

Special Edition
"Food Security and Food Sciences"

Research

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Special Edition 1

Article Ref. #: 1000AFTNSOJSE1105

Article History

Received: August 27th, 2015

Accepted: September 16th, 2015

Published: September 21st, 2015

Citation

Mandisvika G, Chirisa I, Bandaiko E. Post-harvest issues: rethinking technology for value-addition in food security and food sovereignty in Zimbabwe. *Adv Food Technol Nutr Sci Open J*. 2015; SE(1): S29-S37. doi: [10.17140/AFTNSOJ-SE-1-105](https://doi.org/10.17140/AFTNSOJ-SE-1-105)

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Post-Harvest Issues: Rethinking Technology for Value-Addition in Food Security and Food Sovereignty in Zimbabwe

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ABSTRACT

The purpose of this study was to identify a number of critical issues concerning and influencing food security in Zimbabwe. Embedded within this narrative is a critical concern for reducing food losses and enhancing value-addition. Special focus is put on the treatment of fresh produce, especially in rural areas- be it vegetables, fruits or grain. Preservation and safety of the product are important at both the household and market levels. This study used case studies from across rural and urban Zimbabwe to establish the pressing issues surrounding post-harvest management strategies. The study ascertained that Zimbabwe is naturally privileged with fertile soils which are suitable for agriculture, but food security is threatened after harvesting. The study produced an appreciation for the wide range of methods and structures, such as pole-earthed granaries and vegetable drying, that are used in Zimbabwe to gain food sovereignty. Nevertheless, it was established that these methods are not effective in reducing post-harvest losses, hence the need to introduce modern technologies that can supplement the traditional methods of reducing losses to enhance food security.

KEYWORDS: Post-harvest; Food security; Food sovereignty; Value-addition; Food-losses.

ABBREVIATIONS: MDGs: Millennium Development Goals; UPA: Urban and Peri-urban Agriculture; FAO: Food and Agriculture Organisation.

INTRODUCTION

Approximately 80 percent of Zimbabwe's total land area is made up of fertile agricultural land, yet it is quite ironic that Zimbabwe is struggling to feed itself despite its rich soils.¹ The agricultural sector plays a key role in the overall development of the national economy. It is also the main source of food accessibility at the national level, and a prime source of food and income for most households.² The Zimbabwean government and the private sector (e.g. Agribank) were in the past instrumental in providing capital and other inputs to farmers. Yet, current economic turmoil has affected the ability of these institutions to finance farmers. Agribank is reported to have received loan applications worth 29 million dollars, yet it could only allocate 15 million for onward lending.³ Hence, many farmers cannot invest in the new, advanced technology that is needed for the post-harvest handling of crops. Achieving food security, however, can be said to be based on the efforts and technology used to transport, store, process and value-add to harvested crops. Crops can deteriorate and become unfit for sale or human consumption unless preserved, processed and stored under suitable conditions. Poor transport facilities can also result in spoilage and subsequent food-borne illnesses. The intent of this study was to identify critical post-harvest strategies that can enhance food security in Zimbabwe. Attention was given to post-harvest loss reduction strategies through marketing, storage, processing, technology and transportation as well as value-addition to the products. The paper is structured in four major sections. The first sections tackles the theoretical and analytical issues for food security and food sovereignty as well as issues surrounding post-harvest management strate-

gies, such as transportation, storage and processing. The second section gives an analytical description of post-harvest issues that affect food security in Zimbabwe. This section is based on case studies from both rural and urban areas across the country. The third section discusses research results and matches them with theoretical issues to come up with recommended policy options. The final section concludes the paper.

THEORETICAL AND ANALYTICAL ISSUES

This section provides an outline of the key concepts that underpin this study. Key concepts such as food security, food sovereignty, marketing, transportation, processing technology and storage are discussed.

