Chapter 21
Adoption and Utilization of Ethno-postharvest Technologies by Smallholder Farmers in Semi-arid Regions of Zimbabwe: Case of Buhera District

Thomas Marambanyika, Timothy Mutekwa and Winmore Kusena

Abstract One of the major challenges to enhance food security amongst rural populations in developing countries including Zimbabwe is the continued existence of high postharvest losses, accompanied by low yields due to climate change, among other factors. It therefore becomes imperative to investigate the level of adoption and utilization of ethno-postharvest technologies in a bid to evaluate their strengths and weaknesses to safeguard yields before consumption. Data was collected in Buhera district through triangulation, which involved semi-structured interviews with five elderly people snowball sampled and purposively chosen Agritex officers as well as questionnaires administered to 100 purposively selected smallholder farmers. Crops and technology observations during fieldwork also constituted an important component of the data gathering techniques. Research results show that although some long established and effective traditional methods like "tsapi" were abandoned, there are some residual traditional technologies still in use such as drying on "ruware", threshing of small grains by cattle trampling and storing all crops in a traditional hut called "hozi" with the aid of pest repellents like cactus ash. Major factors leading to the demise of most traditional technologies include the absence of suitable education and information dissemination structures and competition from vigorously promoted western methods among others. It was concluded that in order to effectively minimize postharvest losses, indigenous technologies must be studied, documented and promoted by both practitioners and external agencies such as Agritex, and non-governmental organizations. Where possible, they can be augmented by modern day technologies to reduce the costs of post harvest storage for marginalized and poorly resourced smallholder farmers in the area.

T. Marambanyika (✉) · T. Mutekwa · W. Kusena
Department of Geography and Environmental Studies,
Midlands State University, Gweru, Zimbabwe
e-mail: marambanyikat@msu.ac.zw, tmarambanyikat@yahoo.co.uk

T. Mutekwa
e-mail: mutekwat@msu.ac.zw, vmtekwa@yahoo.co.uk

W. Kusena
e-mail: kusenaw@msu.ac.zw, winniekusena@yahoo.com

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21.1 Introduction

Food security is one of the twenty-first century's key global challenges. In developing countries, household food security is precarious for large numbers of people particularly in the rural areas. Food production levels are inherently low and of late worsened by climate change and variability as well as high postharvest losses among other factors. The World Bank (2011) points out that one of the main sources of food insecurity in Sub-Saharan Africa (SSA) is postharvest crop loss. Postharvest losses occur during any of the stages in the postharvest operations such as assembling, drying, threshing/shelling, storage, packaging and milling (Appiah et al. 2011; World Bank 2011; Hodges et al. 2010; Sargent et al. 2000; Centre on Integrated Rural Development for Asia and the Pacific (CIRDAP) 2010; Harris and Lindbald 1978). Therefore, reducing postharvest food losses must be adopted as one essential component in any strategy to make more food available without increasing the burden on the natural environment (Hodges et al. 2010; Wold Bank 2011). At the same time, reducing food losses in developing countries can contribute to rural development and poverty reduction by improving agribusiness livelihoods (Hodges et al. 2010).

Generally, data and information on post harvest losses are scarce (Hodges et al. 2010). This has generated debate on the magnitude of postharvest losses at various scales. It is estimated that a total of 20–40 % of all crops in developing countries is lost to postharvest losses (World Bank 2011; Centre on Integrated Rural Development for Asia and the Pacific (CIRDAP) 2010; Usman 2009). However, there are variations in postharvest losses for different crops, at different times and at different stages of postharvest practices. For example, maize postharvest losses in the tropics have been estimated at about 20 % (World Bank 2011). Quantitative postharvest losses of rice in Sub-Saharan Africa are estimated to be between 10 and 22 % while qualitative losses could be as high as 50 % (Appiah et al. 2011). In Southeast Asia, losses in rice after harvest are estimated between 10–37 % (Madrid 2011). In Southern Africa Development Community (SADC), postharvest losses for cereals is on average 25 % at storage level whilst it is higher for perishable crops such as fruits, vegetables and root crops (Masarirambi et al. 2010). Osunde (2008) observed that storage losses in yams vary from 10–15 % during the first 3 months and reach a peak of 50 % after 6 months. This shows that the rate of food loss at storage stage is also significantly affected by time.

