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# Integrating indigenous knowledge of food preservation with school science teaching in Zimbabwe

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# Integrating indigenous knowledge of food preservation with school science teaching in Zimbabwe

By

Dominic Mashoko

A thesis submitted to the Witwatersrand School of Education, Faculty of Humanities, University of the Witwatersrand, Johannesburg, in fulfilment of the requirements for the degree of Doctor of Philosophy

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# ABSTRACT

The purpose of this study was threefold: first, to analyse relevant science curricula and policy documents in Zimbabwe for their guidance on the teaching of indigenous knowledge (IK) and the promotion of cultural values; second, to explore and document indigenous methods of food preservation; and third, to develop a teaching model for science education in Zimbabwe. Indigenous forms of knowledge are not being used in the teaching of science in schools and could be lost if they are not integrated with school science.

I focused on IK methods of food preservation for the science curriculum. The knowledge encompassed not only the IK practices and methods of food preservation but also the social and the spiritual influences that have a bearing on food preservation. This study was carried out over a period of three years in Chivi, a remote dry rural area of Zimbabwe.

The methodology was a qualitative multiple case research study conducted in the local language of Chishona. Participants were community elders, science teachers, schools and learners from two villages. I generated the data using multiple methods including document analysis, interviews, brainstorming sessions, site visits, participant observations and free-writing sessions. I used document analysis on the Zimbabwe school science curriculum and policy documents. I interviewed community elders, science teachers and school learners on IK methods of food preservation and how such methods could be used in the teaching of the topic of food preservation in school science classes in Zimbabwe. Science teachers involved in the study were also given the opportunity to brainstorm on issues related to IK methods of food preservation and to suggest ways that this knowledge could be integrated into school science teaching. I made site visits to community elders' places of residence where I observed their food preservation artefacts. School learners were also given the chance to engage in free-writing sessions on stories, games, idioms and cultural expressions related to

methods of food preservation. I used journaling throughout this investigation to reflect on my research process. I sought validation of my initial thoughts from community participants. My data analysis was both deductive and inductive. To guide the analysis, I used grounded theory as an analytical tool.

The Zimbabwe Ministry of Primary and Secondary Education recommends that schools should include learners' cultural identities in learning but there are some omissions and no guidance of how this should be done. It also calls for a science content which provides values that mould learners into useful citizens. Documents also indicate that the science topic of 'food preservation' teaching should be drawn from methods used in local communities which include the use of learners' local languages in science teaching.

This study provides numerous examples that may assist teachers to integrate local IK content into their science teaching in schools. For example, community elders use '*hwikwiyo'* (granary with plastered roof) to dry and store their grain crops; and '*chingo'* (clay pots) to ferment and thicken their milk. The study also highlights the importance of Chishona language specific terms which are not usually used in school science teaching.

The interview results suggest that teachers and learners were, at first, not aware of how IK could be used in science teaching and relied mostly on traditional methods of teaching science. However, by the end the of the research project, teachers indicated that the community's IK methods of food preservation, in relation to the use of prior experiences, examples and resources from culture, could be used in their classrooms. Teachers also suggested the use of cultural heritage and an emphasis on mechanism of methods involved in food preservation as important considerations for school science teaching.

The study concludes that IK of food preservation could be integrated into the teaching of school science through the use of specific examples. The IK-science integration policies need

to be strengthened given that some documents did not include how such integration should be done. Research on the use of spiritual values and '*zviera'* (cultural taboos) is not resolved and may be suggested as an important area for further studies for science education.

# DECLARATION

I declare that this thesis is my own unaided work. It is being submitted for the degree of Doctor of Philosophy at the University of Witwatersrand, Johannesburg. It has not been submitted before for any degree or examination at any other university.

……

January 2018.

# DEDICATION

This thesis is dedicated to my late mother (Junika Mashoko) and father (Samuel Mashoko) who taught me cultural values.

# PRESENTATIONS AND PUBLICATIONS FROM THIS RESEARCH

1. Paper presentation at the Fourth International Conference of the Science and Indigenous Knowledge Systems Project/ South African- Mozambican Collaborative Research Programme, University of the Western Cape, Cape Town, South Africa, 29-31 October 2013. **Title of Paper:** Indigenous Knowledge for school science: Insights into the issue of Intellectual Property Rights from three South African Studies.

2. Paper presentation at the Southern African Association for Research in Mathematics, Science and Technology (SAARMSTE), Port Elizabeth, South Africa, 13-16 January 2014. **Title of paper**: Indigenous Knowledge for Plant Medicine: Inclusion into school science teaching and learning in Zimbabwe.

3. Paper presentation at the 12th Annual SAARMSTE Research School, Hosted by Central University of Technology (CUT), Free State, South Africa, 23-26 June 2014. **Title of Paper (PhD Research Proposal)**: Integrating indigenous knowledge of food preservation for Ordinary certificate level Science teaching in Zimbabwe.

4. IK **Poster presentation** at the Faculty-wide Post-Graduate Research competitions: poster presentation cluster, 27-31 October 2014, at the University of the Witwatersrand, Johannesburg, South Africa.

5. SAARMSTE conference paper presentation: 13-16 January 2015, Maputo, Mozambique, 13-16 January 2015. **Round table presentation paper entitled**: 'Culturally-aligned Science Teaching (C-aST) theoretical framework for integrating IK of food preservation in school science in Zimbabwe'.

6. Publication of a research paper, in Indilinga African Journal of Indigenous Knowledge Systems, volume 15 issue 3, December 2016, pp. 303-313. **The published manuscript is entitled:** 'Intellectual Property Rights and Indigenous Knowledge: Insights into three South African studies'.

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I acknowledge the support rendered to me by all my colleagues in the Curriculum Studies at Great Zimbabwe University, School of Education. They carried my teaching load while I was on study leave. Thank you.

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# LIST OF ABBREVIATIONS

| | |
|---|---|
| MOESAC | Ministry of Education, Sport, Art and Culture (Zimbabwe) |
| MPSE | Ministry of Primary and Secondary Education (Zimbabwe) |
| ROSE | Relevance of Science Education |

| | |
|---|---|
| UN | United Nations |
| UNESCO | United Nations Scientific Organisations |
| ZIMSEC | Zimbabwe Schools Examinations Council |
| ZVAC | Zimbabwe Vulnerability Assessment Committee |

# CHAPTER 1: GENERAL INTRODUCTION

## 1.1 INTRODUCTION

This study builds on and contributes to work in science education regarding the integration of indigenous knowledge (IK) into school science teaching. It explores relevant content and examples from culture on methods of food preservation that may be useful for school science teaching using IK from the community members in a rural area in Zimbabwe. This important area of research complements the current debate in science education related to the integration of knowledge systems. There is consensus among science education researchers across the world that the field of IK is growing as critical scholarship continues to challenge the dominance of certain ways of knowing. This scholarship, according to Wane (2014), emphasises the reimagining and repositioning of difference which rejects the view that there exists 'useless' knowledge. This study therefore seeks to integrate IK methods of food preservation with school science teaching.

According to Vygotsky (1978), teaching and learning are dual features of an integrated process of education. So, in this study, I shall use these two terms interchangeably. Matsika (2012) and Mavhunga (2008) suggest that IK present in rural communities may be infused into the school curriculum. For this reason, I specifically focused on teaching as a way to integrate indigenous forms of knowledge into the school science syllabus. I agree with science education researchers, for example, Coe, Aloisi, Higgins and Major (2014), Creemers and Kyriakides (2006) and Tytler (2003), who believe that 'effective science teaching and learning' components can be observed through teacher-learner classroom interactions. However, Oleson and Hora (2014) call this belief a 'one-size-fits-all' approach to teaching, where the teaching strategy is largely a rational and predictable activity. My approach

contrasts such a strategy. I needed to explore possible teaching approaches through a communal and context-specific '*nhaurirano'* (negotiated conversations in the Shona tradition) situation. I regarded this conversation in a similar way to what Dodo, Evensto and Sichalwe (2014) refer to as 'a cultural way of negotiation'. The approach enabled me to capture and interrogate the local cultural resource knowledge of people embedded in food preservation through a free and open way of knowledge generation. I needed to explore how such IK of the people might contribute to school science teaching in Zimbabwe.

Admittedly, the meaning of the concept of IK is potentially sprawling and complex. Pedzisai (2013) describes the knowledge used by the community as IK, which, for this study, is understood as the product knowledge, skills and practices of the people within a community. The concept is explored in more detail in Chapter 3 of this thesis.

Although studies in science education have examined IK integration into schools, the specific topic of 'food preservation' has not been included. For example, in the South African school context, Diwu and Ogunniyi (2012) investigated whether food processing in general could be taught in school science but did not specifically focus on specific topics such as food preservation. My study reveals possibilities for integrating IK methods of food preservation into school science in the context of rural secondary schools in Zimbabwe. This leads to the development of a model that teachers can use in the teaching of this topic in their classrooms. I also analysed policy and science education documents to determine the guidance provided on IK integration with school science for teachers in Zimbabwe.

I selected methods of food preservation as part of the science syllabus for this study because, in spite of the abundance of IK in the communities in which schools are located, that form of knowledge is not being used by teachers. This is confirmed by Shizha (2013) who argues that teachers in Zimbabwe are not including IK in their school science teaching. Odora-Hoppers

(2002) and Ogunniyi (2004) note that IK is holistic in nature therefore I decided to explore aspects of IK methods of food preservation that are relevant for school science teaching. This selection was informed by my twelve years of secondary school science teaching experience in Zimbabwe. Consequently, I decided to focus on 'food preservation', a science topic in the Ordinary certificate level science syllabus in Zimbabwe. This topic is only offered at 'O' Level, integrated science, Code 5006, Zimbabwe.

My motivation for embarking on this study was that I believe that IK could be lost if it is not integrated with school science teaching. IK is under threat from the effects of colonisation, globalisation and technological advancement. Although such threats are reflected in the changes in indigenous people's ways of knowing, there are other aspects of IK methods of food preservation that are resilient. Indigenous people's lives worldwide are still sustained by the use of IK methods of food preservation found within their cultures. However, Shizha (2013), Ogunniyi (2007a; 2007b) and Odora-Hoppers (2005) observe that IK is mostly communicated orally and is therefore at risk of being lost among indigenous communities. These researchers explain that, in such communities, more status and emphasis is placed on 'school knowledge' which is based on western knowledge methodologies. Science teachers are not integrating IK into school science in spite of the fact that there are possibilities for including this form of knowledge in school science to improve teaching in Zimbabwe. According to Shizha (2013), the use of IK in the science curriculum may give voices to both teachers and learners as they interact in familiar cultural contexts and engage with familiar socio-cultural knowledge.

There are many forms of IK in any culture. My study focused on the Shona people's IK methods of food preservation with respect to five indigenous foods, namely, meat, vegetables, cow's milk, sweet potatoes and grain crops. UNDP (2004) reports that the staple

food in Zimbabwe is maize; and Mararike (2001) identifies millet, rapoko, sorghum, vegetables and meat as foods that form most of the communal people's diets hence their inclusion in this study. These foods were chosen because they were readily available on my initial survey. Milk preservation was included to find out how the community traditionally preserves their 'liquid' foods.

I agree with Ottoo and Asiedu's (2009) assertion that sensory evaluation (taste, color, texture and flavour) is a major determinant in the acceptability, subsequent adoption and use of food products. However, my focus was not on quality and nutritional traits of these selected foods, rather, I was specifically exploring their IK methods of preservation and their applicability to school science teaching.

This chapter consists of background for the study, rationale for the study, scope and research objectives, statement of the problem, research questions, delimitations of the study, a summary of each chapter of the thesis and a conclusion.

## 1.2 BACKGROUND FOR THE STUDY

Ways of teaching through IK inclusion into school science education have been extensively researched and many of these studies have suggested ways teachers can use IK to teach science. For example, Kibirige and Van Rooyen (2006) focused on enriching science teaching through the use of IK. Similarly, Erduran and Msimanga (2014) and Ogunniyi (2012; 2007a; 2007b) propose integrating IK into school science as a teaching tool and Vhurumuku (2015) explored traditional and modern ways of healing and their relevance to science teaching for South African schools. These IK studies show that this knowledge can be integrated into school science education. While some of the studies recommend argumentation/debate as a teaching methodology, the integration of an IK topic like food preservation into school science has not been explored based on a specific culture.

For my approach, I drew insights from Ogunniyi's (2007a; 2007b) practical way of recommending IK integration into South African school science using Contiguity Argumentation Theory (CAT) as a tool. He argues for a harmonious dualism or equipollent harmonisations of these seemingly opposing knowledge systems. This argument means that, in the CAT approach, IK and school science can complement each other. However, for this study, I was interested in IK aspects of food preservation as practiced in rural communities that would be relevant for the teaching of the topic 'food preservation' in school science.

There have been studies done in Zimbabwe and elsewhere focusing on rural communities as sources of knowledge, for example, Shizha (2009) who explored the participatory nature of rural indigenous people's IK of environmental conservation in Zimbabwe. In South Africa, Keane (2006) and Khupe (2014) investigated IK which might be suitable for school science. Unlike these studies, my study was not aimed at improving the community's ways of living or changing the mind-set and relationships between those who conduct research and those who are research participants. Rather, I wanted to identify content and examples relevant for school science teaching based on a specific phenomenon, that is, IK methods of food preservation. Arguably, by being non-participatory, my study could be accused of what Kaya and Lyana (2014, p. 54) noted as 'doing research on people rather than with people'. Kaya and Lyana (2014) further explain that such accusations could occur where participants are regarded as not being actively involved in the research process. However, I avoided this accusation by taking data to participants for confirmation at each stage of my study.

I was informed by Beauclerk, Narby and Townsend's (1988) view regarding the nature of indigenous people when selecting participants for this study. These authors argue that human beings differ in cultural traditions and methods of using resources and technology depending on their contexts and that the term 'indigenous' also varies with cultural contexts. Others,

including Odora-Hoppers (2002) and Dei (2014) believe that the term ‘indigenous’ describes people who belong to and have historical connections to a place or land. Semken (2005) also asserts that cultural knowledge, held by ‘indigenous’ people, is a ‘place-based knowledge’. For this reason, I investigated indigenous people’s diverse views of food preservation for school science teaching in specific places in Chivi, Zimbabwe. Based on my personal experiences of these and other indigenous communities, rural community members in Chivi have long historical ties to their land and hence were suitable for this study. I was motivated by my lived-experiences in rural Chivi, Zimbabwe, where I noted that there were traditional foods in supermarkets and also observed their ability to cure human ailments. I considered the ideas generated within such communities as potentially useful to the school science education developments in Zimbabwe.

Evidence of science curricula shifts in Zimbabwe are relevant to my study because they reflect the country’s desire, since its independence in 1980, to integrate IK into schooling in general and science education in particular. In this regard, Gudhlanga, Gudhlanga and Mutemeri (2013) noted the socialist ‘education for all’ principle which the Zimbabwean government implemented in 1980. Chung (2008) identified the Zimbabwe Science (ZimSci) Project in started in 1981 which showed the Zimbabwean government’s desire to integrate IK into school science soon after attaining independence. This was followed by the Quality Education in Science Teaching (QUEST) program (MPSE, 2015) and the inception of the Ministry of Primary and Secondary Education’s Better Schools Programme in Zimbabwe (BSPZ) in the late 1990s. In 1996, the government, through the Curriculum Development Unit (CDU) and the Zimbabwe Schools Examination Council (ZIMSEC), introduced an ‘O’ Level Integrated Science Syllabus (Gudhlanga et al; 2013). This was to replace the Core Science syllabus used by secondary schools and make it a learner-centred curricula document. This new syllabus is currently used in Zimbabwean Secondary schools.

My study was undertaken when Zimbabwe was undergoing curricula shifts in line with recommendations by the Nziramasanga Commission of Inquiry into Education and Training in Zimbabwe (CIET, 1999). This was done in order to guide science education through the use of scientific ideas derived from everyday realities and thus involve the community, which Gudhlanga et al (2013) believes includes the IK of local people when applied in education. In spite of these curricula strides, the integration of IK into schools in Zimbabwe has remained problematic.

This state of the Zimbabwean science curriculum is consistent with what researchers in southern Africa have found in some sub-Saharan countries. For example, in South Africa, Ogunniyi and Hewson (2008) posit that the status of IK is regarded as low in comparison with the status of western science. These authors further point out that some teachers are not familiar with various IK in the country and therefore may not know how to handle such knowledge. In this regard, Pedzisai (2013) bemoans the lack of IK policy in Zimbabwe while Shizha (2008) notes the school curriculum's continued reflection of Eurocentric approaches. These challenges have negatively impacted on IK integration into school science teaching and learning in Zimbabwe. The topic of 'food preservation' which is taught in science curricula in Zimbabwe is, in my opinion, amenable to both IK and western concepts.

## 1.3 RATIONALE FOR THE STUDY

Research studies by Ogunniyi (2016) and Matsika (2012) show that information on the role of IK in science teaching in schools is scant. An understanding of the IK methods of food preservation would provide new insights for policy makers, curriculum designers, scholars and educators who are interested in developing strategies for science teaching in Zimbabwean schools. In line with this view, Mutandwa and Gadzirayi (2007) argue that, although there are some documented indigenous methods of food preservation in Zimbabwe, there is paucity of

information regarding their effectiveness in assisting households overcome short and long term food shortages as well as how this information can be included in schools. In support of integrating IK into school curriculum, the United Nations (2007) article 14(1) states that indigenous people have the right to establish and control their education systems and institutions in a manner appropriate to their cultural methods of teaching and learning. In short, IK is regarded by different authors as important in many development programmes including education.

The findings from this study may provide examples of food preservation methods gathered from the Shona culture in Chivi, Zimbabwe. Such methods, of course, might also exist in many other indigenous communities across the globe. Hence, other researchers may find my findings about IK methods of food preservation worthwhile. This may be a basis for further research into how school science teaching that accommodates both IK and western knowledge can be handled. My findings may also have a wider audience including academics, cultural workers and policy and decision makers in government as well as non-governmental institutions interested in food security issues.

## 1.4 SCOPE AND OBJECTIVES

This research focused on two aspects. First, it analysed relevant science curricula and policy documents in Zimbabwe for their guidance on the teaching of IK and the promotion of cultural values in the science curriculum. Second, it explored community members' IK methods of food preservation in Chivi which might be suitable for school science teaching. Objectives for the study were to

i) document the community's product knowledge of methods of food preservation in Chivi District. By product knowledge, I refer to what Mpofu, Otulaja and Mushayikwa (2013) call 'ideas, knowhow, materials and skills'. This view is backed

by other scholars including Hassard and Dias (2009) who posit that product knowledge refers to a skills or knowledge base. In other words, product knowledge is the end-user or content knowledge;

ii) identify aspects of IK methods of food preservation appropriate to include in the teaching of the 'community topic' found in the Integrated Science Ordinary Level Syllabus;

iii) suggest possibilities for teaching approaches for this IK form in the topic 'Science in the Community'. By teaching approaches, I mean how the ideas or knowhow and skills of this IK of food preservation might be taught to the learners in school science.

## 1.5 THE PROBLEM

The main research problem is that teachers continue to neglect IK and teaching methodologies that include forms of IK in their school science lessons. In indigenous communities, IK could be lost if it is not integrated with school science teaching. Studies, such as Dziva, Mpofu and Kusure (2011) and Shizha (2008), show that integration of IK with school science teaching is not being done in Zimbabwe. Shizha (2008) observes that the syllabus documents were not doing enough to integrate learners' home lives with their school lives. A study by Dziva, Mpofu and Kusure (2011, p. 88) makes similar observations and show that 'the teacher's conception and perception of IK is greatly influenced by the covert nature of secondary school science syllabi on IK'. This relates to teachers' reluctance to integrate IK into school science in Zimbabwe.

A number of reasons are suggested in the literature to explain why teachers are not willing to infuse IK into school science. For example, Hewson and Ogunniyi (2010) believe that teachers' reluctance to use IK could be due to a lack of teaching approaches to guide teachers when implementing IK-school science curricula integration. Shizha (2013) argues that the burden has been left to the teachers who have been trained in a western way and therefore may not know how to introduce this type of integration into schools. I argue that teachers' failure to include IK into school science may, in part, be due to the science curriculum documents that are not explicit on bringing IK into school science. This concurs with Pedzisai's (2013) findings from an analysis of the 'O' Level Agriculture syllabus in Zimbabwe, which could be extended to 'O' Level science syllabus and other school syllabi. The analysis found that the syllabus does not specify how IK should be brought into the school science curriculum. This is supported by Dziva et al (2011) who observe that the education policy and the syllabus documents for science and other school subjects bear little

resemblance to learners' cultures.

The impact of modernisation and the lack of clarity on methodologies are impeding the integration of IK into school science. For example, a study by Mapara (2009) shows that there were strategies used by indigenous communities of sub-Saharan Africa that are no longer in use today for schooling. Pedzisai (2013) argues that, due to unclear IK policy in some Southern African countries, valuable forms of knowledge may remain out of the science curriculum. To explore this problem, the study was guided by the following research questions.

## 1.6 RESEARCH QUESTIONS

My thesis was guided by three research questions:

a) i) What elements of IK methods of food preservation do curriculum documents give to the teaching of science in schools in Zimbabwe?

   ii) What do these curriculum documents suggest is relevant to the teaching of the topic 'food preservation' in school science in Zimbabwe?

b) What elements of IK and methods of food preservation do the rural community members of Chivi District hold?
c) How may culturally relevant teaching be drawn from the knowledge of the community members' indigenous methods of food preservation and the current practices of teachers and learners in Chivi district?

## 1.7 DELIMITATIONS OF THE STUDY

This research is a case study of IK of food preservation in Chivi, Zimbabwe. As noted by Rule and John (2011), findings of such a study can be generalised to similar contexts and

similar concepts or the phenomenon. This case study might apply to people sharing similar cultures in the area of indigenous methods of food preservation.

## 1.8 OUTLINE OF THE THESIS CHAPTERS

To answer the above three research questions, the thesis is structured in eight chapters:

Chapter 2: Gives the description of the context of the study. The study involved the Shona people in Murambwi locality in Chivi, Zimbabwe with specific practices related to IK methods of food preservation. It provides a geographical location that includes climatic conditions of the area and the rationale for the choice of the place. This context provides a platform to answer all three research questions selected for my study.

Chapter 3: Reviews, critiques and synthesises literature relevant to my study. It gives a review of theory relevant to my three research questions for the study. These include: the concept of 'knowledge', indigenous knowledge (IK), school science, culture in science education, integration of knowledge systems and methods of food preservation. In doing this, a report of the findings of closely related studies and the importance of the current study in relationship to previous studies is highlighted.

Chapter 4: Investigates the development of the theoretical framework guiding the study. The chapter provides development of a research orientation based on the constructivist learner-centeredness perspectives. A clear research orientation provides the nature of responses expected to answer all research questions for the study. Since the rationale of my thesis is to bring cultural knowledge into the school curriculum using theory emerging from the data, I used grounded theory as an analytic tool. The framework was guided by constructivist teaching approach, *ubuntu* worldview and indigenous methodologies. The constructivist perspective gives a platform for active generation of knowledge by participants. *Ubuntu*

worldview guides the ethics of my study. Indigenous methodologies offer suggestions for the research strategy that practitioners could consider for school science teaching. My contention here is that the analytic tool will provide a reference point from which the findings can be compared with those of other researchers and the implications connected to my study.

Chapter 5: Examines the methodology used for the study to answer all three research questions selected for the study. In this chapter, I give my research approach and discuss the methodological influences guiding this study. This is then followed by a description of the thesis' paradigm and research design. I then describe how I was involved in the study, access, ethical and quality considerations for the research.

Chapter 6: Provides an analysis of policy and science curriculum documents. This chapter analyses science policy and curriculum documents to find the way in which IK and school science could be integrated in the Ordinary certificate level science topic 'food preservation' in Zimbabwe. The chapter answers the first research question which explores the guidance science curriculum documents and policies provided for the teaching of the topic 'food preservation' in school science. Findings from the documents are related to science teaching and community members' IK methods of food preservation and their suggestions on how this knowledge could be integrated into school science teaching.

Chapter 7: Gives an analysis of interview findings, site visits and observations of community elders' food preservation artefacts. The chapter answers research questions 2 and 3 which guided my study (see section 1.6 above).

Chapter 8: The chapter gives an analysis of the science teachers' content knowledge and examples of IK methods of food preservation that may assist teachers to integrate this form of knowledge into school science teaching. The chapter answers research questions 2 and 3 which guided my study (see section 1.6 above).

Chapter 9: The chapter provides information on what learners were saying on IK methods of food preservation and their application in school science taeching. The chapter answers research questions 2 and 3 which guided my study (see section 1.6 above).

Chapter 10: Shows the implications and conclusions of the study. The chapter also highlights some recommendations in light of the findings from the study on how IK methods of food preservation could be integrated into school science teaching. This chapter gives implications of the findings for the study in relation to all three research questions guiding the study.

## 1.9 SUMMARY

This chapter has provided the background, rationale, problem statement, research questions, specific objectives, and delimitations of the study. This was then followed by an outline structure of the thesis in terms of chapters.

# CHAPTER 2: THE CONTEXT – MURAMBWI LOCALITY

## 2.1 INTRODUCTION

In the initial stages of my study, I was surprised by the following question which the Provincial Research Officer for the Ministry of Primary and Secondary Education (Zimbabwe) posed:

> You are going to study indigenous peoples' ways of life. Which locality are you going to research on? (Access Stage on 08 December 2014).

This was a surprise to me because it captured the importance of a locality for my study which, until then, I had not considered. I then felt obliged to give a description of the context of a locality for my naturalistic study. Stringer (2004, p. 55) posits that the results of naturalistic studies are '"truths-in-context" and are "specific to particular contexts"'. This view emphasises the significance of research context. My overall view of research context was two-pronged. First, I derived the meaning of the term 'context' that, according to Kelly (2007), refers to what people are doing, where and when they are doing it. Second, I it based on Mpofu, Mushayikwa, and Otulaja's (2014a) contention that a research context delimits a study. These two views explain Mpofu et al's (2013) argument that context not only grounds concepts but also minimises the chances of distorting meaning and/or misrepresenting intent. For this reason, I give a description of the location for my study so that meaning or interpretation is clear and accurate.

## 2.2 My view of context

There are various terms used by different authors to describe the context of a research. Khupe (2014) calls it a 'place', Mpofu et al (2013) chose to use the term an 'area' and Duranti and

Goodwin (1992) view it as a 'focal point'. Duranti and Goodwin (1992) further extend the idea of a 'focal event' by referring to a context that implies a cultural setting, speech situation or shared background assumptions.

The findings from my study illustrate what a locality means. The locality I describe pertains to the people of Murambwi sub-clan; hence, it is referred to as the 'Murambwi locality'. This places my view of a locality within Khupe's (2014) perspective which explains that the concept of context includes indigenous peoples' geographical locations, distance of schools and villages from the social amenities and the use of a local language. Kamwendo and Kamwendo (2014), and Lilemba and Matemba (2014) contend that a 'people context' refers to ways of life or culture. This contention is pertinent in designing context for my study.

In the context of people's culture, Keane (2006) argues that this way of life can best be understood within the actual settings in which it occurs. Halfacree (2006) advises that such settings could be understood through an analysis of people's social composition, forms of activities, nature of social relations and relationships with other spaces. The following section presents my understanding of a locality for this study.

## 2.3 THE LOCATION

### 2.3.1 Physical boundaries and social life

The Murambwi locality is in Chivi District of Masvingo Province in Zimbabwe. It has two communities, namely, Gomoguru and Dzivaguru. The remotest village is Gomoguru, which is 15 kilometres east of Chivi Growth Point along the Gweru-Beitbridge road. Gomoguru is in a mountainous terrain comprising mostly poor communities (See Picture 1 below).The village is sparsely populated with 100 families. It is about 7km from the nearest clinic.

**Picture 1: Mountainous terrains in the Murambwi locality**



Another village, Dzivaguru, is 10km from the Growth Point in the eastern direction. It is on a swampy area (*mopani* woodland) and also has poor communities. It is densely populated with more than 300 families. It is far from health facilities; a clinic is 10km away. Both communities are 5km from the tarred road in opposite directions. These communities have different terrains and cultural practices. Most of the young people from both communities have migrated to urban areas for employment. On average, families have six to 12 members. Some young people together with a few old people from these families have acquired new farms in line with the government's thrust on land reform. The communities therefore consist of mostly the elderly and those of school going age. Most of those who remain in the area are content with the type of life they are living. This confirms Mararike's (2001) observation that indigenous communities in Zimbabwe do not want to desert their ancestral land as they regard it as a cultural heritage. Each family has about 4 to 5 hectares of farming land most of which they cannot farm due to labour and agricultural input constraints. They grow field crops including maize, rapoko, sorghum, millet, traditional rice, pumpkins, watermelons,

sunflowers and sweet potatoes. The communities also have large tracts of land they use for pasturing. Most of their cattle are breeds which locals call hard '*mashona*' type, which are able to withstand the dry ecological conditions in the area.

### 2.3.2 The Nature of Schools

The two institutions were established a year after independence in 1980 as rural secondary schools. Chung (2008) explains that these schools are commonly referred to as 'Uppertops' in Zimbabwe. These schools are crowded (with class sizes ranging from 50 to 60 learners) and are under-resourced compared with other institutions at growth points or urban centres in Zimbabwe. Gomoguru secondary school has an enrolment of 832 students and Dzivaguru secondary school has 461 students. Only Gomoguru secondary school has electricity and neither has a science laboratory. The two schools offer a wide curriculum running from Form 1 to Form 6. The pass rate at both schools has ranged from 50% to 78% on both 'O' level and 'A' level for the past five years. The schools have a high staff complement of around 45 and 30 teachers respectively but most staff members are not housed at the schools since they prefer to commute from the growth point. These teachers have between 10 and 40 years' teaching experience so I assumed that they would have a rich source of IK related to methods of food preservation.

Although these schools are relatively old, there were several challenges related to their operations. For example, one school head explained:

> 'Payment of fees is a thorny issue at our school. Communities are poor and they cannot afford to pay school fees on time. Communities segregate girl child over boy child. If they have a boy and a girl, the boy will get more preference for school. We have some programmes that help a girl with regards to issues of reproduction. Some families cannot afford to take care of their adolescent children especially at the onset of their menstrual

> periods. In response to this, we have joined an organisation with parents we call 'Improving Girl Access through Transforming Education' (IGATE) which is facilitated by some non-governmental organisations. The organisation aims at identifying and addressing the factors which affect girls' learning outcomes in rural Zimbabwe. For example, the programme alleviates girl childs' sanitary problems by supplying pads. So, in our communities, we formed child protection committees' (Gomoguru secondary teachers, 26 March 2015).

Discussions with this teacher revealed that most of these girl child problems were caused by a lack of food in most learners' households. The same teacher explained that the programme was being implemented with a consortium of partners who include World Vision (lead agency), CARE and the Ministry of Primary and Secondary Education and was funded by United Kingdom Aid (UKAID) under the Girls Education Challenge Fund. For this reason, I found the topic of food preservation relevant particularly as it may provide ways of dealing with the food crisis affecting a rural locality such as the one selected for my study.

### 2.3.3 Ecological Conditions

This selected locality belongs to the Shona people and is one of the 'communal areas' in Zimbabwe. Munyaka (2003) refers to such areas as 'reserves', which fall under ecological region 5 and has a dry ecology. As one teacher explained, 'In this dry ecology of Chivi, drying of vegetables and preservation of the grains would be relevant for your study' (Access stage, Mr. Choks, Dzivaguru teacher, 29 January 2015). The location of the area is in Masvingo Province in Zimbabwe as shown in Map 1 below.

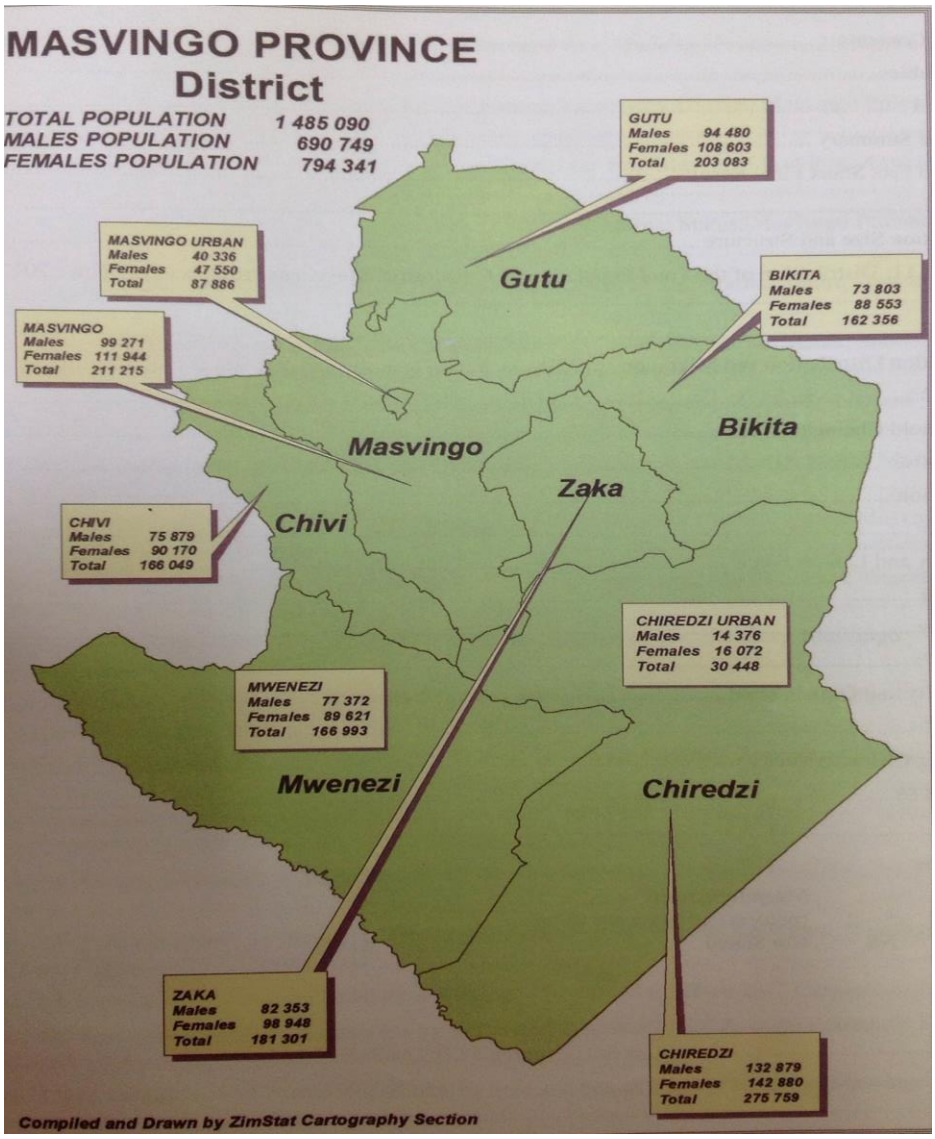



Map 1: A Map of Zimbabwe

(Source: Zimbabwe School Atlas, 2007, p. 56)

As explained by Nyathi (2006), the current boundaries of Zimbabwe were spelt out in the 1889 Royal Charter that was granted to Cecil John Rhodes by Queen Victoria of England. The above map shows that Zimbabwe is a land-locked country sharing borders with South Africa to the south, Botswana to the west, Mozambique to the east and Zambia to the north.

The communal land for my study is located in the 'middleveld' part of Masvingo Province. According to the Zimbabwe School Atlas (2007, p. 10), this area lies 'within an altitude ranging from 915 to 1220 metres, in Zimbabwe'. Map 2 below shows the population figures for all Districts in Masvingo Province.




**Map 2: A Map of Masvingo Province**

(Source: Zimbabwe Population Census, 2012 Provincial report Masvingo (Zimstat, 2014, p. 3)).

### 2.3.4 The Control of Natural Resources

The control of land and resources in Chivi is under the jurisdiction of '*vana sabhuku*' (village heads), '*madzishe*' (headmen) and '*madzimambo*' (chiefs). In Chivi, there are three chiefs each with fifteen headmen and each headman has 20 to 30 village heads. These community leaders take charge of Chivi communal lands with their governing powers distributed hierarchically in order from the village heads to the chiefs. Most of the area under Chivi is

populated. According to Zimstat (2014) report, Chivi has a population of 166 049 people under the auspices of community leaders. These community leaders enforce community cultural by-laws and regulations. My study area falls within an area under two headmen with one community having a stand-alone village and the other has two villages which have been merged for one community.

## 2.4 ECONOMIC ACTIVITY

### 2.4.1 Farming Activities

The study area has a large number of villagers practicing subsistence farming. Most of them do not have formal employment. They keep a number of domestic animals which provide draught and food (see Pictures 2 and 3 below).

**Picture 2: Turkeys in the Murambwi locality**



**Picture 3: Chickens and turkeys in the Murambwi locality**



The Murambwi villagers also hunt wild animals, which include hare, kudu, eland and squirrels. The numbers of these animal species have gone down due to indiscriminate hunting.

There were no amenities in the Murambwi villages such as electricity to sustain irrigation and modern methods of food preservation like refrigeration. The farming activities are wholly dependent on rain-fed agriculture which, in most cases, rain is erratic. The Zimbabwean climate is divided into four main seasons: rainy, post rainy, cool dry and dry hot. These are summarised in Table 1 below.

**Table: 1**

***The seasons of Zimbabwe***

| Scientific name | *Chishona* name | Description of the season | Range of Period |
|---|---|---|---|
| Winter | *Chando* | Cool season | Mid May-Mid August |
| Summer | *Chirimo* | Warm part of dry season | Mid-August-Early November |
| Autumn | *Zhizha orMatsutso* | Main rain season or end of rainy season when crops are about to ripen | Early November-Mid March |
| Spring | *Munakamwe* | Post rainy season | Mid-March-Mid May |

(Source: Ministry of Education Environmental Science Syllabus, Grades 4-7, MOES/S, 2006, p. 3)

Table 1 above shows that Zimbabwe has four distinct climatic seasons. Knowledge of the range of seasonal variations was useful in planning how to generate my data in relation to a specific season. Not all places in Zimbabwe receive normal to above normal rains even during the main rainy season because rainfall and temperature conditions in the country are greatly affected by relief and altitude. The Zimbabwe School Atlas (2007) reports that the hot region of Chivi is the Lowveld and part of the middleveld where temperatures are normally over 20°C. Data collection for the study was done from autumn to winter. As a result, I had the opportunity to look at the community foods while they were fresh in the fields and up to the storage stage. I was able to take photographs of both fresh and preserved food.

### 2.4. 2 Income-Generating Projects

The community elders were involved in various income-generating projects they call '*Fushai*' (where community members pool their financial resources together to start a project). Members borrow money to buy food and return it later with interest. It acted like a banking business in the communities. Members were also involved in gardening projects under the guidance of Environmental Management Authority (EMA), which is a statutory body responsible for the conservation of the environment in Zimbabwe. I learnt that proceeds from these activities would be channelled towards buying food for their families. Apart from these financial responsibilities and environmental stewardship, community members have burial societies where they assist each other during bereavement. They also help each other to pay school fees for their children and to buy Christmas presents for their families.

To eke out a living, some Shona people are involved in '*zvivezwa*' (crafts). They use either wood or stones to carve out artefacts including wild animals, birds and traditional pots.

## 2.5 CULTURAL LIFE OF THE MURAMBWI COMMUNITIES

### 2.5.1 Types of Houses in the Area

Generally, people in the Murambwi locality are very traditional in their life styles. They hold various family celebrations, for example, traditional weddings. Many have traditional mud-brick huts with grass roofs but a few also built modern houses with asbestos or galvanised iron sheet roofs (see Picture 4 below).

**Picture 4: Types of houses built in Murambwi locality**



I was interested to find that there are still many traditional huts similar to those which Mararike (2001) posits have been used by the Shona people as far back as the sixteenth century. These are similar to special houses built for '*madzimambo*' (chiefs) in the Ndebele state in Zimbabwe or the Zulu state in South Africa. I was fascinated to find that these houses were still the people's choice for shelter. This is true not only for the Shona people but for many other people in Zimbabwe. Although some build their houses using brick walls, I have observed that many people are still using pole and dagga to construct circular huts. In terms of the architectural designs, the concept of circular huts has moved beyond cultural barriers and most modern hotels, chalets and holiday resorts in Zimbabwe are re-modelling these types of houses. They are also visible at some learning centres and recreational centres, both in rural and urban areas, in Zimbabwe. Even some families in urban areas have built structures similar to the Shona people's hut designs.

Culturally, the huts are important to the Shona people in many ways. For example, Makaudze and Viriri (2012) identify four reasons why huts are essential to the Shona people in Zimbabwe. First, the Shona people believe that the circle of the hut depicts 'wholeness, perfection and unity; the creation of the cosmos; the womb of the Mother Earth; and the cycle

of the seasons and birth-death-regeneration' (p. 39). Second, the '*chiruvi*' (roof apex) is covered with an earthen cooking pot, which symbolises human nourishment typical of the female breast. Third, when a person dies, the deceased is placed in a hut as a sign of respect for the departed who got nourishment from it during his/her lifetime. The fourth point is that the hut is seen as a school and recreational centre. In the hut, the old and experienced Shona people would teach the young ones cultural education.

### 2.5.2 How Shona children are taught IK

There are various ways through which IK is taught in the shona society. In the following paragraphs, teaching approaches relevant to my study are discussed.

#### 2.5.2.1 The sage practice

According to Gudhlanga and Makaudze (2012) in the traditional Shona culture, knowledge is passed down from the elders to the children through story-telling or oral traditions. Jegede (1998) contends that besides oral traditions other avenues involve passing knowledge on to children by working with them, observing, and mimicking their parents, grandparents, and other siblings; or the sage practice. Regarding source of this cultural knowledge, Oruka (1990) posits that in the sage practice, indigenous people regard very old people to be wise and knowledgeable, with lots of experience. Jegede (1998) agrees with this cultural role of elders and further argues that indigenous peoples' knowledge is determined by age with older members teaching the young ones.

The sage practice is seen as an African philosophy by some scholars. For example, Oruka (1990) who believes that sage philosophy promotes evaluation and analysis of cultural issues. Gwaravanda (2012) concurs with this contention and further elaborates that the sage practice as a philosophy used in teaching young people serves to promote critical thinking as reflected

in the shona peoples' idioms when narrated by older persons in the communities. Gwaravanda (2012) furthermore cited Shona idioms, for example, *'kugamira padenga'* (to join discussion without a sufficient background to it) which teaches relevance of facts; and *'kuzvionera pamhuno sefodya'* (to experience for oneself on the nose like sniffing tobacco) which teaches verification of facts in life. Indigenous people could be taught life situations through these idioms. In conclusion, Gwaravanda (2012, p. 100) believes that cultural teachings through sage practice, 'promotes consistency, clarity, coherence, credibility, and open-mindedness as opposed to contradictions'. By implications, in the context of my study, young people may acquire critical thinking about IK of food preservation from older members of the communities in Chivi. I now turn to cultural methods of teaching in the Murambwi locality.

#### 2.5.2.2 Cultural methods of teaching

According to Mapara (2009), the Shona cultural life and teachings can occur through a variety of methods including proverbs, taboos, and myths. Through interaction with community members, I found that proverbs, taboos, myths, storytelling, games, cultural sayings, and respect of some cultural practices were the most common methods used to transmit IK among the people in Murambwi locality. How each of these methods would teach young people in the Shona community selected for this thesis will be described as follows.

##### 2.5.2.2.1 Shona Proverbs

Proverbs are very important in the Shona culture. For example, Mapara (2009) identified a Shona proverb that states: *'nzira inobvunzwa vari mberi'* which is translated to 'you should ask the experienced for assistance'. Another example, of a Shona proverb used in the Murambwi locality is: *'kandiro kanoenda kunobva kamwe'* (the hand goes and a hand comes). This means that you should give off something in order to receive something else in

return, which shows social reciprocity in the community. In the context of my study, such proverbs are useful in enhancing spirit of working together between and among community members when preserving food.

#### 2.5.2.2.2 Taboos

The other method is use of taboos. The idea of a taboo is defined by Manceau and Tissier-Desbordes (2006) as things that are sacred or forbidden in a culture, for example, early marriages. This definition is in sync with Makaudze and Shoko's (2015) view that taboos were the environmental management of the day which indigenous people are taught to preserve their natural resources. However, Manceau and Tissier-Desbordes (2006) advise that taboos vary from one society to another. In short, taboos are things that a particular culture requires people should not do.

Studies show that taboos are a strategy for teaching indigenous people culture worldwide. In Zimbabwe, Makaudze and Shoko (2015) explain that sexuality or immoral sexual behavior can be considered taboo, for example, sex before marriage in the Shona culture like other cultures is forbidden. Also, as noted by Mapara (2009) in the Shona culture, people are taught not to eat meat of an animal which is their totem; or cut down certain big trees that are believed to provide rain to the people. Such teachings show that Shona people, inclusive of those in the Murambwi locality, divide themselves into various patrilineal clans, each with their own clan name or '*mitupo*' (totems) or '*zvidao*' (sub-clan names). This assertion concurs with Bourdillon's (1998) observation that the Shona people have totems (animals or parts of living creatures), for example, '*tembo*' (zebra), '*gumbo*' (leg) or '*moyo*' (heart). Bourdillon (1998) furthermore argues that, to the Shona people, totems convey cultural messages, values and histories of the clan members. These names are based on the IK in a society and have religious and symbolic connotations. Totems also include, but less

commonly, a plant or other natural object after which the group is named. Young people are taught that totems deter people from killing and eating their totemic animals. Kamba (2017, p. R4) aptly describes totemic animals as 'animals that depict one's totem, considered sacred and not to be eaten by those that use it as their totem'. This description implies that the practice has an environmental conservation focus and the community has selected totemic animals used as food by other people. In the context of my study, these taboos had an effect on the type of, and how is, food or meat preserved in a particular community. Such observations concur with Dei (2013)'s argument that knowledge in indigenous communities is about wholeness and interconnection. For this reason, for community members related their knowledge production to both the tangible and spiritual real, which includes myths as well.

**2.5.2.2.3 Myths**

Myths are also another important way of teaching IK to children in the Shona culture. Ogunniyi (2017) postulates that a myth is a story or legend not necessarily believed to have arisen from direct human experiences but believed to have spiritual or moral lessons. Idowu (1973) regards myth as involving narration of cultural stories which teaches people peoples' language, beliefs, ethos, dispositions, customary practices, and their overall worldview. In other words, peoples' myths are explanatory mechanisms or statements of beliefs for understanding the world, which may be unseen but are real them. The implication of this is that teaching myths to children helps them to understand that an African is a person-in-relation, with the spiritual, moral, and social fabric important in determining their outlook of life. For example, Dei (2011) argues that in an indigenous community spirituality is regarded as encompassing relationships between living and dead, self and collective empowerment. The idea of myths has a bearing on how community members preserve their food, for example, by invoking spiritual guidance in storing food in sacred palces like curves, which

are commonly found in the area of my study.

#### 2.5.2.2.4 Storytelling

Storytelling is another way through which cultural values are taught by the Shona people in the Murambwi locality. For example, Davies (2007) posits that storytelling is the social and cultural activity of sharing stories in every culture as a means of entertainment, education, cultural preservation and instilling moral values. Some authors use the term storytelling interchangeably with folktakes. For example, Mapara (2014, p. 89) asserts that in Africa *(ngano)* storytelling or folktale is an 'active exchange in which the audience participate with responses, songs and at times dance'. He furthermore argues that folktales like other oral art forms carry vital cultural information, values, and language. In conclusion, he advises that folktales highlight a society's major concerns. In other words, the most important benefit derived from a folktale of story is that every piece contains a lesson to teach the audience on cultural knowledge and practices.

Elderly people in the Murambwi locality make use of Zimbabwe's rich and diverse culture to craft stories related to culture. Arguably, *'sarungano'* storytellers have evolved over the years from being '*Mbuya Muzavazi'* an old village woman, to modern communication channels like radios, televisions, and other avenues. In spite of such influences, traditional stories have remained the choice of many due to the cultural depth displayed by storytellers who are mostly old community members. Put simply, to the Shona people, old members of the society have remained the linchpins in imparting cultural values to the young people. As noted by Davies (2007), stories develop in children an understanding about other cultures, respect for others and other cultures, which might be relevant for education. So, the implication of this is that stories help children develop critical thinking and making a judgement about things and happening and actions of people, and ideas. For example, stories can benefit 'food

preservation', a concept which is taught in school science education in Zimbabwe.

#### 2.5.2.2.5 Cultural Games

In the Shona indigenous games are very important in instilling cultural values. To an outsider games serve to entertain people but in the Murambwi locality they serve as a way through which social and ethical values are taught. Related research studies done elsewhere, for example, Khupe's (2014) IK study found that the rural community in South Africa, the rules of the game were underpinned by values of honesty, discipline, collective responsibilities, and fair play. In Zimbabwe, Nyota and Mapara (2008) observe that among the Shona people, get to know their environment and acquire life skills among other things through indigenous games. This observation dovetails with Tatira's (2014) assertion that in the past the Shona indigenous games were performed as part of entertainment in Zimbabwe. Examples of such Shona games include '*mahumbwe*' (an advanced form of playhouse), *'tsoro/fuva'* (a game in the family of draft), and *'nhodo'* (a game where children fork out small objects from a small hole and returning an object at a time). Tatira (2014) further argues that among other virtues of Shona games to the people, they serve also to inculcate spirit of team building, respect, and commitment to work. In respect to my study, cultural games instill the spirit of working together, for example, when preserving food at household level. Community have cultural sayings meant to instill the spirit of working hard among the people.

#### 2.5.2.2.6 Cultural Sayings

Like other Shona cultures in Zimbabwe, the Murambwi elders teach young people through cultural sayings. Examples of such sayings, as what these elders were observed doing, include: *'pasina nzombe hapana dura'* (if you do not have oxen you cannot expect to harvest), and '*mukuru mukuru hanga haigari bvunde'* (young ones should always give respect to their elders). These expressions were meant to inculcate a sense of responsibility

and respect among the Shona people as observed by Mapara (2009).

Community members involved in my study also narrated that they give names to their children those names derived from those departed or living dear relatives. The names given carry with them community sayings that have cultural meanings to their lives. Examples of such sayings include: '*Tapiwa'* (a family has been given a child by the almighty), and *'munhuwei'* (literally, what kind of a person are you, which implies that if one is married at a polygamous relationship, one wife may be neglected by the husband so in the event that she delivers a child, a name may be used showing her disgruntlement emanating from such bad relationship). Through interaction with community elders, I was made to understand that community sayings were meant to encourage members to work hard and also to have a strong attachment to their departed members. Such teamwork and cultural relationships were reflected in the way community members went about doing their day-to-day activities of preserving food for their families. Community members also respected their cultural practices.

#### 2.5.2.2.7 Respect of some cultural practices

I observed that respect for some cultural practices were pertinent for teaching values to young people in my study area. I isolated two aspects I thought were relevant to my study: places where ceremonies are held, and Shona peoples' shrines.

##### 2.5.2.2.7.1 Places Where ceremonies are held

In the Murambwi communities, young ones are taught to respect sacred places. More often than not, young ones are taught cultural values in relation to their lives but globalisation has impacted negatively on such practices. Like other indigenous societies worldwide, Murambwi communities have resilient sacred places that have stood the test of time where

they have specific places to store their grain food (millet and rapoko) in caves. Elders also frequently visit sacred places scattered around the country for their *'mutoro'* (rain-making ceremonies). Chara (2017) concurs with this observation and further elaborates that in some parts of the country, Zimbabwe, the ceremonies are held in caves whilst in other areas they are conducted under trees that are deemed sacred. According to Sekuru Friday Chishanyu, a Shona traditionalist, in Chara (2017, p. S4), 'rain–making is a key component of an African traditional beliefs'. In these ceremonies, elders involved in my study claim that they have a rainmaker; they call *'nyusa'*. This was their rain-making priest or priestess, whom they begged for rains through singing at sacred places until rains come. These rainmakers were spirit mediums who were often tasked with leading the ceremonies at the shrines.

#### 2.5.2.2.7.2 The shrines

Mawere (2010) observes that the Shona people in Zimbabwe perform rain petitioning ceremonies at sacred places they call '*kuzame*' (spiritual place for rain-making). Similar findings were also made by Chara (2017), who explains that in Zimbabwe this spiritual place is referred to as '*Njelele'*, also known as '*Mabweadziva'* or '*Matonjeni'*, as one of the country's prominent rain-making shrines. Further conversations with elders have revealed that their shrine is located outside the Matobo National Park, South of Bulawayo. Hence, it is my contention that this cultural strategy of teaching the people has a bearing on how food is preserved in the indigenous societies, including the Murambwi community.

In the context of my study, what then is the effect of formal schooling on such culture? The following attempts to provide some possible effects of such practices.

### 2.5.2.3 Effect of formal schooling on culture

Although indigenous form of education is mostly imparted to the young people by elders

among indigenous communities as noted by Kawagley and Barnhardt (1998); things have changed now for the Shona people in the Murambwi locality. Commenting on the effect of modernisation, Shizha (2013) asserts that young people's education is influenced by formal schooling, media and interaction with others. For this reason, IK is no longer given the space it deserves in schools due to modernisation. In this respect, Shizha (2009) argues that IK is regarded as 'backward' by the young generation who fail to recognise that this knowledge has sustained lives of indigenous people for many years. Furthermore, Shizha (2009) argues that such IK has supported sustainability of many ecological systems that have enhanced indigenous peoples' lives in Zimbabwe. As elders involved in my study narrated, such resource sustainability is enhanced by community cultural laws, for example, through *'chisi'*.

#### 2.5.2.4 The *'chisi'* practice

The Shona people observe *'chisi'*, a resting day, once a week. Bourdillon (1998) explains that, culturally, on *chisi* no-one would be expected to work in the fields. This observation is supported by Mapetere and Makaye (2013) who explain that this resting day was believed to be linked to the day a founder member of the community died. The practice of *'chisi'* is prevalent among the Shona people in Zimbabwe, including the Murambwi communitities as well. In this regard, communities in Murambwi had separate days they respected as '*chisi*' – Wednesdays and Thursdays. If on the day one is found working in the fields, one would be summoned to a '*dare*' where a penalty would be given. This had implications for how I planned my data collection which was done during their *chisi* days so as not to disturb programmes in the communities. Apart from such laws, moral values also formed the basis of community members' social relationships.