The Food and Agriculture Organization (FAO) of the United Nations⁴ defines food security as a condition where all people have physical, social and economic access to sufficient, safe and nutritious food which meets their dietary needs and food preferences for an active and healthy life at all times. Food security is also defined as access by all people at all times to enough food for an active, healthy life. The opposite of food security is food insecurity, which is defined by Chirimuuta and Mapolisa¹ as an economic and social state of limited and uncertain access to adequate food at a household level. Food insecurity is broad in scope and includes hunger, malnutrition and famine. Food security comprises numerous components, such as food access, food distribution, a stable food supply, and the use of food. Long-term food security depends on food sovereignty, which emphasizes those who produce food and care for the natural environment.⁵ Food sovereignty is an essential precondition for the existence of food security.

Edelman⁶ defines food sovereignty as national food security, which is derived from the local production of food. La Via Campesina⁷ has defined food sovereignty as “the right of each nation to maintain and develop its own capacity to produce its basic foods, respecting cultural and productive diversity”. Advocates for food sovereignty argue that local people should secure control over natural productive resources, possess a right to land, utilize and protect their indigenous knowledge and cultural identity. These aspects of food sovereignty promote food security by taking advantage of locally tapped riches and technology in post-harvest management strategies. Food sovereignty also helps to create local markets while offering income security.⁸ It emerged from the Nyeleni Food Sovereignty Forum, held in 2007, that the aim of food sovereignty is to guarantee and protect people’s space, ability and right to define their own models of food production, distribution and consumption, with the objective being to advance local people’s nutritional status, incomes, economies, ecologies and culture. Food sovereignty is also believed to be a foundation for the promotion of democracy and greater citizen participation. This at a larger scale respects the voices of the poor and marginalized groups in society, which are usually women and children.

Claeys⁸ laments that despite the fact that food sovereignty has the potential to meet current and future human food needs and ecological protection, two processes endanger it. The first process is the globalization of world trade, which has created an opportunity for a few transnational companies to gain a monopoly over different food chain linkages. This undermines the capacity of local people to be self-sufficient and achieve self-determination. The second threat lies in the current modernist development agenda, which is supported by the Millennium Development Goals (MDGs).⁸ Food sovereignty is hindered by the first MDG, which aims at eradicating extreme poverty and hunger and the third one which aims to promote gender equality and empowerment of women. These two MDGs advocate for the reduction of the number of people engaged in food production by encouraging them to get jobs in the largely urban-based manufacturing and service sectors. Yet, there is a pressing demand for agricultural produce to enhance food security. There is a need to facilitate the marketing of the produce so that it reaches consumers inadequate quantities and of acceptable quality.

In general, marketing is a human activity that is directed at satisfying needs and wants through an exchange process. In agriculture, marketing refers to the process of providing agricultural produce to consumers.⁹ Marketing is a broad concept that includes features such as transportation, storage, packaging and supply. Marketing ensures that there is efficient processing and packaging of produce, preparation of marketing facilities and storage, and the facilitation of transportation to the markets. Growers can produce large quantities of good-quality harvest, but if they do not have a reliable, swift, and equitable means of getting such commodities to the consumer, losses will be extensive and food insecurity is inevitable.¹⁰ The major problem that affects the marketing of agricultural produce in Zimbabwe is the lack of improvement in terms of facilities and sanitation in the market stalls. Market places such as Mbare Musika in Harare are overcrowded, unsanitary and short of adequate facilities for loading, unloading and the storing of produce.¹¹ Basically, the first step after crop harvest in marketing is the processing of the farm produce.

Crop processing is an essential step in converting harvested agricultural products into consumable, valuable and saleable products.¹² Processing readies crops for storage, for preservation for future consumption, and for immediate marketing. Good crop processing and preservation methods minimize food losses and keeps food safe for consumption and sale.¹³ However, this also depends on good storage technologies. Technology plays a very critical role in ensuring food security. Post-harvest activities such as the harvesting itself, processing, packaging, storage and sales all depend on adequate and advanced technologies.¹⁴ However, the major challenge in developing countries is that most of the tools are neither manufactured locally nor imported in sufficient quantity to meet demand. In many developing countries, some good facilities are out of order or not functioning properly due to a lack of maintenance and the