Postharvest pests also cause an estimated loss of 30 % at storage level (Bett and Nguyo 2007). Therefore, in Sub-Saharan Africa it was observed that the amount of grain lost due to decay and pests can feed up to 48 million people (World Bank 2011). The World Bank (2011) and African News (2011) further confirmed that grain losses also cost about $ 4 billion a year in Sub-Saharan Africa and this amount is roughly equivalent to the value of annual cereal imports in the region. This implies that reduction in postharvest losses will enhance food security in Sub-Saharan Africa where millions of people are in critical need of food, and help mitigate the problems faced by policy makers on food security issues at local, national, regional and international levels (World Bank 2011). Generally, most of the postharvest losses incurred are due to spillage, decay, mechanical damage and physiological disorders during drying, threshing, storage and transport (Centre on Integrated Rural Development for Asia and the Pacific (CIRDAP) 2010).

It is important to note that postharvest losses have severe impacts on the livelihoods of rural people as well as rural development since most farmers rely on income from farming. This calls for intervention strategies to be put in place in order to reduce production costs and the number of households which are food insecure. The World Bank (2011) observed that only 1 % reduction in post harvest losses can result in annual monetary benefits of US$ 40 million in Sub-Saharan Africa. Meanwhile, the global population is predicted to increase to 9.1 billion by 2050 with the developing world expected to provide the bulk of projected growth (World Bank 2011). The implication of this situation is increasing food scarcity which is likely to adversely erode the resource base for food supply.

Since the 1970s, global attempts have been made to minimize the impacts of postharvest losses on food security at international level. In 1975, the United Nations declared that further reduction of postharvest food losses in developing countries should be undertaken as a matter of priority (World Bank 2011). This was in response to the global food crisis in the early 1970s. Therefore, from the mid-1970s and 1980s, substantial efforts to invest in reduction of postharvest losses were made until these initiatives were abandoned in favor of market liberalization as an economic incentive to enhance food production in the 1990s (World Bank 2011). However, reduction in global food production due to the multiple effects of climate change (African Ministerial Council on Science and Technology 2011) among other noticeable factors like food price increase between 2006–2008, pushing prices beyond the reach of the majority, especially poor people in Sub-Saharan Africa resulted in recognition for the need to revive forgotten investment in postharvest technologies in order to boost household and individual food security (World Bank 2011).

It is crucial to note that the impact and success of any postharvest operations and postharvest loss reduction interventions are influenced by social and cultural norms (World Bank 2011; Ofor and Ibeawuchi 2010; Harris and Lindbald 1978). Harris and Lindbald (1978) warned that policy makers and development planners must erase the stereotype view of culture as stubborn adherence to tradition and resistance to change, as all cultures contain the seeds of change. This means that people must be able to improve on the gains associated with the adoption of culture based innovations, including postharvest technologies and practices without necessarily embracing foreign technologies whose cost may be unbearable to the majority of cash-strapped poor people in the developing world. The World Bank (2011) further hinted that more research and piloting was needed in postharvest technologies to make sure that the steps taken were sensitive to local conditions.

On the other hand, the World Bank (2011) observed that there has been low adoption and success of postharvest technologies initiated by the government and donor community in Africa. Reasons for low adoption of postharvest technologies initiated by governments and the donor community include lack of cultural acceptability, short term support for exotic postharvest technologies as assisting organizations incorrectly assume that change can occur in a short period and unsustainably high financial costs associated with their implementation (World Bank 2011; Bett and Nguyo 2007; Harris and Lindbald 1978). In brief, exotic postharvest technologies did not address the needs of the vulnerable groups in society, especially women and the poor in general who are at the centre of food production in developing countries (Ofor and Ibeawuchi 2010). Meanwhile, there is dearth of literature on postharvest loss reduction in Zimbabwe, a country where agriculture is the backbone of the economy, providing employment and livelihoods to approximately 70 % of the population, where only 60 % of food requirement is produced and 60 % of the population live on less than US$ 1 per day (FAO 2010). Therefore, development practitioners, national policy makers, and other professionals promoting agriculture-related improvements need to start thinking in terms of optimizing postharvest systems, with both food security and income enhancement in rural areas of developing countries as primary objectives (World Bank 2011).

It is against this background that the research focused on how Zimbabwe's main traditional food crops such as pearl millet, finger millet, sorghum and different types of legumes could be sustainably conserved using ethno-postharvest technologies and practices to improve the food security of smallholder farmers in semi-arid areas. In this context there is a need to understand the cost-effectiveness of traditional postharvest crop preservation technologies which are founded on long-established traditional practices. Traditional postharvest knowledge and practices largely remain untapped and in some cases forgotten whilst possibilities nevertheless exist for their continued utilization in this modern day and age. Thus this chapter examines the levels of adoption and utilization of ethno-postharvest technologies and the strengths and weaknesses of current practices, and identifies opportunities for improving these long-established local innovation systems in the semi-arid district of Buhera, Zimbabwe.