#### 2.5.2.5 Moral Values

The Murambwi communities cherish their strong collective social lives as moral values.

Shona people are taught to have moral values. In addition to gender-based Shona people's cultural teachings, Mapara (2009) also observes that collective responsibilities form the basis of the Shona peoples' relationships. Although boys are responsible for herding cattle and girls take up household chores, collective responsibilities were central to their lives but, indigenous influences have changed; both boys and girls now have collective responsibilities. Children are taught to realize that responsibility to communal welfare comes first, although individual rights are respected as well. This observation probably explains why Gyekye (2003, p. 63) believes that 'an African thought holds that a person is by nature a social being oriented toward others in a community of persons'. Mapara (2009) argues that such collective responsibilities are also reflected in African sayings, for example, '*Mwana ndewe munhu wese*', which Kawagley and Barnhardt (1998, p. 15) suggest is translated to 'it takes a whole village to raise a child' This view places African teaching in the context where every adult member of the community is a teacher and a parent of any child even those without any biological links. For the Murambwi communities, raising and teaching a child are the collective responsibilities of all members of the society. Bourdillon (1998) posits that such responsibilities depend on communal relationships existing in a particular community.

#### 2.5.2.6 Communal Relationships

Like many other rural communities in Southern Africa, Murambwi locality is built around patterns of kinship which extend beyond the elementary family. This kinship system is what Monisen (2010) describes as a 'patrilineal relationship', which Nabli and Chamlou (2004) believe that it emphasises the division of labour along gender lines. But, as Bourdillon (1998) observes, many women in Zimbabwe have, in practice, acquired parity with men. This means that indigenous influences are changing. The community has a distinct way of life with collective responsibilities as central in governing the behaviour of individuals. Also, these

collective groups provide social cohesion and such links are dependent on the way these Shona groups in the Murambwi locality live, either individually or collectively.

In addition, patriarchy has a bearing on the Shona people's relationships. For example, Bourdillon (1998) reports that Shona society is mostly patriarchal and all assets are kept under the name and guardianship of men. In other words, for the Shona culture, kinship through males is stressed over kinship through female. Also, as noted by Mashoko, Mushayikwa and Keane (2016**)** most societal duties are done through '*mushandirapamwe*' (working together) where Shona communities practice '*nhimbe'* or '*humwe*' (help each other) so that they work collectively for food.

In emphasising their collective practices, community elders in Dzivaguru informed me not to come for interviews on one particular day due to the commitments of a marriage ceremony they were going to hold in their village. This occasion fell on their '*chisi'* (resting day) and it was expected that they attend. I could not go against what they had suggested and accommodated their programme.

Community members in my study have close bonds with each other. This explains why Wane (2014, p. 12) believes that 'indigenous knowledge goes to heart, spirit, mind and subsequent practices of a community, reflecting symbiotic relationships'. In the case of my study, close relationships could be reflected by IK issues to do with food preferences.

### 2.6 Food preferences

Food preference within the area of my study does not necessarily depend on the age of an individual, since even the older community members interviewed preferred commercially processed food. Analysis of the students' and one teacher's responses indicated that their dislike of traditional foods was based on hygiene. Shumba's (1999) study on non-western

developing countries found that some participants who liked western teaching methods while maintaining their traditional stance. Although this study was not focusing on food preservation, but was looking at an IK phenomenon for science teaching; suggesting the findings may be extended to my study since participants in my study also maintained their traditional outlook when explaining reasons for their food choices. They lamented the lack of hygiene of people who preserve their food traditionally. This might be an issue important for food situation in Zimbabwe.

## 2.7 FOOD SITUATION IN ZIMBABWE

Access to adequate food is a basic human right. According to Parawira and Muchuweti (2008), Zimbabwe has an agro-based economy and 70% of its population reside in rural areas and earn a living largely from subsistence farming. In spite of this, food security remains a problem. The Zimbabwe School Atlas (2007) reports that, since its independence, Zimbabwe, as a member of the then Southern African Development Coordination Conference (SADCC), has a food security portfolio. In this membership capacity, Zimbabwe was and still is mandated to draw up a food security plan for all people in the SADCC (now, Southern African Development Community, SADC) region. In response to this mandate, the country had a number of boards that were/are responsible for crop production at national level. The paradox of it is that, until recently, the country has continued to face challenges of food security at both household and national levels. Gee (2001) laments this current situation which, he argues, presents a worrisome state of food insecurity owing to Zimbabwe's economic status that has been declining for more than two decades. Chirimuuta and Mapolisa (2011) suggest that this dire food situation is reflected in the nation's low crop productivity, persistent hunger and malnutrition. Based on the Zimbabwe Vulnerability Assessment Committee, ZIMVAC (2011) report, food insecurity in Zimbabwe can be traced back from

2001 to the present.

Unfortunately, as proposed by Gudhlanga and Makaudze (2012), Zimbabwe continues to suffer from this food insecurity in spite of the availability of indigenous strategies to deal with it. Similar sentiments were expressed by Chirimuuta and Mapolisa (2011, p. 56) who posit that 'Zimbabwe is in the food insecurity position that she finds herself in today because of failure to tap from the indigenous food security strategies'. For Mararike (2001), this food insecurity is surprising given that indigenous people in Zimbabwe have been depending on their small grains as traditional foods for survival in their communal areas including Chivi.

The Chivi community is rich in IK of food preservation and therefore this is an ideal place to explore the integration of IK into school science teaching. To explore this, I did not use experimental procedures or a technique which Domenech, Amoros and Escriche (2013) refer to as Hazard Analysis Critical Control Point (HACCP) systems which identifies critical points in the community members' food processing chain, especially where potential food safety hazards could be introduced as contamination. Rather, my approach was to understand the IK methods of food preservation from the participants' perspectives.

## 2.8 LANGUAGE USE

According to Vygotsky (1978), a language reflects the culture, tradition and identity of its people. In light of this view, I hoped that an analysis of language used by the people in my study would show their context. In most school subjects in Zimbabwe, English is the usual language of the classroom, although, most teachers were happy to switch to their mother tongue when necessary.

There are many languages spoken in Zimbabwe. The Constitution Parliamentary Committee, COPAC (2013) document reports that there are sixteen spoken languages in Zimbabwe.

COPAC was a Constitution Select Committee of the Parliament mandated with the drawing up a new constitution for *Zimbabwe* by the Government of National Unity between 2009 and 2013. The above report by COPAC has an implication for the local terminologies participants choose for science teaching in schools. Although most of the documents selected for the study suggest the use of local language in schools, it may not be easy to implement this given that there are varied forms of such languages in Zimbabwe. Merrit, Cleghorn, Abagi and Bunyi (1992) contend that issues of language choice in the classroom are much more complex than can be legislated for by policy makers.

Zimbabwe's Ministry of Primary and Secondary Education, MPSE (2014) curriculum guidelines report that a pass in English at 'O' Level is an entry requirement for colleges and universities. For this reason, English is likely to affect the survival of Chishona language and other local languages in Zimbabwe. Mapetere and Makaye (2013) observe that the Shona are the largest ethnic group in the modern nation-state of Zimbabwe. As a result, Chishona is the dominant indigenous language. Community elders in this study spoke the '*Chikaranga'* dialect of Chishona language and, in some cases, used as slang. For teachers and learners, proficiency in English was not high. This had an implication for conversations. Most of our conversations were in both English and mother tongue, as Kaya and Lyana (2014) contend that, holding interviews in a local language, allows clear communication and maximum participation.

## 2.9 CHANGES IN THE COMMUNITY MEMBERS' ROLES

Community elders were knowledgeable about indigenous culture which they felt was useful in imparting knowledge to their children. Even though the elders had low levels of formal education ranging from Standard 1 to 6 (Early childhood to Form 2 level in the current system of education in Zimbabwe), this was no impediment to their teaching of IK to the

youth and may also be an advantage as their learning has not been colonised. They had deep knowledge of the ecology and indigenous technologies which I have lost over the years due to the effect of modernisation. I find a lot of sense in Wane's (2014, p. 5) observation among some indigenous communities in Kenya that, 'indigenous people have what we have lost'. Such findings are in support to what I also found from the community elders in the Murambwi locality. Admittedly, there has been disruption of indigenous ways of knowing, learning and even teaching among most indigenous societies around the world. In other words, some cultural values have changed but there are still other aspects of IK that continue to sustain peoples' lives inspite of threats posed by these changes.

In Zimbabwe, Dziva et al (2011, p. 90) noted that 'teachers have replaced parents and elders as holders of knowledge, as they spent more time with learners at school rather than engaging in hands-on-learning on the land' (the role of teachers and parents in imparting traditional education will be discussed later in my thesis). As a result, learners in schools lose social cohesion and become alienated and disoriented from their traditions. In this regard, Riley and McCarthy (2007) posit that traditional or indigenous education is informal; occurring mostly through observation and 'trial and error' and knowledge is available only to those with 'the right to know'. In simpler terms, for indigenous people, teaching is done in a meaningful real-life context, such as '*padare'* (meeting place), or when performing household chores.

As alluded to before, my study was carried out at a time when the Ministry of Primary and Secondary Education was carrying out a curriculum review underpinned by the Nziramasanga Commission of Inquiry into Education and Training (CIET) that reviewed the entire education and training at all levels in Zimbabwe in 1998. According to MPSE (2014, p. 1), the CIET curriculum review was aimed 'at yielding a broad based curriculum that promotes the learner's spiritual, moral, cultural, intellectual and physical development at

school and in society in general'.

## 2.10 RELIGIOUS BELIEFS

The Shona people are a religious group. Most of them have been inspired by contemporary Christian beliefs and practices but, according to Bourdillon (1998), the African Traditional Religion (ATR) is still intact in spite of the influence of Christianity. In addition to Christianity, Nyathi (2006) observes that the Shona people worship their '*Mwari*', '*Umlimo*' or 'god' who they believe lives at various shrines in the country. For example, as alluded to in this chapter above, the Shona have their '*svikiros*' (spirit mediums) who lived at Matonjeni shrines in Bulawayo, Zimbabwe.

Although Christian missionaries have influenced the Shona people's religion, some still perform indigenous rituals. For Mararike (1999), rituals foster social structures and maintain a balance between people and their environment. An example is the rituals of social relations which serve to maintain good relationships between people and their environment. Bourdillon (1998) explains that the Shona people's lives are spiritual and humanistic and they are especially connected within a group. He explains that the Shona people have '*ukama*' (close family relationships) which do not end at death. In this regard, Mawere's (2010) observations found, firstly, that the Shona indigenous cultures have a spiritual hierarchy of existence with *'Mwari'* (God) at the top followed by the *'midzimu'* (spirits) and then the living beings in the earth. These spiritual departments are expected to work in unison.

The Shona people perform their burial ceremonies with the belief that the dead person will still help them in their lives. However, times have changed because, in the past, the departed would be mostly the elderly but now even young people are dying in large numbers.

Secondly, Mawere (2010) notes that the Shona people still believe that their forefathers left

some grain bins in response to '*nguva yedzviti*' (the refuge war period). Thirdly, he explains that, during this war, the Ndebele raided the Shona in search of food and, to counteract this, the Shona built rough stone walls and grain bins in hidden locations in the mountains.

## 2.11 MY CONTEXT

### 2.11.1 My Family Background

I am a Zimbabwean citizen by birth and speak Chishona. I am married and have a family. I am an elder who has the responsibility of providing food for my family. Although I work in an urban area at a university, I have a rural home background. I was born and bred in a rural community with traditions enriched by more than a thousand years of cultural exchange among the Shona people of Zimbabwe. In this community, I became interested in the way elders store food in granaries as I helped my family to process food during weekends and school holidays.

### 2.11.2 My Formal Education

I did my primary school education in a rural area, Chivi. While I was in primary school, one of our teachers requested food samples from our parents that he intended to use for his teaching. The school had a small field where learners used to grow '*chibage*' (maize crop) for food at school. After primary school, I went to a missionary boarding school in Masvingo province in Zimbabwe for high school education up to 'A' Level. This mission school was located in a rural community characterised by a dry ecology. The villagers from this community sold their preserved grain crops and other fresh crops in a local township near the mission school.

I trained as a secondary school science teacher at a local teachers' college in Zimbabwe. I then taught science in a rural area for 10 years during my 13-year tenure as a teacher in

Zimbabwe. As a Shona by birth and a Westerner by education, I had to negotiate this dichotomy of my life.

### 2.11.3 My School Work Experience

As a school teacher, I found a disjuncture between home and school in the way I taught science in schools. I considered my teaching context to be potentially rich in IK but I was not sure what methodology to use in bringing IK into the school curriculum. I recognised that the knowledge of indigenous food technologies possessed by elders in the communities exceeded what I had gained through my years of Western education. This reality presented a dilemma of teaching western science to learners with an indigenous background. I wanted science that accommodates both knowledge systems to be taught in schools but I was confronted with a myriad cultural barriers which included language, religious beliefs, community expectations and personal and academic agendas relating to my teaching science in schools. For Lowan (2012), these cultural issues are central in the clash of school education with an IK worldview. I realised the limitations of both IK and science worldviews and asked myself a question: 'How should science be taught to learners in indigenous communities?' This confusion was worsened by a realisation that, in the Zimbabwean science curriculum, some assessments were not in tandem with policy requirements. For example, questions in public examination science papers do not reflect IK use in the curriculum. In addition also, some science education researchers in Southern Africa (for example, Shizha, 2013) agree with me that science is at odds with IK in spite of evidence from Khupe (2014) and Keane (2008a) that IK is a valuable way of knowing just as western science is. It is from this background that I sought to understand how this form of IK could be included into school teaching. I believed that if I did not find ways of integrating IK into school science, this would be a travesty of justice to the indigenous peoples' functional ways of teaching and learning.

The dilemmas of how to include IK in science teaching influenced my research questions. In keeping with Keane, Khupe and Muza' s (2016) research suggestion, my study's interest and questions were exploratory, collaborative and personal. This allowed me to acknowledge the tensions and contradictions that are sometimes glossed over in science education research. In this approach, I find resonance with Louis' (2007) contention that collaborative relationships in research reduce misrepresentation and misinterpretation of participating communities.

## 2.12 SUMMARY OF THE CHAPTER

In general, community members had specific cultural practices which governed their day-to-day interactions in the communities. The area was far from amenities and has a dry ecology which community members have worked with to sustain their lives as a collective group.

The way I researched the context of my study in relation to community members' socio-economic influences was a long process. These included: geographical location, economic activities, cultural life, the food situation in Zimbabwe, language of communication, ways of imparting knowledge in the communities, religious beliefs and my own personal context. In light of the effect of these issues that I believed had a bearing on my study, I would argue that a person's identity is locational- you are where you are. So, in many ways, the above aspects shaped my research study from the planning stages to the write up.

I now turn to the next chapter, a review of literature for my thesis.

# CHAPTER 3: LITERATURE REVIEW

## 3.1 INTRODUCTION

In this chapter, I describe the literature that guided my study. My study focused on integrating IK methods of food preservation with school science teaching. The literature I review in this chapter is related to IK methods of food preservation and its relevance to the teaching of school science. This literature search was guided by the research questions I selected for my study. The major concepts for my study to be discussed include IK, school science teaching, culture in science education, integration of knowledge systems and food preservation.

To understand the concept of IK, I need to first unpack the meaning of the term 'knowledge' as it is understood in both indigenous and western perspectives.

## 3.2 THE CONCEPT OF 'KNOWLEDGE' IN THIS STUDY

Literature shows that the concept of 'knowledge' is viewed in a many different ways. For example, Aikenhead (2006; 2002) views it as a 'way of being', 'a way of knowing' and 'a way of living in nature'. Khupe (2014) understands the concept to mean 'a way of belonging' while Hewson (2015) explains it as 'new ways of seeing'. Tefflo (2013) gives a more comprehensive description of the concept as people's ways of life. Gyekye (2003) takes another dimension and proposes that knowledge should be considered for pragmatic reasons where its practical use is of value to people. The above views all suggest that the concept of knowledge should be viewed from a utilitarian position, where practical use of this concept is emphasised. However, Matsika (2012) proposes that this practical utility of IK contrasts with generations of knowledge for its own sake that characterises the western perspectives.

The term ‘knowledge’ has different meanings when used as an IK or a western concept. Riley and McCarthy (2007) describe how indigenous people impart cultural knowledge to each other. They argue that teaching of IK is informal occurring mostly through observation and by trial and error. Furthermore, they explained that, through this method, learning becomes more person-oriented than information-oriented. This implies that in IK a person is taught through verbal instruction in a learning context that is meaningful and reflects real-life situations. Since this study seeks to understand knowledge in the context of indigenous communities, my view of knowledge in form of IK is the way in which it is useful to their lives.

### 3.3 THE CONCEPT OF IK IN THIS STUDY

Studies indicate that the term IK is defined in a variety of ways. For example, Ogunniyi (2007a; 2007b) and Shizha (2013) equate its meaning with that of Indigenous Knowledge Systems (IKS). Other authors, such as Mpofu et al (2013), use these terms in a different but related way. My conception of IKS is in agreement with that of Pedzisai (2013, p. 245) who understands IKS as ‘a community rather than individual knowledge, unique to every culture or society and providing problem solving strategies for that society’. Odora-Hoppers (2002) believes that such strategies are evident through activities of peoples’ product knowledge in agriculture, medicine, botany, food processing and preservation, among others.

Product knowledge, derived from interactions between people and their environment, is referred to as IK as cited by Diwu and Ogunniyi (2012), and Matsika (2012) who argues that this environmentally-derived knowledge is part of a community’s cultural practices and ways of life. In this study, I define IK as the skills and technologies that result from the local peoples’ practical engagement with the natural environment for their survival. My study focuses on the IK concept only in understanding school science teaching knowledge.

Matsika (2012) explains that, like any other knowledge system, cultural interactions used to educate a person are dynamic. IK therefore is not practiced in the same way today as it was before colonialisation. The paradox of this view is that IK, which has transformed over the years, is available only to those with the 'right to know' as observed by Gyekye (2003). Matsika (2012) concurs with Gyekye's (2003) observation, and further explains that most types of IK are accessible only to a few members of the communities who are sources of that knowledge or selected older members. Mashoko, Mpofu, Mushayikwa and Keane (2016) posit that IK is different to western systems because the latter have 'open' forms of knowledge approaches.

In this 'open' system, particularly as practiced in an African context, Riley and McCarthy (2007) argue that a person is judged for his/her suitability as a 'teacher' by displaying appropriate behaviour at all times. As alluded to in chapter 2 of this thesis, Mapara (2009) also posits that indigenous good behaviour would, for example, be shown in story-telling by '*mbuya muzavazi*' (woman story-teller) in Shona and, in some cases, '*sekuru*' (an old man) as a story-teller. Mawere (2012) concurs with this cultural role and further explains that story-telling in an African society is done by older persons who display impeccable behaviour. So, a person with IK has no paper qualifications. This is the reason why Matsika (2012) believes that such an indigenous view contrasts with the European form of a teacher, who is judged by qualifications, knowledge and/or experience. Story-telling is interrogated in more detail in chapter 4 of this thesis.

Considering the aforementioned arguments, African values for education may seem to be difficult to merge with western content in schools. However, some scholars in science education agree that culture is important in education. For example, Lawton (1978) argues that a curriculum is a selection from a culture and, in this case, from *ubuntu* cultures, that

emphasises social responsibility, and spiritual and moral values among other virtues in the African context. *Ubuntu* worldview will be addressed in more detail in chapter 4 of this thesis but a summary shall be provided to show its link with IK for this study.

Khasawney, Miqdadi, and Hijazi (2014) posit that American philosopher John Dewey's apprenticeship type of education matches theory with practice. Dewey's view is true for African cultures even today, based on the conception of *ubuntu* worldview as explained by Keane et al (2016). These authors contend that the *ubuntu* worldview captures an African ontology often presented as 'I am because we are'. The implication of this view is that, in cases where *ubuntu* values hold sway, school science teaching should view reality also in the context of IK perspectives. This is because, as Aikenhead (2006) argues, indigenous communities' ways of life may draw from a particular culture's IK and technologies. For this reason, I believe that indigenous people might have strategies for food preservation that may be useful for school science teaching.

### 3.4 'SCHOOL SCIENCE' KNOWLEDGE

The concept of 'school science' has many tags attached to it. For example, Ogunniyi (2004) uses the term 'western science-oriented classroom science' and, more recently, Ogunniyi (2013) calls it 'modern classroom science'. Others, for example, Pedzisai (2013) and MOESAC (2007), identify it as 'mainstream school science' while Mpofu et al (2013) simply uses the term 'classroom science'. In this thesis, I use the term 'school science' to refer to all these tags.

Mpofu et al (2013) provide a useful starting point for what I consider as constituting school science. These authors propose that classroom science involves what is taught (content), how it is taught (teaching) and the purpose of teaching. This is a similar to the distinctions made by Keane (2006) whose study classified school science, and therefore science teaching, as

consisting of process, content, context and purpose, which can be drawn from culture. These aspects of school science are described below and, in doing so, distinctions between the terms 'science', 'scientific knowledge', 'school science' and 'school science teaching' are made.

### 3.4.1 The Process of School Science

According to Lederman, Abd-El-Khalick, Bell and Schwartz (2002), the 1950s and 1960s saw science teaching following scientific methods characterised by a straightforward and linear process of making and testing predictions as the basis of the learning process. Driver, Asoko, Leach, Mortimer and Scott (1994, p. 5) noted that later developments in science education show that 'scientific knowledge is both symbolic in nature and also socially negotiated'. Thye and Kwen (2004, p. 2) believe that, 'science is dynamic, changing and tentative'. This dynamic nature of knowledge places science within a cultural framework.

A cultural perspective of IK contrasts science taught in a school which is characterised by reductionism and Cartesian dualisms of the 17$^{th}$ century western philosophy. According to Malcolm (2003), this philosophy consists of separations of subject/object, mind/matter and physical/spiritual. This philosophy contrasts what Hassard and Dias (2009) cite as the emergence of constructivist approaches in science education emphasising learner-centred approaches in teaching. Within this learner-centredness realm, science knowledge is viewed as a cultural way of knowing reality. This view places IK in the context of science practice.

Another view of science as a practice has received significant attention from many authors in science education. Mortimer and Scott's (2003) concept of science as a set of 'practices' lends itself to a form of inquiry-oriented classroom practices in which students explore real problems through collaboration, dialogue and discussions. The idea of science as practice originates from the philosophical views of Kuhn (1962) who argues that science was undertaken by a community of scientists whose work was dominated by a set of values and

normative criteria and that these practitioners engaged in consensual practices. In line with the position of science as a practice, Gutierrez and Rogoff (2003) argue that learning involves the development of 'repertoires of practice' while Osborne (2014) believes that the idea of 'engaging in practice' would help students understand the epistemic (the why) and procedural (the how and what constructs that guide learning. Lave and Wenger (1991) also argue that, by using engaged practices in communities, the emphasis is learning by doing and 'learning in situ'. For example, the content of science can be drawn from a rich array of IK from the learners' prior experiences drawn from their communities. My study explored relevant content that could be included in the teaching of IK of food preservation in schools.

### 3.4.2 Content of school science

What constitutes science content is varied in literature. For example, Ogunniyi (2007a) believes that science consists of knowledge developed through empirical findings, that is, content or product knowledge. More recently, NRC (2012) describes subject content in terms of ideas, knowhow, practice, materials and skills, facts, concepts and in science statements that seem to be true in most situations which may not be true in all cases. This means that the content of science teaching focuses on objectivity.

Naidoo (2000) provides a different view of science content arguing that it should include ways we teach science and other technology by drawing from cultural knowledge. Naidoo's view is in keeping with Driver, Leach, Miller and Scott's (1996) perspective on why the nature of science (NOS) is important to understand science education. These authors explain that science should be viewed in terms of its utilitarian (making sense in everyday life), democratic (making informed decisions), cultural (appreciating the value of science as part of culture), moral (understanding norms of community) and science learning (facilitating learning of subject matter) positions.

In a recent study by Lederman, Antink and Bartos (2014), the cultural-relatedness of science is emphasised. These authors believe that scientific knowledge is tentative (subject to change), empirically-based (based on and/or derived from observations of the natural world), subjective (theory-laden), necessarily involves human inference, imagination and creativity (involves the invention of explanations) and is socially and culturally embedded. Their observation suggests that school science and IK have common features which can complement each other. However, Cummins and Swain (1986) caution that the language of school science is 'cognitively demanding' and 'context-reduced', making it difficult to align with IK. So, this lack of contextual clues in scientific language is in direct contrast to the context of IK learning when applied in school science teaching.

In the following section, science context in general is considered and then move to the specific Zimbabwean situation.

### 3.4.3 The context of learning school science

Odora-Hoppers (2004) and Shizha (2009) propose the use of local contexts as platforms for science teaching. These authors are supported by Baine and Mwamwenda (1994) who argue that, through the incorporation of local contexts, an indigenous science curriculum in schools becomes 'ecologically valid'. These authors explain that this will allow learners to view concepts taught in class as relevant to their everyday lives outside the classroom. Vygotsky (1978) argues that this idea of seeking relevance of learning resonates with the lens of viewing learning as progress in the learners' Zone of Proximal Development (ZPD). Bruner (1985) extends the argument of ZPD arguing that local contexts provide 'scaffolding' to learning episodes. Both Vygotsky and Bruner's views probably may support Duit, Treagust and Widodo's (2013) belief that the use of local contexts for education helps learners actively construct their school knowledge using prior experiences. This use of local contexts for

learning is in line with constructivist perspectives in education.

The idea of teaching and learning of science using local contexts has been on the Zimbabwean education agenda since independence in 1980. For example, Chung (2008) argues that projects such as Zimbabwe Science Curriculum Initiative (ZIMSCI) were developed to assist untrained teachers in handling science lessons using cost effective resources from the environment. However, the science curricula in Zimbabwe face the challenges of teaching material shortages, rote learning practices and an emphasis on examinations. In this regard, the Ministry of Education (Zimbabwe, 1992) queried the nature of education teachers were imparting to learners arguing that the teachers' main concern was that of covering the syllabus and not enhancing understanding in learners. In spite of these curricula developments, Shizha (2007) noted that current policies on science are situated in Western cultural definitions which marginalise IK found in the communities. In this regard, Shizha (2007, p. 308) argues that 'knowledge constructs and pedagogical practices used in the colonial educational system are deeply embedded in science curricula and are reproduced by the Zimbabwean education system'. Shizha (2007) concludes by arguing that the relevance and meaning of science are the challenges that teachers face every day in their classes as they try to make sense of their teaching. What this implies is that science teachers are not sure how to integrate IK into school science teaching in spite of their appreciation of the need for learning to be culturally relevant.

### 3.4.4 The purpose of school science

According to Mortimer and Scott (2003), the purpose of science is different from school science teaching. Osborne and Dillon (2010) contend that science seeks to generate arguments falling into three categories: retroduction (inference-making), hypothetico-deduction (prediction like falsification) and induction (making specific observations,

detecting patterns, formulating hypotheses and drawing conclusions).

Popper (1963) explains that scientific arguments start with a problem but can be falsified. Furthermore, Popper argues that what distinguishes a scientific theory from a non-scientific theory is the principle of refutability or falsification. This means that a scientific theory must make specific predictions about what happens under certain circumstances. Lederman et al (2014) also noted that scientific knowledge is never absolute or certain and may be subjective or theory-laden. These authors' view shows that science and IK may share properties and thus should not be regarded as opposites.

According to Mortimer and Scott (2003), school science has its own history of development and is subject to social and political pressures different from those of science. For this reason, my study focused on school science, in particular, teaching. Mortimer and Scott (2003) further advise that school science or science taught in schools focuses on ideas and ways of thinking as defined by a national curriculum. It is through such curriculum, Hassard and Dias (2009) argue that school science provides concepts, skills, processes and abilities to work towards these goals. In this realm, school science teaching can also take into consideration learners' cultural perspectives.

In addition, Lederman (1999) believes that how teachers teach particular topics in schools is determined by their pedagogical content knowledge. This view directed me to enquire what teachers understand about learners and how they learn in a given context. This context-led approach in learning is similar to what Ladson-Billings (1995) refers to as culturally responsive teaching. In this type of teaching, learners who are academically successful demonstrate cultural competence and can both understand and be critical of socio-political issues. Similarly, Calabrase and Tan (2009) suggest that school science teaching should also attend to learners' identity development and cultivate a sense of ownership and agency

among them. In a related study, Moje, McIntosh, Ciechanowski, Kramer, Ellis, Corrillo and Collazo (2004) explain the importance of teaching using culture on identity development among indigenous learners. These authors posit that culturally related teaching serves as a connection between what learners do at home and school culture. In the context of my study, science curriculum should aim at generating content which identifies with the learners' cultural ways of life. A case in point is the use of IK of food preservation for school science teaching.

With regards to the purpose of science, Parawira (2016) proposes that an education system should aim at how knowledge, skills and beliefs are collaboratively constructed in school subjects. Parawira (2016) further posits that the education system in Zimbabwe is guided by the curriculum integration philosophy which requires learners to excel in utilising natural and active exchanges of knowledge, skills and beliefs in school subjects.

## 3.5 CULTURE IN SCIENCE EDUCATION

### 3.5.1 Definition of culture for this study

The term culture carries different meanings in various disciplines. Aikenhead (2006) claims that culture is a broad concept and has various meanings therefore there is need to unpack this concept as used in this study. Carlone, Johnson and Eisenhart (2014, p. 652) propose that 'without clarity of what is meant by culture, theories and reforms based on it are difficult to use, apply, or evaluate'. In light of this, I shall first interrogate this concept in the context of science education and then discuss issues related to science as a cultural enterprise.

The culture policy of Zimbabwe (MOESAC, 2007, p. 6) defines culture as:

> 'a sum total of a way of life a society can offer in terms of material implements and possession; in terms of intellectual and educational level of development; in terms of

> standards of living and ways of life; in terms of values and value systems and in terms of social relations between members of the society, in terms of arts and crafts and in terms of religion'.

The above definition is broad since culture can manifest itself in both visible (tangible) and invisible (intangible) ways therefore Mawere (2014) argues that the concept of culture is elusive. However, for this study, the concept of culture refers to ways of life which are determined by a group's response to a particular environment. For example, school science as a cultural way of knowing.

### 3.5.2 School science knowledge as a cultural way of knowing

The issue of regarding science as a cultural enterprise has received mixed reactions. For example, McKinley and Gan (2014, p. 287) believe that what science entails 'revolves around philosophical positions on the nature of knowledge: universal and multiculturalism'. In terms of universalism, McKinley and Stewart (2009) believe that science is governed by a set of rules that are culture-free and deny difference. Chiromo (2014) proposes that the philosophy underlying universality of science is based on equality and not equity. Chiromo (2014) argues that equality entails providing all learners with the same curriculum, while equity implies providing equal opportunities depending on the cultural needs of the learners. This philosophical position implies that, by ignoring indigenous cultures, western science presents challenges to learners who are coming from indigenous communities. Aikenhead and Elliot (2010) explain that the reluctance to include other cultures contrasts a multicultural epistemology position that recognises science as socially and culturally constructed and, as such, recognises differences. This means that there are multiple ways of understanding the natural world which may be compatible or incompatible with the scientific worldview.

Debates in relation to the above philosophical position show that there are those who occupy

both ends of the continuum and others who have a mid-way position. First, on one side of the controversy, science is seen as a cultural way of knowing. For example, Odora-Hoppers (2002) depicts science as a product of culture. She describes science as a shared asset that should have a responsive and inclusive approach that appreciates interconnectedness and interdependence of knowledges. She believes that science should be regarded as a universal cultural heritage and resource that originates from different cultures, a perspective also held by Lawton (1978) who places science within a framework of all cultures in the world including IK. Lawton's view is consistent with Ogawa's (1995) definition of science as a rational perception of reality. This shows that science is contingent on how a culture perceives reality making it culture dependent. This definition accommodates both IK and western science perspectives.

Second, there are those with a mid-way approach. For example, Van Eijick and Roth (2007) argue that frameworks are incompatible with each other and can only be understood as one-sided expressions of the diversity of human understanding. Carter (2004) describes science as a cultural way of knowing which helps colonised people to fight for their rights. In the context of my study, although science is different from IK, it should be framed within a particular culture for it to be meaningful to indigenous people.

Third, some authors regard science as having no culture. For example, Krugly-Smolska (1995) argues that science is presented acculturally and as absolute truth. However, Aikenhead (1996, p. 10) views science as being without culture which is derived from the way it is presented in schools, that is, as 'socially sterile, authoritarian, non-probabilistic, positivistic and absolute truth'. Krugly-Smolska (1995) explains that school science that is regarded as no culture is presented outside indigenous learners' social lives. Tobin (2006) asserts that social life occurs in multiple fields that may be nested, partially overlap, or be

independent of each other. In this view, classroom has a complex culture and thus school science should embrace culture. Odora-Hoppers (2005) believes that the academic needs of indigenous learners are influenced by their IK therefore IK should be integrated with school science teaching.

## 3.6 VIEWS ON INTEGRATING IK WITH SCHOOL SCIENCE TEACHING

Schools play a particularly important role in transmitting culture. Shizha (2013) argues that schools emphasise western culture because the reality of schooling is constructed in terms of objectivity and empirical validation. However, Mawere (2014) explains that this objective-bias of school science contrasts the IK's pragmatic epistemology as well as practical metaphysics. In this pragmatic perspective, knowledge is judged by the worthiness of an idea and its use in life.

For this study, I drew my inspiration of knowledge system integration from, first, an international project by De Beer and Whitlock (2009) who report that the Relevance of Science Education (ROSE) suggests that the incorporation of IK makes the science curriculum more relevant to learners. Second, in South Africa, DOE (2011) outlines the provisions in the curriculum policies. Such arrangements include C2005, National Curriculum Statements (NCS) and the Curriculum Assessment Policy Statements (CAPS) deriving from the Outcomes-Based Education (OBE) philosophy which embraces the principle of inclusivity. This principle dictates that all learners should be involved in science that embraces their diversity and cultural backgrounds, including their IK. Third, for indigenous communities, Shizha (2013) believes that pedagogy should be approached from diverse perspectives that allow the pedagogical process to be culturally sensitive accepting cultural variations that may exist within the classroom. Fourth, from the observation by Ogunniyi (2007a; 2007b) and Emeagwali (2003) that there is an intersection between IKS

and school science. Lastly, from the belief that IK can improve understanding of local conditions and provide a productive context for activities designed to help indigenous communities. For example, the World Bank (1998) suggests that schools in indigenous communities could benefit from IK. Therefore, I believe that the reluctance to integrate IK into school science teaching is completely unjustified. Essentially, similar to Keane (2008a), I argue, not that science curricula should integrate everything within IK, but should incorporate relevant IK into school science teaching and learning of science. By extension, this includes integrating IK of food preservation into school science teaching.

In my analysis, I found guidance from literature on the rationale of science education. Shizha (2013) proposes that to indigenise school teaching and learning, pedagogy should be approached from diverse perspectives that allow pedagogical process to be culturally sensitive. This view is supported by Goduka (2013, p. 81) who believes that 'from an indigenous perspective, pedagogies are not created in a vacuum; they are created in a cultural, spiritual, historical context'. In this respect, both Shizha and Goduka imply that the content of teaching in indigenous communities should be selected from culture. Wane (2014) uses the notion of epistemological equity to describe what such a culturally sensitive curriculum consists of. For Wane (2014), such equity recognises the multiple ways of knowing, including that of IK. For this reason, many authorities, including Hewson (2012) and Aikenhead and Ogawa (2007), believe that school curricula in indigenous communities should be ecologically suited to the learners' culture so as not to marginalise them on the basis of their cultural self-identities.

Interest in cultural identity construction as a way of influencing students' construction of scientific knowledge has been looked at by many authors (for example, Cupane, 2013; Aikenhead, 2006; Odora-Hoppers, 2005). In the context of teaching indigenous classes, the

cultural identity approach is what Cupane (2013) believes constitutes relevant science education. Similarly, Aikenhead (2006) holds the view that learning science meaningfully for indigenous students is identity work. Odora-Hoppers (2005) underscores the importance of cultural identity which IK bestows on particular groups of people. In this study, I regard relevant science teaching as one that identifies with students' culture, including their IK practices. Ogunniyi (2013, p. 15) contends that 'language especially indigenous languages promote cultural identity'.

To understand this integration of knowledge systems, I need to unpack what food preservation means in the context of my study.

## 3.7 THE CONCEPT FOOD PRESERVATION

Two main perspectives emerge from the plethora of definitions of the concept of food preservation. First, definitions proposed by Tull (2009) and Byrd-Bredbenner, Beshgetoor, Moe and Berning (2009) emphasise the purpose of the process of preservation. Tull (2009, p. 200) defines food preservation as 'the treatment of food to prevent or slow down spoilage by natural decay and contamination by microorganisms'. Olunike (2014) explains that spoilage refers to the process of food becoming damaged. Madigan, Martinko, Dunlap and Clark (2009) explain that this damage is observed as change in the appearance, smell or taste of food that makes it unacceptable to the consumer. For Byrd-Bredbenner et al (2009), food preservation refers to the extension of the shelf-life (time for which food is kept fresh) facilitated by killing or retarding microbial growth which involves avoiding food from being contaminated with micro-organisms which cause food decay.

Second, regarding the concept food preservation, there is the storage of food. For example, Olunike (2014) defines food preservation as the process of treating and handling food to stop or greatly slow down spoilage. Olunike's (2014) definition adds another dimension, that is,

storage, to the concept of food preservation. Kuijt (2015, p. 322) affirms that:

> 'Storage is an inventive example of how humans attempt to extend the shelf life of fresh foods – to overcome shortages of fresh food, seasonal shortages of plants and animals and periods of scarcity'.

The distinction between food preservation and storage is blurred therefore, in this study, I do not draw a distinction between the two concepts. I agree with Singh (2010) that storage implies preservation. This means that the study looked at how indigenous people store their foods at their homes to slow down loss of quality, edibility or nutritive value caused by microbes.

A brief history of the development of food preservation is provided in the following section.

### 3.7.1 A brief historical development of food preservation

Research indicates that the art of food preservation, particularly indigenous methods, has been known since ancient times. Chelule, Mokgatle, Zungu and Chaponda (2014) note that the consumption of indigenous fermented foods dates back to pre-historic times. Pamplona-Roger (2011) shows that Middle Eastern and Oriental cultures dried their foods, inclusive of meat, vegetables and fruits, as early as 12,000 BC in hot sun, fire and wind. Considine and Considine's (1982) study reports that the earliest recorded instances of food preservation date back to ancient Egypt, when grains were dried and stored in sealed silos. Considine and Considine's study shows that drying, salting, sugaring, smoking and fermentation were the oldest food preservation methods. The study proposes that the institution of such methods was in response to the food spoilage since ancient times. Ashraf (2008, p. 7) asserts that 'in modern times, food preservation has become more of a science, based on the latest developments in science and technology'.

Ashraf (2008) describes some significant attempts to explain the causes of food spoilage. First, in 1749, Needham observed that boiled mutton gravy, even if kept in a tightly corked bottle, become spoiled after some time, which he attributed to the spontaneous generation of microorganisms in the gravy. Secondly, in 1765, Spallanzini disputed this theory and said that organisms in the untreated air inside the vessel were responsible for spoilage. For Spallanzini, food spoilage could be prevented by heating the food kept in an air tight container. Such ideas constitute the basic principle of canning. Third, Spallanzini's theory was confirmed by Pasteur in 1864, using pasteurisation method (see below).

Notably, Brown (2008) describes developments related to war which had a bearing on food preservation techniques. First, during the Napoleonic war, the French government was faced with the difficulty of supplying food to its fighting forces at the front, since food deteriorated during transportation over long distances. In the 1790s, a French confectioner, Nicolas Appert, discovered that the application of heat to food in sealed glass bottles preserved the food (sweets) from going bad. In 1804, Nicholas Appert won a prize for being the first to report the successful preservation of food in glass containers using boiling water. This development led to the discovery of canning of food. Second, World War II led to the development of dehydrated foods such as instant potatoes and eggs. Third, the American Red Cross provided irradiated milk in the food packages given to prisoners of war. Lastly, the Vietnam War ushered in the refinement of the freezing method, which allowed the development of lightweight foods that could be carried to the field. These developments were also confirmed by Ashraf (2008) who argues that other scholars modified Appert's method by adding common salt to reduce the time required for sterilisation.

In the 1800s, mechanical refrigeration was invented in America to preserve food. Byrd-Bredbenner et al (2009) report that, in the sixteenth century, beers and wines were

transformed into vinegars in a process called pickling. This method is still applicable as vinegar is sprinkled onto fresh food before it is dried.

Brown (2008) noted that, in 1864, Louis Pasteur (1822-1895) discovered the relationship between micro-organisms and food spoilage. Ashraf (2008) reports that Pasteur managed to demonstrate conclusively the role of microorganisms in food spoilage. Pasteur recommended the heat treatment of food at sufficiently high temperatures to kill the majority, though not all, of the microorganisms in food and to prevent their access to the food inside the container by sealing it hermetically. This led to the birth of food pasteurisation, a sterilisation process that involves heating foods to high temperatures, for example, as in fermentation. For Parihar and Parihar (2007), fermentation in the modern age of microbiology owes its origins to the work done by Pasteur, the founder of microbiology. They report two important milestones in this regard. First, in 1857, Pasteur demonstrated that the souring of milk is due to the action of microorganisms and, second, in 1860, he demonstrated that heating can kill microorganisms in wine and beer. As a result, the process of pasteurisation was named after him. Parihar and Parihar (2007) also noted that, in 1861, Pasteur examined the doctrine of spontaneous generation and concluded that bacteria are responsible for the chemical changes that occur during fermentation.

Other food preservation techniques are constantly being developed and used, for example, chemical preservatives including acids and antibiotics. Tiwari, Valdramidis, Donnell, Muthukumarappan, Bourke and Cullen (2009), and Matasyoh, Kiplimo, Karubiu and Hailstorks (2007) suggested use of natural preservatives in response to the demand for natural foods by consumers worldwide. Besides these developments, there are other techniques and advances in refrigeration and transportation. For example, Tull (2009) posits that people are now able to eat a variety of foods including out- of-season and exotic foods from all over the

world. This is possible because the action of micro-organisms on food is inhibited.

Although bacteria are mostly the cause of food going bad and creating poisons, fungi can also be a menace in destroying food in storage and producing toxins that affect those who accidentally consume them. Adejumo and Adejoro (2014) posit that fungi are major spoilage of foods and feedstuffs producing secondary metabolites which are referred to as mycotoxins. Adejumo and Adejoro (2014) contend that major examples of mycotoxigenic fungi include various species of *Aspergillus, Penicillium and Fusarium*. In the same vein, Richard (2007) also argues that the genus *Aspergillus niger* is a large proportion of all the moulds found in industrial food. It is this genus micro-organism that Ashiq (2015) reports that it is responsible for post-harvest food decay.

### 3.7.2 Action of micro-organisms on food

According to Talaro and Chess (2012), micro-organisms are responsible for food spoilage and reduce food quality and availability. Madigan et al (2009) posit that these microbes include bacteria, fungi, protozoa, algae, viruses and parasitic worms. Brown (2008) suggests that the availability of water for use in the metabolic processes is essential for microbial growth. Some authors believe that both temperature and moisture are important variables determining extent of the action of microorganisms on food. For example, Jayas and Cenkowski (2006) argue that grain stored at high moisture and high temperature spoils. Singaravelavan (2014) adds two important factors necessary for microbial action on food: time for action and the right type of food that should be available for organisms. He noted that foods with high concentrations of sugar, vinegar, oil and salt are not good for bacteria and asserts that food spoilage bacteria live and multiply in foods that are high in protein and moisture and that these organisms are affected by oxygen or air.

In some cases, food spoilage bacteria excrete enzymes which spread over food causing it to

rot. For example, Barker, Kimmings and Phillips (1999) note that an enzyme polyphenol oxidase causes peeled apples and potatoes to brown. In short, micro-organisms are involved in food decay when suitable conditions are available to facilitate metabolic reactions in food particles.

Some authors explain the action of microbes with respect to types of foods with different water contents. For example, Lean (2006) identifies three types of foods, namely, perishable (for example, meats, milk and vegetables) and semi-perishable (for example, potatoes and nuts) that have higher water activities than non-perishable (stable) foods (for example, dry grains). Lean (2006) further noted that foods with high water content are a good medium for microbial action. So, my study will explore how each of these three categories is preserved by indigenous people in rural communities.

### 3.7.3 Examples of good medium for microbial action

In this section, I present different types of foods needed by micro-organisms for growth. I do not suggest that there are some foods that are not vulnerable to microbial attack. Rather, as noted by Krushna, Kowsalya, Rodha and Naraianan (2007), I argue that some foods rich in proteins and vitamins are very good growth media for many pathogenic organisms. Lean (2006) explains that carbohydrates are a favourite microbe food.

Based on availability on my initial survey and literature, I have isolated five types of foods, milk, meat, grain crops, sweet potatoes and vegetables that contain high protein and vitamin content and discuss their ways of preservation as suggested by the participants in my study.

#### *3.7.3.1 Preservation of milk*

Milk is one such food which is good for bacterial growth. A number of strategies are available for controlling bacterial growth on milk. Krushna et al (2007) identifies commercial

methods including pasteurization (heating food to specific temperature for a pre-determined length of time and then immediately cooling it), dehydrating (drying), freezing (use of low temperatures), canning (use of high temperatures), and condensing (removing water). Tasci (2011) adds two more methods: sterilization (any process that eliminates or kills all forms of microbial life through heat, chemicals, irradiation, high pressure, and filtration or a combination thereof), and fermentation (break down of carbohydrate to form alcohol). For example, Dzomba, Ngoroyemoto and Musarurwa (2013) identify the use of heating and sealing, hydrogen peroxide and lactoperoxidase systems, but these have received low acceptance by the public. Krushna et al (2007) report the use of a mellifera honey, which has also been tried as a natural preservative of raw milk. Krushna et al (2007) explain that the antibacterial activity of honey is attributed to peroxide and non-peroxide components, which are sugars. They further note that peroxide is produced during the oxidation of glucose and other monosaccharides by glucose oxidase and that non-peroxide component include phenolic acids and flavonoids. In conclusion, they observe that the lactoperoxidase has been shown to be an effective natural bacteriostatic against milk-borne pathogens, for example, Escherichia Coli and Salmonella spp, staphylococci and Listeria spp. Dzomba et al (2013) acknowledge the natural antibacterial system in milk and human saliva arguing that hydrogen peroxides activate lactoperoxidase in milk thereby inhibiting bacterial growth.

A study by Chimuti, Midzi, Njage and Mugadza (2016) found that, traditionally, Zimbabweans keep fresh milk and '*hodzeko*' (thick milk). The latter is used in my study area by participants as a relish which provides them with proteins at a low cost while, at the same time, it is a delicacy for the affluent who consume it as part of their main meal or dessert. The process of preserving milk to make thick sour milk is facilitated through fermentation. While some people may not regard souring of milk as a form of preservation taking it as a way of processing food, there are scientific reasons to support to position that it is indeed a

preservation method. These reasons are provided as follows but first properties of milk shall be presented.

Winton and Winton (2014) assert that fresh milk is slightly alkaline. Tasci (2011) explains that normally milk contains some lactic acid-producing bacteria (LAB), which are capable of converting lactose to lactic acid, resulting in physico-chemical changes of milk (fermentation). Gadaga, Mutukumira, Narvhus and Feresu (1999) describe this process of milk fermentation as a cheap, traditional way of improving nutritional properties as well as sensory properties. These authors identify taste, colour and smell as sensory aspects that can reflect the nature of traditionally preserved milk. Chimuti et al (2016) also state that the fermentation process is microbiologically safe. However, Parihar and Parihar (2007) caution that bacterial growth on milk is inevitable. They argue that such growth is usually accompanied by milk souring where casein (milk protein) precipitates and thickens the product and this is followed by colour changes. In conclusion, they argue that milk souring is lactic acid fermentation, where a carbohydrate is converted to lactic acid, which happens in muscle cells during exercise. This contrasts alcoholic fermentation, also referred to as alcoholic fermentation by Alexander and Jeffries (1990), who posit that alcoholic is a biological process which is used in yeast cells (for example, Saccharomyces cerevisiae) to convert sugars into cellular energy, producing ethyl ethanol and carbon dioxide as by-products. In simple terms, changes in milk due to lactic acid fermentation suggest that bacteria are responsible for the spoilage of milk food. This means that there is need to control bacterial growth on milk to prevent decay.

Studies show that there are two main reasons why fermentation is generally considered a preservation technology of food. First, Sharma et al (2012) contend that the most well known characteristics of LAB related to preservative property is their ability to produce acid, which

in turn exhibit antimicrobial activity. Sharma et al (2012) further argue that acidification of the milk protects the milk against spoilage microorganisms and proliferation of pathogens. Secondly, Panesar (2011) posits that LAB also releases antimicrobial metabolites so called bacteriocins which together with acids are great potential to be used in food preservation, which are considered as safe natural preservatives.

#### *3.7.3.2 Preservation of meat*

Meat is another food preferred by micro-organisms. Studies show that meat, especially beef, can be preserved in many ways. For example, Lean (2006) identified seven common methods as: drying, chemical means, curing and smoking, cold storage and chilling, and freezing. Just like beef, micro-organisms also affect fish, which was a substitute for beef in the communities under study. Lean (2006) argues that the flesh of fish has no connective tissue making its muscle protein more vulnerable to spoilage than meat. This implies that fish deteriorate more rapidly after death than meat.

The type of meat is an important factor that determines how it is preserved. According to Prasad (2011) mutton can be marinated by soaking it in a mixture of spices and vinegar, wine or lemon juice. Christensen (2006) suggests that mutton can also be air cured and fermented for several months producing a distinct strongly flavoured and scented product. As a comparison, Lean (2006) explains that the preservation of mutton is different from that of goat meat which is usually roasted over embers or charcoal until tender. The farmers in my study area kept pigs which supply them with pork they dry in direct sunlight. However, Diehl (2002) warns that pork meat is often hazardous due to parasite Trichenella spiralis (Trichinea) therefore irradiation (treated with ionising radiation) was applied to control the parasites in pork.

Poultry was another source of meat for the villagers in my study area. Seetaramaiah, Smith,

Murali and Manavalan (2011) posit that the most common method to preserve chicken meat is drying. These authors explain that the most common drying methods of poultry meat include sun drying, mechanical drying, freeze drying, smoking and then drying, curing and electronic drying. These preservation methods are also used in preserving meat from bush animals by community members in the study. It could help to combine these methods with salting since salt is commonly found by these community members at household levels.

Bush meat from wild animals including baboon, mouse and hare meat were part of the diet of community members selected for the study. Nyota and Mapara (2008) explain that large quantities of meat found in a rural community are mostly sun-dried or hung in air to dry as '*nyama yakaomeswa*' or '*chimukuyu*' (biltong). In urban contexts, preservation of meat may be different from a rural area. For example, Prasad (2011) reports that, in the USA, meat animals are usually transported live, slaughtered at a major distribution point, hung and transported for two days to a week in rail cars with refrigerators. In sum, meat is mostly preserved traditionally through drying, although boiling and salting are techniques that are additional to this strategy.

#### *3.7.3.3 Preservation of grains*

In my study area, both small and large grains were grown and preserved. These grains included sorghum, rapoko, millet, maize (corn), rice and beans. Sonowola and Ashaye (2001) explain that *'chibage'* (maize) is susceptible to diseases and pest attacks from planting stage to storage. The IRRI (2008, 2006) research studies attribute this effect to the hygroscopic and moisture content of maize grain which promotes rapid infestation and multiplication of insects, moulds, rodents and birds in open-air storage.

Research shows that stored maize grain could be spoiled by a number of things. For example, Yakubu (2009) describes the effects of wet conditions inside storage facilities as a cause of

food damage. Similarly, Mulungu, Lupenza, Reuben and Misangu (2007) explain that such wet grain conditions facilitate weevil attacks while Jacobs and Calvin (2001) explain that the maize (Sitophilus zeamais) weevils, which are believed to be among the most destructive pests of stored grain products, require moist, damp conditions on grain seeds for their growth and development. Umaine (2007) extended the argument noting that maize is also affected by rodents and bad weather conditions which cause it to decay. Bern, Hurburgh and Brumm (2008) cited three ways used to control maize decay including drying to safe moisture level, exposing it to oxygen-deficient or refrigerated conditions and treating it with mould-inhibiting chemicals. These authors' views concur with those found in a study by Sarpong (2013) in Ghana which shows that shelled maize is mostly preserved using chemicals. However, Yakubu (2009) posits that the use of insecticides and fumigants has not been accepted by consumers worldwide. Traditional methods also were used to preserve grains in Ghana, for example, Belmain and Stevenson's (2001) study describes how Ghanaian farmers' IK has improved grain storage through use of botanical pesticides mixed with stored food.

Umaine's (2007) study reports that maize preservation could be achieved with hermetic storage techniques. In this method, small amounts of grains are stored in bags or sacks which provide airtight conditions while, for large amounts, silos or granaries are used. IRRI (2006) study reports that under airtight conditions, maize weevil metabolism and reproduction cease, especially at low temperatures. Some researchers investigated preservation of grains by carrying out laboratory experiments. For example, Hashem, Ahmed, El-Mohandes and Gharib (2012) exposed maize grains to different levels of carbon dioxide. They found that carbon dioxide levels are critical for the preservation of grains. Martinek (1998) also observed an advantage of a sealed grain pit. In pits, mould growth reduced germination potential and, at the same time, reduced spoilage rates because carbon dioxide and oxygen levels are low and high respectively.

