



UK Research
and Innovation



CAPACITY BUILDING IN FOOD SECURITY FOR AFRICA – CABFOODS- AFRICA

Work package B1: *Take stock and identify appropriate post-harvest practises and technologies to scale-up*

Introduction

Food loss and waste remains one of the major challenges in food supply chains. According to the FAO 2019 report, 14% of the food produced is lost between harvest and the retail stage. An additional 17% of the food is lost between the retail and consumption stage (UNEP, 2021). Food loss and waste has a negative impact of food and nutrition security in sustainable food systems. It is estimated that the food lost/wasted in food supply chains globally every year could be used to feed 1.6 billion people. Lost/wasted food also means lost income (estimated to be between USD 750 billion to 1 trillion, annually). Food loss and waste (FLW) also has a negative environmental footprint with 8% of the greenhouse gases attributed to FLW. The losses are higher in fruits and vegetables because of their high perishability. In Africa, horticultural production is dominated by smallholder farmers who bear the brunt of FLW. Food loss and waste occur at all stages of the supply chain. In developing countries, the losses are higher at the earlier stages of the supply chain harvest and immediate postharvest handling. The losses at these stages are attributed to poor harvest practices, poor handling and lack of appropriate storage facilities. Limited processing capacity upstream is also a factor that contributes to high losses since the perishable produce has to be transported to urban areas for processing.

There is evidence of existence of applicable technologies and practices to address the causes/drivers of losses in horticultural value chains. There is little awareness about the many technologies and practices that have been developed and validated for application for postharvest loss reduction in various value chains. In addition, successful adoption of the available

technologies is context-specific and success factors vary. Therefore, there is need to take stock of available and applicable technologies in the African context as a first step towards creating awareness about them. The need for this action was emphasized during the 1st All Africa Postharvest Congress and Exhibition and other forums. Therefore, the aim of this study was to take stock of the already existing, applicable and appropriate technologies for quality preservation and postharvest management in fruits and vegetables. Following the value chain approach, the study documented applicable technologies at various stages of the value chain from harvest to the consumer level in three target countries – Kenya, Ghana and South Africa. This was achieved through desktop reviews, key informant interviews and field studies. The study sought to document information of existing/applicable technologies and highlight the key success factors. For each applicable technology, examples of their application in various fruits and vegetables was documented. For selected technologies, factors that have contributed to adoption or lack of adoption were documented. In the field survey which targeted mango value chain actors, the extent of postharvest losses and their causes/drivers was established.

Justification of resources

The allocated funds **£12 358,98** were spent on the following activities:

- Engagement of 3 research assistants in Kenya, South Africa and Ghana to conduct a country-specific desk review on applicable technologies
- Compensation of three project team members to supervise the research assistants
- Development of tools to conduct field survey and key informant interviews on success factors for technology adoption or non-adoption targeting farmers, transporters and traders
- Field surveys in the main mango producing counties in Kenya including Embu, Machakos and Makueni Counties
- Data cleaning, data analysis and report preparation
- Logistics

Study approach

- A desk review of published articles, national documents and other relevant publications was conducted between November 2021 and March 2022 to identify existing post-harvest practises and technologies in Kenya, Ghana and South Africa.

- Guided by the findings of the desk review, primary data collection tools were developed targeting various actors in the mango value chain including farmers, transporters and traders. The tools sought to capture information on the extent of losses, causes of losses and awareness of existing technologies and practices to address the identified causes. Further, the actors were asked if they had adopted any of the technologies and/or practices they had knowledge of and the factors that contributed to adoption.
- The study targeted three mango producing Counties in Kenya including Embu, Machakos and Makueni. In each case a representative sample of farmers were randomly selected including 51, 46 and 56 farmers from Embu, Machakos and Makueni respectively. Mango value chain actors who had not adopted the practises and technologies provided data on barriers to adoption of the post-harvest practises and technologies. Respondents who were willing to adopt the technologies in future gave recommendations that would facilitate their adoption.
- The present report includes data from farmers

Project Progress

1. Database of postharvest technologies and practices

The desk review yielded a database of 220 technologies and practices that are applicable at various stages of fruit and vegetables value chains. The technologies and practices were disaggregated based on the stage of the value chain as follows:

- Harvesting, field handling technologies/tools/practices
- Packaging technologies
- Storage technologies
- Shelf-extension technologies
- Sanitization technologies
- Ethylene management technologies
- Ripening technologies
- Transportation including loading and off-loading technologies/practices
- Processing technologies

For each of the technologies identified, the following information was documented

- Name of the technology/practice
- Stage(s) of the value chain where it is applicable
- Commodities where the technology/practice is applicable
- Counties where the technology/practice has been applied
- Cost of the technology
- Effectiveness and/or success factors for adoption of the technology (if provided)
- Reference for further reading about the technology

Annex I – A complete Database of postharvest technologies and practices for postharvest management in fruits and vegetables

2. Survey on extent, causes of losses in mango value chain and success factors for adoption or non-adoption of technologies/practices that could reduce losses.