21.2 Location and Description of Study Area

The study was specifically undertaken in Wards 22 (Mawire) and 23 (Chirozva) in Buhera district of Manicaland province, Zimbabwe (Fig. 21.1). The population characteristics of the two wards according to the Central Statistical Office (CSO) (2004) are shown in Table 21.1. These two wards fall in Zimbabwe's semi-arid natural farming region 4 that receives an unreliable and unpredictable annual average rainfall ranging from 450–650 mm distributed in a unimodal pattern between November and April (Zinyama et al. 1991). Natural farming regions are a classification of the agricultural potential of Zimbabwe, from natural region 1 (> 1,000 mm of rainfall per annum) which represents high altitude wet areas to natural farming region 4 which receives low and erratic rainfall averaging 550 mm per annum (Vincent and

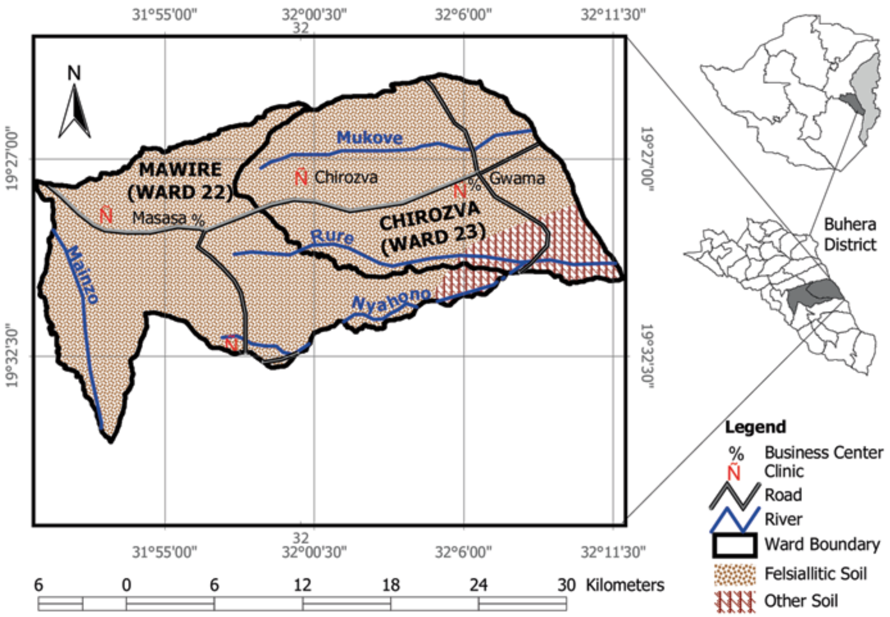

Fig. 21.1 Location of Wards 22 and 23 in Buhera district, Zimbabwe

Table 21.1 Study wards population characteristics (Central Statistical Office (CSO) 2004) and sample size

Place	Population size	Number of households	Average household size	Sample size
Ward 22	10,917	2,236	4.88	53
Ward 23	9,409	1,993	4.72	47
Total	20,326	4,229		100

Thomas 1960 in Mugabe et al. 2007). The changing weather patterns are further complicating the already existing food security problems because in some years semi-arid areas are simultaneously affected by drought and excessive rainfall that affect smallholder agricultural productivity (Mutekwa 2009), hence the need to minimize or eliminate postharvest losses in order to improve household food security.

Nyamapfene (1991) pointed out that the soil types in the two wards are fersiallitic, hence promote high leaching, minimizing amount of water available for plant growth. Zinyama et al. (1991) classifies the soils as arid soils that tend to be light colored because of limited humus additions from vegetation.

Wards 22 and 23 are food deficit areas. The majority of households cannot meet their annual food requirements from their own crop production even in a normal rainfall year (Agritex Report 2010). Zinyama et al. (1991) state that region 4 should be restricted to drought resistant crops such as finger millet, pearl millet, sorghum, roundnuts, groundnuts and cowpeas. Vegetables are grown for subsistence as well as for trading within the community. Other economic activities include selling of goats and chickens or exchange of these with livestock for food (Mararike 1999). Cattle are sold or slaughtered by those who are wealthy or in food crisis (Agritex Report 2010). Mararike (1999) established that Wards 22 and 23 with their poor agricultural potential inevitably have 57% female headed households due to high rates of male out migration to towns in search of employment.