unavailability of spare parts. Advanced transport networks and facilities, such as refrigerated vans, are also an essential component of post-harvest technologies. In developing countries where there is poor road infrastructure, production should be maintained as close to the major population centres as possible to minimize transportation costs.¹¹ Crop storage technologies used across Africa vary according to the scale of the operation or the level of production.¹⁵ Food producers use both traditional and modern methods and structures, for drying, temperature control and atmospheric control. However, traditional methods such as pole structures and woven baskets are now being refuted as being inadequate in offering protection from insects.¹⁶ Developing countries such as Nigeria have problems in accessing appropriate storage technology, and this has resulted in a considerable waste of agricultural output and, consequently, considerable losses to its national economy.¹⁷ Zimbabwe has only one rainy season from October to March, and food is grown during this period. The food is expected to feed people until the next harvest season. This implies that there is a strong need to have good storage facilities which do not impinge on food quality and quantity.¹ Grain storage structures help to protect against crop losses from insects, rodents, moulds, theft and fire.

STUDY DESIGN AND METHODS

The following is a case study by design, and it is qualitative in its approach. We engage in both rural and urban cases in order to unravel the post-harvest issues in these circumstances. Qualitative methods of data collection were employed in developing the argument for this paper. Such methods include documentary review. Data were well analyzed using textual analysis, discourse analysis and thematic analysis to determine which issues are common across different areas in rural and urban Zimbabwe.¹⁸

RESULTS

Post Harvest Management Issues in Rural and Urban Areas of Zimbabwe

This section provides an analytical description of post-harvest issues that affect food security in Zimbabwe. Farmers in rural areas and in peri-urban areas produce grain, especially maize, as a means to enhance food security. The grain is preserved and stored to meet human food needs until the next harvest. However, the food is lost through the inferior post-harvest management strategies that are used. Horticulture is another form of farming that is practiced, especially in urban areas, with the aim being to eradicate poverty through income generation. Post-harvest issues remain critical in this type of farming. There is a lack of institutional support services, poor road networks, a lack of storage space and limited access to reliable markets.¹³

Grain Post-Harvest Management Strategies in Rural Zimbabwe

Maize is the staple food in Zimbabwe, and it is widely

grown across the country. Areas in agro-ecological region five, such as Masvingo and Chiredzi, receive rainfall of less than 650 mm/year, and it is highly erratic.¹¹ This region is unsuitable for crop production, but local people still produce maize, millet and sorghum for their food security. Millet and sorghum are, however, the best crop alternatives, as they can withstand the low rainfall and high temperatures that are indigenous to this region. The maize, sorghum and millet that the country as a whole depends on are produced by communal and small-scale farmers who have very limited access to the advanced technologies needed to enhance value-addition for food security. Large-scale commercial farmers dominantly produce cash crops such as tobacco and cotton. They also depend on small-scale farmers for their own food security. The communal farmers use traditional post-harvest management systems.

Indigenous knowledge and the use of vernacular materials is very common in Zimbabwe's rural post-harvest processes. This has largely contributed to the low levels of cereals that are grown and the lack of adequate income to acquire advanced technologies.¹ Crop harvesting is mostly done manually, and it takes more time than necessary. The harvesting and drying techniques employed make the farm produce more prone to thieves. For instance, maize can be stacked in small pyramids and left to dry in the fields before de-husking can occur, and the corn ears can be ferried to the homesteads. On the other hand, maize plants can be left standing to dry completely before they remove the cobs and leave the maize stalks in the field. This method is encouraged, as it promotes conservation agriculture. Conservation agriculture hinges on minimum soil disturbance, mulching of the soil, and promotion of crop rotation, with the ultimate goal being to improve soil fertility.¹¹

After harvesting and drying, pesticides are applied to the grain before it is stored in plastic bags or sacks. The pesticides applied should be capable of protecting the grain from insects until they are ready for consumption. In rural areas, generally the same facility is used to store all grains, but in different containers or compartments.¹¹ The traditional pole and earth structures (Plate 1) and woven basket structures (Plate 2) are the most commonly used granary structures in rural Zimbabwe. The base of the granary is raised off the ground to prevent animals, such as rats and mice, from eating the grain. The raised base also keeps the grain away from wet ground and facilitates ventilation. Poles alone or poles resting on rocks, as in Plate 1, support the granary. The granary is built with a removable thatched roof, which has a large overhang to protect the mud walls from rain.¹⁶ The interior of the pole earthed granary is cleaned and plastered with fresh cow dung before loading fresh grain. Cow dung is the best local material, as it is believed to have insect repellent properties. If resources permit, the walls and the floors can be flushed with an insecticide before loading the granary, as a supplement to cow dung. However, these granaries are slowly vanishing due mainly to a shortage of the appropriate construction materials, which itself is a result of deforestation. Termites also damage the timber used. Efforts at modernization have led to the rejection