In Zimbabwe, the maize reliance strategy has become risky and a local production of small grains is now preferable. Nsingo (2015) explains that grains including '*mapfunde*' (sorghum), '*rapoko/zviyo*' (finger millet) and '*mhunga*' (pearl millet) are the main substitutes for maize. Franscisco (2015) proposes two reasons for this; firstly, small grains adapt well to semi-arid, subtropical agronomic and other harsh climatic conditions and disease infestation and are easier to grow in comparison to their exotic counterparts. Clay (2004) explains that small grains may be stored for a long time in a granary using local cost free storage technologies, whereas maize needs poisonous organophosphate protectants, often unaffordable by farmers. For these reasons, small grains are widely grown in dry areas of Chivi. In spite of these advantages, all grains decay, hence, need to be preserved.

Some researchers suggest the use of manure and wood ash as possible strategies used to preserve small grains. For example, Winniefridah and Manuku (2013) found the Shona people in Zimbabwe using these materials to preserve their sorghum, millet, maize and rapoko. A study by Pedzisai (2013) reports that some Zimbabwean rural farmers use several local strategies to protect their grains against maize stalk-borers and weevils. These include: tobacco snuff, gum tree leaves, millet chaff and wood ash of the *Mutsviri* tree (combretum imberbe), *zumbani* (Lippia javanica), bitter apple (solanum incanum) and shallots to repel grain pests. Similarly, in South Africa, Xaba (1998) observes how the Nguni people of Southern Africa preserved their maize using pits by burning leaves of dried maize to release smoke as a preservative agent and an insect repellent. Related findings were also found in Nigeria by WED (2013) who reports that cassava tubes are sieved and roasted to produce a foodstuff called '*garri*', which can be stored for long periods.

Use of granaries is another strategy to preserve grains as reported in separate but related studies. Gudhlanga and Makaudze (2012) explain that traditionally constructed granaries are

cleaned and smeared with cow-dung before being filled with grain and then completely sealed. Similar practices were also found among the Ndebele communities in Zimbabwe by Chirimuuta and Mapolisa (2011) who found that melons could be dried to produce what they call '*unkankalu*' or may be preserved in the Shona society using cold room technology provided by the bottom of the granary.

#### *3.7.3.4 Preservation of vegetables*

Vegetables were some of the perishable foods constituting human diet for my participants in the study. Research studies by Jana (2009), and Ndoro, Madakadze, Kageler and Mashingaidze (2007) show that traditional vegetables provide ecological and agronomic advantages. Gudhlanga and Makaudze (2012) also add that vegetables have cultural relevance in that they are identified with a specific locality and appear in particular seasons of the year. This seasonal availability, as well as the perishable nature of vegetables means that vegetables need to be preserved. In my study, not all vegetables were common in both communities. For this reason, I agree with Gudhlanga and Makaudze (2012) that vegetables have cultural relevance.

A number of vegetable preservation methods have been suggested. For example, Fellows (2009) identifies nine such methods which are: sun drying, solar drying, canning, vacuum packing, minimal processing, refrigeration, freezing and irradiation and dehydrofreezing. Vaclavik and Christian (2008) suggest ohmic heat processing of food as a preservation method. Lean (2006) contends that the most common method for vegetable preservation is drying. This view is consistent with that of Masarirambi, Mavuso, Songwe, Nkambula and Mhazo (2010). They explain that drying offers microbiological and physiochemical stability with a reduction in weight and transport costs and has other advantages in handling and storage. Similar views were expressed by Fellows (2009) who argues that the practice of

drying discourages any microbial growth and achieves the longest shelf life possible. Drying is commonly practiced among community members in my study area.

Studies show that cooking is an important step that is done before the drying of vegetables. Masarirambi et al (2010) suggest that cooking is done to prepare '*mufushwa*' (sun-dried vegetables) or what is called '*umfuso*' in Swaziland. Glasson, Mhango, Phiri and Lenier (2010) suggest that, in order to cook these vegetables, fresh leaves and young shoots are used and salt, onions and spices are added. Kaya (2014) argues that the process mixes bitter vegetables with milder-tasting vegetables. Makobo, Shoko and Mtaita (2010) also agree with the benefits of cooking to preserve vegetables. These authors report the use of *'mova'* or Amaranth (*Amaranthus cruentus L.*) as an indigenous vegetable used in some Shona communities in Zimbabwe which are blanched or cooked with other vegetables before being sundried to give a good taste, smell and colour.

#### *3.7.3.5 Preservation of* '*mbambaira*' (*sweet potatoes)*

Sweet potatoes widely known as '*mbambaira*' or '*mabura*' among the Shona people in Zimbabwe and are extensively cultivated in Chivi. According to Karanja, Malinga, Ndungu, Gichangi, Leigut and Kamundia (2015), sweet potato, scientifically named '*Ipomoea batatas (L) Lam*', is a species of the family Convolvulaceae, which are tuberous root crops. There are many types of this crop but mainly the white- or yellow-fleshed varieties are used, including in the area of my study.

Stored sweet potatoes tubers are affected by both biotic and abiotic stresses. Clark, Holmes and Ferrin (2009) identify biotic factors affecting sweet potato to include bacterial, fungal, viral, nematodes and insects. McEwan et al (2015) explain that abiotic influences result from drought, heat, cold and salinity. In recent years, researchers in developing countries have shown that sweet potatoes are affected mostly by viral diseases. For example, Mwanga,

Odongo, p'Obwoya, Gibson, Smit and Carey (2001) report that sweet potato virus disease (SPVD) presents challenges related to sweet potato storage. Amoah, Teye, Abano and Tetteh (2011) believe that such storage problems result mainly from heavy weevil infestation, fungal decay and physiological breakdown under the tropical weather. Mutandwa and Gadzirayi (2007) explain that these effects on sweet potatoes are shown as physical lesions on the roots, dry and soft roots, weight loss and sprouting upon preservation.

A variety of sweet potatoe preservation methods are reported in literature. One method which is prevalent among the Shona people in Zimbabwe is the '*pfimbi*' or sweet potato pits. For Mawere (2014, p. 52), '*pfimbi*' are 'pits are dug to bury the sweet potatoes tubers and seal them up to six months, that is, up to the onset of the subsequent rain season after each harvest'. Amoah et al (2011) report that, in a '*pfimbi*' system, there are temperature and relative humidity management techniques that may be used to extend the shelf-life of potato tuber crops. Woolfe (1992) remarks that sweet potato roots can be stored up to a year when conditions are controlled but Verma and Verma (2006) suggest a period of up to six months under similar conditions. Chirimuuta and Mapolisa (2011) extend the argument suggesting that such long periods of storage are also possible when done in a pit or jute sack filled with ordinary smooth ash. This makes reference to the importance of pre-treating tubers with chemicals before storage.

Studies show that pre-storage treatments on sweet potato tuberous roots have been attempted by researchers with some success. For example, Amoah et al (2011) suggest dipping or sprinkling sweet potatoes with ash, brine or *lantana camara* extracts prior to storage. Brine possesses an alkaline property which kills microbes and insects thus preserving sweet potato roots from decay and weevil damage. Verma and Verma (2006) concur with this view and further explain that the *Lantana camara* leaf possesses both larvicidal and insecticidal

properties by releasing flavonoids which is an active antimicrobial ingredient. Amoah et al (2011) assert that ash has an alkaline property which is not favourable for the development of diseases, acts as moisture absorbent and has a repelling effect on pests. Mutandwa and Gadzirayi (2007) posit that wood ash is smeared onto the plant to absorb moisture and repel pests. Mutandwa and Gadzirayi (2007) further add soil and grass-based techniques they believe could be used to cover sweet potatoes and preserve them. This study will investigate sweet potatoe preservation methods specific to the Shona culture.

I now discuss principles involved in food preservation.

### 3.7.4 Principles of food preservation

Research studies by Talaro and Chess (2012), Madigan et al (2009), Inglis, Sunderland, Finch and Tooley (2007), and Barker et al (1999) show different methods used for food preservation. These researchers indicate that food preservation is based on the general principle of preventing or retarding the causes of spoilage. They suggest many strategies for food preservation. Among these are drying, the use of high or low temperatures, the use of chemicals and fermentation processes are the main principles in food preservation related to my study. Each of these methods is described below.

#### *3.7.4.1 Drying*

Some studies show that drying is the oldest food preservation method practiced. Roday (2014) and Prasad (2011) concur that drying remains the most commonly used method worldwide. These studies describe drying as involving moisture removal from food by application of heat under controlled conditions including temperature, humidity and airflow. The purpose of drying is to reduce the water content of the food to below a certain critical value which is dehydrating or desiccating food to prevent post-harvest losses. Roday (2014)

proposes that drying as a preservation method has several benefits which include the fact that dried foods require less storage space than foods preserved using other methods and that it is a comparatively simple process, requiring little outlay of equipment, time and money. However, drying is not without limitations. Prasad (2011) posits that drying does not kill microorganisms and it requires a lot of time, constant attention, skill and understanding of the techniques for drying foods.

Literature shows that a number of techniques can be used to dry food. First, Talaro and Chess (2009) describe drying food as involving osmotic processes. These authors suggest the use of salting (or curing) where water is drawn from food through a process of osmosis. Similarly, Madigan et al (2009) and Ashraf (2008) contend that sugars dissolved in water in food items result in less water available for the growth of micro-organisms. They further explain that a reduction in water activity in food will inhibit most bacterial growth, with the exception of Staphylococcus species that thrive in high concentrated of solutions. This use of salt or sugar in preserving is commonly practiced by many people worldwide and the indigenous people of Chivi are no exception.

Second, drying of food can be achieved using heat from the sun. According to Lean (2006), sun or solar-drying is the evaporation of water from products by sun or solar heat, assisted by the natural movement of the surrounding air. Similarly, Prasad (2011) argues that effective solar dehydration of foods requires high temperatures in the region of 95 degrees F. and very low humidity. Chivi is located in ecological region 4, characterised by high temperatures all year round.

The third drying strategy is by air or wind. Roday (2014) describes this strategy as involving the material being tied into bunches or strung on a string and suspended out of the sun until dry. This can be under a shed or in the corner of a kitchen and is commonly practiced by

traditional communities. The fourth technique is the use of dehydrators with thermostatic controlled heat and forced air circulations which are available from a number of commercial sources.

Fifth, drying involves the use of desiccators or oven-dryers in drying foods. Madigan et al (2009) explain that food is placed in an oven fitted with a small fan positioned to the side of the oven door blowing inward which removes moist air. However, this technique is used only on a small scale. Axtell (2008) observes that most traditional communities worldwide commonly practice this method since they have their own traditional forms of ovens that they use to preserve food.

The sixth drying technique is lyophilisation or freeze-drying. Ashraf (2008) defines freeze-drying as the process in which water is removed from a product after it is frozen and placed in a vacuum, allowing the ice to sublime. The three-step process begins with freezing. Next the food is placed in a vacuum chamber under low heat. The frozen water crystals evaporate directly from ice to water vapour in a process called sublimation. The food then undergoes 'secondary drying' or 'desorption' in which any remaining water molecules are removed under slightly higher temperatures. In the same way, Brennand (1994) asserts that freeze-drying removes all moisture and further argues that it tends to have less of an effect on a food's taste than normal dehydration does. The first five techniques are commonly practiced in the area of study, while freeze-drying is not available in the traditional communities due to the absence of modern facilities.

In drying of food, there are a number of pre-treatments on food before it is preserved. According to Lean (2006), these steps include blanching, sulphuring and the addition of ascorbic acid to food before drying. In blanching, fresh food is sufficiently heated by cooking to inactivate enzymes. This precooking treatment also reduces the number of spoilage

microorganisms on the product, preserves or sets the colour, checks ripening processes and coagulates some nutrients. Madigan et al (2009) argue that blanching can be done with steam, hot water (scalding) or in a microwave oven. Lean (2006) advises that steaming is preferable to scalding because some of the nutrients that are water-soluble can be lost in the blanching water. For sulphuring, Roday (2014) explains that browning of fruit can be effectively controlled by the addition of sulphur or sodium bisulphite to food before it is dried. Also Roday (2014) explains that pure crystalline ascorbic acid is a good anti-oxidant, so it is added to food before is dried. Gaur (2016) concurs that pre-treatments are important procedures when preserving food. Gaur (2016) explains that grain treatment, for example, parboiling, is an important variable in limiting food storage losses. On the other hand, Ashraf (2008) describes how some tr communities in Africa sprinkle a salt water solution or a mixture of sugar, boiling water and honey onto food when drying it.

#### *3.7.4.2 Use of high and low temperatures*

The other important method of preserving food related to my study is the use of high and low temperatures. Inglis et al (2007) identify the use of sterilisation, pasteurisation, ultra-heat treatment and canning as high temperature methods to preserve food. In sterilisation, all microorganisms are eliminated through extended boiling/heating to temperatures much higher than boiling point. Roday (2014) explains that canning involves sealing containers and heating them to specified temperatures and then cooling them. Winton and Winton (2014) suggest that the use of a technique known as pasteurisation does not kill all organisms. Brown (2008) agrees that pasteurisation is effective in preserving food but cautions that non-spore forming pathogenic microorganisms are not destroyed by the process.

Brown (2008) and Inglis et al's (2007) research studies report that a newer method in food industry is ultra-heat-temperature (UHT) technique. In this method, liquid is heated to a very

high temperature for short time but that bacterial spores can be heat resistant. Kondratowicz and Matusevicius (2002) explain that low temperatures can be achieved through chilling and freezing of food. However, Madigan et al (2009) argue that food preservation by use of low temperatures like refrigeration, which ordinarily slows microbial growth, is ineffective in limiting growth of psychrotolerant organisms, for example, pseudomonas.

It is however important to note that most of these temperature-based methods are not natural and are not readily available in indigenous communities. For this reason, this study will not include these since they are not relevant to my research questions which serve to provide scientific explanations related to community members' methods of food preservation. My study is interested more in indigenous ways of preserving food which may be important for school science teaching.

#### *3.7.4.3 Use of chemicals*

Use of chemicals is another essential method to preserve food. Sandler and Acton (2004) note that smoking, pickling, and additives have been used as chemical food preservatives. Brown (2008) explains that smoking is achieved when original smoke from an open fire is used where food (usually heavily salted) is hung above smouldering wood chips in smoke houses. Lean (2006) contends that such smoked foods have an outer layer consisting of condensed tars, phenols and aldehydes which have a powerful antimicrobial effect and characteristic taste. Brown (2008) further explains that smoked foods are also reported to contain polycyclic hydrocarbons which are known to be carcinogenic, for example, benzo (a) pyrene. However, Lean (2006) warns that the preservative effect of smoke is limited to the surface of the food, but spoilage of the interior is delayed because the outer layer acts as a bactericidal skin. This method is relevant to my research questions.

Pickling is another chemical method used to preserve food which is relevant to my study.

Ashraf (2008) explains that, in pickling, food is immersed in vinegar; the active ingredient is acetic acid, which has an antiseptic action. Brown (2008) asserts that pickling uses vinegar to preserve foods because the acidity of the vinegar keeps many microorganisms in check.

Brown's assertion is consistent with Tull's (2009) observation that indigenous communities have their own traditional chemicals they use to preserve food which they obtain specifically from plants.

#### *3.7.4.4 Fermentation*

The third method of food preservation relevant to my study is fermentation. Tull (2009) describes this strategy as involving the conversion of a carbohydrate to an acid which preserves food. Sandler and Acton (2004) explain that the fermentation promotes the growth of micro-organisms which produce alcohol a by-product of their life-sustaining activities. Madigan et al (2009) propose that these products include carbon dioxide, alcohol and lactic acid which inhibit microbial growth and give fermented foods their characteristic flavours. Brown (2008) explains that fermentation is a self-limiting process because it reduces the pH of the food mixture to acidic which kills bacteria that cause food decay. For example, in the acetic acid fermentation in vinegar manufacture, acetobacter ferments ethyl alcohol to form acetic acid which is antiseptic.

This method is relevant to my study especially in the way community members preserve their milk.

### 3.7.5 Limitations of food preservation methods

Food preservation methods are accompanied by a myriad of challenges. Pamplona-Roger (2011) describes the limitations of food preservation as involving loss of nutrients (for example, Maillard reaction resulting in vitamin and fat loss). He explains that, in Maillard

reaction, there is a reaction between an amino acid and a carbohydrate. He noted that, when meat is heated, proteins are lost due to Maillard reaction. Considine and Considine (1982) assert that the Maillard reaction results in the formation of an insoluble compound that a body cannot use resulting in a loss of nutrients.

Masarirambi et al (2010) identify toxin or carcinogenic formation and deterioration or contaminations with microbes as other challenges for food preservation. Brown (2008) explains that the formation of heterocyclic amines that are carcinogenic result from Maillard reactions. Gadzirayi, Mutandwa and Chikurise (2006) warn that indigenous methods work for a shorter time when compared to scientific ones but Olunike (2014) contends that indigenous methods are cheaper and more efficient than conventional ones.

Apart from the challenges noted above, it is important to note that there are those related to food poisoning. For example, Singaravelavan (2014) explains that some micro-organisms, or the toxins they produce, contaminate food causing food poisoning. Madigan et al (2009) noted that the contamination of meat with *Salmonella* which leads to food poisoning may remain viable for a period of six months or more in dried meat. Madigan et al (2009) suggest that food poisoning or food intoxication is caused by eating foods with preformed microbial toxins. This problem of contamination applies mostly to what Lean (2006) calls 'high-risk foods' which are likely to be infected by bacteria and should not be eaten without further cooking. Tull (2009) proposes that similar problems could be found in inadequate processed canned foods which results in Clostridium botulinum disease.

Some studies show that natural methods are mostly used as methods of food preservation. For example, Tiwari et al (2009) explain that the use of natural preservatives such as bio-preservatives can extend the shelf life of food and enhance the safety of food products. Jeeveratnam, Jamuna and Bawa (2005) concur with this view and specifically suggest the use

of lactic acid bacteria (LAB) which have produced different antimicrobials, including lactic acid, acetic acid, hydrogen peroxide, carbon dioxide and bacteriocins. This is consistent with Madigan et al (2009) who argue that LAB grows anaerobically and obtain energy only from metabolism of sugars. Sakala, Hayashidani, Kato, Kuneuchi and Ogawa (2002) identified five reasons why such natural preservatives are suitable antimicrobials. These include: their low toxicity, stability to processing and storage, efficacy at low concentrations, no deleterious effect on the food and economic viability. Jeeveratnam et al (2005), and Lado and Yousef (2002) also argue that natural preservatives are effective when used either alone or in combination with other non-thermal technologies. This combined approach is what Lean (2006) calls 'the hurdle effect' which is a process that occurs to counteract the potential adverse effects on food products and thus optimises microbial inactivation.

The hurdle effect has the potential to counter microbial adaptation to stress during food preservation. Quintavalla and Vicini (2002) explain that, in the pasteurisation of food, an Escheria coli (E. coli) bacterium that survives UV exposure is believed to have multiple stress resistance. Tull (2009) believes that such resistance could be due to the development of endospores by bacteria where normal heat treatments applied during food processing are insufficient for their complete destruction. By an endospore, I mean what Madigan et al (2009) describe as a highly heat-resistant, thick-walled, differentiated structure produced by certain bacteria that has various protective substances. In this way, bacteria are not destroyed and thus food safety is greatly compromised.

As alluded to in Chapter 2 of my thesis, the modern food industry evaluates food using hygienic practices including the Hazard Analysis and Critical Control Point (HACCP) System (see section 2.5). In spite of the availability of such systems, food safety has remained a challenge. Tasci (2011) questioned the toxicological aspects of high concentrations of

hydrogen peroxide in milk fermentation. This implies that there is likely to be a problem when preserving food in spite of the modern food evaluation techniques alluded to above. Also, Gran, Wetlesen, Mutukumira, Rukure and Narvhus (2003) suggest that fermentation results in a low pH which is effective in inhibiting the growth of many microbes, but some E. coli may remain at a low pH.

Essentially, what these studies imply is that safety concerns in the food industry require the use of natural methods of food preservation, which includes IK food practices. The modern systems of evaluating foods described above are not available in the communities under study which is interested in indigenous ways of preserving good quality foods.

## 3.8 SUMMARY OF THE CHAPTER

In this chapter, I have reviewed relevant literature for my study. In this literature search, there is acknowledgement of the importance of IK in science education by many researchers across the world. Several attempts have been made with regards to the integration of knowledge systems in school science in sub-Saharan Africa, Zimbabwe included. Researchers agree that pedagogy should integrate IK of the learners in school science lessons. In spite of academics and policy makers acknowledging the relevance of IK in school science, very little has been achieved in Zimbabwe with regards to its integration into schooling.

This chapter also considered different types of foods that were commonly found in the area of my study which are susceptible to microbial attack. These foods include milk, meat, grains, sweet potatoes and vegetables. Although they differ in terms of their epistemological underpinnings, both traditional and conventional methods could effectively preserve these foods. Commonly used strategies to preserve food include drying, use of high and low temperatures, use of chemicals and fermentation. However, the general picture at the moment is that the methods of food preservation explored indicate that there is a general shift to

accepting natural methods, including IK, because of their microbial safety and nutritional adequacy as well.

In the next chapter, I look at the theoretical framework guiding my study.

# CHAPTER 4: THEORETICAL FRAMEWORK GUIDING THE STUDY

## 4.1 INTRODUCTION

In Chapter 1, I outlined the purpose of my study which was to explore the integration of IK of food preservation with school science teaching in Zimbabwe. I described the research context in Chapter 2 and then reviewed literature in Chapter 3. In this chapter, I present the theoretical framework that guided my study.

Literature shows that a distinction between a conceptual framework and a theoretical framework is not clear in some cases. The problem is, to some extent, caused by authors who use these two terms interchangeably. In this study, the two terms are regarded as different and a theoretical framework is used instead of a conceptual framework. According to Nyamupangedengu (2015), a theoretical framework is a form of representation of phenomena to be studied. On the other hand, Miles and Huberman (1994, p. 22) explain that a theoretical framework can be used 'to see where the overlaps, contradictions, refinements, or qualifications are'. For my study, a theoretical framework shows relationships between and among concepts or ideas related to the teaching of IK of food preservation in school science. So, as noted by Mdluli, Matshidze, Netshandama, and Kugara, (2017), I use a theoretical framework to provide a grounding base, or anchor, for the literature review, and most importantly, the methods and analysis. In other words, I make theoretical distinctions and to organise ideas related to all aspects of my study.

My research problem was that teachers continue to neglect IK and teaching methodologies that include forms of IK in their classroom teachings. To explore this problem I developed

my conceptual framework guided by three research questions for my study: i) what elements of IK methods of food preservation do curriculum documents give to the teaching of science in schools in Zimbabwe?; ii) What elements of IK and methods of food preservation do the rural community members of Chivi District hold? and iii) How may culturally relevant teaching be drawn from the knowledge of the community members' indigenous methods of food preservation and the current practices of teachers and learners in Chivi district? These questions are culture-specific hence they require answers that can be understood through interpretation based on a particular cultural framework. In keeping with Guba and Lincoln's (2005) advice, I believed that the answers would depend on one's epistemological, ontological and axiological stances. This required me to develop a culture-specific theoretical framework to limit any possible contradictions or confusion that might arise from the findings. In order to present how this framework developed, I discuss this strategy under the following: issues around IK integration with school science, challenges of IK integration and some frameworks used by other researchers on IK integration with school science. Finally, I will discuss how I developed my framework.

## 4.2 ISSUES IN RELATION TO INTEGRATION OF IK WITH SCHOOL SCIENCE

### 4.2.1 Some tags used by scholars to describe integration of IK with school science

In science education, integration of IK with school science has been at the centre of academic debate worldwide for more than three decades. There has been an acknowledgement that the curriculum that is offered in schools does not include IK from the communities around the schools. Shizha (2013), Ogunniyi (2011) and Odora-Hoppers (2005) concur with this view especially in southern Africa where schooling is largely Eurocentric. There have been calls by these and other scholars to integrate IK with schooling to achieve relevant science education for indigenous learners in schools. Such scholars have used different terms in

attempts to integrate IK with school science education. Dei (2014), and Erduran and Msimanga (2014) call it 'indigenising the science curriculum'; Shizha (2006) refers to it as 'legitimising IK in science'; Muyambo and Maposa (2014) use terms linking culture and science; Martina, Nakata, Nakata and Day (2015), McKinley and Gan (2014), and Nakata (2007a) refer to it as 'interfacing' of school science with IK while Diwu and Ogunniyi (2012) suggest mediation between IK and school science. These tags represent spaces of possibilities as well as constraints, which can have negative or positive consequences.

### 4.2.2 Rationale for integrating IK with school science

A number of reasons have been forwarded by different authors regarding the rationale of integrating IK with school science. Battiste (2004) argues for inclusion of indigenous voices in the curricula; Odora-Hoppers (2002) proposes a curriculum that provides a redress, equity and acknowledgement of valuable resources; Malcolm (2002) and Vhurumuku and Mokeleche (2009) call for learner-centeredness or relevant curricula; Nakata (2002) proposes cultural perspective to science education; McKinley (2005) emphasises a curriculum that promotes visibility of IK and raises self-esteem and interest in schooling; Roth and Lee (2005) suggest learning facilitates development for participation in the community; Odora-Hoppers (2005) calls for education that cultivates cultural identity formation; and Manzini (2000) suggests a shift to the teaching of science toward the experiences, values and practices of African learners. Central to this debate are epistemological inconsistencies existing between knowledge systems, resulting in widening of the science-IK divide.

In spite of varied arguments on IK-science integration from literature, work from Ogunniyi (2007a; 2007b; 2011), Odora-Hoppers (2005) and Shizha (2013) was used most because it is relevant to my study. Odora-Hoppers (2005) grapples with the science-IK divide with

reference to colonialism. Her observations are as apt today as they were in 2005. She critiques the type of education offered to students in the southern African school curricula citing that it was culturally irrelevant to the learners. Odora-Hoppers' view invites us to evaluate the school curriculum in the interest of redressing educational inequalities as well as for cultural identity formation. Odora-Hoppers' (2005) view relates to the argument raised by Shizha (2013) that postcolonial education systems in sub-Saharan Africa should reclaim indigenous voices through curriculum reforms. For Shizha (2013, p. 7), 'schools should be cultural spaces and centres that provide strategies to reclaim African cultural identities to counteract threats of cultural identity loss'. Shizha (2013, p. 15) cautioned that 'although pedagogy should be culturally sensitive, it should not ignore aspects of Western knowledge constructs that have benefited African societies during the colonial period'. Hence, Shizha's study is important in that it emphasises integration of knowledge systems in schooling rather than seeing them as antithesis of each other.

### 4.2.3 Suggested pathways for integrating IK with school science

Scholars have suggested various pathways regarding inclusion of IK in the school science curriculum. Central to these pathways is the view that an understanding of epistemological differences between the knowledge systems will provide important markers for ways to proceed with integrating IK into a science curriculum. Naidoo and Vithal (2014) and Pedzisai (2013) identified three approaches that have been suggested by different authors for the inclusion of IK into the school curriculum. These are: the incorporationist approach which seeks how IK best fits into science syllabus; a separatist approach which puts IK side-by-side with scientific knowledge; and an integrationist approach that links and makes connections between IK and science. For instance, Msila (2009) suggests the inclusion of IK and western science through: i) IK as separate strand; ii) Placing transformative pedagogy in science

(harnessing the current education system with cultural contexts where the school is situated); and iii) Hybrid responses to science education systems' approaches, where ideas from the two knowledge systems are combined. The approaches by the teachers to bringing IK into their science curricula are reflected in the contrasting views on the relationship between IK and science as expressed by scholars in the literature. Cobern and Loving (2001), and Msila (2009) highlight the integrity and validity of IK as knowledge. They believe that the best way of acknowledging its value is by keeping IK separate from the Western scientific knowledge systems.

Other authors regard IK and science as different but equal systems that complement each other. Onwu and Mosimege (2004), and Diwu and Ogunniyi (2012) call this approach an 'integrationist position'. Diwu and Ogunnyi (2012, p. 334) note that 'there are points of intersection between the two thought systems'. These authors further add that knowledge systems should be incorporated for the enhancement and growth of scientific knowledge. They concluded that this should be done with the provision that what is taught at school is sensitive to the current multicultural classroom.

Some authors suggest how the integration of knowledge systems should be done. For example, Ogunniyi (2011) suggests that integration of knowledge systems range from total exclusion to inclusion through cautious and partial inclusion. Ogunniyi (2013) uses the term 'exclusion' to mean a way of knowing that takes one form of knowledge as inferior to the other, for example, regarding IK culture as inferior to western science culture. This view constitutes what Shizha (2013) calls 'a colonial mentality', where one knowledge system dominates the other. In contrast, by inclusivity, Ogunniyi (2013) means education that is liberating and empowering. This is in line with the emancipatory pedagogy of Freire (1970) where an individual learner is an active participant in negotiating learning while moving

mentally from one cognition to another. It also resembles Mpofu et al's (2013) proposal on pathways to integrate IK into classroom science, namely, parallel, divergent, convergent and substitutive. Parallel integration occurs when indigenous knowledge ideas and western science are both recognised as legitimate and allowed to coexist. Divergent integration maintains IK and western science in disparate positions until such time as IK is well developed. Convergent integration occurs when these two knowledge systems are synthesised into one comprehensive and holistic system. Substitutive integration is the displacement of one knowledge system by another that precipitates charges of epistemological and cultural imperialism.

### 4.2.4 The Relationship between IK and School Science in this study

My study adopts the integrationist stance based on the view that: i) both school science and IK have limitations. For example, Corsiglia and Snively (2001) argue that indigenous science offers knowledge that western modern science has not yet learned to produce and creates environmental crises which have led to scientists seeking solutions through IK; ii) Modern science, according to Ogunniyi (2013, p. 23), is 'a blend of scientific knowledge that evolved over the centuries among many cultures, for example, Chinese, Egyptian, African, Indian, Arabic cultures as well as several other indigenous cultures'. This view explains why Kyle (1999) believes that western science is itself an indigenous system rooted in western philosophies and culture; and iii) Ogawa (1995) contends that there is science in IK – a view with which Kibirige and Van Rooyen (2006) concur and Ogawa (1995) further argues that western science and IK are not always exclusive of each other but can enrich each other.

## 4.3 STUDIES THAT HAVE BEEN CARRIED OUT INVOLVING INTEGRATION OF IK WITH SCHOOL SCIENCE

### 4.3.1 Studies outside sub-Saharan Africa

A study by Kawagley, Norris-Tull and Norris-Tull (1998) explored the indigenous worldview of Yupiaq culture from Alaska on its relevance to the practice and teaching of science. The Yupiaq culture is interspersed with art, story-telling, hunting and craftsmanship. Kawagley et al (1998, p. 138) observed that, for Yupiaqs, 'scientific knowledge is not segregated from other aspects of daily life; and spiritual understanding is another way of obtaining knowledge'. The study found that there is a large body of science that exists in Yupiaq culture but it is a science that is disappearing as the language is disappearing. Many elders in the Yupiaq village want their children to understand both worldviews because they see both as crucial to the survival of their youth. Suggestions on designing materials and practices which acknowledge and respect Yupiaq society were given by the teachers. From this study, Kawagley et al (1998, p. 143) conclude that a:

> 'pedagogy that draws from indigenous knowledge, worldview and culture can provide students with not only a locally relevant science education, but also in many ways with the kind of learning environment and experiences recommended for students everywhere'.

This study had difficulties in how to incorporate elders into the life of schools and reflect the Yupiaq culture in the classroom. So, in the context of my study, findings could reflect what other indigenous cultures may add to the teaching of science in schools.

Aikenhead (1996) explained learning for indigenous learners in terms of cultural border crossings, where learners are likely to possess a knowledge system that is different from the

conventional science typically taught in schools. For this reason, Aikenhead (1996) believes that science learning requires negotiating cultural borders between the individual and the context of contemporary science in schools. Jegede (1995) proposed a collateral theory that describes a spectrum of cognitive experiences of students as they move from their homes to their school environments; a situation which Sutherland (2005) argues that it applies to concepts that are in conflict. These experiences include: with no interaction at all (parallel), interaction and conflict resolved in some way (secured), hold both schemas at the same level (simultaneous), interaction between conflicting schemata (dependent) collateral learning. In the classroom situation, teachers and learners may hold both traditional and scientific views in their explanations during instruction. Similarly, Sutherland (2005) explored resiliency and collateral learning in science with students of the Cree ancestry in Canada. As the First Nation, the Cree were subjected to the Eurocentric policies of the Canadian government, including education. Through the use of critical incidents, some Cree students held at least two sources of knowledge to explain some science concepts and therefore may have adopted a collateral learning strategy. The problem with the border crossing framework is the assumption that students like to cross borders.

Jegede and Aikenhead's (1999) issue of 'cultural brokers' in explaining collateral learning can be useful in IK of food preservation for school science since, in my study, western science and IK differ in the way in which knowledge is pursued. For Popper (1963), the pursuit of knowledge in the western view arises in the context of conjectures and refutations within scientific communities of practice. However, in the IK world, Matsika (2012) and Odora-Hoppers (2005) believe that, through cultural protocols, there is a demonstration of responsible ownership of that tacit knowledge. Consequently, the two processes are in conflict, as explained by Jegede's (1995) collateral theory. The teacher can help indigenous learners to deal with this conflict; however, the role of the teacher as 'cultural broker' is

complex. Aikenhead and Otsuji (2000) explain that most curriculum developers and teachers themselves embrace the dominant culture and have limited knowledge of IK and culturally appropriate pedagogies.

According to Sutherland (2005), border crossing framework may be limited in that it assumes that learners want to cross borders even though schools have some learners who resist science learning and thus are not catered for by the framework. For example, Phenlan, Davidson and Cao's (1991) study shows that, for non-western learners, transitions from home to school are often bumpy. The study examined pupils' negotiated space between home, school and their peers. Values and beliefs may be contrary (hazardous transitions) or concur (smooth transitions) to those found at school and their peer worlds. For this study, I believe what Aikenhead (2001) suggests that teachers can help learners to negotiate this different cultural construct by creating culturally relevant frameworks for students to make connections between school science and their culture. This connection is what Hatcher, Barlett, Marshall and Marshall (2009) regard as a 'cultural bridge' that offers a 'two-eyed seeing' in the classroom where the strengths of both indigenous and scientific knowledge systems are drawn to help guide human life. In other words, as mentioned earlier on in chapter 3 of this thesis, the two systems as both cultural artefacts have similarities. So, learners may hold different cultural experiences rather than crossing borders.

The issue of a 'cultural bridge' is similar to Riggs' (2003) place-based learning where there are connections between school and home, family, community and world. For Semken (2010), this type of education creates a sense of place which refers to a set of meanings and attachments to places that are held by individuals or by groups. Woodhouse and Knap (2000) isolated five distinctive characteristics of a place-based education. These are: (1) it emerges from the particular attributes of place; (2) it is inherently multidisciplinary; (3) it is inherently

experiential; (4) it is reflective of an educational philosophy that is broader than 'learning to earn'; and (5) it connects place with self and community. All these characteristics illuminate my research problem in that the emphasis on education is placed on its cultural contexts.

This means that place-based education has content and pedagogy that are sensitive to the cultural mores of the community which achieves learning in meaningful contexts focusing on underrepresented learners' knowledge and experiences. This is in line with what Hewson (2015) calls 'tailored teaching', which she argues gives priority to an appropriate learning climate, learner-centeredness, engagement facilitation and self-awareness. But, there are challenges related to integrating IK with school science.

### 4.3.2 Studies in sub-Saharan Africa

A number of studies have been done with regards to integrating IK with school science teaching. As mentioned before, Erduran and Msimanga (2014) propose argumentation teaching for South African school science; Jegede (1995) proposes collateral learning; Aikenhead (2001) suggests the idea of border crossings; and Riggs (2003) calls for place-based teaching. Erduran and Msimanga (2014) explored science curriculum reform in South Africa in light of argumentation teaching. They view argumentation teaching as an aspect of nature of science (NOS) and IK or IKS as relevant for teaching because of the tensions it presents for argumentation. According to Ogunniyi (1988), this argumentation has been an attempt to avoid committing a fallacy called scientism, where science is regarded as the only way for coping with life and non-scientific ways of viewing nature are regarded as primitive, irrational, retrogressive and irrelevant to modern life. The study found that tensions exist because the claims propagated through IK can be in direct opposition to the spirit of evidence-based approach captured in scientific argumentation.

In South Africa, Ogunniyi (2000) uses the idea of border crossing to explore South African

science teachers' and secondary school pupils' scientific and IK of natural phenomena. In exploring science as involving border crossing, both teachers and their pupils were found to hold, to some extent, both the mechanistic and anthropomorphic world views about nature but teachers showed more inclination toward the scientific world view than the IK perspective. In a related study, Ogunniyi (2007a; 2007b) used Practical Argumentation Course (PAC) to equip science teachers with knowledge and instructional skills needed to implement an integrated science-IKS curriculum in their classrooms. Ogunniyi (2007b, p. 1190) observes that PAC 'provided the much needed intellectual or dialogical space for the teachers to voice their views and concerns about the new curriculum without feeling a sense of intimidation'. The study analyses teachers' understanding of specific aspects of NOS and IKS in the context of a science-IKS curriculum. Findings show that teachers made noticeable perceptual shifts from construing science and IKS as polar opposites to considering the two knowledge systems as compatible and complementary. Teachers argued that the two are complementary as long as one knows in what context a given viewpoint is deemed appropriate. In some cases, the teachers see these world views as distinctly different and incompatible constructs. Some teachers argue that they need to study both western science and IK in order to reduce the dominant effect of the science world view on indigenous communities. However, this study had difficulties in separating religious or cultural life from science.

Another study by Dziva et al (2011) explored teachers' conceptions of IK in the science education curriculum in the context of Mberengwa District, Zimbabwe. In this study, teachers' documents, education policies and their classroom teaching approaches were analysed. Some teachers believed that IK is not international and is about African situations and experiences. The study grappled with what content of IK should be included in the classroom. Although not explicit, the study concluded that it is possible to select some

elements of IK to include into the curriculum. These suggestions might be useful in finding ways by which IK of food preservations could be integrated into school science teaching.

A study by Lilemba and Matemba (2014) investigated IK of Mafwe ethnic/cultural group in a post-colonial Namibian curriculum. The Mafwe are part of the black population of Namibia whose education was ignored by the colonial government but have a vibrant oral culture. The study demonstrated the viability, richness and importance of African IK in Namibia. Findings of the study suggest that the education system in Namibia disregards IK as there were no IK policies in place governing Namibian education system. Lilemba and Matemba (2014, p. 119) argue for 'the need for comprehensive theory regarding how indigenous knowledge can become the bedrock and not merely ancillary to modern education in Namibia'. The study recommends that schools, teachers and textbook writers should be encouraged to use traditional pedagogies and languages.

Another study by Hewson (2012) explored African traditional healers on their IK concerning natural science topics and science teaching in Lesotho and South Africa. Traditional healers suggested that African ways of teaching should be included in the school curriculum. Traditional healers offered a list of topics and exemplified indigenous ways of teaching the topics. Examples of such methods include: storytelling, games and field trips. How these topics would be transferred to actual teaching in modern classes was not clear.

### 4.3.3 Challenges of integrating IK with school science

#### 4.3.3.1 Philosophical differences

Many scholars acknowledge that integrating IK with school science remains a daunting task. According to Diwu and Ogunniyi (2012), problems related to integration have been linked to their incompatibility in terms of different epistemology (a view and justification for what is

knowledge), ontology (claims about the nature of social reality – what exists, what it looks like, what units make it up) and assumptions (background used for coming to conclusions or decisions). According to Wane (2014), such philosophical challenges could be minimised through epistemological equity (multiple ways of knowing the differences in personal and collective locations). More recently, Shumba (2017) contends that such challenges could be also be minimised through epistemological access (ability to understand and 'own' both the knowledge and the characteristic ways of knowing). For these authors quality education is inclusive of culture, local context and issues, and practices that have meaning in local societies. Hewson (2012) believes that understandings of philosophical differences will provide important markers for how to proceed with integrating IK into the school science curriculum.

#### 4.3.3.2 Different worldviews

Chiang and Lee (2015, p. 91) define a worldview as 'a culture's collection of thoughts, beliefs and values'. Goduka (2013), on the other hand, describes a worldview as a compass that guides people's everyday interactions in life and in the world. In the context of IK, Aikenhead (2006) contends that a worldview involves a holistic, communal knowledge, ancestral knowingness and wisdoms. So, for a cultural group, a worldview is a product of creative imagination, beliefs, experiences, and practices acquired over long period of time. Differences could also arise since science is embedded in a mechanistic and reductionist worldview while IK is located in an anthropomorphic, pluralist and holistic worldview. According to Fakudze (2017), the former is the dominant scientific worldview and the later is the dominant indigenous worldview. The implication for this is that for schooling, there are different worldviews that could play out among indigenous learners in a science classroom. However, it is possible for the learner to have equipollent worldview as noted by Ogunniyi

(2007a), a framework which he described as involving a person holding on to both indigenous and scientific worldview presumptions. This means that IK and western science have distinct elements, beliefs and cultural practices which might be similar. In other words, the science learner may express his/her views on a concept depending on the context of learning.

In spite of these worldview challenges, there is consensus among researchers worldwide that IK should be integrated with school science. For example, in South Africa, Naidoo (2010) observes that the debate has shifted from 'why' IK should be included in science to considerations of 'how' it could be integrated with school science. Similar views have been raised by other authors in many other Sub-Saharan countries (including Zimbabwe). Barnhardt (2008) and Wood and Lewthwaite (2008) report developments in New Zealand, Canada, the United States of America, Australia, the Middle East and the Far East, as well as Central and South American countries. Key to their observations is that there are possible areas of commonality between IK and school science worldviews with the possibility of each stimulating and supporting the other in the classroom contexts. It is this commonality in practice which my study is seeking to understand in light of other studies that have been done regarding the integration of IK with school science teaching.

## 4.4 THEORETICAL FRAMEWORKS RELATED TO INTEGRATION OF IK WITH SCHOOL SCIENCE

A number of theoretical frameworks for integrating IK with school science have been done by different researchers worldwide. I now describe these models.

### 4.4. 1 The Maori system of schooling

Smith (2000) explains that the Maori-medium schooling was part of a wider revitalisation of

an endangered indigenous language, culture and identity. For McKinley (1996), the curriculum development in the English-medium school framework in New Zealand, was fraught with discontent as people believed that it was grounded in the Maori epistemology. According to Wood and Lewthwaite (2008), the issues in Maori medium settings contrast with those in English medium settings. This means that the Maori medium educators are struggling to be accepted by the Ministry of Education for design and funding. According to McKinley and Stewart (2012), the use of Maori contexts made Maori students feel better about themselves by seeing Maori culture valued in classrooms. The programme, however, failed because it did not receive the support it deserves because it was not clear how to navigate the spaces between science and the Maori media.

### 4.4.2 Contiguity Argumentation Theory (CAT)

Another model is the CAT by Ogunniyi (2007a, b) which is a 'dialogical framework' to resolve conflicts arising from competing or contradictory ideas and thought systems in contexts where IKS and Western science need to coexist. The CAT framework was developed to capture learners' experiences outside school environments and bring them into classroom teaching. Ogunniyi (2015) contends that the CAT model also creates the intellectual space for dialogue where people are able to resolve their conflicts freely. Although my study involved some form of argumentation, it did not focus on the practical application of IK concepts in science teaching and also did not explore any cognitive perceptual shifts in IK integration with school science by participants, as CAT suggests. I did not find the CAT model appropriate for my study because it focuses on observing classroom practice during teaching and learning of science. It was, though, useful for the development of my framework by providing insights into how teachers might frame their arguments when bringing IK of food preservation into school science teaching.

### 4.4.3 The culturally aligning classroom science (CACS)

This research model was developed by Mpofu et al (2013) focusing on traditional plant healing within an African-Zimbabwean context. These authors explain that the CACS model contains five main inter-related features: domains of knowledge, plurality of knowledge, cultural border crossing, alternative pathways to integration and indigenised classroom science. The domains include knowledge as: held by a particular cultural group (enterprise); a way of knowing (paradigm); an inquiry (process); and an outcome (product). Knowledge exists in plurality as IK and modern classroom science where there are cultural border crossings. According to the CACS model, Mpofu et al (2013, p. 20) argue that 'border crossing anchors and precedes integration of IK and modern classroom science'. The CACS model is a multi-perspective framework of integration which takes parallel, convergent, divergent and substitutive forms. Since, according to Mpofu et al (2013, p. 6), the objective of the CACS is 'to explicate a multifocal approach to the integration of these two knowledge forms using the example of traditional plant healing (TPH) as a case in point', it is a research model. In my study, I use ideas from Mpofu et al's (2013) research model for my thesis. The CACS model shaped my research approach to explore how the IK of food preservation might be aligned with school science teaching.

### 4.4.4 Integrative Research Framework

Another model by Khupe (2014) used an integrative research framework to explore possibilities of integrating IK with school science in Mqatsheni, South Africa. Khupe's (2014) framework draws ideas from *ubuntu*, and the indigenous research paradigm. Khupe (2014, p. 82) explains that the resultant 'integrative research framework emphasises relationships as an important condition for research'. Khupe's (2014) model was useful in guiding how elements from culture could be integrated to generate important knowledge or

skills for school science teaching.

## 4.5 MY THEORETICAL FRAMEWORK FOR THE STUDY

I synthesise my theoretical framework from the views described above in section 4.4 of this thesis. I considered my research approach to be fluid and complex and thus influenced by many variables. So, I wanted an analytical tool for handling large masses of data with results and findings are grounded in the empirical world. One such analytic approach is the grounded theory which formed the basis of my theoretical framework.

### 4.5.1 What is Grounded Theory for a Qualitative Research?

According to Glaser and Strauss (1967) grounded theory for a research is the discovery of theory from data. Charmaz (2000, p. 509) explains that 'grounded theory methods consist of systematic, inductive guidelines for collecting and analysing data to build middle range theoretical frameworks that explain the collected data'. Punch and Oancea (2014, p. 165) describe grounded theory as 'a method, an approach, and a strategy'. In light of the views, the essential idea regarding grounded theory is its being a research strategy where the researcher looks for processes, actions, interactions, or ideas to develop a theory from data. Seen in this way, the grounded theory will be developed inductively from data.

Strauss and Corbin (1998) suggest five important reasons of using grounded theory in a research study, as to: 1. build theory rather test theory; 2. provide researchers with analytical tools for handling masses of data; 3. help qualitative analysts consider alternative meanings of phenomenon; 4. be systematic and creative simultaneously; and, 5. elucidate concepts that are the building blocks of the theory. All these five reasons were useful to analysis for my research study.

### 4.5.2 How Grounded Theory could be used in a study?

Patton (2002) explains that qualitative data analysis can occur through coding, which is the heart of grounded theory. This notion of coding is defined by Urquhart (2013, p. 36) as, 'attaching a concept to a piece of data and how we analyse the data'. For Corbin and Strauss (2008), coding is an act of taking raw data and raising it to a conceptual level. The process of coding involves use of codes, which Punch and Oancea (2014, p. 225) explain as, 'tags, names or labels, coding is therefore the process of putting tags, names or labels against pieces of data'. In simple terms, coding may be taken as an actual activity of labelling data with codes as analysis gets underway so as to attach meaning to pieces of data.

In terms of theory building focusing on relationships between categories, researchers have suggested several alternatives of coding pieces of data during grounded theory analysis. Notable ones approaches include the Glaserian, Straussian, and Charmaz versions as identified by Urquhart (2013). The first two versions show that theory generation is proceeded in three levels of data coding. The Glaserian approach coding proceeds through three stages: open coding, selective coding and theoretical coding. Straussian version has three stages for coding: open coding, axial coding and selective coding. Charmaz (2006) uses a constructivist approach to coding by focusing on the importance of meanings individuals attribute to the focus of the study. In this arrangement, Charmaz (2006) adds another dimension to coding, suggesting a four stage process as: open coding, focused coding, axial coding, and theoretical coding. Corbin and Strauss (2008) posit that in these stages there are analytical tools which serve as thinking techniques used by analysts to facilitate the coding process. Each of these stages is described in the following sections.

#### 4.5.2.1 Open Coding

This constitutes the first stage of coding in both strands of grounded theory (Glaserian and Straussian). Open coding is referred differently by different scholars. For example, Creswell (2008) defines open coding as then process when data is run open and exploring data to open up theoretical possibilities in the data. Punch and Oancea (2014, p. 212) use the terms ‘‘fracturing’ or ‘breaking open’ the data’’ to explain the process of open coding. In other words, coding refers to close examination of raw data, identifying conceptual categories implicit or explicit in the data.

According to Glaser and Strauss (1967) coding can be done inductively or deductively, which they explain that inductively, coding is done through reading and interpreting the qualitative data to form in vivo codes (what is in the data). These authors further explain that deductively, codes can be achieved through use of a priori codes (predetermined codes from literature or theory), and use of a related topic (types of information a researcher codes and develops into themes). It is these developed analytic codes, that Remler and van Ryzin (2015, p. 81) argue, ‘can be renamed, clarified, collapsed together, split apart, otherwise reorganised’. This implies that coding scheme typically evolves and changes as the analysis proceeds. For example, coding may change when similarities and differences in data are shown through constant comparisons of pieces of data.

Constant comparison or ‘iteration’ analytic strategy is explained by Corbin and Strauss (2008) as instances where data labelled in one category with other instances of data labelled for that category are compared to see if these categories fit and are workable. Glaser and Strauss (1967) use the term ‘constant sampling slices’ of data to describe how this comparison for similarities and differences of data can be achieved. They suggest that slicing

data can help in relating data to ideas, then ideas to other ideas in order to delimit and set boundaries of the theory to be developed.

Charmaz (2000) advises that open coding can also be reflective, where reflections can be made by an analyst on why a particular dimension might emerge from coding. By emergence, I mean what Glaser (1992) refers to as the idea that the theory emerges from the data. This entails the data should be allowed to tell its own story. Corbin and Strauss (2008) argue that through reflective property of open coding research questions could be refined; consequently, making the research problem clearer through analysis. However, Punch and Oancea (2014) advice that the researcher carrying out open coding should keep an overview of the data in mind as well as looking broadly across data, rather than only doing intensive coding. This advise is consistent with Glaser (1992) calls 'dip and skip', where you intensively code some parts (dip), while at the same time skimming the data using comparisons to look for possible conceptual patterns, and for concepts that tie together different pieces of the data and different incidents in the data (skip). Thus, open coding raises the conceptual level of the data. After open coding, I now describe selective coding.

#### 4.5.2.2 Selective coding

Selective coding is the second stage in the Glaserian version of grounded theory. According to Glaser (1978), selective coding is a process where you are looking to code around a 'core variable'. Urquhart (2013) defines selective coding as the process of scaling up your codes into those higher categories that are important for your research problem, which involves what Charmaz (2000) calls theoretical memos or memoing. Charmaz (2000), memoing is an act of recording reflective notes about the researcher (fieldworker, data coder and/ or analyst). Put differently, it is when ideas or records are written about concepts and their relationships. Selective coding could be done through what Charmaz (2006) refers to as

focused coding (where coding provides clear analytical directions to the researcher to take decisions about which open codes make the most analytical sense); or what Urquhart (2013) calls theoretical coding (how substantive codes may relate to each other). The later coding will led to the attainment of what Glaser (1978) calls 'theoretical sensivity', where researchers become sensitive to theories and have read widely. However, in coding through theoretical sensitivity, Glaser (1978) advises that data should not 'forced' but allowed to tell its own story; and the theoretical code has to fit with emerging theory. Selective coding raise the conceptual level of the data again. Data then is analysed through axial coding.

#### 4.5.2.3 Axial or Theoretical coding

This is the second stage in the Straussian version of grounded theory. According to Strauss and Corbin (1990) the word 'axial' denotes the idea of putting data an axis through the data, where an axis connects the categories identified in open coding. The stage is what Glaser (1978) calls theoretical coding, as described above in this section of the thesis. Strauss and Corbin (1990) explains axial coding as an analytic process which seeks to make links between categories and codes that open coding has developed. Put simply, axial coding entails focusing on interconnections between open codes.

Having outlined the basic tenets of grounded theory, the following section shows how I used grounded theory in my study.

### 4.5.3 How I used grounded theory in my study?

I selected seven characteristics from grounded theory which I considered useful for my study. This selection was done in light of both the Glaserian and Straussian versions of coding data and a method of generating theory.

The following diagrammatic representation shows how I conceptualised this grounded theory analysis for my study.