- At the farmer level, it was reported that the extent of losses varied significantly depending on the mango variety and the County in question
 - In Apple mango, lower losses were reported including 6.5%, 11% and 15% in Makueni, Embu and Machakos Counties respectively
 - In Kent varieties, the losses were reported as 10.7%, 12.5 % and 26% in Makueni, Machakos and Embu respectively
 - In Ngowe, the reported losses were 15.9%, 16.3% and 17.7% in Embu, Machakos and Makueni respectively
 - In Tommy Atkins, the losses were reported as 22.3%, 23.6% and 24.4% in Makueni, Machakos and Embu respectively
- In the varieties where the highest losses were reported, the respondents indicated that main causes of the losses as follows:
 - Lack of markets – 61%, 40% and 42% respectively for Embu, Machakos and Makueni
 - Non-use of postharvest technologies – 32%, 27% and 29% respectively for Embu, Machakos and Makueni Counties
 - Pest and diseases – 7%, 33% and 26% respectively for Embu, Machakos and Makueni Counties
- Awareness about existing technologies and practices to reduce postharvest losses, status of adoption and success factors that contributed to adoption.
 - More farmers in Makueni were aware of the harvest practises and consequently had a higher adoption rate. Adoption in both Machakos and Embu Counties were also found to increase with awareness.
 - In all the 3 Counties, there was low awareness of important mango handling practices including pre-sorting, sorting and grading. Although there is low adoption in all the Counties, adoption of the practice was found to increase with awareness
 - At harvesting and handling stages using a probit model, the study showed that area under mango production, training/demonstration on technologies/practices for loss reduction, belonging to an agricultural group, access to extension services, training on food loss and waste reduction and use of ICT for pre/post-harvest losses reduction contributed positively to adoption of postharvest technologies and practices
 - The study revealed low awareness and adoption of storage practices & technologies across all Counties.
 - Slightly more farmers in Makueni County were aware of the need for dedicated stores but only 9% of them currently use them. Use of dedicated stores was found to slightly increase with awareness across the Counties.
 - More farmers were aware of the need for zero energy brick coolers in Machakos County but more farmers in Makueni County were using them. This implies that farmers in Machakos County prefer another evaporative cooling technology (evaporative charcoal cooler) which more farmers in the County are aware of and have adopted. Use of storage technologies among farmers in Makueni County does not seem to be pegged on awareness of the importance of the technologies as more farmers in the County are also currently using evaporative charcoal coolers despite higher awareness of the technology in Embu County.
 - Factors found to influence adoption of appropriate technologies and practices at storage stage using a probit model were identified as area under mangoes, training/demo on technologies for loss reduction, access to extension services,

training on food loss and waste reduction and use of ICT for pre/post-harvest losses reduction.

Annex 2 – Data collection tools

Annex 3 – Farmer level data on the extent and causes of losses; awareness about applicable technologies and factors affecting adoption of the technologies

Stakeholder engaged during the study

The research team engaged the following stakeholders in different Counties

- County agricultural/extension officers in Embu, Makueni and Machakos Counties
- Researchers in various universities
- Farmers and farmer groups
- Traders – including exporters
- Processors

The above were engaged specifically because of the role they play in the fruit and vegetable value chains and specifically in the mango value chain.

Project Progress (reported above under study findings)

Challenges, Risks and Mitigation Measures and Lessons learnt

Challenge	Mitigation
Restriction in movement which delayed the field studies	<ul style="list-style-type: none"> - We sought for extension of the reporting time
<p>Limitation of funds to conduct a more comprehensive study covering various value chains in the three counties</p> <p>Initially the study was meant to cover only one country Kenya, but it was later recommended that study be expanded to cover Ghana and South Africa. However, there were no additional funds to cover the additional coverage.</p>	<ul style="list-style-type: none"> - Only the desk review activity was expanded to cover Ghana and South Africa - The field survey was designed to cover only one value chain (Mango) and expanded the study to cover 3 mango producing counties in Kenya
Glaring gaps in the data	<ul style="list-style-type: none"> - Recommendations have been made to expand the study and to address the data gaps before the data is published - The data tools will be availed to the researchers in Ghana and South Africa to conduct their own in-country field surveys to generate additional data for their country-specific priority value chains

Conclusion

From the desk review, revealed existence of technologies and practices that can be adopted for postharvest management at various stages of the value chain. However, there are limited studies documenting application of these technologies. Most of the reference studies do not document the cost of the technologies and challenges that may affect successful adoption and effectiveness to address the causes of postharvest losses in fruits and vegetables. Previous studies have reported significantly high postharvest losses in fruits and vegetables. The FAO report of 2011 estimated the losses to be 40 -50%. A subsequent FAO report (2019) estimated postharvest losses in fruits and vegetables from harvest to the retail stage alone to be 20% - this figure excludes the losses from retail to consumption stage. In the present which focused mainly on the mango value chain, the extent of losses at the farm level alone ranges from 6.5% to 26% depending on the County and mango variety. The main causes of the losses according to the farmers were identified as lack of market, pests and diseases and non-use of applicable technologies. The study identified lack of market as the main factor contributing to non-adoption of postharvest technologies and best practices. On the other hand, acreage seems Factors found to influence adoption of appropriate technologies and practices included area under mangoes, training/demonstration on technologies for loss reduction which created awareness, access to extension services and training on food loss and waste reduction.

Annexures

- **Annex 1** – A complete Database of postharvest technologies and practices for postharvest management in fruits and vegetables
- **Annex 2** – Data collection tools
- **Annex 3** – Farmer level data on the extent and causes of losses; awareness about applicable technologies and factors affecting adoption of the technologies
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