tion of the use of local and traditional methods. Nevertheless, woven basket structures are still commonly used in some areas that maintain strong traditional practices, such as in the Zambezi Valley and in North Eastern Zimbabwe.



Plate 1: Pole and earth walled granary.
Source: Google images.



Plate 2: Woven-basket granary.
Source: Google images.

Due to difficulties faced in accessing hardwood supply for the construction of traditional granaries, some farmers are now adopting the use of metal silos. Smallholder farmers are using these silos, with the added advantage that rodents and termites do not attack them. FAO in Zimbabwe implemented a pilot project from June 2010 to July 2011 in the districts of Gureve and Gokwe South. FAO trained local builders and local tin-smiths on the construction of improved brick granary and metallic silos. The aim of the project was to reduce post-harvest crop losses through improved post-harvest management practices in order to improve food security at the household level. The proj-

ect promoted the construction of brick granaries and metallic silos (plate 3) which are much more effective for preserving the grain than more traditional storage structures.

The project empowered local farmers by giving them technical knowledge and skills on effective post-harvest management strategies. Farmers in Gokwe learned improved methods of drying and treating the grain before storing it in either metallic silos or the brick granary.¹⁹ Drying and treating grain before storage prevents the grain from moulding or caking while in storage. By October 2011, the quality of grain was still good, with no signs of pest infestation. The main challenge for the project was the lack of local construction materials. Gokwe south has loamy sandy soils which are not effective for making bricks.²⁰

Horticulture Post-Harvest Management Strategies in rural Zimbabwe

Horticulture is the science and art involved in the cultivation, processing and marketing of ornamental plants, flowers, turf, vegetables and fruits.²¹ In Zimbabwe and other developing countries, small-scale fruit and vegetable production plays an important role in income generation, poverty alleviation and in improving the nutrition and livelihood of the rural population. Just as it is in the case of grain, the horticultural sector suffers greatly from post-harvest losses.²² Post-harvest losses in fruits and vegetables can occur in terms of income, quantity, quality, nutritional value and aesthetic appeal, which affect market value.²³

After Zimbabwe gained independence, many people were involved in the call from the government to support and improve rural livelihoods. Rural capacity building programmes such as the European Union's Lome Convention funding programme were implemented in rural areas to promote small-scale commercial farming and increase household incomes and food security. The European Union's Lome Convention Funding Programme started supporting Small-scale Coffee and Fruit projects in Manicaland province from 1982.²² The projects promoted small-scale commercial production, value-addition and the marketing of coffee and fruits in Honde and Rusitu Valleys. Despite



Plate 3: Metal silo and bricks granary in Gokwe.

all these efforts, the small-scale farmers are still facing post-harvest challenges that result in both quality and quantity losses.²⁴ The losses are attributed to poor post-harvest management of the fruits, especially at peak production, since they mature almost at the same time, causing seasonal gluts. Oranges are also perishable, and a lack of adequate storage facilities causes considerable losses.

In a study conducted by Musasa, et al.,²² it was found that >40 percent of the mature fruit from the Rusitu citrus farmers are lost in the orchard and during temporary storage. A lack of pesticides, poor production practices due to lack of knowledge, poor storage facilities and poor physical infrastructure, such as access roads, transportation and communication, are the major causes of post-harvest losses. The small-scale farmers store their oranges under tree shades waiting for buyers, mostly intermediaries known as *makoronyera*, to purchase and supply to large-scale fruit juice producers elsewhere. Storage of oranges under tree shades exposes the fruit to adverse climatic conditions such as fluctuations in temperature and humidity, leading to deterioration in quality and consequent low market value. From this analysis, it is clear that local producers do not have the capacity to participate fully in the orange value-chain. Farmers only produce for family consumption and sell to local markets; hence, they lose considerable potential income.