21.3 Data Collection and Analysis

The research generated qualitative data and to a lesser extent quantitative data. Qualitative data assisted in giving a detailed description of existing ethno-postharvest technologies and practices. This data was generated through triangulation, whereby semi-structured interviews, questionnaires and direct observations were the key instruments to acquire relevant information on postharvest technologies. The key issues that determined the structure of the data collection instruments were the adoption and utilization of ethno-postharvest technologies, the strengths and weaknesses of current practices, identification of opportunities for improving the local innovation systems as well as how the technologies can be mobilized to benefit the majority of the people. Quantitative data predominantly consisted of socio-economic information solicited through the closed-ended questions of the questionnaire.

Video camera was used to acquire ethnographic information during the semi-structured interviews with the selected elderly people. Elderly people above the age of 75 were interviewed since they were assumed to have a rich history of how ethno-postharvest technologies evolved overtime. Since the elderly were few in number, it was difficult to identify or distinguish homesteads with an elderly person from those without, prompting the use of the snowball identification method. This involves identifying respondents who then refer the researchers to other respondents as a means of overcoming the problems associated with sampling concealed populations (Mutekwa and Kusangaya 2006). (For more details about the method and procedure see Blaxter et al. 1999; Atkinson and Flint 2001; Faugier and Sargeant 1997; Thomson 1997). In this study, snowball sampling was used only as a means of identifying elderly respondents without having to visit all the households. Five elders were therefore sampled using this method. The first elderly person was identified with the help of the local traditional leader. This elderly person then referred the researchers to the next person who did the same and so on.

One hundred (100) questionnaires were proportionally administered to household heads using the quota sampling method. Therefore, 53 and 47 questionnaires were administered to purposively selected household heads in the two wards as shown in Table 21.1. Purposive sampling was adopted in order to target farmers who were known to be very productive. Household heads provided information on existing ethno-postharvest technologies and practices being employed and their effectiveness.

Key informants for semi-structured interviews included purposively selected technical people such as Agritex officers as well as local leadership; councillors, headman and NGO officers involved in food production activities. Observations were made using an observation checklist to identify the types of technologies and practices in use and the data collected complemented that acquired through other instruments.

21.4 Results and Discussion

21.4.1 Background Information of Farmers

Most household heads (67 %) who responded to questionnaires were married and the remaining proportion consisted of widow(er)s who constituted 33 % of the target population. However, 61 % of the household heads were females due to the fact that either the husband was deceased or had immigrated to town for employment compared to 39 % of households which were male headed. This confirms findings by Mararike (1999) who observed a similar pattern in the sex composition of household heads. More than half of the farmers (55 %) were above the age of 46 with the remaining proportion being between the age of 22 and 45 years. Almost all farmers had only primary education, except for 7 % who had secondary education qualifications. The secondary qualification holders were mainly young farmers whose ages did not exceed 33 years. The average household size was 5.7.

The primary source of income for all farmers was farming. However, about 28 % of the farmers supplement their farming income through remittances from husbands, children or relatives employed in both formal and informal sectors in urban areas as well as in the diaspora. All farmers were involved in communal subsistence farming since birth. About 8 % of the farmers supplement their farming income by providing any form of labor required by other people in their community, locally known as *maricho*. The other 12.5 % of farmers derive their income from selling locally abundant *adansonia (baobab)*, *berchemia zeyheri (red ivory) and azanza garckeana (snot-apple)* indigenous fruits either locally or in urban areas. Only 1 % of the farmers indicated that they received pensions from their previous employers.

21.4.2 Major Crops Grown and Yield (Harvest) Obtained

Different type of crops are grown in wards 22 and 23 of Buhera district. The main classes of crops grown are cereals (pearl millet, finger millet, sorghum, maize, rice), legumes (roundnuts, groundnuts, cowpeas), tubers (sweet potatoes) and vegetables. However, the thrust of this research was on traditional cereals and legumes grown in dryland fields. The commonly grown food cereals as indicated by farmers were sorghum (77 %), pearl millet (72.5 %), finger millet (45.8 %) and maize (31 %). The leading significance of sorghum in the study area was also confirmed by Agritex officers who provide technical assistance to the farmers. The main factor behind the choice of crops by farmers was the prevailing semi-arid climatic conditions which

Table 21.2 Estimated average postharvest loss per crop at storage stage using indigenous methods

Crop	Average harvest (kg)	Average yield loss (kg)	Average percentage loss (%)
Pearl millet	126.48	25.38	20.00
Finger millet	97.00	20.90	21.54
Sorghum	140.00	28.33	20.23
Groundnuts	467.50	13.10	2.80
Roundnuts	394.20	17.33	4.40
Cowpeas	73.00	32.70	44.70

are suitable for drought resistant crops. However, the growing of sorghum and pearl millet was also strengthened through the provision of seed inputs by donors. Farmers who grow maize were mainly trying to evade the high labor demand associated with small grain crops.