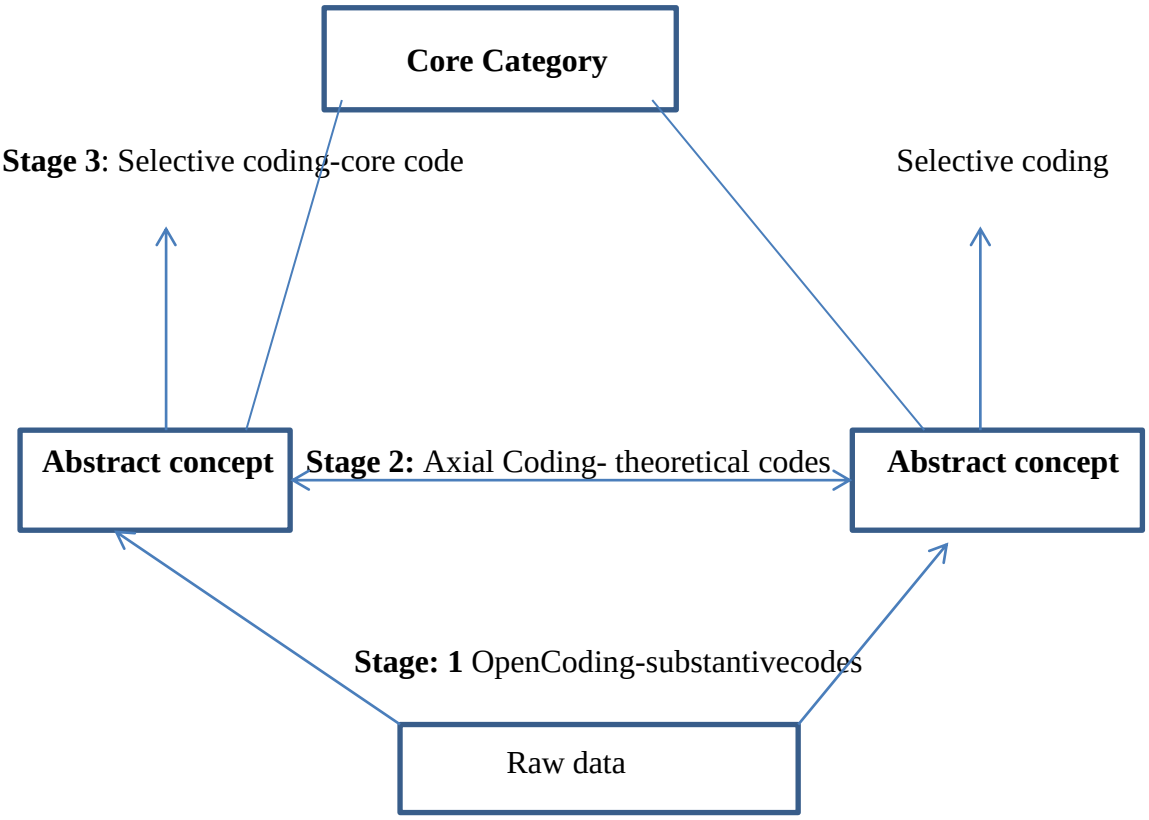



**Figure 1: How I carried out grounded theory analysis**

As shown in figure 1 above, my coding was cyclical. I started from context, which was raw data collected from interviews, observations and documents analysis. Through inductive analysis, I selected data, incidents and observations from this raw data through open coding to form substantive codes. Using constant comparison analytic techniques, categories formed were connected to other categories through axial coding forming theoretical codes. I used these codes to tag different properties and relationships from data. I discovered what I considered to be my core variables and major dimensions and properties through selective coding of data, and these were core codes. I then continued to test whether categories formed fit other categories from data until no more relationships were shown (saturation). I

confirmed patterns and properties formed in light of both new and old data. My initial and final coding systems based for the phenomenon under study are explained in more detail in section 7.3 of this thesis. I now give specific aspects from my study which I used grounded theory.

First, I carried out an interpretivist research study, which is perceived by Treagust, Won and Duit (2014) as a sense-making process for the researcher and, that its research design can evolve- which is consistent with grounded theory. In keeping with the grounded theory, I had to minimise my pre-conceptions and remain open and trust in the emergence of concepts from the data. To do this, first I had tentative questions derived from literature which guided my study. As the study progressed, the focus of my research questions shifted. I immersed myself in the situation of the phenomenon, in order to know the 'prominent' research questions better, and develop a clearer focus and; consequently, changed the research design. This means that my analysis was first deductive and then inductive. I used codes derived from the theoretical framework and literature for the initial deductive analysis. Then data was inductively analysed to yield grounded codes, which I grouped into emerging themes as described in chapters 6, 7, 8, and 9 of this thesis. My initial analysis determined where to go and what to look for in the next data collection. For my study analysis and data collection continually informed each other.

The second important issue from grounded theory is constant comparison method of analysis. This meant that I had to move in and out of data collection and analysis processes. As described in much more detail in chapter 5 of this thesis, I checked and re-asked participants on issues from their data using interviews, document analysis, participant observations and site visits. This means also that for my data generation strategy, I had to visit participants' places of residence checking myself on their IK food preservation artefacts and how such processes were done. I carried out the study through what Creswell (2008) calls naturalistic

settings, where data was collected from participants while carrying out their day to day activities. As noted in chapter 5 of this thesis, I visited community elders in their villages; and teachers and learners were interviewed at their schools. I needed to discover any possible stable patterns in the data. In this comparison, I looked for similarities and differences from the participants' responses as well as science documents and policies on the phenomenon. I used this approach to develop themes related to my topic IK methods of food preservation for school science teaching in Zimbabwe. In chapter 6, I derived the themes for analysis from the documents themselves, comparing them on what guidance they provide on integration of IK methods of food preservation with school science teaching. Then chapters 7, 8 and 9, the participants' views on IK of food preservation were compared within similar groups of participants and across different groups.

The third important issue from grounded theory I used is the selecting major cultural issues as they emerged from the participants or science curriculum documents. For example, participants had specific Chishona terms and cultural materials they use in their IK methods of food preservation. So, I found language, craftwork and buildings as crucial in understanding IK methods of food preservation for indigenous communities. As provided in chapter 7 of this thesis, I had to discuss with other participants use of cultural materials like clay pots in making thick milk they use mostly as relish. I discovered that types and materials used to construct buildings in the Murambwi locality were relevant to the way they preserved their crops. I considered these issues emanating from some participants central to my study, and then other views from the participants were sought in relation to these selected ideas. Also the conclusion of my study, as shown in chapter 10 of this thesis, is framed in the context that calls for a teaching approach grounded in the indigenous peoples' culture. In doing this, I took a relativist ontology and constructivist epistemology research approach, where participants were allowed to construct their understanding based on their experiences,

culture, and context. The idea was to allow data speak for itself, and not to force ideas out of the participants. As advised by Treagust et al (2014, p. 7), I did not 'claim that their knowledge claim is a complete or the right one but that it is a sensible interpretation of the situation'. In the conclusion of my study, I used metaphors which Miles and Huberman (1994) suggest could be used by the researcher to capture the essence of a qualitative study. The metaphors that I used were derived from the Shona culture, are considered useful for my study.

The fourth aspect from the theory is writing notes through memoing while my data collection and analysis processes were on-going. I recorded participants' day to day language, feelings and expectations for the study. This had a bearing on the type of data I collected during the study. I focused on the importance of meanings individuals attribute to the focus of the study. As alluded to above in this chapter, I looked at the participants' aspects including thoughts, feelings, values, viewpoints, and assertions rather than gathering facts and describing acts. As described by Creswell (2008) my grounded theory design was both an emerging (letting theory emerging from the data), and constructivist (where the importance of meanings individuals attribute to the study focus is considered). Although I had to deal with some cultural aspects that were not directly answering my research questions selected for the study, I captured these cultural practices as described in the chapter 2 for this thesis to provide context for the research. In doing so, I wanted to capture the cultural meanings community members were attributing to the topic and reveal to the researcher what they considered important in their lives in relation to food preservation.

The fifth aspect is data collection which I did over an extended period of time for the purposes of ensuring theoretical saturation in analysis. As described in chapter 5, my data collection and analysis spanned over a period of two years (2014 to 2016). In doing so, I also wanted to build rapport, emphathize with the participants to make better sense of the

situation. As shown in chapters 7, 8 and 9, I had to take my data for member checking as advised by Corbin and Strauss (2008) to be done even during the write up stage where participants were required to clarify their own assertions or interpretations. I also checked against the literature on issues related to the phenomenon. I used checking and re-asking as my data generation strategy, as explained in my research process, section 5.2.5 of this thesis.

The sixth aspect regards the effect of close relationship between the researcher and participants, which had ethical considerations. In line with Mpofu et al's (2013) data analysis strategy, I immersed myself in the situation to experience for myself; this had an implication to consider many ethical issues beyond institutional guidelines. As noted in chapter 5 of my thesis, I went further these requirements to include adherence to specific cultural protocols during the study.

The seventh issue regards how I reported my findings. I keeping with the grounded theory approach described by Corbin and Strauss (2008), I had to describe in detail peoples' lived experiences.This meant that I had to provide verbatim quotations from the participants on a specific issue from the study (see chapters 7, 8, and 9). Excerpts from the participants were included in the report. The strategy is what Patton (2002) describes to as validity checks. To identify such detailed information from participants, I had to run my data open and analyse it line by line in order to find its meaning and the direction for the study.

In the following section, I describe how culturally grounded teaching model was developed.

### 4.6 Developing a culturally grounded teaching model

In developing this grounded theoretical framework, I took advice from Chilisa (2012). She advised that ideas on *ubuntu* worldview guides research ethics. I also benefitted from a study by Keane (2013) whose findings show that indigenous methodologies are relevant in

developing a qualitative research strategy which involves communities. These arguments from Chilisa (2012) and Keane (2013) were put together to describe the context for integration for my study. As noted in section 4.3.3.2, a worldview refers to belief systems and experiences that guide a particular cultural group; I believed that peoples' beliefs would also be an important consideration for school science teaching. So *ubuntu* worldview and indigenous methodologies influenced my research methodologies. The concept *ubuntu* is addressed in more detail in next section of this chapter. In using *ubuntu* worldview and indigenous methodololologies, I wanted to avoid what Oviawe (2016) calls the western positivistic, linear and mechanistic paradigms. The *ubuntu* and indigenous methodologies perspectives gave insight into the IK of the Murambwi locality in terms of participants' knowledge regarding food preservation (answering research question 2 of my thesis).

### *4.6.1* Application of *ubuntu* worldview to my study

My study approach was informed by an African *ubuntu* worldview. The notion of *ubuntu* is wide as shown in literature. According to Keane (2008b) *ubuntu* is an African worldview emphasising symbiotic relationships among members of African communities. According to Ndondo and Mhlanga (2014), in *ubuntu*, the emphasis is on an awareness of the fundamental interconnectedness of people in a community. Ogunniyi (2016, p. 420) postulates the notion of *ubuntu* as ''more about us' and not about 'me''. In the context of my study, such communal life is based mostly on '*mushandirapamwe*' (working as a community, or working with others). It is this interconnectedness in indigenous people's lives that Msila (2009, p. 313) explains constitute an African life described as 'one lives for the other'. I found this framework appropriate for my study in order to inculcate a culture of tolerance and sharing of ideas amongst the participants as community members. I therefore enquired from participants how such communal life could be reflected in the teaching of science in schools. My research emphasis shifted from the focus on the 'I' of the individual to a collective 'we' with multiple

participant connections for an IK study in keeping with Chilisa's (2012) advice on *ubuntu* attributes. Nafukho (2006) explains that *ubuntu* worldview as a social foundation is based on the inherent power in community where people dialogue to provide meaning to life. For this reason, I included group conversations and site visit conversations as data generating techniques.

In relation to education, Nafukho (2006) explores the contribution of *ubuntu* worldview to adult learning in the workplace. He claims that learning took place in the African languages that people spoke, and was used to break communication barriers. In light of this claim, I interviewed my all community members in Chishona language except for teachers and learners where I used both their mother language and English. The *ubuntu* worldview helped me to decide what form of knowledge the study should take for IK methods of food preservation. Through *ubuntu* worldview, I believed that I would capture people's personal, as well as my own, experiences related to the phenomenon under study.

I found *ubuntu* worldview's emphasis on culturally responsive teaching in school science teaching relevant to my study. According to Gay (2010, p. 52) culturally responsive teaching is one which, 'insists that all learners will achieve greater educational outcomes when instruction includes and reflects their own cultural experiences'. I needed a teaching approach that identifies learners with their culture related to the methods of food preservation. The idea of culturally responsive teaching is described in more detail in section 4.6.3 of this thesis.

In addition also, *ubuntu* worldview emphasises inclusive type of education for schools. According to UNESCO (2005b, p. 13) inclusive education involves, 'the process of addressing and responding to the diversity of needs of all learners through increasing

participation in learning, cultures and communities…'. Put differently, his means that inclusive education requires that learners' cultural identity be identified in schools.

### 4.6.2 Use of Indigenous Methodologies

According to Lowan (2012) and Kovach (2010), indigenous methodologies are those research approaches where researchers follow that respect cultural customs. In line with this view, it meant that in order to access IK research contexts, I had to follow and respect cultural protocols. This strategy is consistent with the principles of *ubuntu* worldview described above.

In relation to *ubuntu* worldview, indigenous methods take into consideration peoples' relationships in the study. Louis (2007) amptly explains that community networks of relationships should embrace reciprocity, respect, rights and accountability. In other words, the relationship between the researcher and the participants was crucial in my IK study. Kovach (2010) asserts that reciprocity refers to the mutual relationships and benefits among members of a research group. In addition to explaining how I intended to benefit from the study, I felt obliged to explain to participants what my study will provide them with; in keeping with research reflexivity. By reflexivity, I mean what Patton (2002) regards as an exchange of knowledge among members of the research group in which learning from each other is inherent. With regards to the relationship between *ubuntu* and indigenous methodologies, I consider Kovach's (2010) contention pertinent in the development of a theoretical framework for my study. Kovach (2010) contends that like *ubuntu* life, indigenous methodologies ground the principles of reflexivity and reciprocity. This means that a person depends on others to survive which has implications for the ethics of the study. These relationships are discussed in more depth in the methodology chapter of my thesis.

### *4.6.3* Context of knowledge system integration

Using literature, I identified aspects that determine the context of my integration which include: - the use of learners' prior experiences, knowledge in science education, theory of knowledge domains, theorising integration of IK with school science, and culturally-responsive teaching.

The first aspect that influenced the development of my theoretical framework is the use of participants' prior experiences. I believed that prior experiences are important for science teaching in schools. Okanlawon (2012, p. 390) defines prior knowledge as 'a body of information that students 'bring to the table' before engaging in instruction and use to make meaningful connections to-be-learned concepts, information or strategies'. Woolfolk (2010) and Bodner (2007) believe that learning is about making cognitive connections. This implies that prior experiences may help learners make connections between pieces of knowledge drawn from their IK culture and school science. According to Eggen and Kauchak (2007), this prior knowledge provides a natural starting point for teaching. Some authors, for example, Shumba (2015) and Aikenhead (2006), argue that, in using prior experiences, learning is seen as-a-connector principle, where the aim of learning is regarded as one that generates knowledge through social interactions. Prior experiences in my study imply incorporating subjective reality from the learners' knowledge of IK methods of food preservation that may be captured during discussions of the topic in school science teaching. The use of learners' prior experiences also suggests drawing examples of IK methods of food preservation from the communities for use in classroom discussions. This view is in line with Sfard's (1998) two metaphors of learning, that is, participation in the socio-cultural milieu of the classroom and individual construction of knowledge.

The second aspect that can possibly affect teaching proposed in my study was the people's

view of the concept of ‘knowledge’ in science education. My understanding of knowledge was derived from two philosophical positions on the nature of knowledge guiding the construction of the theoretical framework for this study. These perspectives are: universalism and multiculturalism. McKinley and Gan (2014) believe that universalism conceives science as governed by a set of rules that are culture free and denies cultural difference. This position makes western science the most powerful knowledge available to humanity and ignores the contributions to science from many cultures around the world, including that of IK systems. In contrast, Aikenhead and Elliott (2010) explain that, in a multicultural science, knowledge is viewed as socially and culturally constructed and, as such, it recognises difference. Thus, in a multicultural approach to learning, there are multiple ways of understanding our world drawn from different cultures that can be compatible or incompatible with the scientific world view. The scientific world view or science is defined by Aikenhead and Ogawa (2007) as a rational, empirically-based way of knowing nature that yields, in part, descriptions and explanations of nature. A closer look at this definition leaves one to wonder what is referred to by ‘nature’, that is, from which cultural perspective, indigenous or western? However, to incorporate the cultural component into science, Ogawa (1995) refers to science as ‘western science’. According to Odora-Hoppers (2002) and Aikenhead (1996), this shows that western science is grounded in the western culture. Similarly, Khupe (2014) and Keane (2013) assert that indigenous science is grounded in indigenous cultures.

The third aspect deals with knowledge domains within IK and western perspectives. For example, Mashoko, Mpofu, Mushayikwa and Keane (2016) adapted a tetrahedral model by Mpofu et al (2013) and proposed a five-sided model of knowledge: product, process, enterprise, paradigm and pedagogy. Mashoko, et al., (2016) developed an E4P tetrahedral knowledge model to encompass multicultural views of knowledge acquisition. In this tetrahedral metaphor, the human element (enterprise-E) generates knowledge using the

cultural way of knowing (paradigm-P) that guides the inquiry (process-P) of the natural world to generate knowledge (product-P). This knowledge can be used in pedagogy (P). In the model proposed for this study, examples and learners' prior experiences of IK of food preservation may be used to show relationships between two knowledge systems.

In the case of my area of study, discussions might be focused on who the community members involved in the process are, how these members preserve their food, how they are doing it culturally (paradigm), what knowledge do they generate (product) and how this knowledge can be used in teaching of science (pedagogy). Discussions in light of IK and western science methods might be done in relation to how food is preserved. In juxtaposing ideas from two worldviews, convergences existing in knowledge systems could be revealed. Convergences may occur due to some areas of commonality in practices on methods of food preservation which means that a method of food preservation which might be found in an IK perspective may also be practiced in western science. Even if there might be differences related to their philosophical perspectives, variations may be useful in understanding the process of food preservation in general. This understanding may be a result of interrogating strengths and limitations of each food preservation approach.

The fourth issue in developing my theoretical framework is how to go about theorising the integration of IK into school science considering their distinct worldviews (as explained above). In the scientific worldview, food preservation is understood in terms of specific concepts. There is evidence in literature that worldviews held by learners are regarded as important motivators to learning science (see, for example, Aikenhead, 2006). The two worldviews interrogated in my study may complement each other rather than being opposing perspectives.

As alluded to earlier in section 4.3.3.1, divergences of knowledge systems (IK and school

science) exist due to philosophical variations on ways of knowing that may possibly contribute to problems related to their integration in schools. Chilisa (2012, p. 122) summarises the attributes of an IK worldview as that which recognise a 'relational existence that promotes relations among people, the living and the non-living, the environment/land and the cosmos'. In the context of my study, IK perspectives should be understood in relational to ontology (what is reality), epistemology (nature of knowledge) and axiology (values and biases). By implication, this relational philosophy regards knowers as beings with connections to other beings, the spirits of the ancestors and the world at large.

The fifth aspect in relation to my framework is the emphasis of science education on culturally responsive teaching approaches. According to McKinley and Gan (2014), a culturally responsive teaching approach refers to practices that are grounded in the belief that all culturally and linguistically diverse students can excel in academic endeavours when their culture, language, heritage and experiences are valued and used to facilitate their learning. In other words, culturally responsive practices entail constructing knowledge, building personal and cultural strengths, examining the curriculum from multiple perspectives, using varied assessment practices and contextualising learning. In such education systems, school cultures have been described as participatory practices as suggested by Gay (2000). Studies done by McKinley and Gan (2014), Cheeseman and De Pry (2010), Gay (2009), Taylor (2006a), and Villegas and Lucas (2002) suggest strategies that teachers can institute to promote culturally responsive teaching in their classrooms. Some of these strategies include students discussing topics, using examples and analogies from their lives and drawing on expertise of the community members, including their own parents. According to Moll, Amanti, Neff and Gonzalez (1992), the approach of drawing from the community knowledge falls within the idea of 'funds of knowledge'. On the other hand, Archer, Dewitt, Osborne, Dillon, Willis and Wong (2010) contend that this culturally responsive teaching addresses learners' identity

development. For Calabrase and Tan (2009), this teaching serves to cultivate a sense of ownership and agency in learners. For this study, learners' cultural identity and sense of agency may be enhanced by recognising and responding to the influences and strengths of the learners' culture (for example, the Shona people's IK methods of food preservation) as well as drawing insights from this culture. While I am not suggesting that we should match learners' identity and sense of agency with learning outcomes, there is evidence that the approach may provide richer versions of science as suggested by Archer et al (2010). This matching of learners' identity in schools relates to what Lim and Calabrase (2006) call a 'place-based' teaching which recognises and leverages local knowledge about people and their environment to engage students in learning activities such as outreaches to the community. Such place-based approaches had implications in terms of the nature of instruments I used to gather data from the participants. Findings could be different from those one might generate from the western contexts. For this study, conversations with community elders were done using local languages and drawing knowledge from their prior experiences on the phenomenon under study.

## 4.7 SUMMARY OF THE CHAPTER

In this chapter, I reviewed literature on aspects that influence teaching and learning of science in schools. The models I reviewed above all point out that useful knowledge should be derived from peoples' culture. In the context of education, this means that teaching and learning should begin from what learners know from their culture. So teaching and learning in schools has the potential to engender relevance to education to the learners if it starts from learners' cultural experiences. These observations led to the identification of issues that helped the researcher to develop a theoretical framework for the teaching school science. These issues include viewing science teaching that needs learners' prior experiences, requires

understanding of the concept of knowledge, knowledge domains, and theorising the integration of IK with school science as involving different cultural constructs. Culturally responsive teaching is central in identifying learners' cultural identity in schools. Theoretical framework was used in the methodology for this study which I present in the next chapter.

# CHAPTER 5: RESEARCH METHODOLOGY

## 5.1 INTRODUCTION

In the previous chapter, I discussed the conceptual framework guiding this study. In this chapter, I discuss the methodology used to study my topic, 'Integrating indigenous knowledge of food preservation with school science teaching in Zimbabwe'. To understand this IK phenomenon, I will answer the following three research questions: i) What elements of IK methods of food preservation do curriculum documents give to the teaching of science in schools in Zimbabwe? ii) What elements of IK and methods of food preservation do the rural community members of Chivi District hold? iii) How may culturally relevant teaching be drawn from the knowledge of the community members' indigenous methods of food preservation and the current practices of teachers and learners in Chivi district?

To show how I answered these research questions, this chapter gives a review of my research design and discusses the methodological influences guiding the study. Following this, the chapter provides a description of the thesis's unit of analysis, case study, research process, research approach and how access was negotiated. Ethical considerations for the study are provided as are instrumentation, data generation procedures and the data analysis and interpretation framework. A subsequent section reviews my involvement in the study. Finally, a discussion on the rigour relating to the research findings is presented. My methodology is guided by a culturally- relevant conceptual framework, described in Chapter 4 of this thesis.

## 5.2 MY RESEARCH DESIGN

### 5.2.1 Introduction

As explained by Silverman (2005), a research design is an overall strategy that one chooses to integrate the different components of the study in a coherent and logical way. The strategy for this study was responsive to both the context and the participants in order to obtain evidence that would enable me to answer my research questions as unambiguously as possible.

My design was guided by both international and local literature I reviewed on the IK integration in schools (see chapter 3 of this thesis). I then chose to explore the phenomenon by analysing science policies and documents, and IK of food preservation of community elders, science teachers and school learners. A number of issues influenced my methodological design.

### 5.2.2 Influences for my methodological design

According to Keane et al (2016), 'it matters who you are' in an IK study. It was therefore important for me to describe how my life experience and worldview shaped the research purpose, design and credibility. I was born and raised in a Zimbabwean traditional community. My African beliefs and *ubuntu* worldview permeated every aspect of the research process from my interest and orientation towards the topic, choice of paradigm, research questions, engagement, ethics, data and reporting as well as the outcomes and findings of the research. In the following paragraphs, I explain how my research approach was influenced by these beliefs and worldviews.

#### *5.2.2.1 My personal experiences and involvement in the study*

The interest and choice to do the study in a rural community was influenced by my own rural

upbringing. I taught in rural secondary schools located near rural townships. At most of these centres, I saw intersections of traditional practices with modern ways of preserving food. At home, I saw learners bringing their '*mutakura*' (boiled mixture of maize grains and roundnuts or groundnuts). At school, these learners were taught about the topic of food preservation but were reluctant to talk about how they were preserving food at home. For them, there was a gap between school and their homes. I also had other personal experiences that I noted in Chapter 2 of this thesis.

In explaining my involvement in the study, I found guidance from Battiste (2004, p. 63) who said that 'indigenous researches are judged on 'insider' criteria including: family, background, status, politics, age, gender, educational qualification'. In light of this view, I explain briefly how some of these factors influenced my involvement in the study. All these factors, including my family life and professional experiences, had a bearing on my methodology and were explored in much more detail in Chapter 2 of this thesis. These personal experiences drew insights from the *ubuntu,* as an African worldview.

#### *5.2.2.2 How the ubuntu worldview influenced my study*

*Ubuntu* worldview influenced my research methodology as described in section 4.6.1 of this study. This worldview had an influence on all stages of my research, from design up to reporting of data.

#### *5.2.2.3 How the interpretivist paradigm guided my study*

According to Treagust et al (2014, p. 9) 'an interpretivist research study is perceived as a sense-making process for the researchers involved'. This implies that an interpretivist study focuses on making sense about the meaning or knowledge others have about the phenomenon. This study describes people's lived experiences on IK of food preservation in

detail. According to King (2004, p. 356), 'all knowledge is centred or grounded in some cultural context' and for Mackenzie (1981) it is constitutively social, indigenous people's IK of food preservation within their cultural contexts was investigated. My focus was on the localised meanings of human experience by the indigenous Shona people in Chivi Zimbabwe.

In the following section, I explain how I used my conversation research methodology that suits my views of interpretivism for the study.

#### *5.2.2.4 How I used interpretive Conversation Methodology for my study*

I used an interpretive conversation methodology to access data from participants. My approach was grounded in conversation as Patton (2002) explains that, at the heart of an interpretive research approach, is participation with social interaction involving two or more people talking face-to-face. This means that my data generation methodology was conversational with a flexible approach to its design. The strategy contrasts with what Smith (2009) calls 'dominant models' in education that tend to be didactic, planned and task-centred. As a result, such models in education may be problematic when applied to specific cultural contexts. I also needed to add site visiting of artefacts participants were using to my interprevist perspective because I believed that this would add value to the quality of my research findings. I did not want to be just told how participants carry out methods of food preservation but to verify it through site visiting. Such an approach avoided the tendency of interpretive researchers gaining data without actually verifying what is happening on the ground.

My conversation methodology draws from an interpretive perspective influenced by both Afrocentric and scientific paradigms. These paradigms were discussed in much more detail in Chapter 2 (literature review) of this thesis. I visited the participants at their places of residence or workplaces in the spirit of togetherness. Smith's (2009) advice on conversation

was useful for the development of my methodology. He advises that conversations cannot fully describe or capture an experience, situation or idea that a study requires. So, I discussed with participants their indigenous food preservation artefacts and photographed these after getting their consent.

### 5.2.3 Unit of analysis for the study

In light of Merriam's (2009) suggestion, I selected community members' IK of food preservation for my unit of analysis**.** Patton (2002) explains that a unit of analysis in a qualitative study refers to experience, not individuals or groups. For this reason, my selection of cases for the study was not based on representativeness to a broader population but on the possibility of findings being transferred to other similar contexts.

### 5.2.4 Case study design

Leedy and Ormrod (2010) argue that a qualitative study can be carried out when not much is known about the phenomenon. My topic had not been studied for school science teaching therefore I considered a case study as suitable for my purpose. Yin (2009) asserts that a case study as a research design is distinguished by its ability to investigate in-depth the phenomenon in its context, which, in this case, is indigenous methods of food preservation for school science teaching in Chivi rural areas in Zimbabwe.

### 5.2.5 Research Process

A study by Mpofu et al (2014a) in Chiweshe rural community in Zimbabwe follows an interpretive African indigenes (IAI) approach in understanding IK of plant healing for classroom science. Regarding the IAI approach, Lowan (2012) contends that the researcher becomes a community and family member. Extending this argument, Mpofu et al (2014a) elaborate that, in this membership capacity, the researcher becomes one of the IK custodians

and is bestowed with the responsibility and accountability of protecting and conserving it. Hence, in an IAI approach, the researcher takes responsibilities in a community as a family member. Since my study follows an interpretive approach, IAI is relevant because it provides insights into possible methodologies and ethical considerations that should guide my research.

My thinking is summarised in the following schematic diagram.

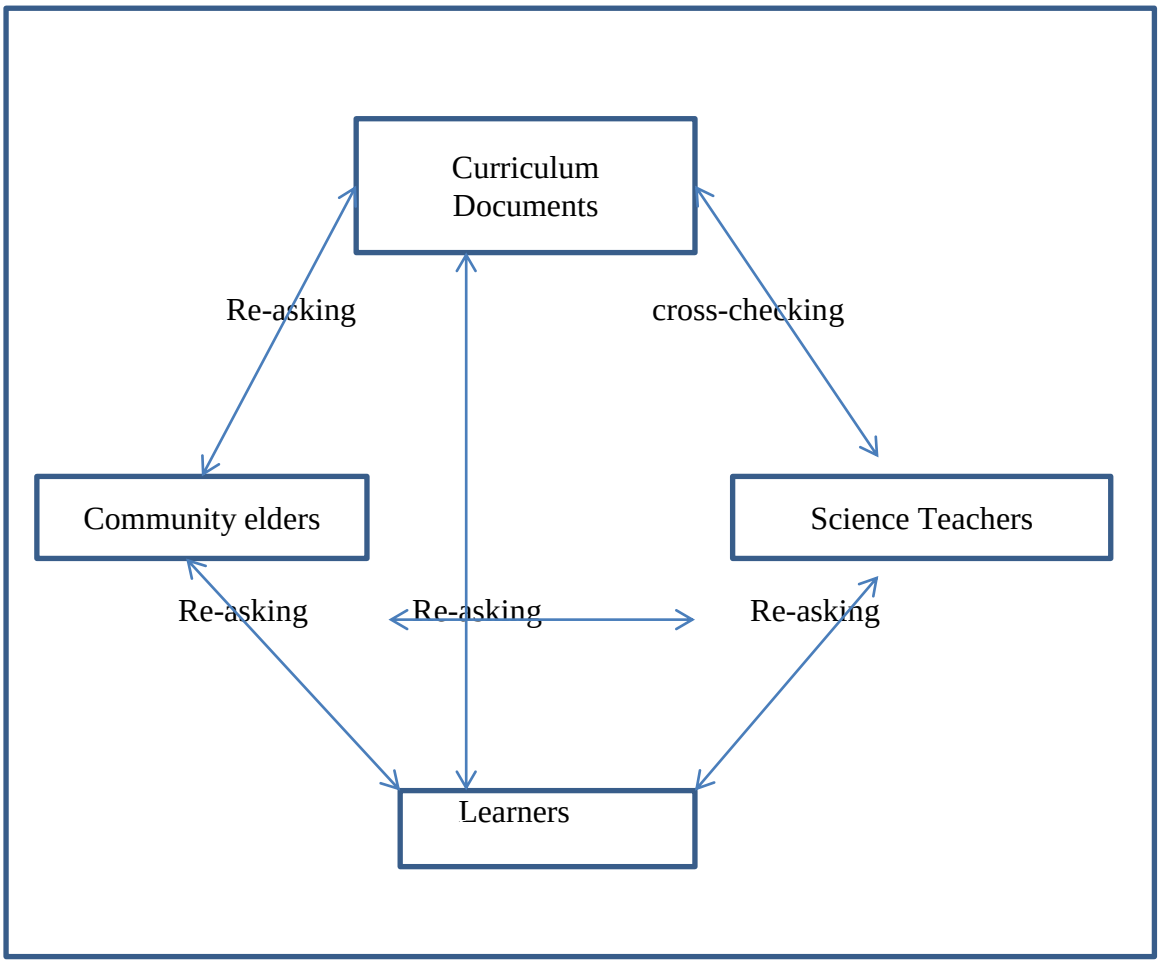



**Figure 2: How I interacted with my data sources in the study**

IK information on methods of food preservation was cross-checked and re-asked from participants in a rural research site. In my research process, I needed an approach that required the research sites to be as close to each other as possible.

## 5.3 RESEARCH APPROACH

### 5.3.1 Introduction

Wane (2014), Chanza and De Wit (2013), and Keane (2013) contend that a qualitative approach is regarded as the best philosophical paradigm underpinning IK studies. For this reason, my study had a qualitative approach because it helped me to gain a deeper understanding of the phenomenon from the researcher and participant interactions. In explaining the importance of a qualitative research study, Guba and Lincoln (2005) argue that researcher and participant interaction may yield useful and credible research findings while Denzin and Lincoln (2000) assert that a researcher is the primary data-gathering instrument. This meant that I had to observe or collect my data directly from first-hand experience of the phenomenon. This means that I generated research data through my direct efforts using interviews, site visits and direct observation.

### 5.3.2 How multiple sources lead to crystallization of my data findings

I generated data from multiple sources to produce understanding for my study. I believe that data from these three methods will lead me to what Richardson (cited in Barbour, 2007) refers to as 'crystallisation' of the findings, where one looks simultaneously at the same issue or concept from a variety of different angles. I believed that these different data sources would provide an account similar to what Patton (2002) describes as 'rich, robust, comprehensive and well-developed'. In keeping with this approach, I focused on multiple data sources by comparing participants with different viewpoints. In the following paragraphs, I present how each research question was answered using different sources (see research questions in Table 2 below).

In terms of the first research question, I analysed data from science curriculum documents

such as textbooks, teachers' schemes of work and school-based and national syllabi. I also compared this data with policy documents such as the culture policy of Zimbabwe, Curriculum Inquiry into Education and Training (Zimbabwe, 1999) report, mission statement of the regional body such as New Partnership for Africa's Development (NEPAD), Science and Technology Policy of Zimbabwe, Ministry of Primary and Secondary Education (Zimbabwe) handbook on curricula review 2014, science subjects results analysis November 2014 (Zimbabwe), Ministry of Primary and Secondary Education (Masvingo province) Mission Statement 2015, Constitution Parliamentary Select Committee of Zimbabwe 2013, Zimbabwe's Environmental Education Policy, Zimbabwe's Environmental Policy, Ministry of Primary and Secondary Education Curriculum Framework 2015-2022, and ZIMSEC past examination papers code 5006 from June 2005 to November 2015. Data from this document analysis supported the view that science curriculum documents require that IK be integrated into school science teaching but are silent on the methodology to be used.

Answers to Research Question 2 were sourced from interviewing community elders, science teachers and Form 4 school learners. I moved within one set of participants and then to different groups of participants, checking the accuracy of the information obtained from the interviews. I also visited participants at their homesteads checking information myself and observed participants actually preserving food. Data from these interviews enhanced the view that there might be some IK elements useful for school science teaching.

For Research Question 3, I took photographs from the elders' food preservation artefacts and discussed with teachers and learners possible ways to integrate such practices into school science teaching. Through brainstorming sessions, teachers were asked to explain how they taught the topic of food preservation in school science and then to suggest ways of teaching the topic in light of community members' suggestions of food preservation. I also engaged

learners in free-writing sessions on cultural aspects relevant to food preservation. Data from interviewing teachers shows that teachers are aware that IK should be integrated into school science teaching but were reluctant to do so. Table 2 below summarises how different sources were used to crystallize my data.

**Table: 2**

***Sources used to crystallize my data***

| **Research Question focused on** | **Data source used** |
|---|---|
| 1. What elements of IK methods of food preservation do curriculum documents give to the teaching of science in schools in Zimbabwe? | Science curriculum and science policy documents. |
| 2. What elements of IK and methods of food preservation do the rural community members of Chivi District hold? | Interviewing community elders, science teachers and Form 4 school learners. Site visit and participant observation of community elders' food preservation artefacts. |
| 3. How may culturally relevant teaching be drawn from the knowledge of the community members' indigenous methods of food preservation and the current practices of teachers and learners in Chivi district? | Interviewing science teachers, community elders and Form 4 school learners. |

In answering these research questions, I was guided by access and ethical considerations for my study.

## 5.4 ACCESS

### 5.4.1 Introduction

My data generation involved many sites in light of Martin and Mirraboopa's (2009, p. 212) contention that IK research approach is 'multi-sited'. The primary research sites were the communities of Gomoguru and Dzivaguru, but there were other localities that gave insights into understanding the phenomenon that were also significant. This required me to be observant to the variety of issues relevant to my study including people's interactions, how they greeted each other, their use of language, their views in relation to food situation in Zimbabwe, comments made by some education officers during the collection of curriculum documents, comments made by community members from neighbouring villages and schools not involved in the study, the general public and media reports. Although these issues were peripheral, they had a bearing on my area of study because they validated my research topic and the food situation in Chivi District, Zimbabwe.

The two villages and two secondary schools selected for this study had different Headmen under Chief Chivi's jurisdiction. I selected two communities on the basis of their geographical location which distinguishes them from each other. One site was located near a mountain and the other near a big river. I used these sites as pseudonyms used in this study. I identified the two institutions using Chishona names as: '*Gomoguru*' for a big mountain and '*Dzivaguru*' for a big pool in a river. Thus, the secondary school was my primary focus and villages were conveniently selected by considering their proximity to the schools. This enabled easy translocation between the school and the village. With this arrangement, Gomoguru Secondary School was located in Gomoguru village and Dzivaguru Secondary School in Dzivaguru village.

### 5.4.2 How I selected participants for the study

I needed to select cases purposefully to facilitate answering the research questions guiding my thesis. Leedy and Ormrod (2010) argue that, in purposeful selection, a participant is selected from those who have the most information about the topic. As researchers, Silverman (2011, p. 388) believes that purposeful selection 'illustrates some feature or process we are interested'. I used my personal judgment and negotiation to select participants that I thought would provide information for the study. In the selection of my sample, I used Lincoln and Guba's (1985) view that, in qualitative studies, participant selection can be done 'to the point of redundancy'. This meant that I selected my participants until the point where no new data emerged from successive analysis. So, the question of 'sample size' was open for my study even though, at the outset, I specified a minimum number of participants based on an expected reasonable coverage of the phenomenon. In other words, I started with small numbers for each category of the participants involved in the study which then increased as the study progressed. In keeping with a qualitative methodology, as explained by Lincoln and Guba (1985), I incorporated 'outliers' and/or 'deviant cases' or 'negative cases' into the study. This meant that I continually revised my explanations of the methods of food preservation until all cases were accounted for. Corbin and Holt (2011) concur with this approach arguing that negative cases do not necessarily contradict a researcher's theoretical formulations but add to the theory's breadth by expanding its possibilities.

During the selection of participants, the issues of gaining of access and ethics were central. In keeping with Denscombe's (2005) advice that qualitative research data needs to be generated within its natural social settings, I generated my data from members undertaking their day-to-day activities.

The University of Witwatersrand's ethics application approval requirements fall within every

stage of my research access. Some of the conditions required in the approval letter by the University were that participants were to be informed that their participation is voluntary, no remuneration will be paid for participation and participants' rights would be respected. As a researcher, I was obliged to meet these requirements.

I sought access for the study from various people at different levels in the communities. These people were located in the Zimbabwean Ministry of Primary and Secondary Education offices from national down to lower levels in schools. Some were located in the villages as either community leaders or heads of schools. I used the ethics approval obtained from the University of the Witwatersrand's Research Ethics Committee to negotiate my study access. My ethics protocol number is: 2014ECE008D (see attached in Appendix A). In accessing schools, I used my study permission granted from the Ministry of Primary and Secondary Education (Zimbabwe) reference number: C426/3 Masvingo. This permission was first sought at head office, then regional level that referred me back to the head office. I went back to the region office which was responsible for the schools that were involved in the study. To facilitate my access to schools and villages, I approached my study through what Creswell (2008) calls research 'gatekeepers' who assist in the identification of the places of study and have an 'insider status' with a cultural group studied. Silverman (2011) proposes that 'gatekeepers' should not only be regarded as merely a stage through which the researcher needed to pass, but can provide valuable data on the setting of the research. This status meant that they had cultural knowledge that I required to complete my study therefore gaining access to my research setting was closely linked to establishing trust-based relationships with the 'gatekeepers' and key informants. In this study, the gatekeepers were heads of schools and community leaders (traditional and political structures). I negotiated and re-negotiated access at every stage of the study first from 'gatekeepers' and then from other participants. This meant that I had to explain the purpose of research and assure confidentiality to all

participants. I now describe how I accessed my participants in the study.

### 5.4.3 Accessing participants in my research

In negotiating access for my study, my 'informed consent' was a matter of day-to-day agreement throughout my study (check appendix 0). Simons (2009) asserts that what constitutes 'valid' consent in a community includes values of reciprocity, survival and protection, and spirit and integrity which became pivotal in my discussion of consent for this study. Seen thus, in developing rapport during my study, I treated my interview method as a two-way process involving gathering and giving of information (reciprocity). Kovach (2010) believes that, for indigenous research study, reciprocity extends to all community members within the research group. This means that participants would gain from my study as much as I would generate data from them.

I committed myself to informing participants of the progress of my study. To achieve this, each time I went for interviews, I would first explain what information has been explored to each group of participants at a station. This also helped me to check findings continuously with my participants by reporting to a group what has been found and requesting that they give their comments on the reported data. For all academic institutions involved, I promised that they will each have a hard bound copy of my thesis upon completion. Also, in the interest of reciprocity for a research study as explained by Keane (2008b), I was compelled me to assume my obligation and responsibility. I had no choice other than to publish my results in accredited journals and present them as conference and research seminar papers at the University of Witwatersrand, Johannesburg, South Africa.

In the context of *ubuntu* worldview, I took the concept of 'informed consent' (where participants were fully aware of the research process) as a matter of day-to-day agreement. In keeping also with Mpofu, Mushayikwa and Otulaja's (2014b) advice, I took it as a natural

part of planning and action for a research study. The implications for my study were that, while I sought participant permission first from the gatekeepers, I went further to consult individual participants for their consent. I even went beyond their written agreements and verbally talked to them. This is a form of *ubuntu* I/We relationship that goes beyond western research issues of power.

In some interviews, I found most participants either taking breakfast or lunch and, in the spirit of *Ubuntu* worldview, I could not refuse their hospitality and accepted the mango fruits and '*chikangireni*' (salt-dried groundnuts) they offered to me. I realised that this hospitality benefitted me since I took dried groundnuts as a starting point for my research conversations. I also realised that I enjoyed eating these dried nuts during my stay in the rural areas and that my rural background, which provided me with rich experiences of IK methods of food preservation, contributed to the choice of my research methodology.

I selected science teachers, school learners and community elders as participants for the study. I now describe how I attempted to make the study ethical.

### 5.5 Ethics of the study

My understanding of participants was that they were not just sources of data but active beings who could contribute to both education and research. This explains why I took photographs of their food preservation artefacts on aspects that I thought were relevant to the teaching of science in schools. The approach exposed the research to what Rule and John (2011, p. 112) call 'researcher positionality' which relates to relationship building. Keane et al (2016) concur with this participant relationship building in a research study and argue that it presents the subjectivity basis on which research ethics are formulated. Mkabela (2005) believes that ethics entails being humane in a study therefore I used it as a strategy to reduce tensions and improve power relations between participants and the researcher. I remained open to the

'truth' in what participants said as I interacted with them as what Freire (1993) refers to as 'equally knowing subjects'. This meant an understanding that some participants may not have had the same access to knowledge or the same opportunities to explain the phenomenon.

I took advice from Louis' (2007) research approach that a researcher needs to ensure responsibility, respectful representation, reciprocal appropriation and rights and regulations to different aspects of the research process. Responsibility means that all parts of my research process were related. Respect was ensured through building cordial relationships with the participants and the creation of space for the voices of all people. Reciprocal appropriation required that the benefits of the research should accrue to both the communities researched and the researcher. For rights and regulations, I followed ethical protocols so that people involved in the study owned the research process. It was my conviction that these approaches would provide academic integrity for my research. As Resnick (1998) advises, such integrity would be facilitated in a research process through fairness (to treat all people as equal and recognise their rights), honesty (to avoid the researcher losing credibility), respect (voice for all participants), responsibility (of the researcher to take care of participants) and trust (not divulging sensitive issues). The implication of this was that I treated the issue of anonymity differently from the way western-based research does. I used totems to identify the participants and the landforms upon which the institution (village or school) was sited. This was a strategy to ensure academic integrity in my research.

In keeping with the *ubuntu* I/We relationship perspective, my consent agreements invoked consensus arrived at through circles of discussions. First, I gave each participant an informed consent form to read and sign. I then asked all participants to verbally express if they were willing to participate or not in my study. In doing so, I went further to check their acceptance of and agreement to the study; assuring them that they will be protected against any harm

(survival and protection) during the study and explaining the phases of the study (guidance). In line with Simons' (2009) advice to revisit the issue of informed consent while in the field, I sought their approval of how I was generating data (process consent) and changed it in light of new contexts (rolling or provisional consent).

I had an idea that, when doing a study in a community, participants' names should not be divulged but participants in my study suggested that hiding names was not a necessary requirement when doing research with them. These findings were in line with the arguments forwarded by other authors about anonymity in IK researches (for example, Keane, 2008b; Steinberg, 2003). Keane (2008b) avers that, in IK studies, anonymity may be viewed as insulting and condescending (showing disapproval of acceptance of others). Keane (2008b) elaborates her view arguing that, in the indigenous project she was undertaking, no-one wished to be anonymous. Steinberg (2003) also argues that hiding the names of research participants may be a ruse as the participants themselves know who they are and could be harmed by uncomfortable disclosures. Thus, anonymity is not always desirable or even ethical and, at times, only provides limited protection. In keeping with these views, I (along with the participants) took a position that I would not hide participants' names and, at the same time, would not directly identify the persons with their actual names, which is in line with the conventional ethical requirements as well.

I asked participants where they wished to be interviewed. All community elders chose open spaces near their homes and teachers and learners chose their science laboratories. Second, I wished to build trust and rapport in the context of asking participants to talk about their lives so that they could reveal stories that were personal and relevant to my study. I had to describe peoples' experiences and views over a long period. I held a total of six (6) in-depth interviews with participants at their places of choice.

For all teachers and learners, we agreed to use the first three letters of their surname and add an‘s’ to make a full name. Teachers were distinguished from the learners by adding a prefix, for example, Dr, Mr or Mrs, depending on highest educational qualification and gender of an individual. Some teachers however resisted the idea of attaching these prefixes to them as, in their view, this was colonial and they believed it would remove their attachment to an indigenous group. Anonymity was easy for both teachers and learners. It was also easier for schools and villages. I considered the site at which each school was built to come up with the names of these institutions. However, it was not possible to remove identification from information obtained during group interviews I conducted with community elders and learners during the study. I found that the issue of anonymity was resisted by all participants in the study. This finding regarding participants’ refusal to be anonymous in IK studies was also found by other studies with similar contexts (see, for example, Keane, 2008b). This issue was not the same as honouring confidentiality in my research process.

I considered confidentiality as an issue to ensure privacy of participants in the study. As Cohen, Manion and Morrison (2011) argue, confidentiality means the privacy of individuals is protected so that the data they provide will be handled and reported in such a way that it cannot be associated with them personally. This meant that, right from the start of interviews, I was obliged to discuss openly with them research procedures and how to deal with any problems that might arise.

I also coded the data obtained indicating the date of the interview, name of participant, site and time taken for the conversations. To avoid data disclosed in confidence to be revealed publicly in such a way as to cause embarrassment, anxiety or suffering to the participant disclosing the information (betrayal), I kept a separate file securely at home containing participants’ information.

The inter-linked community relationships had a bearing on the way I accessed my participants. While following their cultural protocols, I first negotiated my access through community leaders, 'v*ana sabhuku*' (village heads) and 'v*atungamiri vezvikoro*' (heads of schools). In terms of research study, Creswell (2007) refers to these leaders as 'gatekeepers'. Through these 'gatekeepers', I went beyond conventional ethics requirements and asked each participant to express verbally his/her willingness to participate in my study. As Keane (2008b, p. 1) advises that in IK research, 'ethical obligations cannot be sufficiently met through conventional contractual agreements'.

How I viewed ethics of my study is summarised in the flow diagram below.

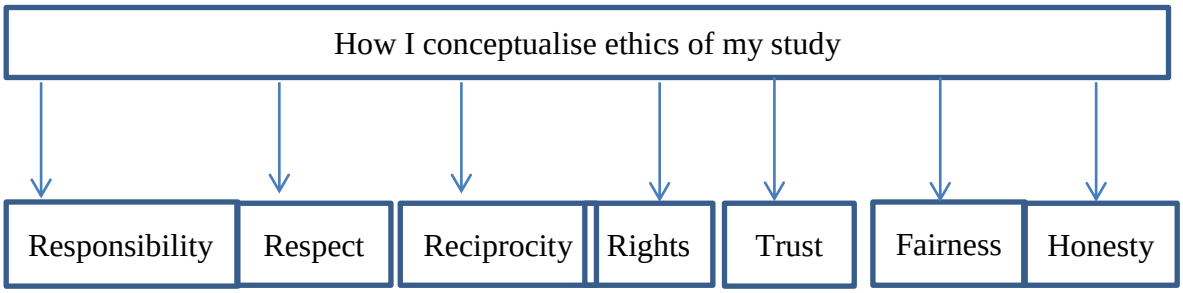



**Figure 3: My view of ethics in this study**

These ethical issues influenced the way I selected participants for my study.

## 5.6 Selection of Participants for the Study

### *5.6.1 Selection of the community elders*

In this study, I generated data from community elders. Some researchers show that community elders should be involved in providing directions for schooling, for example, Battiste (2004, p. 62) explains that 'indigenous peoples must continue to learn from our elders, cultural leaders and others about knowledge not cultivated in schools and universities'. Matsika (2012) observes that, in Africa, community elders are regarded as the custodians of IK. In keeping with these views and my own personal cultural experiences, this

study used community elders as a source of information on the IK of food preservation for school science teaching.

For this study, a community elder was a person aged sixty (60) years or above. This age limit served as a guide to the selection of all my elders, regardless of gender. Although, according to Goduka (2013) and Mpofu et al (2013), age does not necessarily translate into maturity, I felt that the criterion of an age limit would serve to select older participants with rich information on IK of food preservation based on their experiences.

In selecting elders, I first approached the community leaders including headmen, village heads and counsellors, as 'gatekeepers'. In line with Battiste's (2004) research approach, this meant that I had to follow cultural protocols, values and behaviours as an integral part of my study access. Also, Matsika (2012) observed that, in the Shona culture, the village heads are closer to the community members than headmen on a day-to-day basis. Thus, I sought access to the community elders from the village heads. I first approached the Ward councillor in Dzivaguru village and then selected nine members.

I also approached Gomoguru village head (VaZimuto) and explained the purpose of my visit and permission was granted. As a starting point, I then requested four members from his village (including himself) whom he thought could have IK of food preservation. The village head then identified a total of seven (11) participants from Gomoguru village. I found that there were fewer numbers of elders in Gomoguru as compared to Dzivaguru village. In summary, seven (7) elders (from Gomoguru village) and nine (9) elders (from Dzivaguru village) participated giving a total of sixteen (16) community elders involved in the study. Some elders in Gomoguru refused to be involved in the study citing political reasons. They thought I had a political agenda to address (even though my purpose was purely academic) because people in the area had experienced political violence in the last run up to

parliamentary elections held in their area. I treated this experience as a lesson that community researches could not be taken for granted. Instead, researchers should, at the outset, explicitly explain the purpose of their visit to get acceptance by community members. To allay their fears, I had to explain where I came from, what my agenda was and show them some of the papers that I had which confirmed my intention for the study. I even went on to seek community leaders' clearance for the study since these were linked to the spirit mediums of the area while others had political influences as alluded to earlier.

I also had other community members whom I met during my study who were not directly involved in the study. These community members contributed useful additional data to my research that I use in my findings chapter. Their contributions were also kept in a research journal discussed in section 5.6.1 of this chapter. The reason for this was that their data provided insights into the sort of data necessary for my study that could be generated from the participants.

### *5.6.2 Selection of the teachers and the learners for this study*

Participants involved in this section of the study consisted of science teachers and learners at schools. Unlike for community elders, I combined this description of teachers' and learners'selection because some teachers were involved in the identification of learners. So, treating differently these two groups of participants when selecting them, I believed would lead to repetition of some procedures done. As shown in Table 3 below, I selected a total of eight (8) teachers and seventeen (17) school learners for the study to answer my second research question: What elements of IK and methods of food preservation do the rural community members of Chivi District hold?

For minors (learners), I found guidance from Cohen et al., (2011) who suggest that permission should be sought from their headmasters, who acted on behalf of their parents,

and then from the learners themselves. Heads of schools (who were also part of science teachers) involved in my study suggested that they act '*in loco parentis'* for school learners to avoid loss of time for my research. I felt that I should still get their parents or guardians' consents first. Although these learners were indirectly involved in the study because they came from communities from which parents involved in the study lived, I still needed their participation. For this reason, each time I had an interview with them, in addition to written consents made, I would ask them to confirm verbally the consent of their parents/guardians. I followed Mpofu et al's (2014a, p. 9) proposal that the consent for indigenous research should be 'informed, confirmed and verbal' so, in this context, consent for learners was communal rather than individual. I aimed for collective ethics which Mkabela (2005) believes consists of individual, community, group and collective consents. I believe that each of these consents may be applied in a research process when researchers understand the interconnectedness of all things (including the spiritual) and require a long-term perspective in dealing with research issues. This contrast with a formal research consent that Keane (2008b) believes is sought only from the physical, individual person. This had an implication in terms of how I selected participants for my study.

In Table 3 below, I give a summary of the demographic details of the participants selected for the study.

**Table: 3**

**Demographic *details of participants in the study***

| **Community** | **Participants** | **Gender** | **Number** | **Total Number** |
|---|---|---|---|---|
| Gomoguru village | Community elders | Female<br>Male | 4<br>3 | 7 |
| Secondary | Teachers<br>Learners | Male<br>Female<br>Male | 5<br>2<br>2 | 5<br><br>4 |
| Dzivaguru village | Community elders | Female<br>Male | 7<br>2 | 9 |
| Secondary | Teachers<br><br>Learners | Female<br>Male<br>Female<br>Male | 1<br>2<br>8<br>5 | 3<br><br>13 |
| Total | | | 41 | 41 |

In summary, eight (8) teachers, seventeen (17) school learners and sixteen (16) community elders, giving a total of forty one (41) participants, took part in my study. The numbers of participants were different in these two communities.

There were more learners from Dzivaguru, that is, thirteen (13) took part in the study while Gomoguru had four learners who participated. Maybe this possibly could be that this larger sample understood the purpose and benefit of the study thus were eager to participate. I

expected Gomoguru to have more learners involved in the study based on its population size but I found that this was not the case. I found that the number of learners at the school had no bearing on the number of learners participating in the study.

I assured participants that they were free to withdraw from the study if they wished, that they were not going to be harmed in any way and were free to check, before my final report was completed, whether what I had written correctly reflected what they had said. At the outset, I informed schools that I was not there to comment that they were using good or bad teaching approaches. Malcolm and Alant (2004) noted that compiling and presenting evaluations could result in imposed and misleading analyses. However, it was impossible for me to avoid evaluations since I was interested in actions and conditions under which community members preserved their food and/or how to teach the topic in a school curriculum.