Rolle¹³ argues that horticulture post-harvest losses can be attributed to rough handling, untimely harvesting, a lack of appropriate harvesting tools, inadequate field sorting, grading and packing protocols for commodities, poor transportation infrastructure, a lack of appropriate transport systems, and a lack of refrigerated transportation vehicles. However, post-harvest damage to bananas decreased significantly in Chipinge when a private company, Matanuska, invested in modern production technologies, such as handling facilities and pack sheds.²⁵ The farmers were also equipped with a tractor to deliver the product to pack sheds and specialized trucks that could transport the product to the market.

Fruit and vegetable processing is largely influenced by two factors. The first is to promote food security in rural areas. Since Zimbabwe has only one rainy season, there is a need to preserve food produced until harvest the next season. For instance, donors who were engaged in the Musami area of Murehwa introduced communal drying technology to local people to enhance food security at the village level. The traditional technique of sun-drying leafy green vegetables is the most common in Zimbabwe and has been passed down from generation to generation from an early time. This technique enables households to access vegetables throughout the year. Drying of fruit and vegetable is also a preferred method to preserve foodstuffs to be used as raw material in other food products. For instance, both dried vegetables and fruits can be pounded into a powder and used to make soup, or the powder can be added to flour for cakes. The second drive in fruit and vegetable processing is to eradicate poverty through income generation. Processing adds

value to fresh fruits and vegetables, thus permitting producers to generate income from locally available resources that are highly perishable. In this sense, processing becomes a market-oriented activity focused on increasing returns to producers while reducing losses.

Given the huge losses that fruit producers often encounter during temporary storage, some farmers have developed innovative ideas on how to process and add value to low quality fruits.²⁶ Small-scale commercial farms, such as Golden Harvest and Froggy Farm, make jam as a way to reduce post-harvest losses. The marketing of fresh produce generates more sales revenue when compared to selling processed fruits, hence, processing is a secondary activity that adds value to second and third grade fruit, which may be unacceptable to the fresh produce market. Companies such as Cairns Foods Limited buy second and third grade fruits but do not give a rewarding price for these inferior products, so domestic processing increases the farmers' potential returns to lower grade fruit. Other processors, such as the Rusitu Valley Jam Canners Co-op, process jam due to the constraints they face when marketing fresh produce. Poor road networks, deficiencies in transport and high costs make it difficult for farmers in Rusitu to access outside markets, resulting in insignificant losses of fresh produce.²⁷

Post-Harvest Management Strategies in Urban Zimbabwe

Urban and Peri-urban Agriculture (UPA) in Zimbabwe is practiced in two ways, either as onsite or as off-site. On-site agriculture refers to agricultural activities that take place in a residential property while off-site agriculture refers to agriculture that takes place in open spaces as well as in the peri-urban areas.²⁸ On-site agriculture is usually focused on perishable and high-value horticultural products, such as green vegetables, mushrooms, herbs, eggs, poultry and tomatoes that can be grown in confined spaces. The scale of UPA ranges from purely subsistence-oriented, small-scale semi-commercial gardeners and livestock keepers, to medium- and large-scale commercial endeavours. On the other hand, offsite agriculture usually consists of maize production for family consumption while others also sell surplus grain in the market to increase their income.²⁹

Urban areas do not rely totally on the rainy season, except for off-site agriculture. In this regard, there is little processing of vegetables produced at home, since there is no need to preserve for the next season. Mature crops are consumed soon after harvest, and some are sold immediately. Urban vegetable growers do not need storage space, since they harvest and sell them immediately. This gives urban production a niche against their fellow vegetable producers, who are based in rural areas. The drying methods used to preserve food by urban producers are identical to those used in rural areas, but the reasons for this differ. In rural areas, farmers store to preserve the vegetables until the next harvest, while in urban areas, vegetable producers dry the vegetables by choice for consumption.²⁵ On the other hand, maize production is seasonal, and the produce must be

stored and treated to meet the requisite quantity and quality until the next season. The post-harvest management strategies used in urban areas are basically the same as the strategies used in rural areas. The major difference is in storage structures. There are no household granaries in urban areas, rather, they use ordinary living rooms for this purpose.