Leguminous crops serve a dual purpose for local farmers, that is, provision of food and income generation. The number of farmers who grow leguminous crops varies as follows; roundnuts (60.4 %), groundnuts (66 %) and cowpeas (6 %). The average yield per crop grown per farmer varies significantly (Table 21.2). Groundnuts and roundnuts provide most of the income for farmers. The yields from these crops are relatively high and the surrounding cities of Mutare and Harare provide viable ready markets. However, 85 % of the farmers reported a sharp decline in harvests from small grains and leguminous crops in recent years. This was attributed to increasing rainfall variability and aridity, high temperatures, lack of draught power, land shortage and lack of inputs especially seeds since farmers rely on those from the previous season.

21.4.3 Indigenous Postharvest Technologies and Practices

21.4.3.1 Drying Methods

Drying of harvest from small grain cereals like pearl millet, finger millet and sorghum was done in-fields or off-fields, especially by spreading harvest on whaleback (“*ruware*” or large granite rock surfaces) that are a common feature in the area (Fig. 21.2). All farmers acknowledged that drying on whaleback was the most popular method for small grains since minimum losses were experienced as there was no mixture of grain with soil during natural detachment of grain from millet-heads before threshing. Normally small grains were transported to whalebacks using harvesting baskets or scothcarts. However, drying of small grains on whaleback has been associated with visible losses through consumption of harvest by stray livestock. These losses were difficult to quantify since they occur before threshing and were sporadic in nature. Some farmers however claimed that they lead to losses equivalent to a family’s food requirements for several months.

Major causes of small grain losses at drying stage on whaleback were uncontrolled or stray livestock (cattle, donkeys, goats and chicken), wild animals (baboons and monkeys), wild birds (especially quelea bird), mice, thieves, winds and rotting due

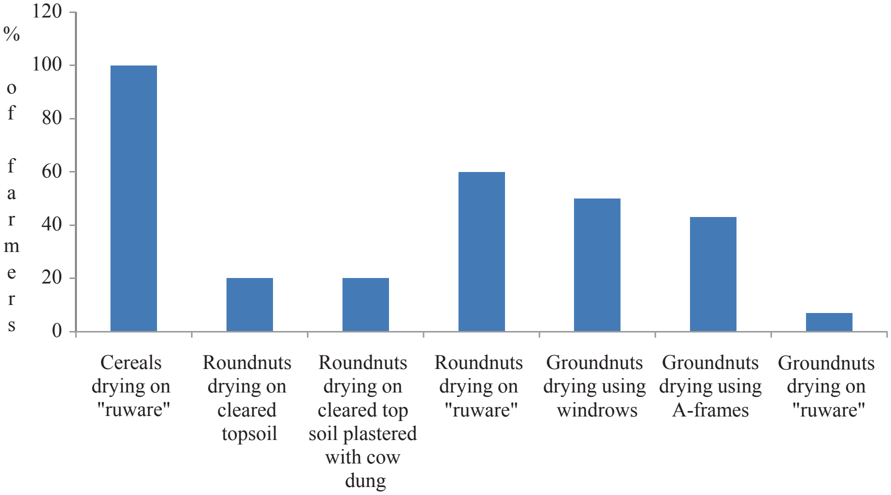

Fig. 21.2 Variations in farmers' level of adoption of traditional drying methods

to moisture in the event of unexpected winter rains. These grain losses were experienced because they were no structures put in place to safeguard yield against these animals and agents. Around 13 % of the farmers, however, temporarily pile harvest from small grains, especially pearl millet in their fields on spread stems of the same crop. Again significant grain losses are incurred especially during transportation of the in-field dried harvest to whaleback for threshing as grains detached from millet-heads and mixed with soil are difficult to separate. Therefore, the use of *'ruware'* for drying grain saves farmers from these losses.