### *5.7 Reflections on my planning stage*

Not all of my planning stages, which consisted of research design, approach, access and ethics for the study, worked out the way I had planned them. By focusing on the topic 'food preservation', I discovered that, during data generation, there were topics in the science syllabus that could be taught using the same phenomenon. The research started with a proposition that I would have four (4) interviews for each participant from December 2014 to December 2015. Owing to the need to gather more clarity on various issues from the participants, I had to extend the period up to June 2016 making a total of six (6) interviews for each group of participants. Access was also a challenge especially to community elders.

Initially, I had planned that I would access my participants only through their community leaders but I discovered that community elders found it necessary to consult their political leaders as well to confirm that the purpose of my study was not political. So, in keeping with their demands, I had to seek for approval from political leadership as well.

## 5.8 REFLECTIONS ON MY RESEARCH INSTRUMENTS

My main instruments for the study were interviews and a minor instrument was document analysis. The selection of the main and surrogate instruments was informed by my culturally aligned conceptual framework for the study. In addition, there was incidental data that I had to generate during the process, for example, photographs of food artefacts and scientific testing like temperature testing, as my instrumental repertoires.

There were instances where I had to use other data generation techniques. For example, I had not planned to take temperature readings under the granary storing crops. Although I had to confirm the temperature underneath the granary using a laboratory thermometer, I went further and asked participants how they were able to tell that the underneath of the granary was cool enough to store crops as they claimed.

In document analysis, it was not easy to get all relevant information needed for the teaching and learning of school science. Although some documents such as textbooks were written by local authors in Zimbabwe, their style of writing was influenced by the way they were trained in colleges and universities. The documents provided little guidance for the integration of IK into school science teaching.

When interviewing, I found that there were sensitive subjects in my instruments, for example, the question requiring participants to compare traditional and commercially-processed foods. These participants felt that their food was processed differently from that of commercially-processed foods, so, to them, comparing the two would mean denigrating their cultural practices. I felt that asking these questions would suggest to participants that I was not considering their practices as important.

Although participant observations and site visits seemed to be an intrusion into community

members' individual lives, they yielded valuable information for my study. These instruments were a quicker way of accessing what community members were actually doing with regards to their methods of food preservation. Observations and site visits were useful in providing some practical activities that teachers could do to teach the topic 'food preservation' in schools.

## 5.9 DATA GENERATION METHODS

In this section, I describe what actually happened during my data generation process. I generated data for my phenomenon during fieldwork over a period of seven months (December 2014 to June 2016). My participants comprised both people who had acquired formal education and others without any. Some could neither read nor write, so information for my study could not be obtained from methods such as questionnaires or tests. I could circumvent this problem by reading the questions and writing responses from the respondents but as warned by Silverman (2001) that some could lie or guess at answers rather than providing accurate feelings of the phenomenon to the researcher. For this reason, I used methods including interviewing, observation of food artefacts and site visits. In interviewing, I would cross-check their responses to find out whether they agreed with each other or not. As a way of reflecting on my study, I kept a research journal and engaged in discussions with critical friends concerning my study approach. Both journaling and discussions with critical friends were continuous processes throughout the study. I now explain my choice and use of each of these data sources in detail.

In Table 4 below, I give a summary of data generation strategy.

**Table: 4**

***Data generation strategy***

| **Method** | **Aspects collected/focus** | **Tools used** |
|---|---|---|
| 1. Document analysis | Research question 1: rationale, content and pedagogy | Document analysis |
| 2. Interviewing-small group and focus group discussions; audio, and video-recording | Research questions 2 and 3: IK content and integration with school science teaching | Audio-recorders, open conversations and cameras |
| 3. Site visits and Participant observations | Research question 2: photographs, food preservation artefacts | Cameras |

Research journaling and discussions with critical friends were just reflection on my data gathering methods. As a result, they were not focused on any research question of my thesis.

### 5.9.1 Research journaling

In a research journal, I kept a record of my research process. Ortlipp (2008, p. 703) argues that a journal in a research study makes, 'experiences, opinions, thoughts and feelings visible and an acknowledged part of the research design, data generation, analysis and interpretation process for the study'. In light of this, the major aim of the journal was to 'talk about myself' and show my role as a researcher through reflection and writing. At every stage of my research, a number of changes were made to the research design, methods used and approaches taken.

There were a number of issues, though peripheral to my study that I found to be pertinent. I encountered many instances where my topic of 'food preservation' was topical in various discussions in public places during data generation. I recorded these cases since they were useful in rethinking the possibilities and potential of my study. For this reason, I became interested in the ways people were speaking and sharing ideas in relation to the food situation in Zimbabwe. This meant that I recorded their day-to-day languages, thoughts and focus in relation to the food crisis in Zimbabwe. I also had to analyse my science curriculum and policy documents in light of this.

### 5.9.2 Document analysis method

I had to analyse some science documents in order for me to answer the first research question of my study: What elements of IK methods of food preservation do curriculum documents give to the teaching of science in schools in Zimbabwe? Marshall and Rossman (2006, p. 107) posit that, in a research study, documents are 'rich in portraying the values and beliefs of participants in the setting'. These documents are what Goetz and Le Compte (1984, p. 153) refer to as 'artefacts' to describe the assortment of written and symbolic records which have been used by the participants in a social group. There are many documents that were selected for analysis in my study. Figure 4 below shows the design I used to select documents for the study.

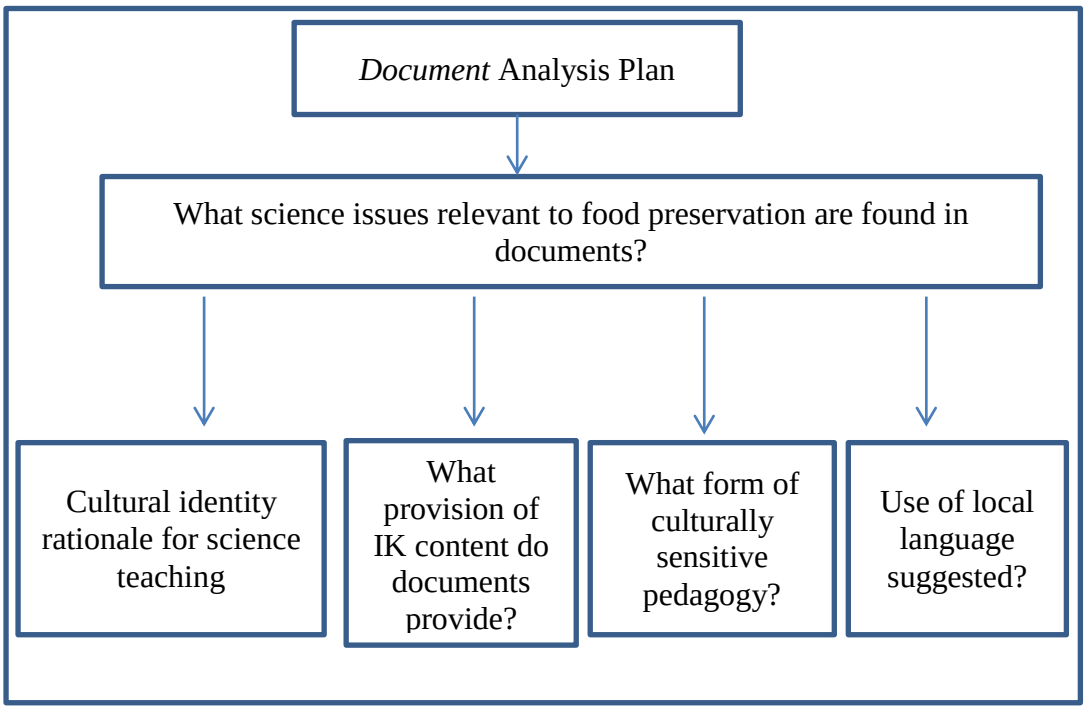



**Figure 4: Document selection design for my study**

Initially, I found 30 documents and selected 15, which were related to the teaching of Integrated Science in Zimbabwe, for analysis. As criteria for this selection, I looked for what teachers identified as 'useful' documents they use in teaching school science in Zimbabwe. I also visited Education Officers at District level and enquired about documents at both school and policy levels that were relevant for the teaching and learning of school science and for any IK aspects relevant to the teaching of the topic of 'food preservation' in school science.

The following Table 5 shows documents consulted and their selection criteria.

**Table: 5**

***Documents Consulted***

| **Document** | **Selection Criteria** | **Reason for Selection/Rejection** |
|---|---|---|
| Science Syllabus | Aims, content and methodology suggested | Whether it is explicit on the aims, content and methodology that should be derived from culture |
| Teachers' books for teaching | How do teachers scheme for the topic 'food preservation'? What materials and resources do teachers cite as relevant for teaching the topic? | How do teachers scheme? What practical activities do teachers use as examples in school science teaching? |
| Pupils' textbooks | What are the main textbooks used? Who are the authors of textbooks? Any cultural examples, diagrams and pictures a textbook uses? | Does the textbook contain the topic 'food preservation'? |
| Science curriculum and policy issues | What science teaching guidance at National and local level is provided? Are there any Ministerial policies and regulations? Any policies on food in Zimbabwe? Any reference to culture by the document? Any environmental management policies related to food? Any regional bodies emphasising the use of IK in schools? | Is the policy relevant to the teaching of science in schools? Any relationship to culture with reference to required competencies, content and teaching methodologies? |

### 5.9.3 Use of open conversations

In this section, the intention was to answer research questions 2 and 3 of my study. According to Smith (2009), an interview involves conversations so I generated data from each participant through conversations to answer my research questions. However, I took Johnson's (2001) advice that a conversation in a research study should follow wherever the participant's data leads.

To facilitate the interviewing process, I developed an interview guide. Leedy and Ormrod (2010) define an interview guide as a document that provides topics which are freely explored and probed and that asks questions that serve to elucidate the particular subject (see interview protocol attached in Appendix J). I treated initial topics for my study as provisional departure points and therefore some were discarded as the process continued. Kvale (1996) advises that all interviews conducted started with an 'ice breaker' or 'easy to answer' questions. This guided me to start my conversations on social life and then move on to topical issues. However, I noted that the informal conversational interviews were difficult to pull together and analyse. Prior to the discussions, I pilot-tested my interview protocol.

#### *5.9.3.1 Piloting the interview protocol*

The reason for piloting the interview protocol was that I wanted an interview that would generate the data required to answer the research questions. In line with Chenail's (2011) advise, I asked my colleagues for feedback to identify ambiguities and difficult questions and then either discarded them or refined them where necessary. I agree with the purpose of a pilot study for any investigation but I also realised that my colleagues were academics who were likely to provide a perspective similar to mine that would not answer my research questions whose purpose was to explore cultural knowledge in indigenous communities. So, I realised that the pilot group should also contain community elders. For this reason, I included

some community elders in the pilot study whom I thought had a worldview suitable to provide answers about IK of food preservation needed for the study. Also, drawing insight from Punch (2006), and Best and Kahn (2000), I wanted to check for the relevance and adequacy of my research instrument in terms of how it would gather data to answer the research questions. In keeping with the 'interviewing the interviewer' technique, as suggested by Chenail (2011), I assumed the role of a study participant and enlisted a colleague (PhD student) to conduct the interview prior to data gathering. I requested my friend to give feedback to identify ambiguities and difficult questions, and to assess whether each question gave an adequate range of responses to answer the proposed research questions. After the pilot test, we discussed the interview and she suggested re-wording the questions and shortening them for clarity. As a result, a total of six questions were considered viable from ten. I reformulated the questions and held another pilot test which she critiqued and reviewed. Still not satisfied with the document, I held a series of meetings with my PhD thesis supervisors who critiqued my explanations in relation to what I required from each research question. Consequently, five topical areas were considered suitable as a starting point for my study (see interview protocol Appendix J). My interviewing strategy was that I would move from community elders to teachers and learners at school or vice versa depending on the availability of the participants. Kaya and Lyana (2014) suggest that moving from one participant to another is a way of cross-referencing various sources of information and obtaining a comprehensive understanding of the research problem. My pilot study served to build trust and rapport with respondents.

The following diagram serves as the basis for the design of my interviews with my participants.

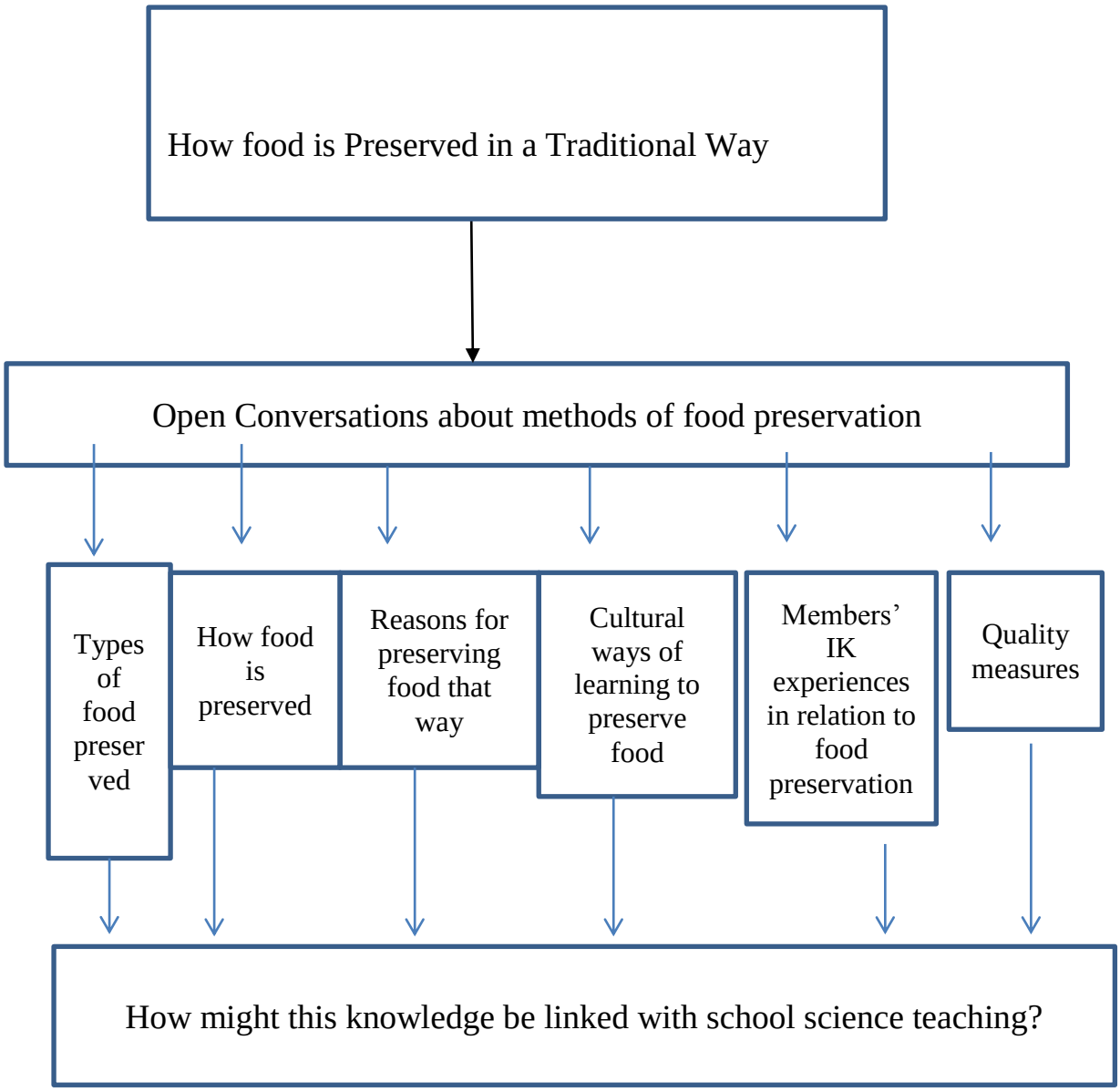



**Figure 5: Interview plan for my study**

The above issues contained in an interview plan served as themes for my open conversation questions. In many cases, I explored participants' views even if they digressed from my initial focus. In keeping with Creswell's (2007) suggestion that the qualitative data generation process should be iterative, I interviewed teachers, learners and community elders by moving back and forth between them.

#### *5.9.3.2 Open conversations with community elders*

##### 5.9.3.2.1 Language used for conversations

In order to facilitate my conversations, I translated my interview protocol into the vernacular language (see in Appendix K included). All discussions were held using this local language, Chishona. Polanyi (1962) argues that language is regarded as a vehicle of knowing and thought and carries meanings which we ascribe to words. For this reason, this study used the local language of Chishona to articulate the traditional knowledge of food preservation with the community elders. In addition, village heads were interviewed to obtain information on the general profile of the study communities, the local environment, occupations of the residents, food situation within the each village and the traditional strategies of food preservation. This was done to establish the context for the study.

##### 5.9.3.2.2 Small group discussions

I held four (4) one-to-one conversations with community elders moving from door-to-door in their villages. For community elders, two (2) one-to-one and ten (10) group interviews were audiotaped and transcribed verbatim into Chishona and typed into Word documents.

In conversations, I assigned community elders codes derived from their totems. In keeping with the *ubuntu* philosophy, I showed respect of the elders involved in the study by adding a prefix '*Va*' before their totem names. This might sound a western style of research approach; however, '*Va*' is a Chishona word for the titles of Mr, Mrs, Dr or any other that shows respect to the individual. Each time I interviewed them, I also added their totemic names.

The first interview explored community elders' knowledge of traditional methods of food preservation. Participants provided their demographic details including their education, work and personal information. Questions seeking demographic details were evenly spread

throughout the interviews starting from one-on-one sessions to group discussions. While I was conducting one-on-one interviews, I realised that both communities had community programmes that required them to meet once a week during their rest days, or any other day, as necessary. So, I requested that we meet for interviews as a group after their community deliberations and all agreed to that arrangement.

#### 5.9.3.2.3 Focus group discussions

I held twenty-one (21) focus group interviews in the form of '*indaba*' or '*musangano*' (meetings) which is characteristic of the Shona practices found by Mapara's (2009) study on IK among the Shona ethnic groups in Zimbabwe. The study found that the Shona people come together at a specific meeting place and discuss issues. For this reason, I met community elders at a place of their choice. I had seven (7) members in one community and nine elder at the other community, giving a total of sixteen (16) elders. Best and Kahn (2000) explain that interviews provide different ideas of an issue under study. So, I wanted more people to be interviewed at one time to provide perspectives to improve the quality of the findings. In focus group discussions (FGD), as Kaya and Lyana (2014) maintain, the discussant knows the topic to be covered in advance and the group consists of the researcher as a moderator and the participants. Literature shows that FGD may consist of seven (7) to twelve (12) people (see, Marshall, & Rossman, 2006; Fontana, & Frey, 2000). My focus group discussions generally comprised seven (7) to seven (10) people.

The FGD approach promotes what Fontana and Frey (2000) call 'group think', a situation which Cohen et al (2011) argue that it is difficult to ensure anonymity and confidentiality of the data. To deal with these challenges, at the outset, I explained to all participants that we would take turns to talk during our discussions. I made it clear that everyone should contribute to the conversations. I addressed the issue of anonymity differently from the

requirements of conventional research study by going beyond institutional requirements.

All interviews were held at the participants' places of choice. At Gomoguru village, interviews were held under a tree shed while, at Dzivaguru village, they were held on a '*ruware*' (rocky out-crop) in their village. In our discussions, I found information in relation to the preservation of grains, sweet potatoes, meat, vegetables and milk. Through agreements with participants, I took notes and tape-recorded interviews, transcribed and translated them from the local language, Chishona, into English.

#### *5.9.3.2.4 Open conversations with teachers*

I held twenty-four (24) conversations with eighty (8) teachers, conducting three (3) conversations for each teacher at two schools. Eighty (8) of these were audio-taped, transcribed and notes added. All conversations held with teachers were one-on-one, except at Dzivaguru Secondary School where, in addition to these interviews, teachers were engaged in four (4) brainstorming sessions on topics related to traditional methods of food preservation. Patton (2002) defines a brainstorming session as an activity which involves tasking a team to generate ideas to solve a problem. So, in my case, the session consisted of small group activities that encouraged teachers to focus on topic, IK of food preservation and school science teaching, and require them to contribute freely to free flow of ideas regarding the phenomena.

I was guided by what I consider as the rationale for science education in my thesis. In developing the rationale guiding what I regarded as relevant science education, I remained mindful of what some extant researchers have noted. For example, UNESCO (2001) calls for sustainable development, and De Boer (1991) emphasises education for socio-economic development and scientific literacy. More recently, Vhurumuku, Holtman and Mikalsen (2008) suggest the development of human resource needs, while Hassard and Dias (2009) cite

science and technology as the main goal for education.

My interest in this study lay in looking at the cultural relevance of science education which was justified by drawing from Odora-Hoppers' (2002) argument of relevant science teaching and learning for indigenous learners in Africa. She argues that, for indigenous learners, relevant science refers to one that affirms the learners' cultural identities. Archer, Dewitt, Osborne, Dillon, Willis, and Wong (2010) postulate that, in culturally responsive teaching, cultural identity takes precedence in determining learning. Calabrase and Tan (2009) believe that this cultural identity would cultivate a sense of ownership of the learning process among learners. In this study, conversations with all participants in relation to knowledge integration were guided by the view that relevant teaching involves linking with learners' culture.

#### *5.9.3.2.5 Open conversations with school learners*

At first, Form 4 learners were engaged in small group discussions (SGD). At Dzivaguru, as their numbers in the study increased, I shifted to focus group discussions (FDGs). In keeping with Denzin and Lincoln's (2000) research approach, I engaged them in storytelling and in free writing on a variety of issues related to food preservation. I held ten (10) conversations (two SGDs, eight FDGs) at both schools and four free writing sessions with Dzivaguru learners only.

Cole (2001) and Elbow (2000) describe a free writing session as involving learners responding to questions in an undirected way.

**Picture 5: Researcher with learners in one of the free-writing sessions**



(Source: Free-writing session in Dzivaguru secondary school)

I asked learners with cell phones to take photographs of the preserved foods and materials their parents use to store food and also to bring samples of the preserved foods for conversations. Learners were also were requested to make drawings of materials their parents use to preserve food and played games related to food preservation.

I supplemented my 'open' conversations with the use of participant observation of IK of food preservation artefacts and a review of curriculum documents. I compared multiple data sources in search of common themes.

## 5.10 Participant observations on IK of food preservation artefacts

I observed community elders' food preservation artefacts. The following diagram shows the design for my participant observation.

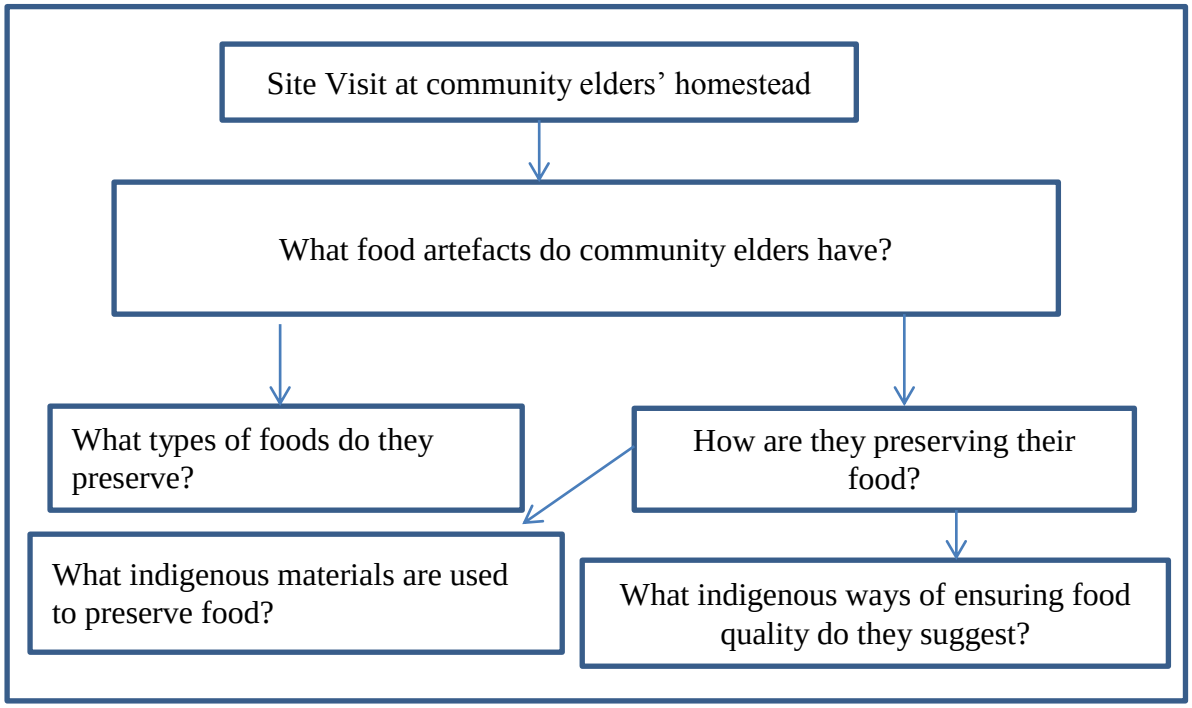



**Figure 6: My participant observation design**

Marshall and Rossman (2006) advise that a qualitative researcher should have first-hand involvement in the social world chosen for the study. I immersed myself in the setting that permitted me to hear, to see and begin to experience reality as the participants do. This approach was a useful tool to answer the second research question guiding the study. Hornsby-Smith (1993) argues that the researcher visiting the setting to conduct interviews may unintentionally uncover much data and many themes for conversations.

Participant observation, related to my proposed methodology, ICSV, enabled me to request to visit the homesteads of interested participants to check food artefacts personally that, I believed, would increase the quality of my research data. I used an observation protocol and also took photographs of the community elders' food artefacts while being cognisant of the limitations related to participant observation as a data collection method. Kaya (2014) points out that researchers may not be easily accepted in the communities under study. However, this was not the case for my research since I was familiar with the culture and way of life

within the study area.

### 5.11 Reflections on my data generation methods

I encountered ethical challenges while I was generating data. For example, '*Sabhuku*' (village head) was running a tuck shop and some elders had to go for mid-week church meetings. This meant that I had to reorganise my plan since I had arranged to meet them at their homes. My visits also coincided with some community gatherings such as cultural merry-making activities and funeral ceremonies. In my plan, I intended to meet my participants on Wednesdays and Thursdays, the two communities' resting days. I had to change my programme upon arrival since unplanned events could not be communicated to me as they had no cell phones. Initially, we had agreed with all participants that we would meet in the afternoon of the proposed days, but we then changed this to the morning upon realising that unplanned community meetings were usually held in the afternoons.

### 5.12 APPROACHES TO DATA ANALYSIS AND INTERPRETATION

In this section, I describe how I analysed the data of my research. I derived my codes for the findings in line with Patton's (2002) suggestion of deriving theory from data. Punch (2009, p. 182) concurs with this view arguing that grounded theory analysis 'aims directly at generating abstract theory to explain what is central in the data'.

I coded the first group of repeating units as 'use of IK from the community'. I took advice from Strauss and Corbin (1998) in coding and recoding the repeating ideas to identify any connectedness and therefore collapsing or merging themes. I continued this process until links between themes were revealed. Keane (2008a) proposes that coding should continue until relationships between categories are well supported. In order to check for the quality of my analytic framework, I used peer critiquing to verify my coding (see Table 5 above). This

checking was done by moving back and forth through the data. Bryant and Charmaz (2007) contend that grounded theory is an iterative, comparative, interactive and abductive method. This meant that I had to go back and forth between analysis and data generation (iterative), comparing data, to sharpen my emerging analysis (comparative and interactive) and making sense when I came across surprising findings during inductive data generation (abduction).Table 5 above shows how I checked for the quality of my data.

### 5.12.1 How I used thematic content analysis to analyse science policies and documents

I used thematic content analysis, as explained by Bernard (2010), to analyse my documents. Bernard (2010) explains that content analysis involves category development followed by describing and interpreting the meaning of the categorised data to arrive at substantive conclusions. In other words, issues, themes and categories of analysis emerged out of the data rather than being imposed prior to data generation and analysis. This search for raw data to discover emerging themes is similar to what Creswell (2007) refers to as 'inductive analysis'.

In keeping with Merriam's (2009) suggestion on qualitative data analysis, the search was guided by my literature as well as my conceptual framework for study. This literature foregrounded four aspects which I considered to be relevant for science teaching in schools (see Figure 3 above). To identify the links, I searched for relevant curriculum disconnections and connections as explained by Mpofu et al (2014b) in relation to affirming learners' cultural identity rationale for science teaching. In line with Guest, MacQueen and Namey's (2012) strategy of data analysis, I looked for convergences (how things fit together leading to classification of the data) and divergences (flushing out the categories) of my data. This approach led to an extension (building on items of information already known), bridging (making connections between different items) and then surfacing out (proposing and verification) of information related to IK methods of food preservation. Howell (2013)

proposes a strategy of checking for curricula links to make sense of the coded and categorised data through simultaneous evaluation of similarities and differences. So, I checked to see if parts of the argument did not contradict each other and if the conclusions followed from the premises.

My approach involved cross-examining all my documents vertically, horizontally and concurrently in an integrative manner. All documents were as advised by Patton (2002, p. 713), 're-observed, re-analysed and re-interpreted' to check the links between theory and coded data (correspondence). This method is similar to what Glaser (1992) calls 'dip and skip', where one would intensively code some parts of the data (dip) and compare data for any possible conceptual patterns and issues that tie together pieces of data and different cases in the data (skip). I used this technique throughout my analysis of data for my thesis. This approach enabled constant comparisons of my data as an analytical strategy as suggested by Urquhart (2013) who explains that the technique involves comparing cases of data labelled in one category with those another case. In the context of my study, this meant I had to compare through exposing my codes and categories to rigorous scrutiny. It is this strategy that Charmaz (2006) believes ensures that quality of data may be achieved. While scrutinising my data from documents, I realised the extent of my data for analysis. This search for links helped to reduce the data and discard what I thought was irrelevant, nonetheless, no data related to the purpose was excluded due to lack of a suitable category. In sifting through my document data, I looked for the information that was relevant to answer my first research question.

### 5.12.2 Interviews and observational data analysis

My interview and observational data analysis was thematic. In keeping with an emergent design, I started both interview and observation data analysis following wherever the data

led. This analysis started simultaneously with the fieldwork and continued throughout the study. Initially, I ran my data from all field notes, observations and from audio-taped interview transcripts 'open', a term coined by Glaser (1978). This 'open' system involved 'coding of the data in every way possible'. It required me to read and re-read it several times to get the sense of it. Identification of units of meaning in the data was informed by grounded theory analytic tool. In 'breaking open' the data through open coding, I discovered there were new ways of connecting my data, a strategy that Strauss and Corbin (1990) call 'axial coding'. Punch (2009) describes 'open coding' as a close examination of data, identifying conceptual categories implicit or explicit in it and the theoretical possibilities the data carries. For Urquhart (2013), 'open coding' is about attaching initial labels to the data. In other words, by open coding of my data, I looked for data relevant to my research questions, discarding irrelevant information and focusing on the direction the data suggests. I related the codes to each other and looked at the nature of the relationships between those codes, which Glaser (1978) refers to as 'theoretical coding technique'. The Table 6 below shows the steps I followed to code my data.

**Table: 6**

***How I coded my data***

| **Type of Coding** | **How I coded the Data** |
|---|---|
| 1. Open | I coded line by line fleshing out what I thought was important. I looked for indicators from the data given as statements by participants to infer a concept. My labels were 'in-vivo' (generated from what participants exactly say). |
| 2. Axial or theoretical | I observed for connections of the data by considering the interconnections of the data to the categories created by open coding. To identify connections, I looked for explanations, reasons, feelings, attitudes, description and interpretation of relationships and contextual meanings to the methods of food preservation given by participants. |
| 3. Selective | I selected a central core category based on my research question. All other aspects were related to the central concept. Selected aspects include: process and mechanisms of the process of food preservation. |

I was guided by Huberman and Miles' (2002) and Creswell's (2003) advice that codes can be developed *a priori*. So, I developed codes for analysis informed by my conceptual framework, research questions and problem as well as the key ideas I brought from literature. The reason for creating codes before fieldwork as suggested by Lincoln and Guba (1985) was to tie the research questions directly to my data when developing themes. This would mean working deductively, which Patton (2002) defines as 'reasoning that works from general to

specific'.

To develop theme boundaries, I used Guest et al's (2012) strategy of key-word-in-context (KWIC) to cluster each idea around an overarching issue or theme. This clustering resulted in a reduction in the number of my units, an analytic strategy which Creswell (2007) calls 'pattern coding'. To check whether the codes 'fit' the data, I drew insights from Huberman and Miles's (2002) double coding strategy. In keeping with this strategy, I used peer debriefing to legitimise the data interpretations through using a fellow doctoral studies student in the science department who acted as 'devil's advocate' to keep my data as honest as possible. For contradictory information, I asked participants to clarify their ideas. To comply with the notion of 'redundancy' in a research proffered by Lincoln and Guba (1985), I stopped data collection and analysis for this study when I found that no new relevant information was being uncovered.

## 5.13 QUALITY ISSUES IN MY ANALYTICAL PROCESS

I had several strategies to ensure quality for my findings. First, I held discussions with my friends who critiqued my work. The following paragraph shows how this critiquing was done.

### 5.13.1 Discussions with critical friends

I had several platforms that helped me to discuss critical issues concerning my study with friends. I presented papers at conferences both locally and internally. These academic foras included: IKS project South African-Mozambican collaborative research programme in October 2013, Southern African Association for Science and Mathematics Education (SAARMSTE) conferences held annually covering the period 2014 to 2016 and post graduate research degrees held four times a year at the University of Witwatersrand, Johannesburg,

South Africa. These discussions centred on critiquing my work in order to develop a coherent argument and organisation of work in relation to all chapters of the thesis. This critiquing is shown in Table 7 below.

**Table: 7**

***Ways to ensure quality of the findings***

| **Stage of my research** | **What I have done to ensure quality of data** |
|---|---|
| Planning | Discussions with colleagues at the University of Witwatersrand (Wits), Johannesburg, South Africa |
| Proposal | Peer critiquing at science conferences organised by Wits (SAARMSTE, SAARMSTE Research schools, Methods workshops at Wits, Formal review at Wits Postgraduate Research Degrees weekend school March 2014, Faculty-Wide Competitions at Wits, October 2014) |
| Piloting data generation | Interviewing colleagues and some community elders in the study area |
| Data generation and preliminary analysis | Peer critiquing at Wits Postgraduate Research Degrees weekend school, 13-14 May 2016 |
| Code checking and discussion | Peer critiquing at Great Zimbabwe University doctoral workshops, for example, held on 18$^{th}$ of May 2016 |
| Final checking | Wits Postgraduate Research Degrees weekend school, writing retreat organised by Faculty of Humanities, Wits, November 2016 |

The second aspect involves ways to ensure trustworthiness in my research findings as I describe below.

### 5.13.2 Strategies to ensure trustworthiness of the findings

#### 5.13.2.1 Introduction

Lincoln and Guba (1985) maintain that all research must respond to the canons of quality. For this reason, I consulted all key informants in the study about methods of food preservation as data emerged from the analysis so that their 'truths' could be corroborated. To achieve 'truths' or a concept which Graneheim and Lundman (2004) calls 'trustworthiness' in a qualitative study, I was interested in the processes of credibility, dependability, transferability and confirmability of the findings. In the following paragraphs, I explain how I achieved these processes for my data.

#### 5.13.2.2 Credibility

According to Marshall and Rossman (2006), credibility or believability is the confidence in how well data and process of analysis addresses the intended focus. Chilisa (2012) defines credibility in terms of what evidence should represent the multiple realities revealed by participants as adequately as possible. To ensure credibility of the findings, I was interested in how participants described and interpreted their human experiences in a way that revealed their accuracy and 'truth'. My study specifically focused on understanding integrating IK methods of food preservation with school science teaching in a rural cultural context of the Shona people in Chivi, Zimbabwe. But, based on my interaction with the general public, I realised that even urban set ups could yield valuable information related to the phenomenon under study. In terms of selecting participants, I asked for the oldest community elders since these were considered sources of IK methods of food preservation based on their extensive rural experiences. This view did not turn out to be correct as young people were also found to be useful sources of information. My study did not consider formal education as a requirement for participation since, as noted by Matsika (2012) that from an African point of

view; IK is acquired mostly through observation and orally. I attempted to understand this phenomenon broadly through rich insights provided by the community elders based on their cultural knowledge

In light of Wolcott's (2009) suggestion that the researcher takes the findings to the participants seeking their agreement and asking them if the results are plausible, informative, or thought provoking, I carried out a number of strategies. First, I held meetings with participants to judge the similarities and differences between categories. Leedy and Ormrod (2010) define this as a 'respondent validation', where study conclusions are taken back to the participants to check whether conclusions were valid and the participants agreed with them. This validation process enables participants to recognise the findings by confirming rather than verifying them. Charmaz (2006) describes the notion of 'confirmation of findings' as a situation where all researchers' assertions, findings, interpretations and research approach are linked to the data in readily discernible ways. Excerpts from the field notes accompanied arguments raised to establish the fact that the data and interpretations of the inquiry were not merely figments of my imagination. I also captured their varied views on the phenomenon.

In keeping with Lincoln and Guba's (1985) proposition to ensure credibility of research data, I spent eight months studying (prolonged engagement in the field, January 2015 to August 2015) and observing the phenomenon persistently. My assumption was that, by staying in the field, rapport with participants would increase and they would volunteer different and more sensitive information than they did at the beginning of the research study. I took the data and interpretations back to the people from whom they were derived and asked them if the results were plausible, a technique that Merriam (2009) calls 'member checking'. I shared my research report, compiled from the interviews, with community members for their comments. Where I found reasonable explanations from the participants, the credibility was enhanced. I

also used what Kvale and Brinkmann (2009) refer to as 'peer debriefing', where different people are brought in to help in an instrument improvement process (interview protocol and document analyses – see Appendices J, K and L), findings, conclusions and analysis. These instruments were pilot-tested to check whether the methods were appropriate or too complicated. My approach involved the use of multiple methods including interviews, document analysis, participant observations, storytelling, artefacts and poems.

#### 5.13.2.3 Transferability

Another practice I used to promote accuracy of the research findings was transferability. The concept of transferability, which Lincoln and Guba (1985) call 'generalisation in a qualitative study', shows the reader's decision whether or not the findings can be transferred to other settings or groups. To achieve this, I used more than one source of data to provide information as alluded to above. Rossman and Wilson (1994) contend that different methods are used to corroborate, elaborate or illuminate the research questions. So, for this reason, I used different sources to answer my research questions adequately. My study focused on one situational unique case of food preservation within the Murambwi locality in Chivi, Zimbabwe. Consistent with Graneheim and Lundman's (2004) contention that qualitative research should be done through a provision of a rich and rigorous presentation of the findings, I used appropriate quotations to enhance their transferability. The use of a variety of findings also had a bearing on how I communicated my interpretation. For Clarke (2006), the use of different results serves to contextualise the theoretical propositions of the research study. In other words, a variety of descriptions of the phenomenon enables a reader to judge whether the findings are applicable to his/her own settings.

#### 5.13.2.4 Crystallization of data

I gave a dense description of the participants, context and setting of the research through a

'storytelling research approach' as described in a study by Keane et al (2016). In this description, I created a strong image of the lived experiences of the participants through a comprehensive presentation of the situation. I hoped that this approach would crystallise my issues. This concept of 'crystallisation' was coined by Richardson (1994) as a method of analysis that included creative forms of representation in order to tap deeper thinking. Richardson uses crystals as a metaphor to describe the data analysis process. In the context of my study, I wanted to capture the different ways participants think about the phenomenon of food preservation. To facilitate this crystallisation, I purposively selected participants who were knowledgeable about the topic under study who I regarded as suitable for my study. However, it is important to note that research findings are produced by constantly changing interactions between researchers and the participants – a quality issue known as 'dependability' (consistency of issues over time).

#### 5.13.2.5 Dependability

In line with Chilisa's (2012) proposition on ensuring dependability of data, I coded the data, waited for two weeks, and re-coded the data to see if the results would be the same. To achieve consistency, I used the same interview questions for all participants, guided by topical areas contained in my interview protocol. I also held open dialogues with participants in an attempt to produce similarities and differences of content that were consistent or dependable over time as suggested by Lincoln and Guba (1985). This strategy resembles Clarke's (2006) suggestion of an 'audit trail' in a research. As indicated in Table 5 above, I presented my work, from the beginning to the end, to my fellow PhD friends at the University of Witwatersrand so that the process by which conclusions were made was apparent. This led to the opening up of the whole research process to scrutiny as advocated by Clarke (2006), or subjecting research through auditing as suggested by Lincoln and Guba (1985). As such, I

availed all my research approaches to the auditors for improving the quality of my qualitative research and to confirm the findings.

#### 5.13.2.6 Confirmability

For confirmability, I took Walcott's (2002) advice that the findings in a study can be traced to data derived from the informants and the research settings and not to the researcher's biases. As a result, critical friends assisted me as described above. Lincoln and Guba (1985) argue that critical readers are necessary in a study to check logical inferences and interpretations of the data. In line with Marshall and Rossman's (2006) critical reading was reflective of an auditing process where I tried to find out whether my colleague would arrive at the same comparable conclusions, given the same data and research context. Put differently, by confirming research findings, the researcher makes interpretations transparent to the reader for critiquing. In doing so, I believe that the quality of my research findings was enhanced.

#### 5.13.2.7 Cross-checking

I cross-checked all my data sources for this study. Information obtained from the community elders, science teachers and learners was compared within and between these groups. For example, I took pictures of community elders' food preservation artefacts to the teachers and learners and discussed them with them. In turn, I took what teachers and learners said about the phenomena to the community elders so that they could give their own views. What I found from interviews was further verified with site visits at the community elders' homesteads. I cross-checked community members' assertions by asking other members to provide explanations of the phenomenon during conversations. I observed participants preserving their foods and compared this with what other members suggested during conversations. As alluded to above in section 5.3.1 of this thesis, this method is regarded as a form of crystallization of data where a researcher would get data from different sources on

the same phenomenon.

#### 5.13.2.8 Representation of reality

I needed to avoid the problem of not showing how reality and participants were represented in the study, a phenomenon which Denzin and Lincoln (2000) call a 'crisis of representation'. To counter this problem, I needed to describe what Urquhart (2013) calls 'reflexivity' of the study. This meant that I had to reflect self-critically on my own views, biases, beliefs and experiences, and show how these might affect the entire research process. I therefore requested my fellow PhD friends to use what Raven (2008) refers to as their 'critical eyes', a strategy where ideas necessary to refine the methodological approach are offered. This was also consistent with what Patton (2002) calls 'multiple interpretations' of the phenomenon, where different ideas related to the phenomenon are provided. One of these friends was a Shona-speaking Zimbabwean who understood the cultural circumstances that influenced my interpretation of the findings which were in keeping with Alvesson and Skoldberg's (2009) advice on qualitative research which is to examine findings and place them within the social and historical context of a study.

I also found guidance for research from Chilisa (2012) of keeping a record of reflexivity, where I exposed my background and ways of perceiving reality, perceptions, experiences, ideological biases and interests during the research. I did this to avoid over-involvement that would have threatened the credibility of my study. To check on this, I kept all these personal issues in a research journal that diarised all events that affected the way my study was conducted, analysis made, interpretation reached and conclusions made.

For this study, I also kept a 'reflexive journal' that contained information about my schedule and logistics (date and time to meet participants), insights, limitations related to my subjectivity and reasons for methodological decisions. I did this to avoid what Clarke (2006)

refers to as ‘hygienic’ representation of research, where the researcher ignores problems and emotional connections to the research process.

## 5.14 HOW I REPORTED MY RESEARCH FINDINGS

In this section, I describe how I reported my findings through what Geertz (1973) calls a ‘thick description’ of a phenomenon. This strategy, as described by Kvale (1996), should capture rich quotations from the participants’ accounts of the phenomenon that, in turn, led me to a situation similar to what Patton (2002) calls ‘thick interpretations’ of the issue under study. These authors described this form of interpretation as gathering a comprehensive database on the phenomenon that allows sense making of the findings. For example, rich descriptions and interpretations were realised through the use of interview quotations. However, Kvale (1996) argues that interview quotes are necessary but cautioned that, for them to be useful, they should be linked to the text, that the contexts of the texts should be clarified and quotes should be interpreted for readers to understand their meaning. For this reason, I included excerpts from field notes to accompany arguments as a way to ensure quality of the findings.

In addition, I could not avoid asking some participants to check the rough report I had done. Kvale (1996) advises that direct quotations and attributed judgments in reports require the explicit permission of the respondents. Simons’ (2009) also advised that interviewees should be given an opportunity to see their comments and observations about the phenomenon and to edit and add in, if necessary, criteria of accuracy, relevance and fairness. The implication for this is that it is my responsibility to publish results that are accurate, fair and relevant to all stakeholders and interested parties.

As an interpretivist researcher, I was not expecting all my research findings to be readily or directly translated into general science education policies or strategies. Rather, as Bryman

(2012) explains, qualitative findings could be used in other similar contexts.

In the following chapter, I discuss data analysis (1) for my study.

# CHAPTER 6: WHAT DOCUMENTS INFORM US ABOUT IK INTEGRATION INTO SCHOOL SCIENCE: ANALYSIS OF POLICIES AND SCIENCE DOCUMENTS AND PRESENTATION OF FINDINGS

## 6.1 INTRODUCTION

In this chapter, I analyse and present findings in relation to the first research question guiding my thesis. In this question, I sought to understand elements of IK contained in policy and science curriculum documents that may guide the integration of IK of food preservation into school science teaching.

To identify my documents, I used codes by capitalising the initials of the name of the document. For example, MT-D1 for main textbook, showing initials of the name of the document in capitals separated from the number (1) assigned to the document using a dash. I did not use a particular format in numbering my documents but I did it in a way that I thought would best assist me in the analysis. For this reason, what teachers indicated from interviews as their main textbooks, I coded document one (D1). My numbering was done following the order of how I found the document. This means that D1 was the first document I selected and therefore, D15 the last.

My analysis and interpretation of findings were guided by the grounded theory. Donald, Lazarus and Lolwana's (2010) view on social constructivist perspective, that emphasises a shared construction of the meanings through social interaction, guided my framework development. This relates to the Vygotskian notion of learning as an interaction between

learners and teachers with curriculum materials as postulated by Vygotsky (1978). In line with this view, I searched for documents that provided guidance on the teaching and learning environment and that promoted effective learner-learner and teacher-learner interactions.

At first, based on a literature search, I selected thirty (30) documents related to science education. I found that some of these documents did not specifically focus on science teaching and learning. So, from these thirty (30) documents, I selected fifteen (15) documents I thought contributed to effective teaching and learning for science education. Extant literature shows that the concept of 'effective teaching' has gained significant attention in the field of science education worldwide. For example, Hassard and Dias (2009) explain that some would consider effective teaching in terms of sequencing content in accordance with Piagetian levels of cognitive development. Others, inclusive of Tytler (2003), describe effective teaching in terms of process which focuses on teacher knowledge and skills and can be observed through classroom observations. For this study, I did not focus on understanding knowledge integration through classroom observations and neither did I explore the phenomenon through cognitive development of learners. Rather, in line with Odora-Hoppers (2005) and Keane (2013), what I considered to be effective teaching for this study is that which identifies with the learners' cultural environment. Seen thus, in selecting my documents, I identified issues that I thought would promote identification of learners' cultural environment for school science teaching and learning in Zimbabwe.

In addition, Vygotsky (1978) argues that knowledge construction is closely tied to social, historical and cultural contexts. For this reason, I selected and analysed documents that I thought were useful for teaching of the topic 'food preservation' in schools. I therefore used my experience as a science educator in Zimbabwe to select the documents for analysis.

## 6.2 HOW I ANALYSED MY DOCUMENTS

In the document analysis, I searched for any IK aspects relevant for teaching of the topic of 'food preservation' in school science. Identification of elements of IK were done using E4P research framework (see Mashoko, Mpofu, Mushayikwa, & Keane, 2016). The E4P model is related to the grounded theory (alluded to chapter chapter 4 of this thesis) since its concepts are derived from the data itself. This E4P model depicts interaction of domains of knowledge in terms of process (P), product (P), enterprise (E), worldview/paradigm (P) and pedagogy (P). I captured a detailed description of these knowledge domains in the literature review section of this thesis. The major focus was to find out what forms of E4P knowledge domains curriculum documents contain. I was not focusing on documents that would specifically mention 'food preservation' and I did not discard them even if they mentioned other forms of IK. Those documents which included issues related to, for example, *ubuntu*, culture, lightning and others as different forms of IK, were included.

I found inductive analysis best fitting my research purpose. In this analysis, I immersed myself in the details and specifics of the data to discover important inter-relationships. As Khupe (2014) advises, getting deeper into the details of study would facilitate clear observations of the inter-connections of themes. I did this to tease out any issues in documents that I thought may contain related aspects that would serve to identify with learners' cultural environment. In keeping with this inductive approach, my patterns, themes and categories of analysis emerged out of the data. This means that my approach was data-driven involving reading through the sections of the documents of the curriculum and selecting relevant issues for science teaching. In this thesis, the concept of 'curriculum' relates to conception. Marsh (2009) asserts that curriculum encompasses the content (syllabus), as a product (how and what is to be taught) and a set of performance objectives

(specific skills or knowledge to be attained by students). This premise guided my strategy for data generation for this study.

In this study, I have used Alexander's (2001) perspective of the curriculum that it can be expressed in a narrow sense (what must be taught) rather than a broad one (pedagogy). Since teaching (an act of using a method or methods to enable pupils to learn a concept or concepts) is part of pedagogy, my study will also look at pedagogical implications in light of approaches sought from the curriculum document analysis.

I grouped my documents according to four categories: policy documents, reports on public examinations in science, assessment of science subject and teachers' documents. I did this in two ways: first, I read the introduction of each document and analysed its aims and foci with a view to establishing whether it would be useful for the teaching of IK of food preservation in schools. To do this, I included even those documents not specifically focusing on food issues. Second, I considered sections that specifically focus on food preservation.

I now present the findings from my analysis of the documents as follows.

## 6.3 PRESENTATION OF DATA FROM ANALYSIS OF DOCUMENTS

My presentation will be done here in terms of the above cited selected themes. I searched and analysed 15 documents in total and coded them as identified in Table 8 below.

**Table: 8**

***Identification of documents***

| **Documents selected** | **Code** |
|---|---|
| Main science textbooks used by teachers | MT-D1 |
| Science teachers' schemes of work section covering 'food preservation' | SW-D2 |
| 'O' Level integrated science syllabus (Zimbabwe) | IS-D3 |
| Cultural policy of Zimbabwe | CP- D 4 |
| Commission of Enquiry into Education and Training, Zimbabwe (1999) | CIET-D 5 |
| Science and Technology Policy of Zimbabwe | ST-D 6 |
| The Zimbabwe Ministry of Primary and Secondary Education Handbook on curriculum Review 2014 | MPSE-D7 |
| Science subjects results analysis November 2014 (Zimbabwe) | SSA-D8 |
| Ministry of Education, Masvingo Province, Mission Statement 2015 (Zimbabwe) | MPSEP-D9 |
| Constitution Parliamentary Select Committee of Zimbabwe, 2013 | COPAC-D10 |
| The Zimbabwean Environmental Education Policy | ZEE- D 11 |
| The Zimbabwean Environmental Policy | ZEP-D12 |
| New Partnership for Africa's Development (NEPAD) African regional body | NEPAD- D13 |
| Curriculum Framework for Primary and Secondary Education 2015-2022 (Zimbabwe) | CFPSE-D14 |
| Past Zimsec Examination (Code 5006) science papers June 2005-2015 November. | ZSEP- D15 |

As shown in the Table 8 above, these documents constituted main science textbooks, teachers' schemes of work, 'O' level integrated science syllabus, Cultural Policy of Zimbabwe, Science and Technology Policy of Zimbabwe (STI, 2012), the Zimbabwe Ministry of Primary and Secondary Education Handbook on Curriculum Review 2014, Science Subjects Results Analysis November 2014, the Ministry of Primary and Secondary Education's Mission (Masvingo Province), the Nziramasanga Commission of Inquiry into Education Training Report, CIET (1999) in Zimbabwe, science (code 5006) past examination papers (June 2005 to November 2015), the New Partnership for Africa's Development (NEPAD) African regional body, Zimbabwean Environmental Policy, the Zimbabwean Environmental Education (EE) Policy 2003, Constitution Parliamentary Select Committee of Zimbabwe (COPAC) and Integrated science (5006) Zimbabwe Assessment Guidelines.

As a result, my analysis isolated four themes drawn from the findings in the literature that I found relevant to the teaching of food preservation in schools: cultural identity for epistemological equity, provision of guidance of content to be taught, identification of pedagogy for use and requirement of the use of local languages. To assist in my analysis, I grouped these documents into four categories as alluded to earlier in this chapter. I then analysed the documents contained in Table 8 above with respect to selected examples of some issues showing each of these themes.

