markets for smallholders once crops are harvested. Despite the high potential of the WRS system to solve postharvest infrastructure challenges facing smallholders, since its launch, the implementation of the WRS program has not achieved its desired impact [69]. Many factors have been cited for WRS's limited success, including lack of transparency, inadequate engagement of farmers in the program development processes, weak legal framework, and high transaction costs that discouraged farmers from participating in the program [69–72]. For example, while the WRS program is meant to help smallholders, unregulated and high storage fees set by private warehouse operators were too high and unaffordable, causing many smallholders to disengage from the program [69, 70].

Getting the private sector to fund postharvest programs

Since the WRS program continues, these past implementation failures indicate that though private enterprises can make significant contributions in postharvest management, unfavorable terms for small-scale farmers in such programs may lead to poor results. The involvement of small-scale farmers in program development is vital if such programs are to be successful over the long term. Creating an enabling policy and regulatory framework in which farmers' interests, such as land tenure rights

and access to financing, are met and protected under win–win collaborative arrangements with private actors will be crucial [64, 65]. With a supportive policy environment, the private sector can fund the deployment and establishment of postharvest management facilities such as food processing equipment, cold storage facilities, and others needed by farmers to avoid crop losses. More importantly, due to the complexity of the postharvest food loss problem, addressing postharvest management challenges facing farmers in Tanzania requires the mobilization of substantial financial resources and technical knowledge, a role often played by private agribusinesses in most developing countries [66, 67]. MOA's mission to engage the private sector in Tanzania's agriculture development should, therefore, go beyond food production.

Conclusion

The study reveals that though MOA has implemented several agriculture development programs to tackle food insecurity in Tanzania, the postharvest food loss problem continues to be overlooked. With almost half of the food produced wasted, Tanzania's ambitions to achieve food and nutrition security can only be achieved if policy measures are in place to help food producers avoid crop losses after harvest.

While funding for agriculture and food security programs has been and continues to be a priority agenda for Tanzania and its development partners, the economic impact of food loss is often overlooked. According to the World Bank "Missing Food" report, postharvest grain losses experienced by most small-scale farmers in Africa cost governments in sub-Saharan Africa about US\$ 4 billion a year [2]. It is, therefore, clear that postharvest loss is not just a food security problem but also an economic loss for Tanzania. By pushing policies to increase food production instead of investing in infrastructure and technologies to limit unnecessary food wastage, Tanzania's mission to become a food-secure nation could be derailed and take much longer. With the passing of NPHMS (2019–2029), MOA should use NPHMS and its implementation as the opportunity to have the postharvest food loss agenda as its top agriculture policy priority. More importantly, existing agriculture development programs must incorporate postharvest food loss reduction indicators and monitor their contribution to food loss and waste reduction during and after program implementation.

Of particular importance is the need to invest in year-round extension services for rural small-scale farmers who are the backbone of Tanzania's agriculture sector and suffer most from postharvest food loss. This is vital because farmers in most rural communities in Tanzania rely on traditional storage practices such as polythene

bags, sacks, and granaries made using locally available materials like bamboo that are inefficient and cannot last long. The food loss problem will be even worse because of increasing climate change risks and food loss driven by fungi, pests, or diseases believed to be driven by changes in local climate conditions. Investing in storage infrastructures and rural agriculture extension services that help farmers avoid crop losses or spoilage during postharvest operations and keep their harvests till the growing season, regardless of weather conditions, becomes necessary.

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