However, interviews with elderly people confirmed that losses of small grains at the drying stage used to be insignificant. In the past, harvested yield before threshing was put in a hut traditionally known as *"tsapi"*. This hut was built on whaleback using wooden poles, anthill soil and thatched with grass as a storage and drying facility before threshing. Threshing was normally done between July and August after farmers had successfully completed harvesting of other crops like roundnuts and groundnuts which demanded a lot of their labor. Therefore, the *'tsapi'* method eliminates losses from small grains as well as leguminous crops since farmers were able to distribute their labor equitably. "*Tsapi"* was constructed on whaleback to retain heat during the night hence facilitating the drying of stored grains. The roof was thatched in order to allow for adequate ventilation and protect the yield from winter rains. The structure of "*tsapi"* enabled farmers to safeguard the small grains harvest against stray livestock and wild animals like baboons and monkeys. No major losses were therefore incurred from crops stored and dried in *'tsapi'* before threshing.

Since the location of *'tsapi'* was determined by the availability of a suitable whaleback, it was sometimes constructed away from homesteads, necessitating the use of traditional medicines ('*juju*') to protect the stored grain from thieves. Anyone who attempted to steal from a 'protected' '*tsapi*' would invite terrible misfortunes or suffer from an incurable ailment. As a result, few theft cases were recorded. Despite the significant ability of "*tsapi*" to reduce yield losses at the drying stage before threshing, today no farmers are using this method mainly because of low yield obtained due to increased climatic variability, erratic rainfall and droughts. Secondly, very few modern farmers are able to use traditional medicines to protect "*tsapi*" from thieves since no mechanisms were put in place to pass on this knowledge from generation to generation. Thirdly, some of the traditional medicines are no longer available due to increasing biodiversity loss as human pressure for settlement and farming land have markedly increased over the years.

Whilst 60 % of farmers dry roundnuts on whaleback, the remaining 40 % dry in-field (Fig. 21.2). Twenty percent (20 %) of farmers who dry in-field remove topsoil and spread their shelled harvest on a hard subsoil surface. The other 20 % of farmers use cow dung to plaster on top of subsoil where again they spread their harvest. Removal of topsoil and plastering were done to avoid loss of harvest into the ground during drying. In both in-field and off-field drying, the methods result in losses of no economic importance unless unpredictable winter rains were experienced which could weaken the soil structure; hence losses can be realized from in-field drying if there is no timely intervention by farmers. Moreover, some cause of loss during drying of roundnuts was untimely attack by mice.

About 93 % of the farmers dry groundnuts after uprooting them in their fields using windrows and A-frames (Fig. 21.2). These two methods have been in existence since time immemorial. In the case of windrows, farmers simply pile uprooted groundnuts forming an arc shape to resist dispersal by wind with cocks facing the sun. A-frames were constructed using wooden poles and groundnuts were piled on either side of the A-frame with cocks facing inside. This method was developed in order to safeguard yield from rains as well as minimize loss of nutrients from sun scotching as in the case of windrows. Recently, through the advice of Agritex, 11 % of farmers now use a method called groundnuts hallow curing cocks which are constructed using 25 l jugs to form a cone shape for drying. According to Agritex, this method is cheap and effective as well as environmentally friendly as there is no need for wood when constructing the structure as in the case of A-frames. The remaining 7 % of farmers dry their groundnuts on whaleback. Although postharvest losses were said to be insignificant, the major causes of leguminous postharvest losses in-field were stray livestock (donkeys, cattle, goats and chicken), dogs, jackals, mice, termites and thieves. Cowpeas were dried on whaleback and no losses were recorded. It is important to note that all interviewed farmers were not able to quantify the amount of losses incurred from both small grains and leguminous crops at drying stage, although they indicated that they were insignificant.

21.4.3.2 Threshing Methods

The most common traditional threshing method for small grains especially pearl millet was organized cattle trampling of dried yield spread on whaleback, locally known as "*kutsikisa*". In operationalizing this threshing method, people spread and surround the dried harvest on whaleback and one or two individuals chase around cattle in either clockwise or anticlockwise direction continuously until the grain is separated from the chaff. However, the popularity of this method is gradually declining as it is now mainly confined to years of bumper harvests, which is no longer the case today for most households. Unquantified grain losses were recorded through crushing of grain by cattle hooves, consumption of harvest by livestock as well as soaking of dried yield with cattle mud if the process was not well controlled. Additional grain losses were experienced when threshing was done on harvest which was not well dried; hence yield was lost together with the separated waste. If millet harvest was well dried and the process was well controlled, no meaningful losses were recorded. Winnowing using winnowing trays was done immediately after threshing to separate grain from waste.