**Table: 9**

***Science issues relevant to food preservation***

| **Science issue relevant to food preservation** | **Policy** | **Reports** | **Assessment** | **Teachers' documents** |
|---|---|---|---|---|
| Cultural identity for epistemological equity | 'to include the nation's values' (COPAC, 2013, p. 21) | 'unhu/ubuntu philosophy' (CIET, 1999. p. 18) | 'investigation of methods used in local communities (ZIMSEC, 2012, p. 31). | 'pupils will draw examples of IK from their local communities' (Gomoguru teacher's schemes of work) |
| Provides content to be taught | 'practical competences necessary for life' (mission statement, CFPSE, 2015) | 'the integration and relevance of content from real world problems (CIET, 1999, 405) | 'list three traditional methods of food preservation'- textbook by Chavunduka, Mutodi and Tambo (2009, p. 77) | 'content coverage that includes conditions for the growth of micro-organisms (ZIMSEC, 2012, 12) |
| Gives pedagogy of the subject | 'core values include integrity based on unhu/ubuntu philosophy' (MPSE, 2015); | 'socio-economic growth' –NEPAD African regional body | 'formative and summative CFPSE, 2015) | 'apply scientific knowledge and skills including indigenous knowledge systems (ZIMSEC, 2012: iv) |
| Use of local language | 'indigenous languages and English language' CFPSE, 2015) | use of indigenous languages in the teaching of science' (CIET, 1999,p. 406) | All assessments done in English (June 2005-December 2015). | 'use of examples from local culture' (Chavunduka, Mutodi and Tambo (2009, p. 77) |

This analytic process was influenced by grounded theory since the issues emphasised were directly taken from the documents themselves. I analysed each document according to the four themes identified above that I found relevant to the teaching of the topic 'food preservation'. Data of the emerging themes was used to answer the first research question of the thesis:

### 6.3.1 Research Question 1

What elements of IK methods of food preservation do curriculum documents give to the teaching of science in schools in Zimbabwe?

As indicated in Table 7 above, documents provide four themes as guidance to the teaching of the topic 'food preservation' in school science. These selected four themes are discussed below.

#### *6.3.1.1 Theme 1: Cultural identity for epistemological equity*

##### 6.3.1.1.1 What policy says on IK integration?

A majority of the policy documents allude to the inclusion of cultural identity in all fields of development in Zimbabwe. For example, the GoZ (2009) reports that Zimbabwe's Environment Education (ZEE-D11) policy states that 'communities and individuals have the sovereign right to retain or share their indigenous technical knowledge and practices concerning the properties and uses of natural resources and should therefore benefit equitably from any use of that knowledge' (p. 16). Most of these documents mention that IK should be given more attention in school science as this would serve to include learners' cultural identity in learning. In this regard, the ZEE-D11 policy recommends the incorporation of IKS into the teaching of environmental education in schools. According to Mapira and Mazambara (2013), one of the ZEE-D11 policy objectives states that it includes

'incorporating appropriate IK in the formal education curricula at all levels' (p. 93). This desire is also indicated in a more recent Zimbabwean Ministry of Primary and Secondary Education Curriculum Framework 2015-2022 (CFPSE-D14) aim. For MPSE (2015, p. 2), the purpose of this framework, among others, is to 'motivate learners to cherish their Zimbabwean identity and value their heritage, history and cultural traditions'. This implies that the curriculum model gives expression to the learners' culture as suggested by the theoretical framework guiding this study.

Apart from the above IK integration strides, there is also significant evidence of the desire to include IK in schooling shown by other documents. For example, GoZ (2009, p. 16) reports that the Zimbabwean National Environmental Policy (ZEP-D12) seeks to 'integrate environmental education in teaching, training and extension programmes in the formal and informal sectors of education'.

#### 6.3.1.1.2 Values promoted by integration

Indeed, the MOESAC (2007, p. 14) says education and training section of CP-D4 states that 'our traditional knowledge systems should provide sources for the curriculum needs to our societies and such knowledge should be infused into the main school curricula'. In particular, the policy on youth and children, section 4.7.1 (p. 30), seeks to 'promote expansion of learning of cultural values, norms and practices through the school system using such specific subjects including science'. Specifically on food and settlement, the policy states that 'steps should be taken to preserve and promote traditional recipes and food preparation habits … promoting the consumption of local indigenous dishes through including such menus in hotels and other catering public institutions' (p. 14). In the same manner, the Draft Constitution of Zimbabwe's (ZEE- D11) founding provisions formulated by the COPAC-D 10, in January 2013 are anchored on 'values and principles [that] are based on the nation's

diverse cultural, religious and traditional values' (p. 2). These documents are placing emphasis on the recognition and response to the influences and strengths of learners' culture in science education. This is in keeping with McKinley (2005) who argues that connecting learners' cultural background to science education makes science relevant to learners. Collins (2008, p. 2) re-affirms McKinley's position by stating that 'learners' prior knowledge deserves recognition and may be utilised in constructing new meaning'. This recognition of the knowledge that learners possess is crucially important in the learning of new concepts as suggested by the theoretical framework guiding this study.

#### 6.3.1.1.3 What regional partnerships says about integration

The idea of knowledge integration is also spelt out even in some socio-economic regional bodies, for example, New Partnership for Africa's Development (NEPAD) which is a socio-economic development flagship programme of the African Union (AU) adopted by African leaders at the 37th Summit of the Organization of African Unity (OAU) held in Lusaka, Zambia, in July 2001.Indeed, Matsika (2012) argues that in 2001 NEPAD even today as a regional body seeks to review the indigenous content of the current curricula in the African countries and then find ways of integrating IK into formal education (NEPAD-D13). These findings suggest that the issue of knowledge system integration is central in curriculum development and implementation, particularly for science teaching in Zimbabwe.

#### 6.3.1.1.4 Emphasis of textbooks on integration

Science teachers maintain that they use specific textbooks in teaching the topic 'food preservation' in their lessons. Of the four main textbooks (MT-D 1) used by the two schools, reference to examples from the communities is contained in 'Longman 'O' Level Integrated Science, Students' Book 4' and 'Focus on 'O' Level Integrated Science, New Edition Students' Book Four' by Darwin and Du Toit (2011). The first text from the book by

Chavunduka, Mutodi and Tambo (2009, p. 77) presents a model question requiring learners to ‘list three traditional methods of food preservation’. In this way, the text is making reference to IK that learners might cite as examples.

It is evident there is recognition by policy and science documents that cultural identity is important in school science learning for indigenous learners as suggested by the conceptual framework guiding my thesis. In addition, these documents provide guidance of the content to be taught when integrating IK into school science.

#### *6.3.1.2 Theme 2: Provision of guidance of content to be taught*

Most documents provide science content that I found to be relevant for the teaching of food preservation in schools. My discussion of this guidance here is four-fold. First, the Zimbabwean Ministry of Primary and Secondary review's 2014 (MPSE, 2014, p. 1) aims, in section 2.1, states that 'the curriculum lacked values that should mould the learners into useful citizens of Zimbabwe'. Furthermore, MPSE (2014, p. 5) emphasises that the review targets, among other issues, 'integration of new, emerging and cross-cutting issues'. According to Khupe (2014), focusing on cultural values and ways of understanding shifts IK-science integration away from content to ways of teaching and learning. Odora-Hoppers (2002) and Keane (2006) believe that such a shift has the potential of avoiding any disregard of the indigenous learners' value system that school science worldwide has failed to prioritise. Richards, Conlin, Gupta and Elby (2012, p. 334) argue that 'connections to science should not be just found through identifying with a particular topic, but a particular way of approaching knowledge and learning in science, that is, a particular epistemological stance'. In other words, school science should not disadvantage students especially in indigenous communities; rather, school science content should be drawn from students' cultural experiences.

A second point to note is that all MT-D1 syllabi ('O' Level IS-D3) and schemes of work (SW-D2**)** provide content coverage that includes conditions for the growth of micro-organisms (temperature, moisture and air) and methods of food preservation (refrigeration, dehydration, canning, pickling, salting, sugaring and smoking). Some of these methods, namely, salting, sugaring and smoking, are not just western but are also used by indigenous people. Evidence shown from these documents has support in literature. For example, Chirimuuta and Mapolisa (2011) propose that indigenous people in Zimbabwe have their own

'cold room technology'. This suggests that there is useful IK from the communities that can benefit school science. Hence, IK content could be integrated into school science teaching and learning via community interactions.

A third point is that these documents emphasise skills development in the teaching and learning of school science. For example, Matabvu (2015, p. 5) reports that the Zimbabwe Schools Examination Council (ZIMSEC) November 2014 science examination results analysis (SSA-D8) by an educationist, Maxwell Rafemoyo, who commented that 'science and technology are the solving mechanisms in any society, therefore should be emphasised'. This educationist's acknowledgement of the role of science and technology is important to the teaching of school science for indigenous learners. The educationist is not specific on what technology the curricula require but Keane (2008a) and Odora-Hoppers (2005) advise that, to an indigenous person, useful technology can be drawn from an IK domain. Apart from this rationale, the Nziramasanga Report 1999 (CIET- D5) seeks to prepare learners for life and work including self-employment. Ogunniyi (2007a) contends that, for an indigenous learner, skills to be gained also include those that are relevant to cultural practices. By implication, therefore, IK of food preservation is suitable for schooling.

Lastly, the ZIMSEC (2012, p. 3) reports that the Ministry of Primary and Secondary Education Integrated science syllabus 2011-2020 has an assessment (section 1.5) stating that pupils should have the 'knowledge and understanding of personal, social, economic and environmental implications of science applications'. The aim of the syllabus does provide spaces for inclusion of IK in the science content in schools. In spite of this, assessment in public science examination papers in Zimbabwe from June 2005 to November 2015 (ZSEP-D15) contradicts this endeavour. My analysis of ZSEP-D15 shows that the nature of its questions does not specify whether pupils could answer using their IK. For example,

ZIMSEC (2011, p. 11) reports that Paper 2 November 2011 past examination question 10(b) says: 'State and explain three methods of food preservation. [6]'.

It is clear that most curriculum documents suggest the content to be taught for school science. They also suggest how this content should be taught.

#### *6.3.1.3 Theme 3: Identification of pedagogy for use*

Some documents suggest the pedagogy that should be used for the teaching of science in schools. For example, the 'O' Level integrated science syllabus requires that science pedagogy in schools should be drawn from the communities. Among other aspects, ZIMSEC (2012, p. 2) reports that this syllabus aims to 'recognise that the study and practice of science are inter-related and are subject to economic, technological, social, political, ethical and cultural influences'. The desire to integrate IK into school science is also captured in section 5.1.4 of this syllabus on the teaching aspect of the topic 'food preservation' requiring 'investigation of methods used in local communities and discussion of their advantages and disadvantages' (p. 31). IK is not mentioned specifically in this teaching approach however, as Khupe's (2014) study concludes, pedagogy in schools should be based on school-community knowledge inter-relationships. The science syllabus emphasises a pedagogy that chooses examples from local contexts that relate to learners' interests. Aikenhead (2007) believes that pedagogy should focus on the development of curricula that acknowledge the priorities of indigenous peoples. By extension, pedagogy should include peoples' IK from the communities.

According to ZIMSEC (2012, p. 1), the 'integrated science (code 5006) is a compulsory subject offered to all government secondary schools in Zimbabwe'. Furthermore, this syllabus is a two-year course of study consisting of five content sections: science in agriculture, science in industry, science in energy uses, science in structures and mechanical

systems and science in the community. This is summarised in Table 10 below.

**Table: 10**

***Content for Integrated science syllabus***

| **Section** | **Section of the integrated science syllabus (5006) Zimbabwe** |
|---|---|
| 1 | Science in Agriculture |
| 2 | Science in Industry |
| 3 | Science in Energy Uses |
| 4 | Science in Structures and Mechanical Systems |
| 5 | Science in the Community |

(Source: ZIMSEC, 2012, p. 7)

Table 10 above shows five sections of the integrated science syllabus used by secondary schools in Zimbabwe. This table is important in pedagogy since it outlines the aspects that the science syllabus is expected to cover. The focus of this study was under 'science in the community' on the food preservation strand of the syllabus. An examination of the content and activities under the 'science in the community' section indicates that teachers can investigate methods from the local community to assist learning. For the purposes of this study, extract of section 5.14 'Science in the community' strand is shown in Table 11 below.

**Table: 11**

***Food preservation section***

| **Topic** | **Learning Objectives** | **Content** | **Notes and Activities** |
|---|---|---|---|
| Food Preservation | Investigate the optimum conditions for the growth of micro-organisms | Temperature, moisture, air | Experiments on growth of bacteria in sour milk and growth of mould on bread only |
| | Describe methods of food preservation | Refrigeration, dehydration, canning, pickling, salting, sugaring and smoking | Suitability of each method to foods |
| | Explain how each method limits growth of micro-organisms | Methods of food preservation | Investigation of methods used in local communities and discussion of their advantages and disadvantages |

(Source: Section 5.14 Science in the Community, ZIMSEC, 2012, p. 31)

This part of the syllabus also articulates that learners are required to master two broad areas: first, optimum conditions necessary for the growth of micro-organisms and second, methods of food preservation. According to ZIMSEC (2012, p. 6), the 'emphasis of this syllabus' methodology is placed on providing pupils with practical experience through problem-solving and group work approaches'. However, this syllabus is not explicit on which methods are to be used by teachers in schools. Similar observations were also found in some textbooks used by teachers in the two schools.

Some textbooks suggested how the topic food preservation should be taught. For example,

the Focus on 'O' Level integrated science textbook by Darwin and Du Toit (2011, p. 73) cites that 'in communities with no electricity for refrigerators, the main methods used in the home are salting and smoking'. This text further requires students to answer the question: 'List ways and means by which people preserved their food long ago' (p. 73). Although this might be an example of a simple recall question in line with Bloom's taxonomic classifications of behavioral objectives lower level as suggested by Krathwohl (2002), the learners are expected to go beyond that and explore ways in which their forefathers preserved food. Teachers' textbooks provide indications of what should be learnt in the schools. Makgato and Ramaligela (2012, p. 33) posit that 'textbooks guide what should be learned and how the field of knowledge is to be taught and learned'. Furthermore, Makgato and Ramaligela (2012) explain that textbooks give content subject matter, teaching strategies and procedures. Ben-Peretz (1990) argues that a textbook is a dominating pedagogic instrument to understand curricula at schools as it serves as a source of insight into the intended curriculum for most teachers. While this repositioning of the textbook as a key resource is a positive development, it is based on the assumption that textbooks are inherently useful. In this regard, Cameron (2007) and Khupe (2014) argue that textbooks for school curricula serve to project that the national cultural values and beliefs play an important role in shaping and socialising learners. This seems to bring the issue of knowledge integration in school science through culturally responsive teaching, as suggested by Ladson-Billings (1995), out into the open. Mudaly and Ismail (2013, p. 180) contend that teachers can facilitate teaching 'through instruction which leads to meaningful learning (which is) more advanced' and be enabled to 'galvanise multiple functions'. The function that is alluded to here is that learners will be prompted to discuss the application or evaluation of the IK of food preservation in light of its relevance to their social lives. Such links were found to be absent from teachers' schemes of work in the two schools.

What emerged from the SW-D2 was that teachers do not include IK of food preservation in

their teaching of the topic ‘food preservation’ in spite of the fact that their syllabus requires them to do so. The documents teachers use when preparing their schemes of work and the reasons why they are not including IK in their work are discussed in the next chapter of this thesis. However, some documents emphasise the importance of the use of local languages in school science teaching.

#### *6.3.1.4 Theme 4: Requirement of the use of local languages*

Some documents are explicit on the use of local languages in school science. For example, the Zimbabwean Ministry of Primary and Secondary Education Curriculum Framework 2015-2020 (CFPSE-D14) suggests that, from Forms 1 to 4, teaching and learning should be done in indigenous languages and in English. The cultural policy of Zimbabwe, in section 1.1.7 of MPSE (2014, p. 14), proposes that ‘indigenous languages should be used as a means of general communication to promote development through understanding of concepts’. The policy furthermore states that languages are a strong instrument of identity, be it culturally or otherwise. Aikenhead and Michell (2011) point out that language, for indigenous people, supports life-long learning. Keane (2006) also argues that language strengthens identity. All documents are written in English without any reference to the local languages. Such a view contradicts Kaya and Lyana’s (2014) assertion that the use of local language for local people allows for articulating knowledge for integrating various dimensions coherently. This explains why the CFPSE-D14 calls for the use of indigenous languages and the English language as medium of instruction at all school levels. Despite the fact that conventional language for modern schools is English, it is also pertinent for school science teaching to make reference to learners’ local languages as suggested by conceptual framework guiding this study. Although this is not the focus of my study, data shows that use of local language might facilitate learning of science in schools as reflected in other curriculum documents. For

example, CIET-D5 (CIET, 1999, p. 3), recommends that ‘there should be a language policy making Ndebele/Shona national languages in Zimbabw’. It is evident from these documents that the use of local languages for school science teaching provides a relevant platform for the understanding of science concepts by indigenous learners.

## 6.4 SUMMARY OF THE CHAPTER

In this chapter, I analysed and presented findings related to the first research question: What elements of IK methods of food preservation do curriculum documents give to the teaching of science in schools in Zimbabwe? The most important findings from my analysis were that some documents inform science teaching in Zimbabwe through an emphasis on cultural identity for epistemological equity, provision of guidance of content to be taught, identification of pedagogy for use and the requirement of the use of local languages. So, to a large extent, the documents were able to provide answers to the first research question for the study. Although these documents emphasise these four main aspects, they do not give guidance as to how IK could be taught in the school science curriculum. The same gap exists in other sub-Saharan countries, including South Africa and Botswana, where the school curricula are not explicit on the methodology teachers might use in bringing IK into school science teaching. So, there is need for a clear methodology that guides teaching for sub-Saharan school science curricula.

In the next chapter I analyse, present and discuss findings in relation to what interviews inform about the methods of food preservation by community elders.

# CHAPTER 7: DATA ANALYSIS-COMMUNITY ELDERS' IK OF FOOD PRESERVATION

## 7.1 INTRODUCTION

In Chapter 6, I analysed, presented and discussed findings from policy and science curriculum documents on elements of IK that might be relevant for the teaching of food preservation in school science in Zimbabwe. In this chapter, I analyse, present and discuss data generated from the interviews, site visits and observation of food artefacts for community elders' IK of food preservation. I used any emerging contradictory findings as a resource rather a problem. As a resource, I needed insights into what my findings might mean from sixteen (16) community elders. This analysis endeavoured to answer research questions 2 for the study: Question 2: What elements of IK and methods of food preservation do the rural community members of Chivi District hold?

In this analysis, I used Urquhart's (2013) strategy for grounded theory to identify key elements of the phenomenon and categorisation of the links of those elements to context and process of the experiences. In simple terms, it means that I coded my data showing such relationships. The concept grounded theory, how it can be used in a study, and how I used in my study were fully explicated in chapter 4 of this thesis. My analytic codes were based on three elements: concepts, categories and propositions derived from the participants' perspectives. This means that my data passed through what Strauss and Corbin (1990) refer to as three coding stages: first, data was 'run open' to form initial conceptual categories in data; second, axial coding was done to connect these categories; and finally, I did selective coding of higher order concepts upon which my theory was built. I used excerpts and direct

quotes from the participants' interviews in analysis. This means that I derived explanations of the phenomenon from the data guided by grounded theory analytic tool.

To answer the above research question, I firstly explain how I selected and identified my community elders as participants for this study.

## 7.2 SELECTION AND IDENTIFICATION OF COMMUNITY ELDERS

My participants consisted of community elders. Matsika (2012, p. 208) argues that 'community elders are respected for their experience, wisdom and the belief that they are closer to the ancestors'. So, I included them in my study. In selecting them, I followed cultural protocols by seeking consent via their village heads. After explaining the purpose of my research to the village heads, these leaders selected elders they thought would best provide information that I needed. Their initial selection was based on age, where older villagers were named as potential participants for the study. Mpofu et al (2013) argue that age is an important attribute of knowledge possession in an African culture and older citizens are expected to have full knowledge of their culture through experience but I later discovered that age was not really important for IK of food preservation. From the participants for the study, I found all age groups equally competent in the knowledge that I wanted to research. Also, later on, it was found that the two village heads' selection of community elders was biased towards women as, according to them, food preservation was mostly a mother's responsibility. As a result, of the four elders selected from one village, only one was male. From the other village, all elders were female. After seeking consent from the selected community elders, these elders themselves recommended other elders whom they thought had the knowledge for the phenomenon that I wanted to explore. This approach constitutes what Patton (2002) refers to as 'snowballing' which is a selection method of participants for a study. In my approach, for the two communities, some potential participants were selected

based on initial participants' recommendations. This final selection had five (5) males and eleven (11) females giving a total of sixteen (16) community elders (seven (7) from one village and the remainder from the other).

I used various ways to identify participants in my study. Many community elders involved in research wish to be called by their names. These findings are supported by other related studies involving members from indigenous communities. For example, a South African study by Malcolm, Gopa, Keane and Kyle (2009) found that identity disclosure deepens relationships among members of a research group as it tends to increase the participants' sense of belonging to the study. I had to devise a way of taking on board elders' wish and at the same time not compromise conventional ethical requirements. As a result, for community elders, I used Mpofu's (2016) totemic method as a way to hide participants' identities. As evident from the participant themselves, they were happy with totemic identification. For example, one village head, VaMusaigwa, during my access to the study, introduced the researcher to the participants reiterating that '*he is* "*Va Murambwi*" *or* "*Shumba*" *of the Lion totem', who is one of us*' (Access stage in Gomoguru village, 17 December 2014). These findings led to a new paradigm shift in the way researchers may identify their participants.

I then identified community elders as indigenous people by considering their '*mitupo*' (totems); which Bourdillon (1998) explains that totems can be expressed specofically through '*zvidao*' (sub-clan names). For example, if a female community elder is of the '*zhou*' (elephant) clan, I referred her as '*VaMadhlovu*'. Similarly, a female elder is from the '*shumba*' (lion) totem, I referred her as '*VaMasibanda*'. A male person is from a '*hove*' (fish) totem, I referred to them as '*VaMusaigwa*'. In the event of two or more community elders involved in the study with the same totem or sub-clan name, I named them using a subscript following the order of interviewing. In the spirit of *ubuntu* framework which influenced this

study's research approach, I attached participants' names by using prefix '*Va*' (see Appendix K). This approach was in line with Mpofu's (2016) totemic research strategy of showing respect to participants in an indigenous community in Zimbabwe. So, I used this strategy, for example, for those of the '*moyo*' (heart) totem – I referred them as '*VaMamoyo*' or *VaMamoyo*$_2$. In this case, VaMamoyo$_2$ was interviewed after VaMamoyo. Also, if participants had the same name, a distinction was made by attaching their leadership or cultural position titles in the villages.

In the interest of *ubuntu* worldview that calls for respect of people as explained by Van Wyk (2014), I could not just designate my participants using the alphabet, A, B, C, D and so on, or with any other possible identification strategies that do not encompass the idea of cultural identity to participants.

## 7.3 HOW I ANALYSED MY INTERVIEW DATA

I now discuss how I analysed my data. I took a number of steps in analysing my data. I present these stages as follows:

1. Stages: i) I read through the data several times; ii) I transcribed audio data with the help of an independent transcriber and with a video that I watched checking unique instances; and iii) I coded the transcripts with guidance from literature – a strategy which Patton (2002) refers to as an *a priori* system of codes.

2. My initial coding: My initial coding was guided by the interview protocol I developed for this study. As explained by Merriam (2009), my questions were derived from literature and my own personal experiences in the communities. As alluded to earlier on in this thesis, my unit of analysis was community elders' IK methods of food preservation. At first, I formulated my codes as: description of the method, description of ways of learning the

method, cultural terminology used, description of the outcomes, description of self-identity, actual word as code (recurring words) and ways of evaluating science teaching in schools.

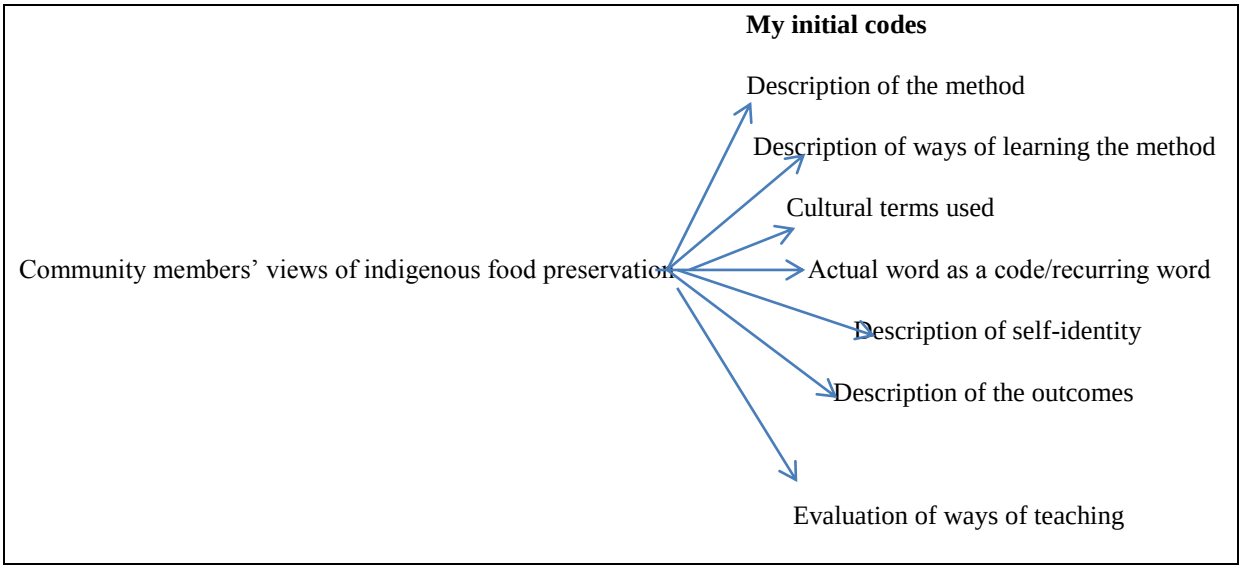



**Figure 7a: My initial codes**

I then grouped all my initial codes above into categories:

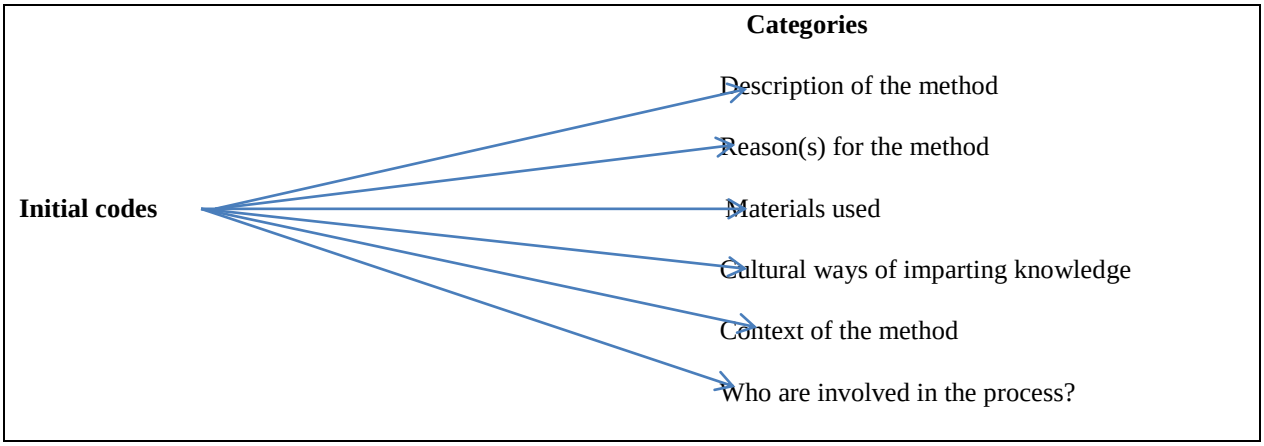



**Figure 7b: My initial codes with categories**

After grouping all my codes into various categories, I then revisited my interview transcripts to study it thoroughly for any missing codes that might be present.

From the findings, I isolated four issues that became my final codes, namely, dehydration, fermentation, use of chemicals and community elders' ideas concerning integration of IK of food preservation with school science teaching. I then developed specific codes for community elders (E). So, my codes were: dehydration (ED), fermentation (EF), use of chemicals (EC) and importance of IK of food preservation for school science teaching. Other codes also emerged from the data itself as analysis proceeded. So, my analysis was deductive and then inductive as described by Huberman and Miles (2002) - in keeping with grounded theory alluded to in chapter 4 of this thesis.

## 7.4 PRESENTATION AND DISCUSSIONS OF THE FINDINGS

### 7.4.1 Introduction

I present and discuss my findings in relation to the community elders' views on indigenous methods of food preservation. Findings show that community elders have unique methods of preserving their food which are informed by their cultural practices. I discuss each finding in

light of literature and the theoretical framework guiding this study. Findings of the analysis of all participants' responses are presented and discussed together. In doing so, I explored the connections and differences between these elders in terms of their IK methods of food preservation.

I now present how I analysed my data using four main themes: dehydration/drying, fermentation, the use of chemicals and community members' ideas concerning integration of IK of food preservation with school science teaching. Selection of these themes was based on literature search as shown in chapter 3 of this thesis.

### 7.4.2 Theme 1-Dehydration/ drying

Findings for this study show that community elders were using mostly dehydration as a method to preserve their grain crops. As evident from their responses, community elders dry both large and small grain crops at their homes. These community elders suggested that they had a variety of preservation methods which depend on the type of grain crop involved. This was not surprising to me because all foods consist of different nutrients. Pamplona-Roger (2011) identifies these nutrients as including proteins, carbohydrates, fats, moisture, vitamins and minerals in different proportions that have different preservation methods. According to Lean (2006), each of these food nutrients binds water in their cells and the rate of drying is largely controlled by the chemical composition and physical structure of the food, for example, particle. This explains why the method of dehydration was prevalent among the community elders in my study area.

I found community elders keeping a variety of grain-crops including '*chibage*' (maize), '*mupunga*' (rice), '*mhunga*' (millet), '*mapfunde*'(sorghum), '*nyimo*' (roundnuts), '*rukweza*' (rapoko*) and* '*nzungu*' (groundnuts). Most of these foods are commonly found in the local supermarkets in the form of mealie meal, samp and mealie rice. The paradox here is that a

number of these crops are not indigenous. For example, UNDP (2004) explains that maize and rice are not indigenous crops but are found in indigenous communities worldwide. However, they have become standard food items in the area and members preserve them regularly. By their own admission, community members noted that the drying of foods was not commonly practiced by people in their area, but acknowledged its importance to ensure food security (access to the basic food at both individual and household levels) in Zimbabwe.

With respect to ways of ensuring food security by the participants, two aspects should be noted. First, there is easy access to most of these crops due to improved transport and communication networks enabling smooth food exchanges or purchases locally or regionally. Such improvements explain why it is possible to find a crop from another ecological region being sold in a market. As a result, some people may not find it necessary to preserve food when it is possible to access it fresh at any time throughout the year. It was not the task of my thesis to carry out any experimental tests. Suffice it here to note that the other possible reason might be as suggested by Lean (2006) the availability of modern methods of food preservation such as refrigeration and the use of desiccators which extend the shelf-life of most foods. Secondly, the shift from rain-fed agriculture to irrigation services that the Zimbabwean government has installed has enabled indigenous people to access different fresh crops throughout the year. Nonetheless, food preservation is still an important security in the region which is rich in IK.

Consistent with research by Kamwendo and Kamwendo (2014) and Shizha (2009), this study found some community elders helping each other to harvest their groundnuts in their indigenous communities. I took photographs of their activities during my site visit to their households. This is shown in Picture 6 below.

**Picture 6: Community elders harvesting groundnuts**



(*Site visit, VaChihera's homestead, Gomoguru village, 19 March 2015)*

In Picture 6 above, community elders were helping each other to harvest their groundnuts. VaChihera explained how they do it: 'We help each other to harvest our groundnuts in our area and we place them on a '*mutanho*' or '*rujada*' (raised surface) for sun drying. After drying, we place them in sacks or granaries for large quantities'.

The above finding correlates with Lilemba and Matemba's (2014) contention that indigenousness carries with it a sense of belonging to a place. This is echoed by Matsa and Manuku (2013) who argue that there are interconnections between rural women and agricultural activities which they practice collectively. Another explanation for the above elders' way of life is linked to the sense of *ubuntu* that people are inseparably interconnected. Van Wyk (2014, p. 183) explains that *ubuntu* involves 'caring, sharing, respect and compassion and ensures a happy and qualitative human community life in the spirit of family'.

Community elders involved in my study explained that they store their grains in rigid sealed containers, metal cans and sacks. They, however, lamented that these grains would still decay

after some time due to ingress of moisture or pest attacks if they are not properly preserved. The elders' concern was of particular interest to me because it shows that they were acknowledging the shortcomings of their indigenous methods. It is also significant because it illustrates the importance of cultural ways of solving social problems. Seen thus, for schooling, IK and school science could be possibly integrated when it considers structures used by community elders to dry their grain crops as platform to carry out practical activities.

I took photographs of the community elders' method of grain storage using '*mutanho*' (raised surface). Picture 7 below shows this structure.

**Picture 7: '*Mutanho*' (Raised surface to store crops)**



(Source: Site visit, VaZimuto and his wife, VaMamoyo$_2$ homestead in Gomoguru village 26 March 2015)

A closer look at the above grain storage structure shows that it is situated high above the ground. As informed by the participants themselves, any grain crop could be placed on a '*mutanho*' or '*rujada*' for storage and provides cool temperatures below. This view parallels a strategy found by Kamwendo and Kamwendo (2014) known as '*msanja*' (raised, table-like structure, locally constructed of poles and sorghum stocks) among the Lomwe people in Malawi that they use to store their maize cobs. In the study area, this technology is no longer common but is practiced in newly settled areas in Zimbabwe.

In the context of these assemblies, some participants felt that the use of '*mutanho*' provided cool environments underneath the storage structures. Because indigenous communities have no scientific ways of measuring quantities like temperature, I was prompted to ask the elders how they could tell that there are cool temperatures underneath their storage structures. One participant, VaMasibanda, responded, 'we would tell if, during the hot season like in October, panting dogs would stay underneath the granary to cool themselves'. On further discussions, it became clear that participants would store a variety of crops such as watermelons and pumpkins under the granary. These findings are consistent with findings done elsewhere, for example, Chirimuuta and Mapolisa's (2011) study on the Zimbabwean IKS for food security found that the Shona and the Ndebele people had special granaries which provided cool atmospheric environments underneath as 'cold room technology' to keep pumpkins intact for extra months well after their expected seasonal life span. The same findings are alluded to by Kamwendo and Kamwendo (2014) in their study of the IKS and food security using examples from Malawi. The study found that dry banana leaves or dry grass were used by the Lomwe people to provide cool environments in a pit needed to store their potatoes for one year.

Highlighting the structure they use for storing grain crops, one elder, VaMadhlovu, described it as '*tsapi*' (storage hut for unthreshed grain), which they use to store their millet and rapoko. I took the picture of this storage hut as shown below.

**Picture 8: '*Tsapi*' (storage hut for unthreshed grain)**



(VaMadhlovu's homestead, Site visit Gomoguru village 29 January 2015).

As can be seen in the above picture of a '*tsapi*', community elders construct such structures using locally available materials including wood poles, grass and clay soil. VaMaphosa explained that a '*tsapi*' is built on a rocky out crop on a ground which will not easily get wet if it rains. I learnt that community elders had unique strategies to eliminate water or moisture from their food using cheap materials which are found abundantly in their environment. However, the use of a '*tsapi*' for storing food is no longer viable today due to the low crop yields community elders were experiencing due to recurrent dry spells in their area. Most community members indicated that they use special type of '*matura*' (granaries) they call '*hwikwiyo*' (a raised granary with a plastered roof) to store their unshelled grains. Picture 9a below shows this.

**Picture 9a: 'Hwikwiyo' (granary showing plastered roof)**



(Source: Site visit 1, VaMancube's homestead, Gomoguru village 05 February 2015).

The above form of a granary, when thatched, appears in Picture 9b.

**Picture 9b: 'Hwikwiyo' with a grass thatched roof supported on a circular base**



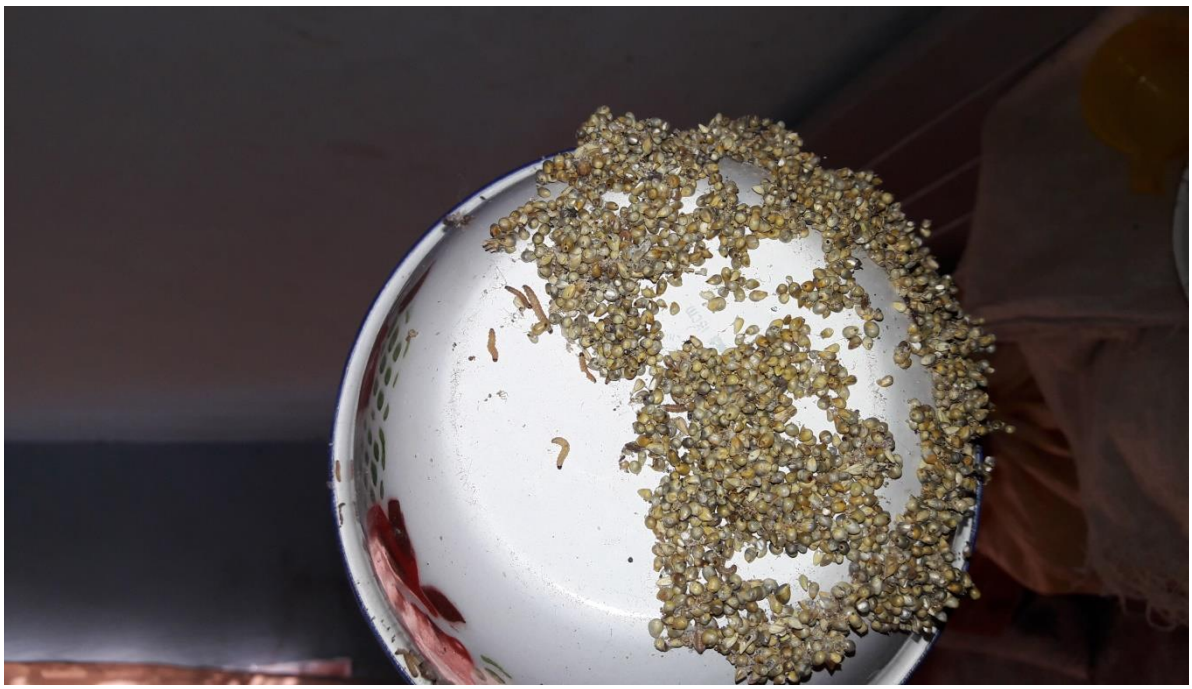
(Source: Site visit, VaMamoyo$_1$ Gomoguru village 19 March 2015)

Even though there were variations in the shapes of the granaries constructed by the two communities, participants almost unanimously indicated that these structures were used for the same reasons. A closer look at the above pictures shows mud-plastered walls and a thatch roof granary with either a circular stone or a rectangular base of large boulders. In the case of '*rujada*' alluded to earlier in this chapter, most community elders explained that their

granaries will always have low temperatures necessary to keep food for a long time. The explanation agrees with Brown's (2008) contention that insulators keep temperatures of the environment constant and this has an effect of slowing down the action of microorganisms on food. This view affirms the relevance of the community elders' materials including stones, grass, soil and wood used to construct their granaries. The use of their indigenous cold room technologies was not widespread in the communities under study. This was due to the people's preference of modern techniques such as refrigeration over indigenous methods for food processing but for some, it has to do with lack of a clear understanding regarding IK. In this situation, Ogunniyi (2011) and Hewson (2012) believe that it would result in people shunning IK.

Findings regarding how elders were preserving their small grains were encouraging as far as science education is concerned. For example, one elder, VaMaphosa explained that 'our sealed granaries are used to ensure that nothing enters to disturb our stored crops' (site visit, VaMaphosa's homestead, 29 January 2015). This sealing ensures that millet can have '*rutandira*' or '*dandemutande*' (cobweb-like coating) and 'can stay for six or seven years' (VaMaphosa, Interview 1 Dzivaguru village 26 December 2014), or it develops '*zvihundudzo*' (worm-like covering) and can remain there for a long period of time. 'It could stay two to three years in that good condition since nothing enters. While this is so, the worm will be growing as well' (VaMasiziba, Group interview 1 Dzivaguru village 29 January 2015). The following picture 10 shows a worm-like coating formed on the grain surface.

**Picture 10: Worm-like coating of grains**



In light of the above quotation, four pertinent issues surface. First, IK food preservation ensures the elimination of things that might result in food decay. After sealing using indigenous methods, VaMaphosa emphasised that 'nothing enters' their granaries. She further explained that their granaries would be tightly sealed to prevent things like air, moisture and both small and bigger organisms from entering. VaMusaigwa corroborated VaMaphosa's views explaining that:

> 'Millet and sorghum we would place them in the granary. We close any cracks of the roof or openings and smear either cow dung or smooth clay soil. This is done to prevent pests and rodents from entering' (Interview 1, Gomoguru village, 26 December 2014).

Views given by both VaMaphosa and VaMusaigwa above are pertinent for science teaching because they concur with Martinek's (1998) observation that sealing a grain storage or pit increases carbon dioxide levels. This means that sealing will prevent the growth of bacteria, yeasts, fungi and other micro-organisms which require oxygen. These findings provide support and implications for classroom practice and science curriculum developments,

specifically, for the teaching of the topic 'food preservation' in school science.

The second issue that emerged from participants' explanations relates to the need to exclude air from food or grain to enable it to protect against decay in a natural way. More specifically, participants alluded to the development of '*rutandira*' or '*dandemutande*' (a cobweb) or '*zvihundudzo*' (a worm) that forms a coat around the grains during preservation. When asked what part of the granary is affected by cobwebs, most participants said only the top most grains will be covered to protect those underneath. Martinek (1998) reported that, in a grain pit, there is differential spoilage with commodities rotting at the bottom or sides of pits but not in the centre. This reflects natural ways indigenous people use to preserve their grain crops and about the limitations of indigenous methods since some affected grains will serve to protect others.

Thirdly, the length of time possible for grains to remain in good condition was emphasised. In an interview, VaMasiziba was specific and suggested that grains may remain in a good condition for six to seven years for spider or web-like coating and two to three years for a worm covering. However, she argued that the worm will still grow if it covers the grains therefore this method offers limited protection as, after some months, food will get bad.

Lastly, these participants noted that food decay is caused by both small and large organisms. This view is supported by Roday (2014) who argues that decay is also caused by bigger organisms, including insects and rats, which cause physical changes such as bruising and the absorption of moisture which results in the deterioration of food quality. While participants' explanation that food decay is caused by both small and large organisms is valid, the concept is not well described in science textbooks for schools as they only mention the role of smaller organisms in food preservation.

In explaining how they close their granary entrances, participants in Gomoguru village said

that they use a '*gwandefa*' (a flat stone) as '*zeteko*' (door of granary) that they design to fit the measurements of the entrance. Although, villagers in Dzivaguru use different materials to close the opening of their granaries, the method is generally the same as that of the Gomoguru. For example, VaMasiziba suggested the use of a clay plate holding a small shrub called '*mufandichimuka*' (myrothamnus flabellifolius) as '*zeteko*' shown in picture 11 below.

**Picture 11: A community elder holding a '*zeteko*' for their granary doors**



(Source: Site visit at VaMasiziva's homestead, Dzivaguru village )

**Picture 12: 'Hwikwiyo' showing two entrances of the granary**



(Source: Interview 5, VaMamoyo $_1$ Gomoguru village 19 March 2015).

When asked about the reasons for using doors made from local materials to close granaries, three issues emerged. First, it ensures that large organisms such as rats and insects do not tamper with their food. Second, sealing ensures that a limited amount of air would get in contact with stored food in the granaries. In this sealed state, food will stay in good condition for a long time. Also, the special clay soil plate seal acts as an insulator. This finding highlights how indigenous people keep their food safe for consumption for a long time. Martinek (1998) illustrates that, for some indigenous people, there are special soils they use for lining grain preservation pits which are similar to granaries. He found that these soils have the potential to decrease grain loss rates by reducing internal moisture levels, reducing oxygen levels and restricting access to these areas by rodents and insects.

Brown (2008) noted that these clay plates serve to keep the temperatures low to prevent rapid bacterial action on food. So, the way community elders seal their granaries may be relevant to the teaching of food preservation in school science. Although the indigenous materials used to seal the granaries differ from modern methods, Lean (2006) argues that sealing granaries eliminates conditions needed for micro-organism growth including warmth, food, acidity, moisture and oxygen or air. More importantly, this IK requires considerable skills to build such structures.

Participants lamented the lack of effective methods to preserve maize for a long time in good condition. For them, maize, like sorghum, was problematic since it lasts barely two to three years before it is attacked by pests. They further explained that both maize and sorghum can be dried first on a '*rujada*' or '*mutanho*' used also for groundnuts as cited above.

Besides drying maize, community elders also dried their '*mbambaira*' (sweet potatoes) and preserved them in a '*pfimbi*' (a hole dug underground). The following figure shows a *'pfimbi'* system one elder, VaMasiziba was using to store her sweet potatoes.

**Picture 13a: A *'pfimbi'* system to store sweet potatoes**



In explaining how she construct this '*pfimbi'* system, VaMasiziba noted that she digs an underground pit, half a metre down. She then would build with bricks and clay soil surrounding the pit about one metre above the ground.

The tubers that are placed in a pit are sorted according to size as VaMasiziba demonstrated in the photograph below.

**Picture 13b: Showing selection of sweet potatoes stored in a *'pfimbi'***



VaMasiziba remarks that '*majeza*' (immature) and scratched sweet potatoes are not suitable for underground storage because they will decay quickly if buried underground. Roday (2014) also observed that sweet potato patches may cause rotting of the plants due to a disease called potato scub. Amoah et al (2011) concur with this effect of patches on sweet potato tubers. They further explained that scratching results in tubers being susceptible to

fungal infections but storing sweet potatoes in a pit ensures that dry conditions prevail and thus no air or moisture enters for microorganisms to decompose food.

Drying was also the main method used by the community members to preserve meat. In general, the kinds of meat the communities depend on are similar except for Dzivaguru villagers who had also fish in their main diet because they are very close to a big dam. Baboon meat is also unique to Gomoguru members who are located near a big mountain. These differences concur with Nyota and Mapara's (2008) findings among the Shona people in Zimbabwe that indigenous people are preserving diverse types of meat including fish, beef, poultry and birds**.**

All participants explained that the above meats were preserved by slicing them into small thin pieces and adding salt to dry on the fire or in the sun. Some of them described the formation of '*chimukuyu*' (biltong) using salt (for example, VaChihera, Site visit 1 Gomoguru village, 29 January 2015). Similarly, in Dzivaguru village, VaMaphosa believed that:

> 'If we have goat meat, you cut it into small pieces, add salt and dry it and form "*chimukuyu*"' (Group interview 1, 29 January 2015).

Evidently, this method of drying meat to form biltong is widely practiced as shown in various supermarkets and resting places along the highways in Zimbabwe. The method used for such supermarket products is similar to that used by community elders. The paradox here is that I observed that the younger generation is shunning indigenous methods but biltong meat from various food outlets in Zimbabwe is consumed by all age groups. My findings indicate that those who shun IK methods had no problem with the IK food quality but were not eager to be associated with these methods. This finding shows the effect of modernisation on indigenous peoples' way of life. It does not, therefore, indicate that indigenous people do not like IK, rather, it is indicative of their profound developmental shift from IK to western methods of

food preservation.

Apart from drying meat, community elders said they dry their vegetables as well. For example, VaMancube, explained that:

> 'In the case of vegetables, we take wild vegetables like '*rudhe*' (psis gynandra), clean it first, boil it and spread on a '*ruware*' (rock out crop) for sun drying' (Interview 1, Gomoguru village, 26 December 2014).

This emphasises drying as the main method to preserve vegetables. I visited VaMasiziba's homestead in Dzivaguru village and took photographs of some fresh vegetables that she had preserved (see picture 14 a below).

**Picture 14a: Fresh vegetable '*rudhe*' in a '*tswanda*' (basket).**



(Site visit, Dzivaguru village, VaMasiziba's homestead 12 March 2015)

As shown in the above picture, fresh green '*rudhe*' had just been harvested by VaMasiziba. According to her, such fresh produce may be cooked before drying. The type of container used to store vegetables shown above is not widely used but is still relevant to modern day principles of food preservation. The container is made of wood which does not allow freshly cut fermenting vegetables to retain moisture. Prasad (2011) argues that containers which

exclude water prevent fungal growth on food keeping their food fresh for a long time after cooking.

In the latter conversations, my focus went beyond the issue of cooking food but shifted to how elders preserve their food as it was relevant to my study. One participant, VaMasiziba, said that:

> 'I use soft leaves not "*wakakomba*" (become hard) then cook and dry them on a rock outcrop in the sun. I will place it where there is no moisture because water makes vegetables go bad. It can stay for a year to three years in good condition. During the rainy season, I can cook my vegetables, dry them and place them in a moisture-free environment ... So that it does not get moisture to avoid '*kuvhunda*' (becoming stale or mouldy; or begin to rot). It will have '*chahuvhe*' (become stale) if it gets in contact with moisture. Secondly, I will hang to avoid rodents that might feed on my vegetables' (Group interview 1 Dzivaguru village 29 January 2015).

VaMancube, another participant, explained that she would remove water from boiled vegetables through sun drying. Prasad (2011) explains that, if sun drying food is placed on a flat surface and is then exposed to ultra-violet radiation, it reduces the water in food. The above quotation shows that community elders have their own terminology based on culture to provide scientific explanations to describe the quality of vegetables they preserve. She mentioned terms '*kuvhunda*'or '*chahuvhe*' which, in their Shona cultural way of life, means the development of moulds as food decays. Further conversations with VaMaphosa brought another term related to these two concepts – '*unoshova*'. These special cultural terms that refer to the development of moulds illustrate the detail of the IK. This plethora of terminologies has an implication on the development of the science curriculum in Zimbabwe, particularly with regards to textbook writing.

All community elders were familiar with most wild vegetables except '*tsvengetsvenge*',

‘*mhuu*’ (bidens bidernata) and ‘*nhoriyarudende*’ (climbing flowering plant with bulbous root, leaves used as vegetable) which had slight differences in the way they were preserved, but for most of the wild vegetables, methods of preservation were similar.

Some of these vegetables are shown in the following picture 14b below.

**Picture 14b: Samples of preserved vegetables**



The above photograph, moving from left to right in an anticlockwise direction, shows samples of: ‘*tsvengetsvenge*’, ‘*mhuu*’ (bidens bidernata), ‘*muboora*’, ‘*nyevhi*’, ‘*mowa*’, ‘*derere*’ and ‘*musemwasemwa*’’. The picture above may give an impression that community elders have no specific cultural containers used to dry their vegetables. This is misleading because the picture only displays what had been preserved in their usual ‘cultural containers’ as one elder in Dzivaguru said:

> ‘We use “*matende*” or “*tswanda*” or “*matemhe ema uyu akaoma*” (dried baobab fruit-shell) to store our dried vegetables that we place in a granary for two to three years’ (VaMasiziba, Dzivaguru village, interview 2, 19 March 2015).

Regarding their belief that metallic or plastic containers were not good to dry their vegetables, she argued that these containers easily capture ‘*runyenhe*’ (moisture) and food will develop moulds. Community elders explained that ‘*tswanda*’ is good for storing

vegetables as they smear cow dung on its walls to ensure that it is completely sealed against any moisture from the ground and provides a cool environment. On the same issue, VaMusaigwa$_1$ lamented noting that:

> 'Nowadays some people no longer traditionally preserve these vegetables due to technology like fridges and in some cases people phone each other to collect fresh vegetables rather than drying them or purchase them from a far away market in town'(Gomoguru village interview 4, 26 February 2015).

So, most community elders acknowledged that modernisation has influenced the types of containers they use to store their vegetables.

Given this dilemma, it raises the question of whether it is useful or not for schools to use IK resources in science education. I argue that IK should be used in science education and schooling should get knowledge from the local people. As Freire (1993) argues, education should promote knowledge 'owned' by the people as the foundation for development of curricula by integrating the sociocultural attribute of their daily lives.

The findings also highlight that community elders' IK methods of food preservation follow '*zviera*' (cultural taboos) that govern local people's ways of life. This shows the complexity of the process of food preservation for the community. Dei (2013) argues that elders understand the lived interconnections of the social, the physical and the spiritual environment. This view explains why one participant, VaMadhlovu, believes that:

> 'If we have mushrooms which as a gatherer you are not supposed to gather before thanking the Spirits for their generosity; and if you find *Mopani* caterpillars, they were not supposed to be cooked in a closed "*hadyana*" (cooking pot for side dish) for the spirits of the forest to continue providing' (Group Interview 1, Dzivaguru village 29 January 2015).

These findings affect how IK methods may be extended to science education in schools. The elder's allusion to spiritual approaches raises questions about food preservation on another level – that of including spirituality in the content of school science teaching. These findings are in line with Gyekye's (2003) proposition that African thought is understood holistically in terms of supernatural or mystical powers and Dei (2013) who posits that knowledge is about wholeness and interconnection, and knowledge production is linked to both the tangible and the spiritual realm (see also Mpofu, 2016). In contrast, Ogunniyi (2000) argues that scientific knowledge is testable which differs from IK. This view is true given that some IK is not amenable to testing since is derived from a socio-cultural environment. Having said this, however, there is little evidence to suggest that commonalities in knowledge systems do not exist. In the context of food preservation, I agree with Ogunniyi (2000, p. 77) who suggests that 'what is needed is a kind of integrative reconciliation and creative accommodation of school science into their essentially traditional worldview'. This view suggests possibilities which might exist for integrating IK with school science teaching.

In terms of preference for methods of food preservation, participants explained that indigenous methods are healthy. For example, in Dzivaguru village, VaMasiziba asserted that:

> 'People like traditionally-processed food so much because it is not usually good to eat fresh meat every day. *'Chimukuyu'* (dried meat) would help them to take water which is good for the body. Cutting meat into pieces helps to eliminate bones' (Group interview 1 Dzivaguru village, 29 January 2015).

This quotation implies that apart from ensuring safe food to the families, dried foods are also regarded as healthy by community elders.

I now turn the second theme which emerged from my study.

### 7.4.3 Theme 2 – Fermentation

Fermentation was another important method of food preservation practiced, for example, beer brewing using grain crops such as maize, millet, sorghum and rapoko. Sorghum was often used to brew beer for cultural ceremonies and '*ngwevo*' (foam on top of fermenting beer) from sorghum malt to ferment mixtures from different grain crops. Xaba (1998) notes that the surface froth in sorghum has a high content of yeast therefore it is traditionally used for brewing and baking. The following excerpt illustrates participants' understanding of the process of fermentation:

> VaMaphosa: '*Masvusvu*' (boiled mixture of malt and water, first stage in the preparation of both sweet and strong beer) made from prepared malt.
>
> VaMasiziba: Yes, you need to ferment them.
>
> VaMaphosa: Yes, if there is yeast you can add, if not available one can add '*ngwevo*'and add to prepare '*masvusvu*'.
>
> VaMachuma: That sweet beer taste very well.