There are also large-scale horticultural farmers in urban areas, and especially in Harare, Bulawayo and Mutare. The farmers mainly produce mushrooms, flowers and herbs.³⁰ The produce is sold locally by the smaller farmers, while large-scale commercial farmers export their produce worldwide. The problem with local markets is that local supermarkets and retailers prefer importing horticultural products from South Africa regardless of the fact that the products will be readily available from local farmers. Retailers import farm products that include beetroot, grapes, peaches, frozen vegetables, carrots, bananas, cucumbers, peaches, plums, and even fruit juices. Local horticulture farmers and traders are failing to find markets for their produce, since local retailers import the same products elsewhere.³¹ This leads to post-harvest losses as farmers end up throwing their vegetables away after failing to secure markets, hence, threatening food security and income generation. Chiutsi³⁰ reiterates that the problem lies with the policy makers who allow imports into the country. This policy is an abject failure, and it has opened the country to the importation of foreign goods.

Poultry production has gained popularity in recent years as a type of urban agriculture. Poultry gained recognition because of escalating prices for beef and pork, with more consumers resorting to poultry and poultry products due to its relatively low pricing.³² Urban residents have ventured into poultry production, and they sell their chickens to fellow residents. Some have the privilege to supply large supermarkets and fast food outlets, such as Chicken Inn. However, poultry farmers face numerous challenges once the birds are ready to sell. The major challenge is a lack of access to reliable markets as well as electrical failures. These failures cause severe losses, as it affects refrigeration storage facilities.

DISCUSSION AND OPTIONS

This study revealed that many loopholes are affecting the attainment of food security in Zimbabwe. The current level of post-harvest management that is being practiced in the country both in urban and in rural areas is not adequate to secure the country's food needs. The use of traditional storage technology has many problems, including mould development and the failure to regulate temperature and moisture. In this regard, there is a need for advanced storage facilities, such as metal silos, which efficiently reduce pathogen losses in grain. Since this technology is expensive and beyond the reach of many communal farmers in Zimbabwe, who encompass the bulk of the national food provid-

Operation/ Activity	Current methods	Issues
Harvesting	- picking - handling	- rough handling - lack of appropriate harvesting tools, equipment and harvest containers
Processing	- sun drying - shelling/threshing - sorting/grading - packaging Secondary processing	- inadequate field sorting, grading and packing protocols - lack of hygiene - lack of adequate processing technologies
Storage	- pole- earth granaries - general/ living rooms - tree shades	- poor temperature conditions and sanitation of the storage facilities - lack of cold storage rooms - intensive electricity power cuts
Marketing	- neighbourhood markets - supply to retail stores - sell to food processors - sell to mediators	- poor road infrastructure - limited market information - lack of marketing strategies - inadequate and unsanitary market infrastructure - inability to market products in domestic and international markets

Table 1: A summary of emerging post-harvest issues in Zimbabwe.

Source: (Rolle, 2006)¹³

ers, there is a need for the government and private sector institutions to assist these farmers financially in constructing metal silos. Projects such as that conducted in Gokwe and Gurube are sustainable, as they give relevant technical skills to local builders and tinsmiths on how to construct these silos even when the project executors have terminated the projects. The experience gained in Rusitu Valley indicated that there is a lack of access to markets for fresh produce, and it showed that there is a general lack of communication between producers and receivers as well as a lack of market information. Farmers should be well advised on market needs before they produce their crops so that they can minimize their post-harvest losses. Construction of good physical structures, such as road networks and communication channels facilitate marketing from producers to all participants in the value-chain, up to the consumer (Figure 1). In value-chain system development, farmers need to be linked to the needs of the consumers. This can be achieved if they work closely with traders and processors to produce the specific goods in specific quantities and quality as required by the end consumers.