Almost 97 % of interviewed farmers indicated that they use tree branches (*kupura*) to thresh their small harvest especially for sorghum, finger millet and cowpeas on whaleback. However, in terms of grain losses, crushing is the most dominant. Wind splitting was also done later after threshing using winnowing trays. Generally, farmers, elderly people and Agritex officers agreed that these two threshing methods were the most ideal ones as they were meant to minimize loss of yield through spillage, an objective they achieved. Shelling of groundnuts and roundnuts was done after storage as storage with their shells reduced loss of yield from pests. In the case of groundnuts, farmers crack the shells with their hands in order to separate them from the nuts inside. Roundnuts were shelled using mortar and pestle (*duri nemutswi*) and later winnowing as in case of small grains. Farmers were not able to quantify yield losses during threshing and shelling as losses were said to be both quantitatively and qualitatively insignificant.

21.4.3.3 Storage Methods

Small grain losses at storage stage were said to be low or even zero for some farmers. About 12 % of the farmers said the existence of zero yield loss was due to low yield obtained which could be stored safely using modern storage facilities like sacks. In addition, these sacks were stored in traditional huts used as kitchens where the smoke from fire places tends to repel pests from attacking the stored grain, making the use of chemical insecticides irrelevant, a positive development for the poor rural communities. Therefore, smoke provided a cost-effective means to preserve yield.

However, elderly farmers indicated that they used to store their harvest from different crops in traditional huts called *"hozi"*. This hut is built on rocks (acting as pillars on corners) with wooden poles and mud to avoid transfer of moisture from the ground. The hut has subdivisions or compartments inside which are first plastered with anthill mud and coated with cattle mud. This material was used as it made the compartments inaccessible to pests or insects likely to destroy the yield. In the event of bumper harvest, either small grains or legumes were poured into these compartments which were later sealed to protect against pests and kept for

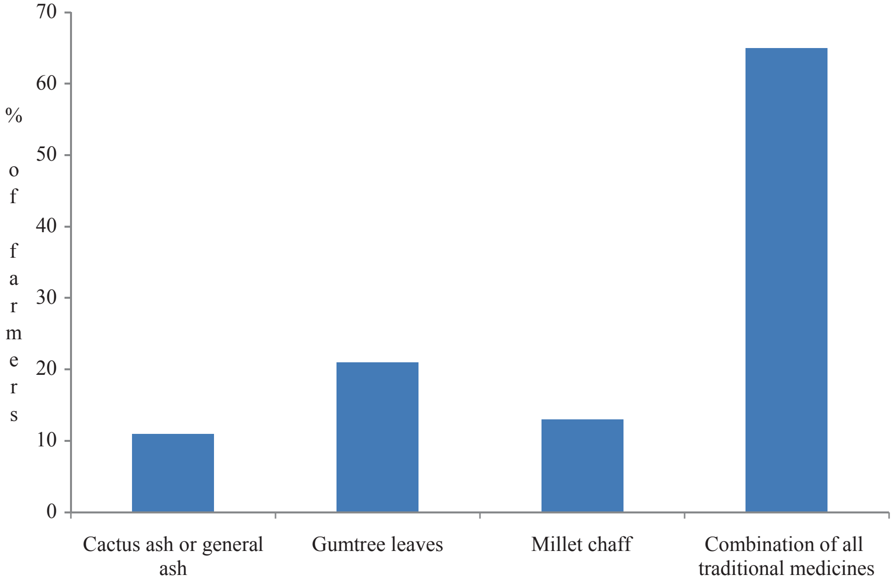

Fig. 21.3 Traditional medicines used preserve small grain crops at storage

future use. The produce remained un-degraded as long as these compartments were not opened and no losses were incurred. During storage, no traditional medicines or modern chemicals were added to these sealed compartments. The roof of the hut is thatched with grass to allow for ventilation. Elderly farmers indicated that this method conserved yield for a period between 1 and 3 years depending on the type of crop, with small grains being less durable than shelled leguminous crops.

Increasing climatic variability has been causing a decline in crop yield in recent years since 2001. Despite this problem, 88 % of the farmers again acknowledged that they still use "*hozi*" for storing their yields since these structures were put in place when they used to record high harvests. However, they no longer seal compartments after putting in their yield because storage would be temporary as they would need the food for daily sustenance. Lack of compartment sealing has been exposing the harvest to degrading pests like rats, weevils and grain-borers. In order to control these pests, 44 % of the farmers confirmed that they primarily use traditional chemicals to conserve their grain yield compared to 41 % who preferred modern chemicals and 15 % who want both.

Of the farmers who use traditional chemicals, 11 % use ash of cactus tree or general ash from fireplaces which they spray on the yield whilst 21 % use eucalyptus or gumtree leaves and 13 % use chaff of pearl millet or finger millet spread in the stored yield at defined intervals like 30 centimetres (Fig. 21.3). These traditional chemicals are said to repel pests for a period between 6 months and 1 year, the time within which most farmers would have exhausted their yield for consumption. About 65 % of the farmers use a combination of all these traditional methods.