Beer is part of the community diet. The findings are in line with Chelule et al's (2014) study on use of fermented foods for infants and young children of the Odi community, Gauteng. These foods include yoghurt, *amasi, mageu* and *ting* which improve the nutritional quality and increase probiotic bacteria. The findings of their study are consistent with Madigan et al (2009) who identified this micro-organism as lactic acid bacteria (LAB) in dairy food products. Pamplona-Roger (2011) uses a variety of terms to describe microorganisms in milk that include: acid-producing bacteria (streptococci, lactobacilli), coliforms (esterichia and enterobacter), butyric acid-forming bacteria (clostridium-produce lactic acid) and enzyme-producing bacteria which decomposes fats and proteins producing a bitter or rancid taste (bacillus and pseudomona).

The other important issue concerns milk preservation. All community elders indicated that

they store their milk in a '*chingo*' or '*hodzeko*', a vessel in which milk is set to thicken. One participant, VaChihera explained that:

> … we use "*hari*" (clay pot) not in a plastic archer. Fresh milk is placed in a clay pot at home. Then the following day after forming "*zifa*" (one day thick milk), "*ruraza*" (cream) is skimmed off before adding fresh one. Experts like our mothers would find a clay pot with small cracks placed inside a bigger pot at the bottom into which milk will be preserved for almost five days. Fresh milk would be added while "*mutuvi*" (whey) would drain off leaving '*mashoronga*' (thick curds of milk)' (Interview 1, Gomoguru village, 26 December 2014).

When asked for the reason of using two clay pots, one placed inside the other, VaChihera explained that 'two clay pots are used to process thick milk which is cold and nice to eat. This milk is better than the one bought from shops'. On the same issue, another elder, VaMadhlovu, made an observation that:

'Young ones do not know "*chingo*" and "*wedza*" (milking container) milk will be so cool that ... We used to eat "*mashoronga*" (thick curds of milk) that you can pick from the ground' (Dzivaguru village, access stage, 17 December 2014).

A number of issues can be discerned from the above quotations. First, Al-Shemmeri (2010) attributes temperature changes in a reaction to the application of thermodynamics in physics. Al-Shemmeri (2010) explains that temperature is the degree of hotness or coldness of the system. This means that, in scientific terms, thermodynamics involves temperature control. However, I was not interested in comparing IK practices with scientific ways of preserving food, rather, my main focus was to understand how participants themselves carry out the process and subsequent implications for science teaching.

Secondly, participants have a special type of '*ivhu*' (soil) that they use to make their pots.

Community elders explained the advantage of using specific soils to make pots stating that '*ivhu*' does not allow heat in or out of the container which helps to keep the temperature inside constant. This explanation is in line with Kumar's (2014) view that properties of soil are influenced by the size, proportion, arrangement and mineral composition of the particles. Kumar (2014) further argues that soil may be classified as clay, sandy, silty, or loamy according to particle composition. In conclusion, he noted that soil is a good absorber of water making it a thermal insulator, meaning that it does not transmit heat to the surroundings.

Lastly, the elders claim that their traditionally processed milk is better than that bought from shops. The reason they gave for their claim is that their processed milk is thick and has cream which makes it healthier than that bought from shops.

The following picture shows clay pots used by elders to preserve their milk.

**Picture 15: Clay pots for milk storage**



(Source: Site visit, at VaMamoyo's homestead, Dzivaguru village)

In picture 15 above, the institutions used by community elders, '*hari*' (clay pots) to preserve their milk depict community's cultural customs. Nyota and Mapara (2008) argue that

indigenous people have customs that are unique to them that inform them how to preserve food. Rundell (2002) defines the term 'custom' as anything which lots of people do, that is traditional; and have it done for a long time. By implication, therefore, the community elders had a 'customary' way of preserving their milk in special containers. As a custom, these community elders thickened their milk in clay pots which they mould to their specifications. Interestingly, some containers including plastic jars, '*dende*' (gourd), or '*mazai emhou*' (ostrich eggs) were readily available in the elders' communities but were not used for their milk fermentation. One of the reasons given by elders for this is that they are not suitable for keeping required temperatures to facilitate 'good' thickening of milk. Further research might be needed in terms of the advantages of these local materials over modern porcelain and plastic used as milk storage containers.

Apart from the type of containers, I was also interested in the descriptions given to processed milk by the community elders. Community elders had various terms to describe their processed milk using cultural terms including '*mahorakora*', (*VaMancube),* '*masugudu*', (*VaMasiziva),* '*mage*', *or* '*mashoronga*' (*VaMadhlovu)* and '*magake-magake*' (*VaMasibanda)* (Dzivaguru village, 29 January 2015). The Standard Shona Dictionary in Zimbabwe by Hannan (2000) shows that, although these terms are different, all refer to 'very thick sour milk'. It is this type of milk community elders said is 'good'. Related to this was the issue of '*zifa*' (one day thick milk), to which one elder, VaMasiziba in Dzivaguru, suggested they add '*matunduru*' to thicken it instantly. Adding to this, VaMadhlovu noted that they can add 'lemon juice' or '*mapfura*' (sclerenchyma berea) fruit juice to thicken it as well. VaMadhlovu furthermore explained that these juices are added because they have a sour taste which thickens fresh milk. Further research needs to be done on the properties of these indigenous fruits.

All community members explained that '*ruraza*' (cream) contributes to the overall colour and good taste of the milk. For example, VaMasiziba suggested that:

'We remove '*ruraza*' or 'cream' for shop milk. Traditionally, they would remove '*ruomba*' (fats to cook vegetables or as body oil). Milk from a dairy has no '*ruraza*' hence 'it does not taste good. Our milk tastes very nice' (Interview 1, Dzivaguru village, 29 January 2015).

The above quotation shows that how community elders would tell that their milk is 'very nice'. For them, enhancing coldness and thickness makes milk better than commercially-processed milk found in shops.

However, village head lamented lack of cultural values on process of fermentation due to modernisation. He commented:

> 'Nowadays young ones do not know milk processing pots such as '*chingo*' (clay pot to thicken milk) or '*hwedza*' (milking vessel) which we were using to preserve milk. Our grandparents were experts in processing thick milk. We used to eat '*mashoronga*' (curds of milk), so such knowledge is important to be taught in schools for learners to know their cultural practices' (Gomoguru village, 17 December 2014).

I now turn to the third theme – use of chemicals.

### 7.4.4 Theme 3 – Use of chemicals

Most participants mentioned using wood ashes, cow dung and fresh plant leaves placed on grain crops while they stored them in the granaries. Most community elders in both villages seemed to agree on the use of fresh cow dung which they smear inside the surface of their granaries. For example, a village head, VaZimuto explained:

> ‘We use ‘*muchacha’* (cucunus metiliferus), or ‘*zumbani*’ (lippia javanica) whose plant leaves produce a pungent smell that repels insects from our stored grains’ (Interview 2, Gomoguru village, 12 February 2015).

In addition, the community elders in Dzivaguru village had other methods. For example, VaMaSiziba cited the use of ‘*mutsviri*’ (combretum imberbe), ‘*muchacha*’ (cucunus metiliferus), ‘*muzeze*’ (peltophorum africanum) or ‘*mushozhowa*’ (pseudobehnatylis maprounifolia) wood ashes which they smear onto the inner walls of the granary to repel pests (Interview 1, Dzivaguru village, 26 December 2014).

These findings are in line with findings elsewhere. For example, Matsa and Manuku (2013) conducted a study in Gwanda, Kezi and Plumtree in Zimbabwe and found that indigenous people were using goat manure, wood ash and a plant they locally call ‘*Nyakambanje*’ placed on grains to deter weevils and stalk borers. In some circles, use of some of these plants is common in Zimbabwe, for example, the Ministry of Health and Child Welfare recommends use of ‘*zumbani*’ to deter mosquitoes. This confirms the relevance of this plant as it produces a pungent smell that can prevent even weevils. In my study, most participants were using ‘*muchacha*’ as a plant to deter pests from their grains.

Apart from the grains, interesting findings were also made in the way some community elders preserved their sweet potatoes. For example, VaChihera explained that:

> We wait until winter season around June to harvest our sweet potatoes. This gives them a chance to harden. We then dig a “*pfimbi*” (storage pit) almost a metre down then place sweet potato tubers. We sprinkle “*dota*” (wood ash) and close the pit with a “*gwandefa*” or “*zeteko remafuri*” (flat layer) (Interview 1, Gomoguru village 26 December 2014).

However, in Zimbabwe sweet potatoes are commonly found at various ‘*misika*’ (trade

centres) around the country such that this indigenous way of preservation is no longer viable for some people. The findings also concur with findings from another study by Kamwendo and Kamwendo (2014) on the IKS and food security among the Lomwe people in Malawi. For the Lomwe people, 'potatoes would be buried in a pit which is filled with dry soil and sprinkled with ashes'. For Kamwendo and Kamwendo (2014, p. 100), sprinkling ashes on sweet potatoe tubers is 'a way of sanitising the area'.

The application of smoking in preserving other foods other than meat was also mentioned by other participants. For example, one elder, VaMasibanda, also explained that:

'I dry maize cobs in direct sunlight first and then further take some which she would eventually use as seeds, to hang inside a kitchen that provides smoke' (Group interview 4 19 February 2015).

The above views are in line with Pamplona-Rodger's (2011) assertion that moke is a drying agent and it works by coating the meat surface with pyroligneous acid and formaldehyde, which acts as a disinfectant and preservative. So, although participants' views might be different from the literature, whatever effect chemicals in smoke have on taste suggests that it contains an effective preservative.

Apart from the exposing their understanding of the issue of IK of food preservation, participants also provided insights into possible ways in which such forms of knowledge could be integrated with school science. Their perspectives on IK integration are presented and discussed as follows.

### 7.4.5 Theme 4 – Community elders' ideas concerning integration of IK methods of food preservation with school science teaching

Another important issue emanating from the findings was participants' suggestions on how IK of food preservation could be integrated with school science teaching. My rationale for science teaching guiding my thesis also guided the selection of participants' views. For this study, I considered teaching that relates to the learners' cultural identity as important for science education in schools. Overall, my analysis was guided by the theoretical framework for the study.

As noted in chapter 4 of this thesis, apart from being inductive my analytic framework was also deductive by drawing guidance from literature. I needed a grounded analytic framework which was informed by my rationale for science teaching and ideas from Lawton's (1978) cultural analysis model. Lawton believes that, in order to plan a curriculum effectively by selecting it from culture, cultural analysis should be done. For Lawton (1978), this analysis involves a systematic process of examining a particular society in its social and historical context. Such an analysis would involve an examination of a society's culture, language, technology, knowledge, beliefs and values, in order to make judgements about what ought to be transmitted to the next generation, in other words, what is worthwhile to teach and learn. I also wanted a model that would help me to provide a qualitative description of the key elements that occur during the teaching process, bring these elements out into the open and then encourage reflection and discussion regarding the experience. I found Stake's (1967) transactional model suitable for my purpose. Stake's transactional model focuses on description and judgement to guide reflection on transactions (actions occurring during implementation).

I wanted a teaching model that guides conception, design and implementation of classroom

science in light of the community elders' views on IK of food preservation. I then designed a 'teaching experiment' for the topic of food preservation. I was interested in assessing the feasibility of the community elders' ideas of food preservation in school science. This was a 'trial-study' rather and not an intervention study.

In developing this teaching model, I took advice from Gudhlanga et al's (2013) curricula model. These authors suggest that, in science education, one of the most critical issues is what determines quality or 'effective' teaching and learning. It was my hope that social identities of learners may be acknowledged. De Beer and Whitlock (2009) advise that noting culture might positively change learners' experiences and attitudes towards science. Of course, there are various models focusing on the concept of 'effective' teaching. But in all such models, there is emphasis on education that focuses on learner-centeredness and educational activities that bring about some desired learning (see, for example, Creemers, & Kyriakides, 2006). I found a teaching model by Cho, Scherman and Gaigher (2012) useful to provide insights into what effective teaching may mean. These authors developed a model of effectiveness in science education in South Africa. Their evaluation model of science education is based on the Trends in International Mathematics and Science Study (TIMSS) by Cho (2010) which suggests that resources and what teachers do and what learners become are important quality factors in teaching. This approach is what Gudhlanga et al (2013) call 'effective successful teaching'. In light of this, I further split my fourth theme into the following four sub-categories guided by the above analytic framework. These categories include use of learners' prior knowledge, using examples and resources from culture, teaching and learning should serve to consider the importance of our cultural heritage and mechanisms for the process.

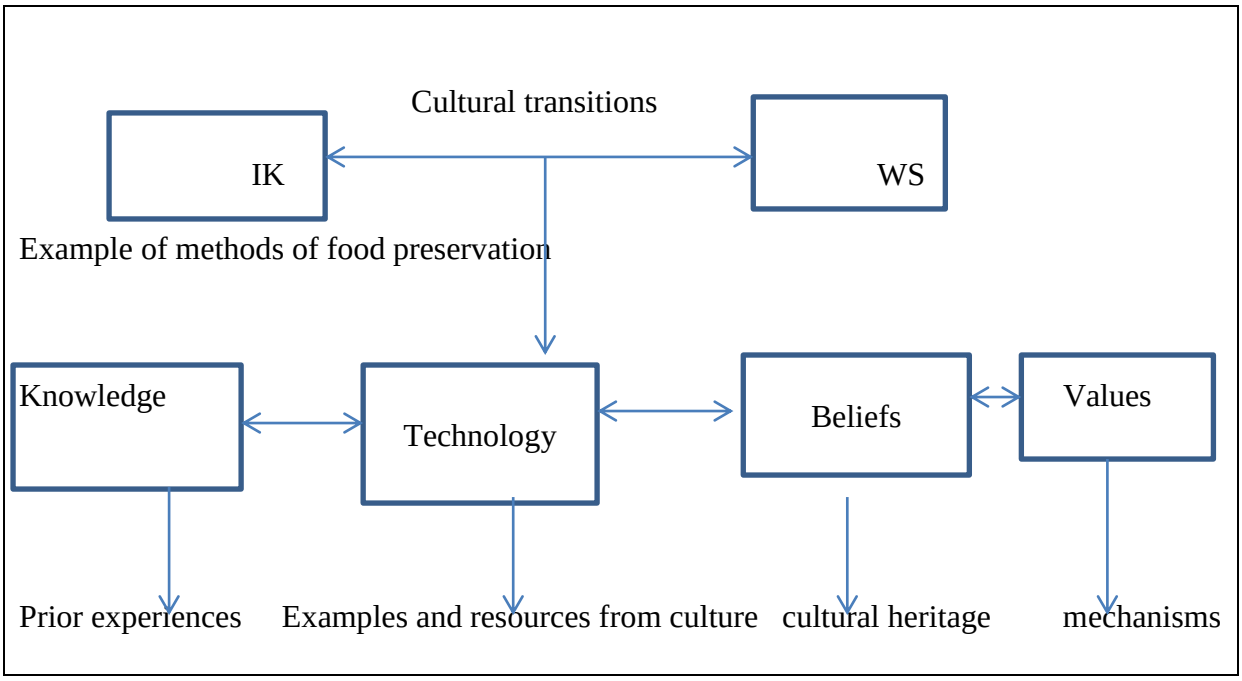



**Figure 8: My analytic model – a 'teaching experiment'**

I discuss selected aspects emerging from community elders as follows.

### *7.4.5.1 Sub-category 1: Use of learners' prior experiences*

Community elders in this study hold the view that cultural knowledge, which is rooted in IK, as prior knowledge held by learners can be used as a foundation or a building block for learning in the science classroom. This view resonates well with Roschelle's (1995) assertion that science knowledge is often just a refined product of some prior everyday knowledge. Prior knowledge is defined by Kambeyo (2012) as the knowledge that learners possess which has been gained from their surroundings (environments), parents, friends and from previous lessons. This form of prior knowledge can be in the form of IK. This form of integrating IK in schools is emphasised by some authors, for example, Khupe (2014), who argues that it may assist learners to build on what is more familiar to what is new. This view concurs with Aikenhead's (2006, p. 119) assertion that cultural border crossing is 'a metaphor that captures the act of negotiating the transition from, for instance, a student's home culture to the culture

of school science'. In this study, I do not regard knowledge acquired by learners from home for schooling as involving border crossings; rather, I take it as different cultures which have similar elements.

#### *7.4.5.2 Sub-category 2: Teaching and learning should serve to consider the importance of our cultural heritage*

Whilst I embrace the western models of teaching school science, I question their applicability in African contexts and particularly in rural settings. The real issues by community elders in the area studied are characterised by feelings of bringing African heritage back into the teaching sessions of learners at school. Yet, the concern in the western form of schooling is on standard ways of imparting facts which are culture-free for all societies; an issue which may not be a priority for people in rural African settings. Such people may be disadvantaged at all levels of development to an extent that all that they are expected to learn is framed outside their cultural fields. This is evident from the views expressed by one village head, VaZimuto:

> Nowadays, young ones at school do not know very important containers referred to as "*chingo*" (clay pot for milking purposes) and "*hodzeko*" (clay pot in which milk ferments). So, if this knowledge is taught in schools, young ones will definitely benefit. If indigenous materials are used in schools, indigenous knowledge will not be lost due to modernisation (Gomoguru village, interview 4, 19 March 2015).

As alluded to in this quotation, due to the effects of modernisation, these indigenous people accepted that they know metallic or plastic containers may be suitable to process their milk. However, community elders hinted that such containers are not as effective as their own cultural materials. I therefore question the school science's over-emphasis on using western materials and its apparent avoidance of cultural materials for teaching. The importance of

culture could be reinforced by highlighting, what Odora-Hoppers (2005) argues, that schools should avoid academic imperialism by embracing other knowledge systems including IK. By implication, this is the recognition that societies have different ways of understanding, influenced by their cultural belief systems. One community elder, VaChihera, concurred with the Village head's comments above, and posits that,

> Yes, school children should have knowledge about indigenous ways of preserving food. This is because some do not know how dried pumpkin leaves vegetable is prepared, some do not know that mushrooms can be dried; they take these as useless things (Gomoguru village, interview 3, 12 February 2015).

The other significant finding in the above quotation is the issue of justice in knowledge acquisition. For Hodson (1993), ensuring justice in education constitutes some of the assumptions of multicultural science teaching. This explains why, for schools in southern Africa, Hewson (2015, p. 130) sees merit in instituting 'a model of culturally responsive teaching involving content integration, knowledge construction, prejudice reduction, social justice and academic achievement'. Such views are in line with an earlier version by the same author, Hewson (2012, p. 328), who believes that if 'curricula in Africa are not ecologically suited to the intellectual niches of the people (especially their cultural heritage), they will not work'. Both views by Hewson are line with the calls in science education, for example, by Shizha (2013), to include the voices of the participants.

The whole community is involved in marriage parties: people cook sadza prepared from sorghum, rapoko and millet. Elders entertain themselves by drinking '*maheu*' (sweet beer) and '*masvusvu*' (boiled mixture of malt and water). In explaining how they brew these drinks, one elder, VaMaSiziva, commented that she uses millet, rapoko or sorghum as powder for preparing beer in '*makate*' (large earthenware clay pots in which beer is set to ferment). In modern day Zimbabwe, these cultural materials are still used. In addition, beer manufacturing

both at household and industrial levels is done mostly using plastic, metallic or ceramic containers which, users claim, are user friendly in terms of weight. The establishment of Growth Points or townships in rural areas has made it easier for the Shona people to access industrially manufactured beer. Observations in local shops show that times have changed. Some people have moved from use of cultural materials to modern materials as the latter are considered easy to use. So, the issue is that cultural materials are still useful in the communities but their use has been suppressed by the influence of modernisation.

## 7.5 SUMMARY OF THE CHAPTER

Community elders were preserving mostly grain crops (maize, sorghum, millet, rapoko, groundnuts, rice and roundnuts), milk, sweet potatoes, vegetables and meat. Community elders used mostly three methods to preserve their foods: drying, fermentation and the use of chemicals. Practically, community elders were found to have IK strategies that were useful in the way food is preserved commercially. These three methods used by community elders were given as shown Table 12 below.

***Table:*** *12*

Relationship between IK and science processes in food preservation

| **The Science involved** | **Process** | **IK approach** |
|---|---|---|
| Removes water or kills microorganisms through osmosis | Dehydration | Salting and placing on fire or sun to dry. Also hanging in air to dry. Water is removed.<br>Use of sealed granaries and '*tsapi*' to store grains |
| Production of alcohol | Fermentation | Use of clay pots to process milk |
| Chemicals kill microorganisms and pests | Use of chemicals | Use of wood ash and smoke to kill bacteria and pests |

For the topic 'food preservation', participants suggested 'possibilities' of practice. Their call is similar to what Skovsmose (2009, p. 109) suggests as researching 'what is not, but could be' in an educational context. For example, the use of IK of food preservation was suggested in two ways: use of prior experiences possessed by learners in schools, and; teaching and learning should emphasise the importance of cultural heritage.

I now turn to the next chapter, findings from teachers in the study.

# CHAPTER 8: DATA ANALYSIS-TEACHERS' IK METHODS OF FOOD PRESERVATION

## 8.1 INTRODUCTION

In Chapter 7, I analysed, presented and discussed findings from community elders. In this chapter, I analyse, present and discuss data generated from the interviews, site visits and observation of food artefacts for teacher's IK of food preservation. This data, from eight (8) teachers was combined in my analysis. This analysis endeavoured to answer research questions 2 and 3 for the study: 2) What elements of IK and methods of food preservation do the rural community members of Chivi District hold? and 3) How may culturally relevant teaching be drawn from the knowledge of the community members' indigenous methods of food preservation and the current practices of teachers and learners in Chivi district?

In analysis of data, I used the same procedure as described for community elders in chapter 7 of my thesis. To answer the above research questions, I firstly explain how I selected and identified teachers for this study.

## 8.2 SELECTION AND IDENTIFICATION OF TEACHERS

My participants consisted of science teachers.I selected teachers through the heads of their schools. Initially, I wanted all science teachers from two schools who might have been interested to take part in my study. Through the heads of department at two schools, I selected five (5) teachers from one school and three (3) from the other. So, in summary, this study involved a total of eight (8) participants. These participants were identified in the study as follows.

I identified teachers by using the first three letters of their surnames and adding an‘s’ to form an identification word (see Appendix I). Initially, I distinguished teachers from by adding a prefix, for example, Dr, Mr, or Mrs, depending on gender. Also, I identified teachers involved in my study by adding titles to their post of special responsibility within their institutions. However, through interactions with teachers, I found that most of them were not happy with the idea of adding a title when identifying them. Rather, they preferred to be called simply by their surnames. But, for this write up, I identified teachers with the titles to show the relationship among these participants even if it was against their wishes.

## 8.3 HOW I ANALYSED MY INTERVIEW DATA

I analysed my data following the same procedures as described for community elders in section 7.3 of this thesis. I then show how this data was presented in the following section.

## 8.4 PRESENTATION AND DISCUSSIONS OF THE FINDINGS

### 8.4.1 Introduction

I present and discuss my findings in relation to the teachers’ views on indigenous methods of food preservation. As noted before, my analysis was guided by literature and the theoretical framework used for this study. Like for community elders in chapter 7, this presentation of data focused on four main themes: dehydration/drying, fermentation, the use of chemicals and community members’ ideas concerning integration of IK of food preservation with school science teaching. As for community elders in chapter 7, my codes for teachers (T) were: dehydration (TD), fermentation (TF), use of chemicals (TC) and importance of IK of food preservation for school science teaching. The second letter stands for the theme, for example, (F) for fermentation.

### 8.4.2 Theme 1-Dehydration/ drying

Teachers alluded to the view that they use mostly drying as a method to preserve their grain crops. For example, Mr. Shaas' explained that:

> 'In spite of low uptake of indigenous methods by mostly the young ones, salting and drying are indigenous methods and these methods are commonly practiced in our local communities' (Interview 2, Gomoguru secondary 5 February 2015).

Evidently, this method of drying meat to form biltong is widely practiced as shown in various supermarkets and resting places along the highways in Zimbabwe. The method used for such supermarket products is similar to that used by community elders. The paradox here is that I observed that the younger generation is shunning indigenous methods but biltong meat from various food outlets in Zimbabwe is consumed by all age groups.

My findings indicate that those who shun IK methods had no problem with the IK food quality but were not eager to be associated with these methods. This finding shows the effect of modernisation on indigenous peoples' way of life. It does not, therefore, indicate that indigenous people do not like IK; rather, it is indicative of their profound developmental shift from IK to western methods of food preservation.

Regarding the quality of their food, some participants indicated that they sometimes do not use direct sunlight to dry their meat. For example, Mr. Choks claims that:

> 'Salt which is a drying agent and place it in the sun which is a bleaching agent. So by drying in the shade, you are preserving the flavour of that meat' (Interview 2, 5 February 2015, Dzivaguru secondary teachers).

Pamplona-Roger (2011) agrees that heat affects the quality of meat as, when meat is heated,

proteins are lost due to the Maillard reaction between an amino acid and a carbohydrate. Considine and Considine (1982) explain that this reaction causes an insoluble compound that the body cannot use and therefore there is a loss of nutrients. I enquired from Mr. Guns, the Foods and Nutrition expert at a local university in Zimbabwe, about the effect of sunlight on meat. He agreed that sunlight has both a drying and a bleaching effect on food as, when drying in direct sunlight, food dries very fast and when cells shrink, they dehydrate. Brown (2008) explains that, although the effect of the sun is different from that of desiccators which are hygroscopic (attract and hold water), there is evidence that bacterial (DNA) damage may result from sunlight. So, in terms of food preservation, sunlight can serve to preserve meat as participants have suggested.

Some teachers liked both indigenous and commercially-processed foods, for example, Mr. Shaas asserted that:

> '… but as far as I am concerned my interest could be 50-50. Yes, that is I rate them as equal because there are times when you want food which is preserved traditionally. I have told you about dried meat, all these give variety to our food and, as such, it makes it equally important. Because sometimes I do not feel like eating some things which are fresh but preserved dry like '*hwowa'* (mushrooms) such as "*matindindindi*" (sporobolus pyramidalis) and other different kinds of mushroom' (Gomoguru teachers interview 4, 19 February 2015).

Raising similar sentiments regarding preference of dried food, Mr. Mups was of the idea that:

> 'If it is food like meat maybe, I would prefer' (Gomoguru teachers interview 4, 19 February 2015).

In contrast to the meat preserved using modern methods such as refrigeration, food preserved with a traditional method like drying or dehydration can last longer periods but loses the taste

as noted by some teachers. For example, Mr Mups commented:

> ‘I do not favour traditionally preserved thick milk. There is also a possibility of food being contaminated if it is not covered, for example, in a kitchen it can be contaminated by flies, rodents or ants (Gomoguru teachers, interview 4, 19 February 2015).

Some teachers were more interested in modern technology than IK methods even though it is expected they would be more interested in issues that relate to their culture rather than what could be described as ‘alien’ to them. For example, Mr Tingwas commented:

> ‘Use of bricks instead of wooden poles for building granaries has a big advantage and even metal roofing sheets are better. They do not accommodate termites’ (Interview 2 Dzivaguru secondary teachers, interview 2, 05 February 2015*).*

These findings contradict those found by Matsa and Manuku’s (2013) study on the IK of food preservation for the people in Matebeleland, Zimbabwe. Their study found that indigenous people preferred indigenous ways of storage to modern ways arguing that modern methods use chemicals which are dangerous, unlike traditional methods. In light of Hewson’s (2015) and Aikenhead’s (2015) studies, a possible explanation for the findings in my study could be that the issues of IK are often associated with ‘backwardness’ or ‘archaic’ practices.

Although it was not the focus of this study, drying as a method of food preservation was sometimes found to be gender-specific usually done by mothers. One teacher, Mr. Choks, said:

> ‘Mothers basically are responsible for food, fathers simply procure and processing has to be done by mothers especially cooking. For smaller quantities of meat, mothers simply do it alone’ (Dzivaguru secondary teachers, Interview 2, 05 February 2015*).*

Matsa and Manuku (2013) observed gender disparity regarding involvement in food preservation for indigenous communities in Sourthern Africa and argue that it is women who tend to be responsible for food crops, storage, processing and preservation. Similarly, Parawira and Muchuweti (2008) also observed that, in Zimbabwe, processing and storage of food is mostly done by women. Although I did not carry out classroom observations, I saw this gender differentiation reflected in some classroom science situations in Zimbabwe during my tenure as a secondary school teacher. This past experience merited my further search for the topic in a different context. However, as participants noted, the situation might be different due to modernisation where males are assuming responsibilities that were deemed feminine in the past.

Mr. Mups noted that sweet potatoes can be stored in an underground pit. He commented:

> 'An underground pit can store sweet potatoes for a long period of time. Usually people harvest them in winter (May, June or July), then keep them in the pit up to October, December. So it is a good way of preserving sweet potatoes. So, this method does not change the taste of the crop' (Gomoguru secondary teachers, interview 3, 12 February 2015).

Commenting on use on underneath the granary by community elders, Mr Shaas noted:

> 'Yes, I want to concur with those people who say they put watermelons there for cooling. If you break it and eat it, it will very cold because of the temperatures, its reasonably cold. The idea of being cold, I do not know whether you will allow me to call it traditional technology, because we compare with other methods like refrigeration. The majority of our rural population do not have fridges, so it helps them to preserve food for a long time' (Gomoguru secondary teachers, interview 3, 12 February 2015).

Overall, teachers in the study noted that drying is the most preferred method of food preservation. However, some teachers have a feeling that it is gender-specific.

I now turn the second theme which emerged from my study.

### 8.4.3 Theme 2 – Fermentation

All teachers explained that they use fridges to preserve milk. Some however indicated that they still visit rural homesteads around their schools to buy traditionally preserved '*hodzeko'* thick milk. For example, Mr Choks explained:

> 'I eat traditionally preserved thick milk as dessert during lunch two times a week. Thick milk is delicious; I cannot afford to miss it' (Dzivaguru secondary teachers, interview 3, 12 February 2015).

This view was corroborated by Mrs. Chiks who noted:

> 'I usually buy fresh from the shops and add a few drops of lantana camara juice or from caffra fruits which is abundant in the bushes around our area. By doing so, I will thicken my milk and becomes ready for consumption as food. I have a clay pot to process my milk at home' (Dzivaguru secondary teachers, interview 3, 12 February 2015).

Explaining community elders' clay pots for preserving milk, Mr. Mups asserted that:

> 'In our communities it is alright. Clay pots have thick walls that keep milk for a long period of time, may be for a day, on the following day, you find that it goes sour, people usually like sour milk as relish' (Gomoguru school, 12 February 2015).

Like community elders, teachers see relevance in the indigenous materials that they use to

preserve milk.

I now turn to the third theme – use of chemicals.

### 8.4.4 Theme 3 – Use of chemicals

Most teachers mentioned using wood ashes, cow dung and fresh plant leaves placed on grain crops while they stored them in the granaries. Teachers cited the role of ashes as sanitisers. According to Mr. Mups, a teacher at Gomoguru Secondary, the application of wood ash in the soil increases the soil pH due to its liming effect. Furthermore, he argued that the carbonates and oxides remaining after wood burning increase the pH of the soils. Further research is needed here to ascertain the acidity and alkalinity of wood ashes used by the community elders alluded to in chapter 7 of this study.

Participants unanimously concurred that wood smoke is another more commonly used method to preserve large quantities of meat in their communities. For example, one teacher Mrs. Chiks explained that:

> 'In smoke we have a chemical which kills bacteria. This chemical, formaldehyde which is found in smoke, it kills bacteria; and where there is smoke, it means there is also heat. So, smoking kills bacteria, it also dehydrates food, the meat' (Dzivaguru secondary teachers, interview 3, 12 February 2015).

The above views are in line with Pamplona-Rodger's (2011) assertion that smoke is a drying agent and it works by coating the meat surface with pyroligneous acid and formaldehyde, which acts as a disinfectant and preservative. So, although participants' views might be different from the literature, whatever effect chemicals in smoke have on taste suggests that it contains an effective preservative.

Commenting on the use of cow dung on the roof of granary, Mr Tingwas explained that:

> ‘There would not be termites that would pass through those buildings because of its acidic nature. Sometimes *‘machachacha’* are mixed with cowdung. They also have those acids so that those termites would not attack the maize, rapoko and other grains- so the nature of the dung is very important- which is acidic’ (Dzivaguru secondary teachers, interview 3, 12 February 2015).

This view was corroborated by Mr Mups who argued:

> ‘Juice from indigenous plants can be mixed with cowdung and smear it on the granary wall. Yes, it is traditional way of keeping things like ‘*zvipfukuto’* grain borers from entering the granary to destroy stored crops. It also produces a smell that scares away some organisms that might want to destroy crops in the granary’ (Gomoguru secondary teachers, interview 3, 12 February 2015).

So, in terms of chemical use, teachers concur that plant sources supply acidic substances that are used to preserve grain crops.

I also gathered teachers’ perspectives on IK methods of food preservation integration with school science teaching. I now present and discuss them as theme 4 in the following section.

### 8.4.5 Theme 4 – What teachers were saying concerning integration of IK methods of food preservation with school science teaching

To identify teachers’ views on integration of IK of food preservation with school science teaching, I followed similar analytic model as used for community elders in chapter 7 of this thesis. This analysis was guided by the selected aspects from the ‘teaching experiment’ as described in section 7.4.5 of this thesis. I needed to capture teachers’ emerging views on the phenomenon.

I discuss each of these selected aspects as follows.

#### *8.4.5.1 Sub-category 1: Use of learners' prior experiences*

The most significant finding in this category was the importance attached to the socio-cultural background held by learners that most teachers suggested can be used by teachers for teaching. Shizha (2009, p. 148) argues that, 'learning process is constructed around people's everyday life thus contributing to holistic and interconnected experiences'. This was evident from the views expressed by one teacher, Mr. Shaas, when he said:

> 'After they have indicated and reflected on the methods they use at home, I recommend that that is very important because it helps us to keep food for a long time. It saves us from going to buy from other peoples' gardens and from having diarrhoeal diseases. Then also tell them that those are not only the methods but there are other methods which are used at home. But those used at home are very important elsewhere and not' (Gomoguru secondary teachers, interview 2, 05 February 2015).

On the same issue, Mr. Mups commented:

> 'If we look at traditional methods of food, indigenous methods were there from time immemorial-learners know these methods' (Gomoguru secondary teachers, interview 1, 29 January 2015).

The above interview quotation shows that IK methods of food preservation are also useful in the teaching of science in schools. Kelly, Carlesen and Cunningham (1993) argue that the product of science is a result of the society's interests and questions as well as the socio-economic and cultural challenges that need to be addressed. The above view by Mr. Shaas is consistent with a culturally sensitive science curriculum that Ladson-Billings (1995) believes would foster among learners the acquisition of valid knowledge. As noted earlier in chapter 4 of this thesis by Gay (2010) this culturally responsive pedagogy entails teaching and learning

that goes on in school which is based on the learners' background, the learners' cultural knowledge and the learners' ways of learning and knowing. In this context, the content of science in schools should be presented as value-laden rather than value-free. Using this approach, Keane (2008a) contends that IK may be seen as a resource for learning rather than a problem.

It was clear that all teachers in the study share the view that learners come into the science classroom with knowledge gained from their homes or backgrounds. All teachers stressed that there should be a connection between learners' prior knowledge of food preservation and science learning in the classroom. This finding complements Stears, Malcolm and Kowlas' (2003) contention that the informal or background knowledge that learners possess can be used as a foundation to learn science concepts. This is suggested by Naidoo (2010) who argues that science teaching should take into consideration learners' cultural backgrounds (rooted in IK). Similarly, McKinley (2005) posits that connecting learners' cultural background to science education makes science relevant to learners.

For some teachers in the study, this recognition of the prior knowledge learners possess brings about the creation of an enriched learning environment. This resonates with Collins' (2008) assertion that when learners are given the opportunity to engage actively in processing prior knowledge with new information to construct meaning, the result is an enriched learning environment. However, in the current developments in science technology, this knowledge from prior experiences might be problematic since it can emanate from multiple sources including media, observations of natural phenomena and interactions with others and is not always embedded in indigenous knowledge.

Nonetheless, teachers in this study hold the view that cultural knowledge, which is rooted in IK, can be used as a foundation or a building block for learning in the science classroom.

This form of integrating IK in schools is emphasised by some authors, for example, Khupe (2014), who argues that it may assist learners to build on what is more familiar to what is new.

#### *8.4.5.2 Sub-category 2: Using examples and resources from culture*

Teachers' respective views were in agreement that learning could be facilitated in a science classroom with the use of food samples that learners bring from their homes. For example, Mr. Shaas explained:

> 'When I like to teach the topic food preservation, I will ask learners to bring samples of food their mothers have preserved. Obviously, these learners will bring different types of food found in the communities. I will then split them into groups, allowing discussion of different methods used to preserve such foods. If some methods are not common in the communities but are emphasised by the syllabus, I would then discuss with them how they are done' (Gomoguru secondary teachers, interview 5, 19 March 2015).

On the same issue, Mr. Chikos suggested that:

> 'Learners can bring the food samples from home. You may not find all the methods represented in all the samples that they brought. So you have to include others like preparation of other types of foods like mushroom, that is, common foods that they can easily grasp' (Dzivaguru secondary teachers, interview 5, 19 March 2015).

As a reaffirmation of the same point he alluded to earlier, Mr. Chikos reiterated that:

> 'Food preservation is practiced at home, so you can task the pupils to bring the samples of food preserved using whatever method but avoiding repetition of say pupil A, pupil C both bring smoked beef. You now work with what pupils have brought. So insead of the teacher just explaining smoking, they have to see because seeing is believing' (Dzivaguru secondary teachers, interview 6, 26 March 2015).

The above views from the teachers show that teachers see value in incorporating examples and materials from learners' culture in school science teaching. The implication of this is that there is science in IK as noted by Emeagwali (2003) and Ogunniyi (2004).

Acknowledging the importance of a rural context to school science teaching, Mrs. Chiks explained that:

> 'In our rural areas we do not have any problems especially on such issues. This is because these traditional methods we are talking about are exactly what is being practiced at their homes. So integrating them here at school it is just a revist of what they are used to what they are doing at their homes' (Dzivaguru secondary teachers, interview 4, 19 February 2015).

Similar sentiments were also raised by Mr. Mups, when he explained on the use of traditional preservation methods in school science teaching:

> 'There are some IK practices in the rural communities that can be involved in our syllabus like drying or dehydration, those ones are there. We are required to teach those in our schools'. (Gomoguru secondary teachers, interview 4, 19 February 2015).

Another teacher, Mrs. Chiks was clear on specific method of food preservation that could be taught in school science using materials from learners' culture. She explained:

> 'In the case of fermentation, I would ask learners to bring some clay pots from home which their parents use to preserve milk. I would ask them to request their parents to provide pots they would not mind if we do not return to them. I would also ask learners to bring containers that are used to keep milk prepared commercially and then compare the two processes' (Dzivaguru secondary teachers, interview 5, 19 March 2015).

In light of the above quotations, the emphasis for all of them is on the importance of culture

for science education. These findings are in line with Lawton's (1978) view that curriculum is selected from culture. In a more recent study, Chiang and Lee (2015) believe that, to make science learning meaningful to indigenous learners, educators need to design and collect teaching materials from indigenous learners' daily life and living environment. This is consistent with McKinley and Stewart (2012) finding on the teachers' inclusion of Maori knowledge (IK) for science classes in New Zealand that all teachers in English-medium schools spoke of using IK as a resource to be drawn on in the science classroom. Through this, McKinley and Stewart (2012) note that teachers would capture learners' interest in schools. This idea of using local language in school science is similar to what Lubben and Campbell (1996) call 'contextualising science teaching' in schools that they describe as follows: 'students' interests in learning science is stimulated by contexts with which there are perceived to be immediate, or future, personal links' (Lubben, & Campbell, 1996, p. 319). Since, according to McKinley and Stewart (2012, p.551), 'indigenous local languages carry both identity and knowledge', it may be valuable to contextualise the science curriculum.

However, one teacher, Mr. Mups, lamented the lack of hygiene in some indigenous methods of food preservation; and made hinted that school science syllabus does not incorporate IK methods of food preservation. He explained:

> 'In some indigenous methods, food is processed in the open where it will get in contact with flies that provide pathogens causing decay. For school science, our syllabus does not include traditional methods of food preservation. These can be talked about in science clubs' (Gomoguru secondary teachers, intervierw 5, 19 March 2015).

This perception by the teacher suggests the need for cultural materials to be kept abreast with current trends. This teacher's explanation is that IK possessed by the learners is very useful but is not for schooling; it could be done in science clubs. So, integration of IK, in the views of Mr. Shaas and Mrs. Chiks is tantamount to 'reflection on what happens locally'. The

contrast here is that what happens locally is IK of food preservation which Mr. Mups suggested is not in the syllabus and hence should not be taught.

### *8.4.5.3 Sub-category 3: Teaching and learning should serve to consider the importance of our cultural heritage*

Teachers felt that teaching and learning of school science should take into consideration communities' cultural heritage. For example, Mrs. Chiks explained that:

> 'You know what I think this practice should be even taught at primary school level because they listen much to teachers than to parents. If it seriously taught at that level, it will be alright, that food traditionally preserved is more important not equally important than commercially processed food. Although these can have disadvantages here and there but I think for health reasons these days it is very important' (Dzivaguru secondary teachers, interview 4, 19 February 2015).

In a similar manner, Mr. Chikos concurred with the above view and brought another dimension to the arguement:

> 'I think food preservation apart from being a topic in the O'Level integrated syllabus, it is also an important life skill. Pupils actually benefit whether for examination or for life, it is a life skill' (Dzivaguru secondary teachers, interview 6, 26 March 2015).

In this regard, while Mr. Choks seemed to acknowledge the absence of IK methods of food preservation in school science syllabus, he sees merit in incorporating such practices in lessons since it may equip leaners with life skills.

While some teachers spoke of the importance of cultural heritage to be brought back to learners in schools, some thought otherwise. Those with dissenting voice maintained that not

all indigenous methods practiced by community elders work. They suggested that some of the symbols they use are spiritually-anchored, hence may not be suitable for school science learning. It was apparent that these teachers found the integration of IK with school science teaching a challenge as they did not possess adequate background or content knowledge of IK. The effects of this challenge filtered through to the way they suggest how actual teaching of a science lesson using IK would be done. Some said it is impossible in some cases. This agrees with Ogunniyi's (2007a) assertion that science teachers do not hold valid understandings of IK or possess adequate knowledge to implement a science IK-curriculum.

The teachers' attitude is similar to what Manzini's (2000) study found in South Africa that many teachers seemed to be oblivious of the cultural bias of the present curriculum. There appears to be confusion in understanding the nature of science (NOS) and the nature of IK (NOIK) as observed by Cronje, De Beer and Ankiewicz (2015). I argue that such confusion might have arisen due to differences in teachers' conceptual understandings of the NOS and NOIK with respect to ontology (what is IK), epistemology (ways of knowing), methodology (methods of action) and volition (the will to teach values, beliefs and attitudes of IK). Unfortunately, with this confusion, Cronje et al (2015, p. 32) argue that, 'IK is seen as an "add-on" to teachers' explanations'. For Robson (2002), this is a positivist (standard) view of science that separates facts from values where IK is seen as 'culture-free'. Malcolm (2003) claims that the pursuit of science in a positivist sense is characterised by reductionism and Cartesian dualisms of the seventh century Western philosophy – with their separations of subject/object, mind/matter and physical/spiritual knowledge forms. This contrasts a realist view of science which Howell (2013) suggests acknowledges values and sees knowledge as a social and historical product that can be specific to a particular time, culture or situation. As Shizha (2009, p. 148) explains, 'science is not value-free; it is shaped by our culture'. This argument places science as a cultural construct which includes also indigenous ways of

knowing or epistemology as also observed by Smith (1999). Fortunately, for indigenous epistemology, Shizha (2009, p. 148) maintained that, 'knowledge is a representation of the local people, constructed by the people and controlled by the people themselves, [and] should be reflected in informal and formal learning situations'. Thus, indirectly, Shizha (2009) is suggesting that IK could be included into school science teaching.

#### *8.4.5.4 Sub-category 4: Teaching and learning should emphasise the importance of mechanisms for the process of food preservation*

When asked about the link between IK and school science, most teachers mentioned that IK and science practices should be connected through an emphasis on the mechanisms of the phenomenon. For instance, on school science teaching, Mr. Choks suggested that:

> 'The methods are not covered but the mechanisms – how salting as a method is also an indigenous method, it is covered. Wood smoke it is covered and also the mechanism is covered. So, I think what may seem to be lacking is the link between traditional methods and the mechanism – just that' (Dzivaguru secondary teachers, interview 4, 19 February 2015).

On the same issue regarding need for teaching and learning to emphasise on mechanisms of IK methods of food preservation, Mr. Mups explained that:

> 'We have methods such as canning, learners may not be away that food will have been preserved in canned tins; also smoking and drying seem to be similar both produce heat but in smoke there are chemicals which kill bacteria' (Gomoguru secondary teachers, interview 1, 19 January 2015).

The above response by Mr. Choks shows that similarities and differences between IK and school science food preservation processes were noted. For example, Shizha (2013, p. 5) argues that, 'school knowledge should align itself with learners' experiences that are characterised by their socio-cultural world views'. Shizha's (2013) position concurs with the

above responses by both teachers. Data from these teachers highlights the need for school teachers to emphasise mechanisms rather than methods if integration of two forms of knowledge is to be realised.

The above views are in line an intersection perspective to IK integration with school science teaching as suggested by Ogunniyi (2007a) and Emeagwali (2003). Their suggestion is similar to what Naidoo (2010) refers to as 'an integrationist approach' that, she believes, would link and make connection between IK and school science. In this approach, IK is brought into school science by finding out how best IK can fit into school science. In contrast, Mr. Mups was negative about the use of IK mechanisms in school science teaching. He suggested, 'when I teach a topic like this in school science, I ask learners the methods their parents do at home. We then discuss these methods but it can be different from a scientific perspective'.

In the opinion given above by Mr. Mups, 'the methods can be different from the scientific'. This view shows that he was not interested in IK. Concerning use of IK in schools, as Ogunniyi and Hewson (2008) found, this teacher was 'less optimistic about its success' in schools. This is akin to a separatist approach to IK in schools as suggested by Ogunniyi (2011). The approach entails introducing IK side-by-side with similar scientific knowledge in school science. This finding raises the question of whether IK should be used as context in science or not. I argue that IK should be integrated in science teaching in a way that clearly shows the links or connections of mechanisms of the processes for both IK and scientific worldviews.

## 8.5 SUMMARY OF THE CHAPTER

For teachers, the use of IK of food preservation was suggested in four ways: use of prior experiences possessed by learners in schools, use of examples and resources from culture,

teaching and learning should emphasise the importance of culture and the emphasis on mechanisms of methods rather methods per se.

I now turn to the next chapter, on what learners were saying on IK methods of food preservation.

# CHAPTER 9: DATA ANALYSIS-LEARNERS' IK OF FOOD PRESERVATION

## 9.1 INTRODUCTION

In Chapter 8, I analysed, presented and discussed findings from science teachers on IK of food preservation and its teaching for school science in Zimbabwe. In this chapter, I analyse, present and discuss data generated from the interviews for school learners' IK of food preservation. My analysis was based on data from seventeen (17) learners who participated in the study.

In this analysis, I was guided by two research questions: 'What elements of IK and methods of food preservation do school learners in Chivi District hold?' and 'How may culturally relevant teaching be drawn from the knowledge of the community members' indigenous methods of food preservation and the current practices of teachers and learners in Chivi district?'. To answer these questions, I firstly explain how I selected and identified my participants for this study following the procedures as used for elders in chapter 7 of this thesis.

## 9.2 SELECTION AND IDENTIFICATION OF PARTICIPANTS

My participants consisted of O'Level Form 4 school learners. Teachers who expressed interest in the study helped me to select four learners from each school from a class that was currently doing the topic 'food preservation' in science. Since these learners were minors, I sought study consent from their headmasters, parents and the learners themselves. Later, as interest in the study grew, three more learners joined the group from one school and nine

more from the other school, giving a total of seventeen (17) school learners for the study. These participants were identified in the study as follows.

As for teachers, I identified learners by using the first three letters of their surnames and adding an‘s’ to form an identification word (see Appendix I). Initially, I distinguished teachers from learners by adding a prefix, for example, Dr, Mr, or Mrs, depending on gender. In the case where learners had the same surname, I distinguished them using superscripts, for example, as, Maus and Maus $_1$ (as can be observed in section 9.4.3 of this chapter).

## 9.3 HOW I ANALYSED MY INTERVIEW DATA

I now discuss how I analysed my data. I took a number of steps in analysing my data. These steps were described in section 7.3 for this thesis.

## 9.4 PRESENTATION AND DISCUSSIONS OF THE FINDINGS

### 9.4.1 Introduction

I now present how I analysed my data using four main themes, similar to those used for both community elders and teachers. The themes include: dehydration/drying, fermentation, the use of chemicals and learners’ ideas concerning integration of IK of food preservation with school science teaching. So, my codes for learners (L) were: dehydration (LD), fermentation (LF), use of chemicals (LC) and importance of IK of food preservation for school science teaching. The second letter stands for the identified theme, for example, (D) for dehydration.

### 9.4.2 Theme 1-Dehydration/ drying

Findings from learners show that dehydration was mentioned as a main method to preserve grain crops. Although all learners concur that indigenous methods of preservation including drying were useful, some learners expressed that some of these methods were old fashioned

and not hygienic. The following excerpt exemplifies this view (R=researcher; Hlas=a learner).

> Hlas: Traditional method is old fashion and not hygienic.
>
> R: What exactly do you mean by this?
>
> Hlas: Some people are dirty, if they preserve it.
>
> R: What about yourself?
>
> Hlas: I prefer traditional food like dried one because I can preserve it myself because food can last for a long time.
>
> (Dzivaguru secondary learners, interview 2, 05 February 2015).

In another related excerpt on food preferences (Conversation between researcher and a learner)

> R: Which method keeps food like meat fresh for a long time?
>
> Baws: Drying is the best
>
> R: So why have you previously mentioned that you prefer commercially preserved meat than traditional?
>
> Baws: We would be moving with events, since nowadays there are refrigerators but dried meat is not bad because even if you go to distant places you can eat it why it is not cooked' (Gomoguru secondary learners, interview 3, 19 February 2015).

The above first excerpt shows that this learner did not prefer traditional foods prepared by some other people, but if he does it himself, he would like them without any problems. So, the issue here was dislike of traditional foods; rather, it was to do with who does the preservation that determines his preference for food. The second excerpt shows that even if modern technology has had an impact on the peoples' lives, use of indigenous methods is still preferred by some in the communities.

More specifically, some learners from the same school concur that drying was the most preferred method of preservation at their homes; and further cited examples of organisms responsible for spoiling foods as well as type of foods kept safe for consumption. The following excerpt illustrates this:

> R: How do we protect our food?
>
> Macs: By smoking
>
> R: What are we protecting food from?
>
> Macs: From microorganisms such as bacteria
>
> R: How are we able to do that by smoking?
>
> Chigs: It dries the food, for example, meat and vegetables.
>
> (Dzivaguru secondary learners, interview 2, 05 February 2015)

This excerpt shows that learners were aware of smoking as a method used to dry food. They had knowledge on specific microbes that are involved in food spoilage. The above findings concur with Tull (2009) who argues that microbes are responsible for food spoilage; and Brown's (2008) assertion that smoking provides heat and chemicals that dry food.

All learners acknowledged use of granaries in storing grain crops after drying in direct sunlight. For example, one learner, Chigs explained how fresh maize cobs could be dried at home. He noted that:

> 'After harvesting you place cobs on the rakes, and expose to sunlight for drying before placing them in the granary at home' (Gomoguru secondary learners, interview 2, 05 February 2015).

This finding shows that sunlight is the most preferred method of drying grain foods in the rural communities. These findings are in line with Bern et al's (2008) contention that exposing maize grains to sunlight reduces moisture level to an extent that microorganisms responsible for food spoilage will not function properly.

A learner from another school extended that argument of the function of a granary to include maintaining cold conditions underneath it as some of its roles. In this regard, Macs commented:

> 'I think there is a shade which keeps moisture resulting in cold conditions underneath the granary. This keeps watermelons fresh for a long time' (Dzivaguru secondary learners, interview 2, 12 February 2015).

The above comment indicates that the learner was aware of indigenous methods of maintaining cold conditions suitable to keep some perishable foods fresh for a long time. Although some learners were saying these indigenous methods of preserving food were no longer commonly practiced due to the effects of mordenisation, there is acknowledgement from them that such methods were still practiced in the rural communities. This observation agrees with findings of Chirimuuta and Mapolisa (2011) from their study on the Shona people in Zimbabwe who are still preserving underneath of traditional granaries as their cold room technologies for keeping a variety of crops.

I now turn the second theme which emerged from my study.

### 9.4.3 Theme 2 – Fermentation

Fermentation was another important method of food preservation practiced, for example, fermenting milk in clay pots at home. In this regard, one learner, Maus commented:

> 'Milk stored in the refrigerator takes a longer period in good condition than milk at rural homes without fridges. In rural areas, elders use clay pots to ferment their milk, which they eat as relish. Thick milk that is formed is nice to eat' (Gomoguru secondary learners, interview 2, 12 February 2015).