Food security can be accomplished if there is continuous innovation, research and communication among the various participants in the value-chain. This will also increase the farmers' market influence and profitability and consequently improve their livelihood.³³ Marketing cooperatives can be useful among producers of major commodities in specific production areas. This facilitates the flow of market information, improved market

access, and increased access to higher-value markets. Cooperatives also help small-scale and communal farmers to share advanced materials used for post-harvest crop management. The government and respective organizations should advocate for a deliberate policy that regulates the importation of products that can be produced locally. This will help to protect the rights of local producers to access retail markets and thus minimize the losses that occur when their produce is not sold.

CONCLUSION

This study has demonstrated that the traditional methods of post-harvest crop management that are used in Zimbabwe cause major losses in vegetable, fruit and grain production. Grain, which is normally the major source of food, goes through five post-harvest stages. These are: harvesting, drying, shelling, storage and marketing. Horticultural products are usually perishable, and they are consumed soon after harvest. A lack of advanced technology in terms of transportation systems, storage facilities and marketing services is the major cause of post-harvest food losses in Zimbabwe. This affects food security for the entire country. Food sovereignty is also a critical issue that needs to be incorporated into the concept of food security. Local knowledge and traditional practices, such as vegetable drying, have proven to be relatively efficient in enhancing food security. Nevertheless, there is a need to combine traditional post-harvest management strategies with new emerging technology in order

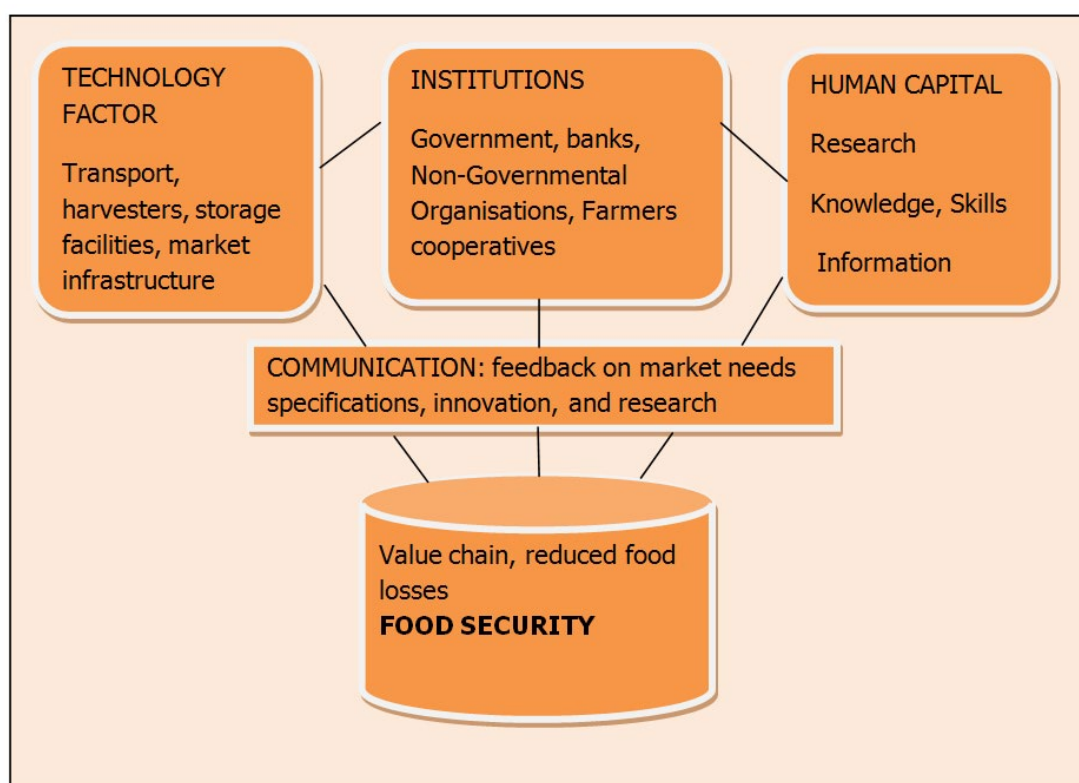


Figure 1: A synthesis of issues that can enhance food security.

Source: Authors' creation

to minimize overall food losses.^{4,34}

COMPETING INTEREST

The authors declare that they have no competing interests.

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