The proportion of farmers (47.5 %) who prefer to use modern methods have been experiencing huge losses since they cannot afford the relatively high prices of modern chemicals like agricura, *chirindamatura* and rat pellets. Estimated postharvest losses at storage for different crops by farmers who use indigenous methods are shown in Table 21.2.

Low yield loss is realized from legumes like groundnuts and roundnuts as shown in Table 21.2 despite the fact that no additional traditional and modern chemicals are added. Low losses have been attributed to storage of groundnuts and roundnuts in shelled state, hence their ability to resist pests. However, percentage loss for roundnuts is relatively higher than that of groundnuts due to weak shells which will gradually become vulnerable to pests with time, normally after 8 months from harvest. Of significant concern to farmers is the inability of both modern and traditional methods to protect cowpeas from weevils since they are stored in unshelled form. Estimated postharvest losses for all crops as shown in Table 21.2 are relatively lower than the average of SADC which is 25 % (Masarirambi et al. 2010). Therefore strengthening of these ethno-postharvest technologies and practices could result in a further reduction of losses.

21.5 Challenges Associated with the Use of Post-harvest Indigenous Technologies and Practices

Whilst great potential exists for ethno-postharvest technologies and practices to cost-effectively minimize postharvest losses, there are several problems which affect their continued effective use at present and in the future. Most farmers indicated that they do not have adequate knowledge of traditional chemicals which can be used to repel pests or the knowhow for their safe use. For example, improper handling and application of cactus ash could distort the taste of food by making it sour or injure the user. Therefore some farmers have been confining the use of cactus ash to protect seeds for the next farming season. Some farmers are cautious about the use of eucalyptus leaves as these are reported to have health risks such as diarrhea if one consumes food milled with these leaves. Secondly, the mixture of eucalyptus leaves or ash with grains at milling results in the preparation of thick porridge *(sadza)* difficult, as it does not thicken as expected. About 77 % of the farmers who use modern technologies and practices argued that traditional practices and technologies were less effective as the results do not last long compared to modern chemicals such as agricura, *chirindamatura* and rat pellets, a view which was denied by most elderly farmers who said these modern farmers especially those below the age of 40 lack prerequisite knowledge on the existence and effective use of traditional practices. Some farmers confirmed that they were merely reluctant to adopt and utilize traditional methods as biodiversity loss was making it difficult for them to access some important plant species like cactus.

21.5.1 Future of Indigenous Postharvest Technologies

Farmers, elderly people and Agritex officials had mixed feelings on the future of ethno-postharvest technologies. Around 63 % of farmers who responded to questionnaires as well as the elderly people consulted, concurred that the future of indigenous practices was bright considering the fact that these technologies and practices were readily available locally and cheap. This means that with the high poverty levels amongst farmers, their solutions were likely to remain grounded in traditional methods; hence there exists a need for them to be strengthened. Therefore it was observed that it is necessary to equip children and other farmers with prerequisite traditional knowledge, especially those who are not familiar with traditional methods and have no capacity to buy modern chemicals. About 13 % of the farmers indicated that they were not quite clear about the likely continued existence of traditional practices in the future as information dissemination structures were poor. Today there are no formal structures for the dissemination of traditional knowledge as it was mainly carried out through informal interactions and observations. Elderly people and Agritex officials therefore hinted that formal education structures as well as projects for regeneration of ideal tree species should be put in place in order to pass on this wealth of information from generation to generation. However, the remaining 24 % of farmers said that traditional methods were ineffective and need to be abandoned.

21.6 Conclusion

Farmers in Wards 22 and 23 of Buhera district in Zimbabwe revealed that various traditional methods were used at drying, threshing and storage stages of both traditional cereal crops like pearl millet, finger millet and sorghum and leguminous crops such as cowpeas, roundnuts and groundnuts. Although farmers could not quantify the postharvest losses at drying and threshing stages, estimated losses especially at storage stage confirmed that ethno-postharvest technologies remains a panacea for minimization of losses amongst poor small scale farmers in semi-arid areas. Despite the obvious potential of indigenous postharvest technologies for farmers, improvements are needed in safeguarding against known health risks as well as establishing a sustainable means of passing on knowledge and skills to use these technologies and practices. Therefore it is imperative that indigenous technologies must be preserved and where necessary fussed with modern day technology as they are most appropriate for local conditions.

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