The above comment shows that the learner's knowledge that fermentation of milk leads to production of thick milk which community elders are able to prepare for sustainance of their families as food. The importance of the clay pots used in preserving milk was also

emphasised by another learner in their free-writing sessions. Some important issues emerged from a story by $Maus_1$. $Maus_1$ focused on processing of milk using indigenous materials:

> 'Once upon a time, hare and his uncle baboon organised to steal milk. Hare was the first to undertake the job and used a string to tie cows so as to facilitate the milking process. The hare placed his milk in a "*hwedza*" (milking clay pot) and then returned home. Upon his return, baboon was felt encouraged to do it as well. However, baboon was cheated by hare who advised him to sing as he moves step-by-step towards the household. In doing so, the baboon was severely beaten by the household owners' (Dzivaguru secondary learners, interview 2, 12 February 2015). .

In the story of hare and baboon, there is reference to the use of '*hwedza*'. I asked learners the advantages of using such types of containers for preserving milk. Their explanation was similar to that given by one community elders mentioned in chapter 7 of this thesis whose indigenous containers, unlike plastic or metal, provide cool temperatures for the stored milk. These findings are in agreement with what Nyota and Mapara's (2008) contention that the Shona people have special customs like indigenous materials including clay pots they use to preserve their foods. So, learners are demonstrating their knowledge of indigenous materials that can be used to preserve milk. However, they lamented lack of wide use of such indigenous materials by people due to availability of modern materials which they believed are opted for favourably instead. I now turn to the third theme – use of chemicals.

### 9.4.4 Theme 3 – Use of chemicals

Some learners mentioned that elders at their home use wood ashes, cow dung and fresh plant leaves which they place on grain crops while storing them in the granaries. These findings concur with those of community elders and teachers who were involved in the study. For example, one learner Chigs explained:

'*Muchacha'* (Cucunus metiliferus) taste salty, thus termites will not feed on crops in the granary' (Dzivaguru secondary learners, interview 2, 12 February, 2015).

The above explanation suggests that learner believes that chemicals used to preserve food have an effect on bigger organisms that are responsible for spoiling food. On further discussions with the learners, it was revealed which they believe those plants that give off pungent smell could be placed in the granary to scare away insects which feed on food. Their belief concurs with Tull's (2009) observation that indigenous communities worldwide use specific plants that give off smell to control insects that eat grain crops.

I selected some themes from the conversations I had with the learners, and these themes were similar to those identified for community elders and teachers involved in this study. I discuss each of these selected aspects as follows.

### 9.4.5 What Learners were saying concerning integration of IK methods of food preservation with school science teaching

#### *9.4.5.1 Sub-category 1: Use of learners' prior experiences*

In terms of use of prior experiences in school science teaching, learners indicated that it was useful assist class discussions related to how preservation processes can be done. For example, on leaner, Wecs explained that:

'We can take a piece of that we have preserved at home and discuss with others in class. Those who know how to dry it can explain to others how the process can be done' (Dzivaguru secondary learners, interview 3, 19 February 2015).

This strategy of bringing the school closer to home and the experiences of the learner motivates them. In this regard, Ogunniyi (2007a) believes that learners'prior experinces serves to identify learners with the content taught and therefore appreciate the process of learning. The strategy also goes well with what Otero and Nathan (2008) call 'contextualized

science teaching', which involves use of learners' everyday experiences as a mechanism for conceptual attainment.

#### 9.4.5.2 Sub-category 2: Using examples and resources from culture

On the use of examples and resources from culture, learners indicated that these were relevant for school science teaching in many respects. For example, on learner, Maus commented:

> 'This is what we do at home, like beef we cut it into pieces for drying in sunlight. So it is important that this knowledge be done at school so that people can prepare their food in a smart way. In addition, the addition of spices to meat makes meat stay for a long time in fresh condition' (Gomoguru secondary learners, interview 3, 19 February 2015).

Similar comments were also found from another learner, Wecs, who commented:

> 'Indigenous methods of preservation are good for the teaching of science because learners can do experiments to check how they work, identifying period taken by that food in good condition' (Dzivaguru secondary learners, interview 3, 19 February 2015).

The above two quotations show that learners were eager to use their culture and context when constructing school science knowledge. This is consistent with Vygotsky's (1978) socio-cultural theory that he believes enhances meaningful learning to the learner. As noted by Ogawa (1995), the inclusion of cultural practices in hands-on practical as suggested by these learners may be important in developing the learners' respect for their culture.

### *9.4.5.3 Sub-category 3: Teaching and learning should serve to consider the importance of our cultural heritage*

In terms of using local communities for science lessons, some learners concur that the practice might help in bringing cultural heritage from their homes into schools. For example, one learner, Vavs, explained:

> Indigenous methods can be used in class when carrying out experiments. This knowledge we know it from home that it works but is not done in schools. We can use storytelling, games and riddles and experiential learning in science lessons (Gomoguru Secondary, interview 3, 12 February 2015).

Similar sentiments were also raised by another learner, Kuns, who explained that:

> 'We like such forms of knowledge to be taught in schools. This is because we will be helping our parents in rural where there are no modern facilities like refrigerators' (Gomoguru secondary learners, interview 3, 19 February 2015).

These learners seemed to find that community knowledge emphasises the linkage between community and classroom practice. This is similar to findings from Odora-Hoppers (2005) who argues that science lessons should make use of community's ways of knowing. These findings are consistent with other findings by, for instance, Hewson's (2012) study on Basotho traditional healers' IK for classroom science. These traditional healers noted that teaching methods should include indigenous approaches such as storytelling, asking and answering riddles, and that selected folk-tales could be documented and used for teaching.

### *9.4.5.4 Sub-category 4: Teaching and learning should emphasise the importance of mechanisms for the process of food preservation*

In terms of the understanding of mechanisms for the process of food preservation, learners acknowledged that they may be ignorant of how the process of preservation occurs. For example, one learner, Wecs commented:

> 'Indigenous methods are good but for us we know that for you to dry meat, you have to put the salt,but we may not know what the salt may actual do-how it works' (Dzivaguru secondary learners, interview 3, 19 February 2015).

As found from teachers as well, what is found from the learners points to the idea that linkage of IK and school science should emphasise mechanisms of the processes of IK methods of preservation. Such practices may make a culturally relevant science curriculum, which Khupe (2014) and Afonso-Nhalevilo (2013) believe would enable learners to view science as a human enterprise not as an esoteric subject to be encountered only in the school environment.

## 9.5 SUMMARY OF THE CHAPTER

For learners, the use of IK of food preservation was suggested in terams of use of prior experiences possessed by learners in schools, use of examples and resources from culture, teaching and learning should emphasise the importance of culture and the emphasis on mechanisms of methods of food preservation. They believed that such approaches in teaching would help class discussions, teaching from the known to unknown, and would facilitate easier conducting experiments in their science practical lessons.

I now turn to the next chapter, conclusions and recommendations for the study.

# CHAPTER 10: FINDINGS, RECOMMENDATIONS AND CONCLUSIONS

## 10.1 INTRODUCTION

The purpose of this study was threefold: first, to analyse relevant science curricula and policy documents in Zimbabwe for their guidance on the teaching of indigenous knowledge (IK) and the promotion of cultural values; second, to explore and document indigenous methods of food preservation; and third, to develop a teaching model for science education in Zimbabwe. The study was guided by the following three research questions:

1. i) What elements of IK methods of food preservation do curriculum documents give to the teaching of science in schools in Zimbabwe?

   ii) What do these curriculum documents suggest is relevant to the teaching of the topic 'food preservation' in school science in Zimbabwe?

2. What elements of IK and methods of food preservation do the rural community members of Chivi District hold?

a) How may culturally relevant teaching be drawn from the knowledge of the community members' indigenous methods of food preservation and the current practices of teachers and learners in Chivi district?

This chapter is presented in the following sections: a) how research questions 1, 2 and 3 are answered; b) my revised conceptual framework. In addition, I present conclusions and recommendations. Finally, I provide reflections on my PhD study journey which culminated in the new knowledge production in relation to IK methods of food preservation. In the following sections, I provide answers to each of my research questions.

## 10.2 ELEMENTS FOR IK METHODS OF FOOD PRESERVATION WHICH CURRICULUM DOCUMENTS GIVE TO THE SCHOOL SCIENCE TEACHING IN ZIMBABWE

Analysis of documents yielded a number of IK elements which can guide school science teaching in Zimbabwe. Documents suggest that school science teaching should incorporate the values derived from people's culture to motivate learners to cherish their Zimbabwean identity, history and cultural traditions. Some documents call for the preservation and promotion of traditional recipes and food preparation habits. This intention is also suggested by documents which explain that learners in school science should identify traditional methods of food preservation found in their communities. Apart from this, some documents mention that teachers should give examples and contexts relating to learners' interests and that these should be drawn from their culture. For this teaching, indigenous local languages should be used to help pupils understand science concepts. These views resonate well with the conceptual model guiding this study.

Apparently, the documents are silent on suggesting IK policy in Zimbabwe in spite of indications in some documents that culture and food policies should guide indigenous people's diets in Zimbabwe. In the absence of a clear policy, it is difficult to understand how IK could be integrated with school science teaching. For some, this absence of IK policy may mean that integration of IK into school science is a matter of choice.

In assessments, there is total disregard of IK examples and content. The content tested for assessments in schools is Euro-centric. Indigenous knowledge is not examined as evident from public science examination reports in Zimbabwe. Expected examination answers do not include IK examples which are relevant for indigenous learners in the communities where schools are located. So, there is a disregard of IK in the teaching and learning of school

science in Zimbabwe.

## 10.3 ELEMENTS OF IK METHODS AND PRACTICES OF FOOD PRESERVATION MURAMBWI COMMUNITY MEMBERS OF CHIVI DISTRICT HOLD

Indigenous communities have a well-developed system of food preservation based on cultural values and traditions. Community members have architectural and traditional plant chemical knowledge that reflects indigenous philosophies and local food technological values that relate to food preservation. For Wane (2014), such values help people to sustain engagement with culture, history, politics, identity and collective agency. There are specific Chishona terms for methods of food preservation which they use. These terms reflect the richness of the Shona people's language with regards to their methods of food preservation. The findings presented suggest that community members' methods of food preservation are based on science. At the same time, my research data opens up new avenues for further study to generate fresh insights that can inform science curriculum policy. Science teaching should draw from IK and values that indigenous people depend on for survival.

## 10.4 RELEVANT CULTURAL TEACHING WHICH COULD BE DRAWN FROM THE KNOWLEDGE OF THE COMMUNITY MEMBERS' INDIGENOUS METHODS OF FOOD PRESERVATION AND THE CURRENT PRACTICES OF TEACHERS AND LEARNERS IN CHIVI DISTRICT

Community members' IK methods of food preservation as found in this study are useful for school science teaching. Most of these members made reference to cultural values which, they believe, should not be separated from the content of school science and should be part of teaching in schools. Science teaching should appreciate community members' cultural values, particularly their architectural hut and granary designs and the 'delicious taste' of thick milk elders claim are the resultant effect of their food preservation processes. These findings relate

to those observed by Hernandez, Morales and Shroyer (2013) on culturally responsive science that involves content integration, knowledge construction, prejudice reduction, social justice and academic development. These characteristics should guide the practice of science education for indigenous communities inclusive of Murambwi locality in Chivi Zimbabwe. The focus of indigenous school science content would be inadequate if it does not include values which are important for indigenous peoples' lives. These values are derived from the elder people in the communities. In this regard, findings show that young boys and girls should be taught similar skills including the preservation of food at home. Hence, science teaching in schools should provide similar experiences for all learners, regardless of gender.

Teachers and learners suggest that school science should inculcate a sense of identity for it to be relevant to the society. This study, through free-writing sessions, was able to discover different ways community members teach their children values and norms of their societies. These findings are in agreement with Mapara's (2009) study that found that traditional knowledge is imparted through many cultural methods including '*zvierwa/ zviera*' (taboos) and '*ngano*' (folktales). Mawere (2014) concurs with such ways of transmitting cultural knowledge and adds the use of '*ngano* and *mitupo*' (totemism) and common property as part of indigenous education that could reflect learners' cultural identity in schools. This cultural knowledge transfer resonates with De Marrais' (1998) classification of ways of knowing. She categorised such ways of knowing as 'archival knowing' (people's artefacts), 'narrative knowing' (people's stories), 'observational knowing' (participation of the researcher noting people's behaviours) and 'relational knowing' (people's shared learning and understanding). This implies that there are various ways of knowing which teachers can use for school science teaching.

Community members have food preservation artefacts which can be used in the teaching of

school science. See, for example, in Figure 6.4, a photograph of preserved vegetables by community elders. School science teaching could make use of abundant locally found vegetables like those in the Murambwi locality. These findings concur with Masarirambi et al (2010) who also found that some traditional vegetables are not widely cultivated but are gathered from the wild in most parts of Africa. Kaya and Lyana (2014) believe that these vegetables are stigmatised as 'food of poverty'. This view is also shared by Tsiko (2016) who argues that, in modern times, such vegetables can be referred to as neglected and under-utilised crop species (NUS). Kaya and Lyana's (2014) research corroborates Tsiko's (2016) observations that there has been a practical disappearance of local vegetables from the Zimbabwean diet due to consumer preference for exotic vegetables. Some communities still use these vegetables that science practical lessons could use to teach indigenous ways of vegetable preservation.

Findings from the study show that indigenous food technologies could be extended to other important aspects of social life other than food preservation. Indigenous peoples' collective responsibilities could not be separated from school science teaching as informed by all participants in the study. These collective responsibilities were reflected in all stages of food processing. Members find it difficult to leave other members in the community to work alone. For example, they respect collective burial activities, income-generation ventures and '*humwe*' (working together) at every stage of food processing from planting to preservation.

In the following section I present my reflections on the theoretical framework for the study.

## 10.5 REFLECTIONS ON THE EMERGING THEORETICAL FRAMEWORK

### 10.5.1 Introduction

Section 10.2 shows what curriculum documents provide to the teaching of school science,

section 10.3 explains IK methods community members in Chivi practice and section 10.4 gives relevant cultural teaching methods drawn from the community for school science in Zimbabwe. Based on my findings, I realised that my initial theoretical framework has to change. In the following sections I present how my theoretical framework shifted.

The theoretical framework shows possible relationships which might exist in relation to two ideas that I thought were crucial for school science teaching in indigenous communities. These concepts are: *ubuntu*, which seeks to guide ethics of my study and indigenous methodologies offering suggestions for the research strategy. I developed this framework to assist in the analysis and interpretation of the findings from my participants comprising community elders, science teachers and school learners.

### 10.5.2 My Revised Theoretical Framework

Part of my experience was the shift in the realisation of the nature of IK. The research process allowed me to understand better my IK. This understanding has necessitated the need to change my theoretical framework.

A number of issues emerged from the findings which influenced the way I developed my framework. My understanding of what constitutes science knowledge for indigenous communities has expanded to encompass what Keane's (2008a) study refers to as categories for decisions of IK inclusion in schools. Specifically, these categories are: factual knowledge (community histories and understandings of environment), performative knowledge and values (talents usually manifested in cultural practices) and ontological knowledge (philosophical knowledge that includes worldviews). Emerging values from my study also corroborate the above mentioned IK classifications by Keane (2008a). Such values include respect, collective responsibilities, common good and *ubuntu*.

I have been approaching this study from an objective point of view, taking a western paradigm. However, as I discussed these issues with indigenous people during the study, western approaches in teaching became inadequate. For example, reference to spirituality was common among the participants' methods of food preservation. In terms of western science, it appeared that some food grains were simply dried in the sunlight. But when I asked the community elders, their methods appeared to be more complicated as there are unseen processes. In the scientific principle, drying of grains could be done by spreading out the grains on a rock out-crop to be sundried. Whilst both IK and science agree on that, I found that one elder, VaMusaigwa, commented, 'We take our grains and place them in the sacred rocks up hill for our ancestors to keep it safe' (Gomoguru village, interview 3, 12 February 2015).

This begs the question: Why are grains dried on sacred hills and not on rocky out-crops? This participant introduced an issue not connected with science but with IK. What makes this contribution valuable is that it added something which is intangible, which is the spiritual meaning of the actions of food preservation in their communities.

The activities of people at home and at school show that they are both practising science. What I have seen from the methods used to preserve food both in IK and western approaches are not different. Scientific methods require certain procedures which might not be necessary for those who go to the hills or mountains to dry grains but in IK, there is spiritual dimension which suggests that integration must also include values, beliefs and worldviews of the community.

So, my theoretical framework had to change. Hence, I realised that teaching science is not only for imparting facts but beliefs, philosophies and actions as well. Mentioning a phenomenon, say IK in science, does not make it integration. Rather, this could constitute

what Otero and Nathan (2008), and, Lubben and Campbell (1996) call 'contextualisation science teaching'. Without these insights, my original theoretical framework was erroneous. In the following paragraphs I show how I developed this framework.

In my study, there were hints of the primal place of water in the lives of indigenous people. One elder simply commented, 'all life depends on water which is important for our processes of food preservation' (Gomoguru village, interview 5, 05 March 2015). This concurs with Keane's (2006, p. 209) observation regarding the importance of water in a community that, 'water has a primal place in ancient African cosmology'. This understanding allowed me to use the idea of water as my theoretical framework.

My study illustrates aspects of Barnhardt and Kawagley's (2005) iceberg model on the concept of knowledge and, more recently, Mpofu's (2016) '*tsime*' (water well) indigenous knowledge of plant healing (IKoPH) model. Barnhardt and Kawagley (2005) described IK in terms of latent (hidden cultural norms and values) and concrete (product, process, paradigm and enterprise) forms of knowledge which can be transmitted to the learner. Mpofu (2016) takes a '*tsime*' (well) analogy to represent the source of IK which is relevant for classroom science. The assumption of this analogy is that if a well is full of water, the situation is similar to abundant IK in the communities which schools can use for the teaching of science.

In the context of IK, spirituality is also a latent form of knowledge. For Dei (2014), this form of knowledge connects the physical with the metaphysical world. Using IK ideas of food preservation help school science to build science knowledges, expand them and refine them out of spiritual resonance with their environment. The ideas of spirituality should not be seen as operating contrary to the ideals of western science teaching approaches that Ogunniyi (2013) argues focus on logic and empiricism. Rather, spirituality emphasises the protection of land and the environment. In this case, science concepts regarding teaching of the topic 'food

preservation' can be derived from both IK and western ideas. In IK, there are issues that can be scientifically explained, but there are also some that are hidden forms of knowledge which are like water coming out from underneath the ground where the exact source is difficult to ascertain. In this case, the teacher might decide to use an IK or scientific explanation for a science concept to the learners. A concept can have several ideas which might be relevant to explain, be it from an IK or western perspective.

My concern in the study was that science education in Zimbabwe should address these issues, particularly when Zimstat (2014) reports that 80% of the population are living in the rural areas. Shizha (2009) argues that most of these rural people eke out a living using IK practices. As a result, science education in Zimbabwe and other areas should not ignore the issues raised in this study, as it was carried in a rural area. Some research studies suggest that rural communities are sites of knowledge generation in education, for example, Tefflo (2013) argues that IK resides in the rural sites and is available as tools for institutional transformational processes and education. In the same way, UNESCO (2000) has affirmed the position that IK can make valuable contributions to science and technology through the provision of cultural heritage and empirical knowledge from indigenous rural communities.

Participants for this study had a bearing on the nature of the findings which could be different if participants came from other settings. In this study, as ZIMSEC (2012) reports, Form 4 school learners were chosen as they studied a science subject that is considered terminal where graduates would be channelled to either college or technical vocational centres for professional training. Also, learners who were pursuing a school leaving certificate were expected to respond to examination questions using scientific terms. These concerns could possibly have influenced the findings of the study. The study participants were living in a community far from social amenities including electricity and roads. So, the findings could

be different in communities with such facilities at their disposal.

In light of these findings, I present the following conclusions for my study.

## 10.6 CONCLUSIONS FOR THE STUDY

The purpose of my study was to analyse relevant science curricula and policy documents in Zimbabwe for their guidance on teaching of IK, the promotion of cultural values and identifying and exploring community members' IK methods of food preservation in Chivi which are suitable for school science teaching. Although some IK methods of food preservation in Murambwi locality do not lend themselves to scientific explanation, there is rich IK in this indigenous community which could be included in school science teaching. The rich source of IK methods of food preservation from the communities should provide a fertile ground for the implementation of IK-school science integration, failure of which is tantamount to miscarriage of justice for learners in indigenous communities.

Integration of knowledge systems should focus on what is relevant for school science teaching regardless of whether the concept is from an IK or western perspective. It is very difficult to draw a line between indigenous and western methods of food preservation since some western methods could be classified as indigenous and vice versa. These intersections are deployed within cultural contexts. IK methods of food preservation by the indigenous community members are not wholly traditional because western modern methods have influenced their practices. As noted in section 7.4.2 of this thesis, conversations with one elder in Gomoguru village, VaMusaigwa$_1$ have revealed that improved communication and transport technologies which facilitated access to different types of foods on market places dotted around the country has impacted negatively on the use of IK methods of food preservation by people. In this regard, learners in section 9.4.2 of the study commenting on their food preservation preferences that indigenous methods of food preservation are archaic

and are no longer up to date with current developments in technology. There is a serious threat of extinction of this IK as more and more people are no longer frequently using such traditional methods to preserve their foods. As explained by one teacher in section 8.4.2 of this study, Mr. Tingwas, that people are no longer using indigenous materials such as wooden poles and dagga to construct granaries; rather, they prefer using modern day iron or asbestos sheets. These findings also find support from scholars in science education, for example, Odora-Hoppers (2005) and Shizha (2013), who have argued that modernisation has influenced indigenous peoples' lives, resulting in disregard of their culture. Hence, technological innovations have erased some indigenous values and food preservation practices resulting in significant reluctance to use IK methods by some community members.

Integrating IK with school science teaching should not be seen as 'one-way benefit' in favour of the latter but all knowledge systems could benefit from each other. There is a need to balance the use of IK and western perspectives in the teaching of school science since both knowledge systems have limitations. The science curriculum needs to focus on the benefits for the learner that can be realised from knowledge system integration.

In light of one community elder, VaZimuto, in section 7.4.2, who believed that bringing knowledge of cultural customs such as materials used by elders to store milk would makes learning meaningful in schools. Most teachers had the view that some indigenous methods of food preservation were part of the science syllabus; and if included in the teaching and learning of school science it would help learners to understand from their culture. In this regard, one teacher, Mr Shaas commented that salting is indigenous and common in the rural areas; and learners are intrested in giving the practice they do at home sincev they want to prove that what they know from home is important. Learners also concurred that they could use some cultural artefacts of food preservation to carry out practical activities in their school

science lessons. These findings are supported by scholars, for example, Hewson (2015) and Shizha (2013), and science policy documents that school science should resonate with cultural outlook of the learner. Some textbooks cited in chapter 6 of this study used by learners, for example, a text by Chavunduka etal (2009) requires learners in school science to identify methods they use at home to preserve food. Science policies emphasise that learners should cherish their cultural identity in schools. Hence, learning of school science becomes useful if it identifies with the learners' cultural experiences. This means that school science should reflect the content, examples and experiences that learners bring during teaching and learning. For school science teaching to ignore local ways of understanding, for example, food preservation as raised by the Murambwi community members through this study is detrimental. Thus, teaching IK methods of food preservation in school science for indigenous learners coming from communities that have a rich array of IK techniques may be a noble activity considering the reality of contextual differences of the two systems of knowledge. In terms of community development, Munyaka (2003) posits that cultural knowledge provides a significant base upon which developmental interventions can be based. In the context of education, cultural underpinnings could be a possible avenue that can benefit school science teaching and learning in Zimbabwe.

In terms of the role of gender in food preservation, from the findings emerging from the community elders, it is the role of the mothers to preserve food and not the fathers. This finding was supported by teachers, who argued that it is the duty of the mothers to keep food fresh for the families. Elders emphasise teaching their young ones to observe the method of preservation. Teachers explained that at school, their teaching centres on mechanisms of the process rather the method per se. While some science documents analysed during this study like textbooks require learners to make reference to their indigenous practices, some, for example, examination question papers do not make candidates refer to indigenous methods of

food preservation. The nature of these questions determines the form of assessment emphasised by teachers in schools. Hence, there is disjuncture in what indigenous people at home regard as important and what teachers emphasise at school. Possession of IK techniques of food preservation by all participants has demonstrated that they have cultural knowledge needed to preserve their foods. Although this cultural knowledge is not emphasised in schools, it has both technological and economic functions for the community members. In this regard, IK methods of food preservation provide a useful link with the community members' economics as excess food is saved for future consumption. In this context, IK methods of food preservation go a long way in ensuring food security at household level. School science should acknowledge various forms of learning as identified in this study. For example, the spiritual world has a place in the Murambwi locality which contrasts school science forms of learning. For Wane (2014), spirituality and the questions of ecology go hand-in-hand. Community members' indigenous philosophies and local food technologies, informed by spirituality, teach about character development and moral values as they relate to environmental consciousness and responsibilities. In this regard, IK methods of food preservation support holistic sustainability of ecological systems. This means that teaching approaches should reflect what people do to sustain their ecosystems. The present school science curriculum is ineffective given that it does very little to accommodate local people's worldview. In doing this, Keane (2008a) argues that, instead of school science focusing on facts only, the use of IK will extend into performative and ontological knowledge which is relevant for indigenous communities. In Zimbabwe, the absence of IK policy is impacting negatively on the implementation of IK-school science integration. This is worrisome particularly when it is explicitly stated in the integrated science syllabus that one of the aims of teaching science is to apply scientific methods to other disciplines and in everyday life. The absence of IK in the curriculum is not in tandem with the culturally

responsive education as postulated by Ladson-Billings (1995).

The study found that indigenous food technologies practiced by community members in the Murambwi locality are relevant for experimental skill acquisition by learners. It was interesting to note that community elders, teachers and learners involved in the study regarded IK they hold as useful for school science teaching. Curriculum documents such as policy guidelines and textbooks support the use of examples of preservation methods from learners' culture. This desire to include IK issues in science education is also in line with other researchers' call for schools to integrate cultural values in science teaching, for example, Shizha (2013, 2009), and Ogunniyi (2013). The IK methods of food preservation for all foods which community members consume are important as they illustrate ways of preventing food decay. In the case of experiments done in science education to illustrate the effect of moisture and oxygen, instead of focusing on bread only, these can also be directed towards how all foods are preserved.

The use of IK methods of food preservation in science does not lead to low engagement in science experimental skills by learners. For example, there is also the capturing of the indigenous peoples' cultural practices from an ethnographic perspective. Indigenous people like those in Murambwi locality have their own traditional techniques for establishing food quality. For example, placing a hand in home-made porridge and checking the drying of meat by hand by plucking out a piece of meat with ease. The indigenous members' quality assurance strategies are useful for school science experiments on food preservation. Also, for indigenous communities, school science experiments could be done using IK methods of food preservation artefacts and storage structures like those found in the Murambwi locality. This approach is in keeping with one of the major thrusts of the school science syllabus for experimental skills development requiring learners to extract information from data presented

in diagrammatic form. In addition, photographs of IK food preservation artefacts and structures demonstrating methods of preservation are worth publishing in school textbooks since these are culturally unique and relevant for teaching school science concepts. These findings are consistent with findings from other studies in science education, for example, Otero and Nathan's (2008) contextualized teaching, which they believed culture should be the source of materials for the process involved.

Regarding relationship between community members' IK and science teaching, the study has shown that alignment is possible. Science documents such as cultural policy, science and technology policy; and Ministry of Education directives show that there is need for teaching in schools to reflect cultural identity of the learners. Effective teaching could result if there is alignment between community members' IK practices with what schools seek to impart to learners. This alignment of IK values with school science teaching is supported by other scholars in science, for example, Odora-Hoppers (2005) and Shizha (2013), who believed that such cultural links would help in inculcating a sense of identity in the learners and thus could avoid loss of community's cultural heritage. The alignment contrasts a culture-free perspective which school science and modernisation in general seeks to attain. In this sense, the study demonstrates the dynamic nature of knowledge. As a result, there is tension between the need to change and the need to preserve culture among community members.

The IK methods of food preservation from Murambwi locality are legitimate examples and resources of science which should be integrated with school science teaching. All community elders held IK worldviews while teachers and learners had dualistic or amalgamated worldviews regarding methods of food preservation. All participants considered IK as a useful form of knowledge worth integrating with school science teaching. As alluded to in this section of the thesis, science text books require that learners select examples of methods

of food preservation from their culture. In particular, as alluded to in the findings in Chapter 7, both learners and teachers realised the importance of IK and suggested its relevance to the scientific worldview. The findings are significant because IK, according to participants themselves, should be given a chance in school science teaching. These findings concur with Ogunniyi's (2016, p. 418) suggestion of IK inclusion into school science as 'forward-looking-curriculum' rather than 'backward' form of education which makes science teaching culturally relevant to all learners.

Teachers and learners suggested the use of culturally aligned teaching strategies which included story-telling, games, poems, riddles and cultural sayings related to the phenomenon under study. These strategies were noted by participants as they would provide opportunities for learners to develop skills rather than compartmentalise knowledge forms. In this regard, Duit (1996) argues that the inclusion of learners' prior knowledge offers possibilities to teachers of exploring, challenging, revising and restructuring learners' worldviews during teaching. This idea of learning through *prior* experiences is consistent with Wenger's (1998) theory of social learning, where participants in the practices of social communities actively construct identities in relation to those communities. In other words, experiences may provide teachers with tools to understand their own practices and to plan for the future. The knowledge, beliefs and cultural experiences learners have should be acknowledged and addressed by the teacher.

There were emergent parts of my study which did not directly answer the research questions. For example, indigenous people have a well-defined system of practices which are governed by *ubuntu* worldview, as an African way of life. School science teaching therefore could include *ubuntu* core values in education comprising humanness, togetherness, relatedness, cooperative learning and respect for the views of others. This has an implication for the

science curriculum in the way teachers and learners could interact with each other during classroom teaching and learning sessions. The knowledge of *ubuntu* values could inform textbook authors or writers of science curriculum materials to include them as contexts for school science. Inclusion of cultural values in science teaching serves to concur with Aikenhead and Elliot's (2010) contention that school science should include IK to avoid conveying a mythical image of science and scientists. Elements of methods of food preservation found in indigenous communities could be regarded as science. Cobern and Loving (2001) agree that every culture has its own scientific knowledge which is not necessarily called science. This is because I found elements from the communities that could be regarded as school science. Though peripheral to my study, I also found that community elders wanted good behaviour, food on the table and school fees for their children. This was important in raising the issue that curricula materials should be relevant to the needs of the community.

The issue of language and terminology was shown to be important for school science curricula as explained by all participants in the study. As alluded to before, just as science requires the learning of many specific terms, this study shows that much of the knowledge, techniques and processes have specific Chishona terms. This has implications for the science curriculum and science educators and is relevant to those researchers who are calling for the use of local languages in the teaching of school science for indigenous communities. Science educators need to take into consideration the importance of language, particularly mother tongues, in helping indigenous learners to understand concepts in school. Even science policy documents such as Ministry of Education curricula directives, and the Ministry of Education's inquiry into education and training, require use of mother tongue in teaching. In this regard, McKinley and Stewart (2009, p. 59) contend that 'in education, knowledge and language are intimately interwoven'. Keane (2006, p. 145) argues that, 'language for

indigenous peoples is important for strengthening identity' while Aikenhead and Michell (2011) believe that, for indigenous communities and other communities as well, language supports life-long learning in schools. However, such attempts are not without challenges, as Shizha (2007) advises, not all western science terminology exists in indigenous languages.

Although tension between the western science and IK emerged during my encounters with some participants, this requires a discourse of possibility in which indigenous voices and knowledges can be heard, appreciated and cherished in school science teaching. Indigenous people have knowledge which those with only western knowledge from colleges and universities have lost. IK, which is looked down upon by some modern day life practices, is useful not only for the community members but also for the science curriculum. The western teaching approaches have not only compromised the cultural identity of indigenous learners in schools but they have destroyed self-sufficiency, contributed to dependency and affected self-direction of the community-controlled survival.

Indigenous food technologies also extend to other realms of life of societies, that is, social responsibility and caring for others. There are useful IK practices that provide more than food security but community cohesion and useful social endeavours in life. Indigenous ways of living are approached holistically rather than in isolation. This does not mean that all elements of IK are different from western science, but there are spaces where these knowledge systems could benefit from each other particularly for science teachers and their learners.

I propose a model for the teaching of science that will assist teachers and policy makers in bridging the gap between IK and school science. Teachers can use the results of this study in similar contexts to teach science in schools. More specifically, from the data in my research, there is evidence to suggest that the integration of IK with school science is feasible.

The findings could be summarised using the Shona sayings: '*rume rimwe harikombi churu*' (one man cannot do the job alone) and '*chengaose manhanga hapana risina monzi*' (everyone has an important part to play in life) that explain what may happen when knowledge systems complement each other. In particular, the link and acknowledgement of sources of knowledge for school science teaching may be aptly captured by the Shona saying, '*zvikomo zvinopanana mhute*'. This can be translated to 'hills which are close together exchange mist'. The implication of this is that IK which community members hold is useful for school science teaching. There are possibilities of integrating this form of knowledge in school science teaching method repertoires. The study provides possible content and examples from culture on methods of food preservation that can be useful in school science teaching using IK from the community members in rural areas in Zimbabwe. Thus, IK methods of food preservation should be integrated with school science teaching to have relevant science education for learners in indigenous communities. Based on these conclusions, I make the following recommendations for further study.

## 10.7 RECOMMENDATIONS FOR FURTHER STUDY

This study makes several recommendations. The study recommends that IK methods of food preservation should be integrated with school science teaching. This integration could be extended to other topics of the science curriculum, for example, physics concepts including thermodynamic temperature variation applications like cooling effects. Building structures could, for example, be used for a concept force. In chemistry, IK chemical methods of food preservation could show processes inclusive of neutralisation, diffusion, acidity and basicity. In biology, concepts, for example, osmosis, and plant and animal diseases can be taught using IK concepts.

The study also recommends that curriculum documents such as textbooks should include IK

examples, food artefacts and methods of food preservation to guide teachers on how this form of knowledge could be integrated into schools. There should also be science curriculum efforts to include specific cultural terms of IK in school textbooks and, more importantly, in the syllabus, as shown by the rich terms used by community members. Curriculum documents such as science textbooks used in schools should have such pictures of indigenous people's food preservation structures. Assessments in public examinations should not just be crafted in western modes which disregard indigenous ways of knowing, rather, the framing of questions should also include those items that test knowledge of IK methods of food preservations. There is also need for science content items in schools to include cultural ways of testing knowledge, as shown by extensive ways of determining food quality by community members.

There is a need for the enactment of IK policies at both national and school levels in Zimbabwe to guide teachers on how such knowledge could be co-opted into science teaching. The IK-science integration policies need to be strengthened given that some documents are silent about how such integration should be done.

Research on the use of spiritual values and '*zviera*' (cultural taboos) is not resolved and may be an important area for future studies suggested for science education. Although the area might be controversial for some researchers, further investigations into this domain may yield useful insights for the school science curriculum in indigenous communities.

I now turn to the presentations of the reflections of my study in the following section.

## 10.8 REFLECTIONS ON MY PHD JOURNEY

As a researcher, I encountered several insights. Overall, my PhD journey had both moments of frustration and excitement. There were so many things that I took for granted. First, I

thought, that by carrying out a research study in the area where I was conversant with the participants' culture, would be easy. This did not turn out to be since new things that I never expected would matter with regards to methods of food preservation emerged from the study. Such things included the spiritual dimension which has a place in the community members' lives. This aspect of life was what elders regarded as important in their methods of food preservation. My PhD journey was not easy since, as a family man, I needed to balance both family and course responsibilities. At the beginning, I thought indigenous people had very little, if anything, to offer to the teaching of science concepts in schools. Findings emerging from my study indicated otherwise.

New interesting things emerged from the study which excited me. First, I learnt that teaching is not a straight forward activity. More so, teaching becomes complicated for indigenous education where cultural values as ways of imparting knowledge reign supreme. There are so many cultural issues that I found were important in determining the purpose of teaching in schools. While the content of teaching might focus on the empirical facts, cultural values are crucial in determining what should be taught in schools.

In drawing conclusions, I used proverbs and metaphors in the context used by both Chilisa (2012) and Yusuf and Mathangwane (2003). According to Yusuf and Mathangwane (2003), proverbs are short sayings used as tools by people to persuade others in their culture to see the world and behave in a common way. Chilisa (2012, p. 133) also adds that 'in addition to proverbs, metaphors communicate values'. Schmitt (2005) notes that metaphorical sayings are used to uncover both objective and subjective patterns of thought and action and, consequently, determine how individuals think and act. For Chilisa (2012), metaphors are used as substitution of direct words that would have been regarded as disrespectful, offensive, or taboo by a cultural group. Huberman and Miles (2002) advise that a qualitative researcher

should think metaphorically, not only write metaphorically. Alvesson and Skoldberg (2009) believe that metaphors stimulate reflection and movement between levels of interpretation. In the context of the use of metaphors in language, Kamwendo (2017, p. 12) argues that 'meaning is given colour, language is brought to life and form is crystallised'. This means that the eye of the mind can be reflected by the metaphor that is used. As alluded to in section 10.6 of my thesis, I found the sayings in Chishona language useful for my study. These expressions include: '*Rume rimwe harikombi churu*', '*Zano ndega akapisa jira kumasese*', '*Kutsva kwendebvu varume vanodzimurana*', '*Gumwe rimwe haritswanyi inda*' and '*Rwizi runozara nemadiriro*'. Although these expressions translate to the same meaning, which is that 'one man cannot do the big job successfully alone', they can be used in different contexts. I coupled these metaphors with a tributaries metaphor, that is, IK and western science as tributaries flowing into the main river (integrated into school science teaching) that can be used to reach a conclusion. I took the Shona saying '*rwizi runozara nemadiro*' (small rivers meet to form one big river) in order to interrogate school science teaching in Zimbabwe.

I did not know that ethics for IK studies is so complicated. In my study, all participants insisted that they wanted to be known, which contrasts with conventional ethical procedures. I was able to refer to them by their actual names during conversations but was unable to include their actual names in the final report. Following this tension, I decided to use their totemic names. In the field, I also realised that photography was necessary to capture the participants' food artefacts and buildings. So, I included it as one of my tools to generate data.

After realising that my early theoretical framework was naïve, I had no option other than to adjust it. Two main reasons led to this adjustment. First, I did not think that cultural values

were important in the teaching of school science. I therefore had no choice but to suggest the incorporation of values into the content aspect of school science teaching. Second, I found this useful given my third research question which focused on culturally relevant teaching approaches that can be used for school science. The third research question had ethical implications for my study. This taught me that the path of undertaking a research study is not straightforward and not without tensions and issues. I had to follow cultural protocols that required generating dialogue with participants. For example, participants indicated that they had issues which could only be revealed after consultation with their community leaders.

I have learnt that, at heart, I am a positivist, but I have to work using an interpretivist paradigm. There were issues which participants raised that I thought may be verified objectively. In light of Ogunniyi's (2004) opinion that IK practices encompass spiritual components, I found that they may not be amenable to empirical testing. Haralambos, Holborn and Head (2010) posit that social action can only be understood by interpreting the meanings and motives on which it is based. This view shows that there is dissonance between what indigenous people practice in their lives and school science values. So, as an interpretivist researcher, in keeping with Patton's (2002) qualitative research strategy, I had to negotiate, re-negotiate and gain access to the data to generate knowledge. This strategy stands in opposition to the positivist paradigm that is usually grounded in somewhat 'linear' thinking.

I realised that there were challenges related to research on IK topics in the community with various social influences. During my visit to Dzivaguru village, one elder narrated an unfortunate incident that had happened to her. She said she lost all her grains when a fire gutted the granary where crops were stored in mysterious circumstances. I found myself in a difficult position dealing with a person who had voluntarily reached out to me. I needed to

capture those emotions because they had a bearing on how I would proceed with my interactions with participants. I also realised that community members lacked resources for effective food preservation even though, in some cases, they had well-constructed indigenous structures in which to preserve their foods. In my opinion, these incidents may be leveraged to make people aware of improving their preservation methods.

Now I understand how the indigenous communities feel regarding food security and I can champion their aspirations. Community members have cultural structures and materials they use to preserve their foods and have various theories of food preservation which are part of their belief systems. Some elders lamented the disappearance of cultural knowledge from the youths' lives due to the influence of modernisation. For them, it was sad that the young have permanently lost their indigenous culture. However, Gudhlanga and Makaudze (2012) posit that although western culture has tried to erase what they considered as backward, indigenous communities still have IK practices that have withstood the test of time.

I realised that all my research questions were adequately answered.

## 10.9 SUMMARY OF THE CHAPTER

This chapter gives conclusions and recommendations for the study. In doing so, the chapter outlined how the theoretical framework shifted as the study progressed. The chapter then ended by giving reflections of my whole PhD thesis journey.

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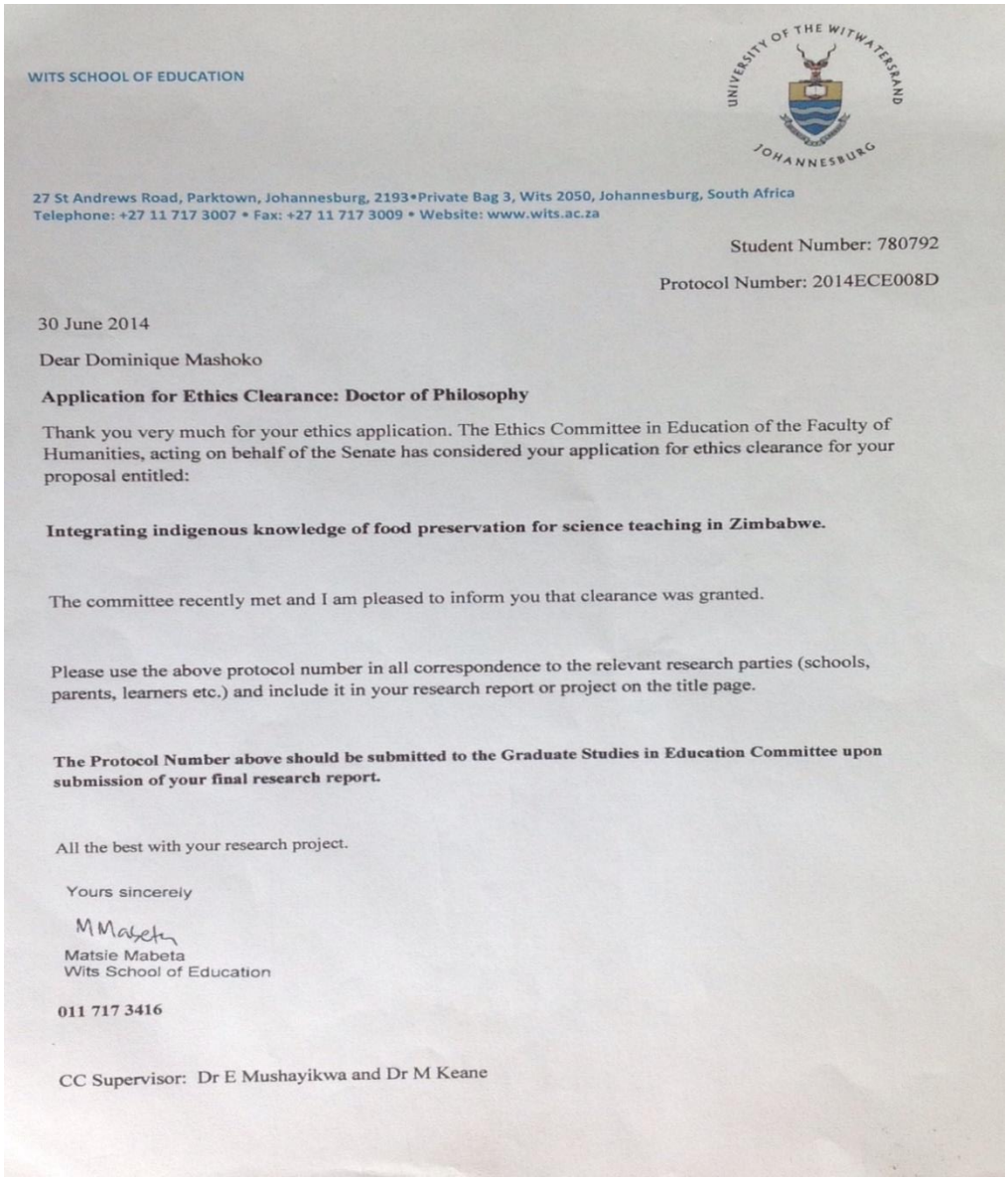
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# APPENDICES

## APPENDIX A: STUDY ETHICS APPROVAL



WITS SCHOOL OF EDUCATION

UNIVERSITY OF THE WITWATERSRAND JOHANNESBURG

27 St Andrews Road, Parktown, Johannesburg, 2193•Private Bag 3, Wits 2050, Johannesburg, South Africa
Telephone: +27 11 717 3007 • Fax: +27 11 717 3009 • Website: www.wits.ac.za

Student Number: 780792

Protocol Number: 2014ECE008D

30 June 2014

Dear Dominique Mashoko

**Application for Ethics Clearance: Doctor of Philosophy**

Thank you very much for your ethics application. The Ethics Committee in Education of the Faculty of Humanities, acting on behalf of the Senate has considered your application for ethics clearance for your proposal entitled:

**Integrating indigenous knowledge of food preservation for science teaching in Zimbabwe.**

The committee recently met and I am pleased to inform you that clearance was granted.

Please use the above protocol number in all correspondence to the relevant research parties (schools, parents, learners etc.) and include it in your research report or project on the title page.

**The Protocol Number above should be submitted to the Graduate Studies in Education Committee upon submission of your final research report.**

All the best with your research project.

Yours sincerely

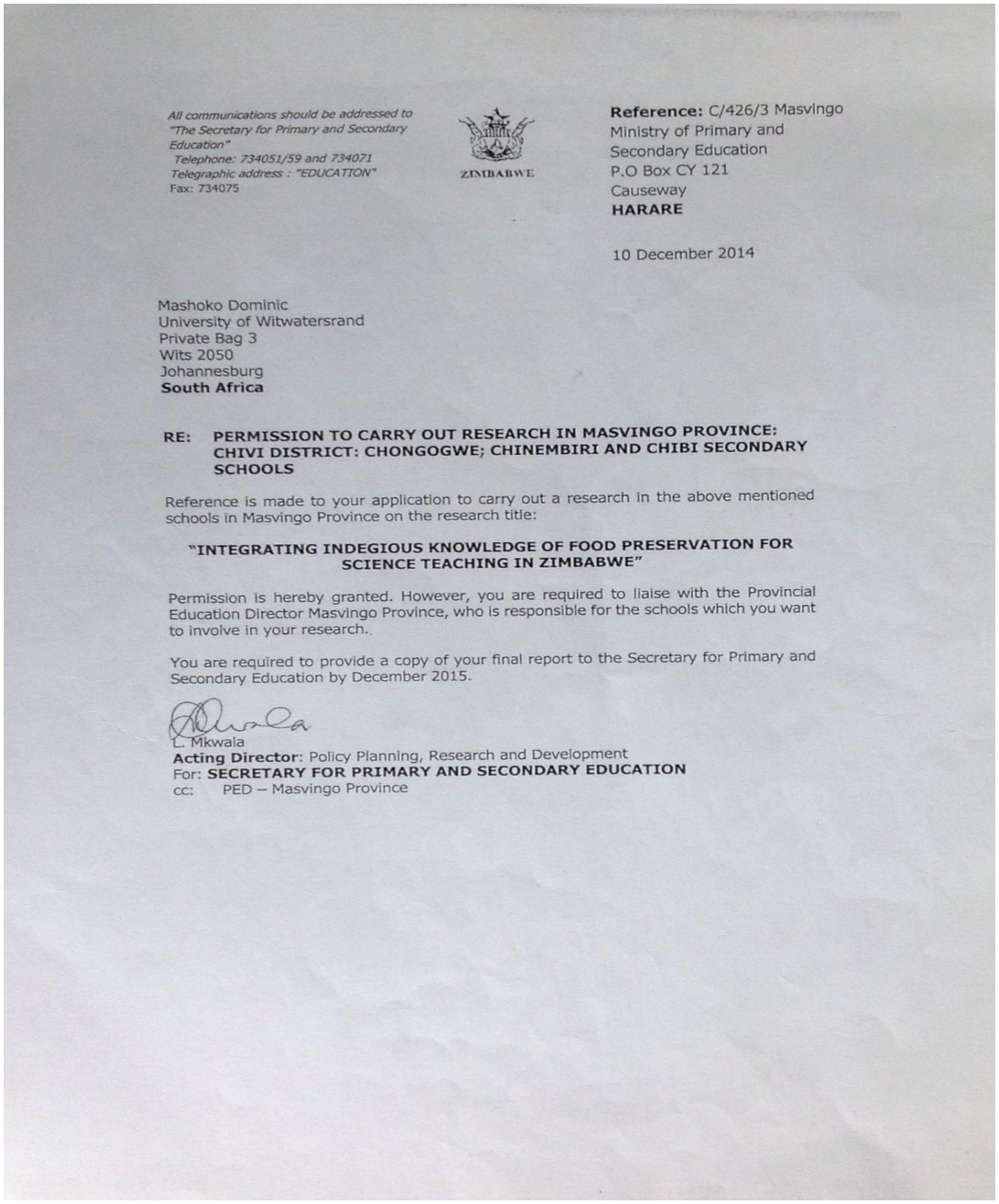
M Mabeta

Matsie Mabeta
Wits School of Education

**011 717 3416**

CC Supervisor: Dr E Mushayikwa and Dr M Keane

## APPENDIX B: STUDY APPROVAL FROM THE HEAD OFFICE



*All communications should be addressed to "The Secretary for Primary and Secondary Education"*
*Telephone: 734051/59 and 734071*
*Telegraphic address : "EDUCATION"*
Fax: 734075

ZIMBABWE

**Reference:** C/426/3 Masvingo
Ministry of Primary and
Secondary Education
P.O Box CY 121
Causeway
**HARARE**

10 December 2014

Mashoko Dominic
University of Witwatersrand
Private Bag 3
Wits 2050
Johannesburg
**South Africa**

**RE: PERMISSION TO CARRY OUT RESEARCH IN MASVINGO PROVINCE: CHIVI DISTRICT: CHONGOGWE; CHINEMBIRI AND CHIBI SECONDARY SCHOOLS**

Reference is made to your application to carry out a research in the above mentioned schools in Masvingo Province on the research title:

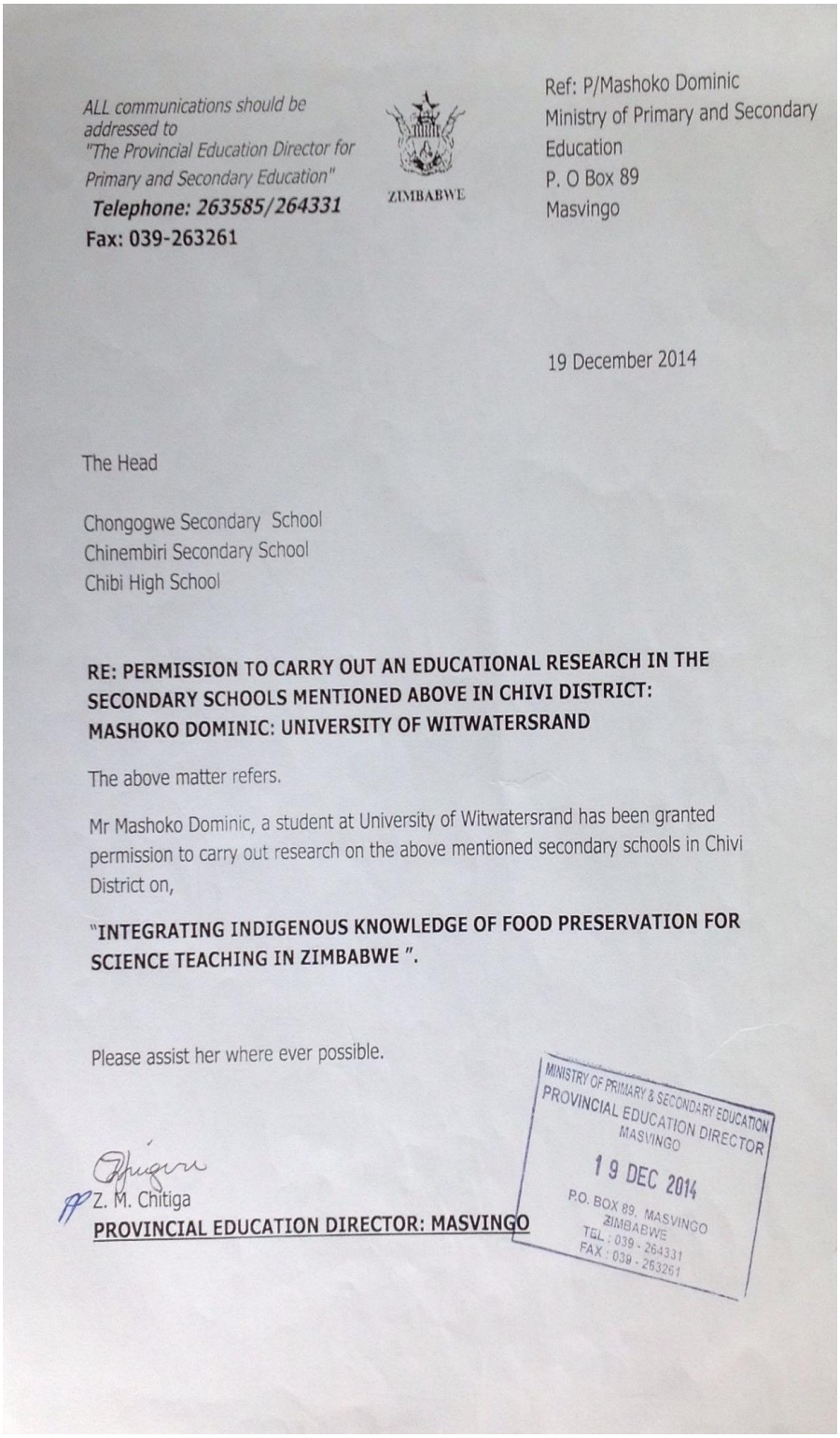
**"INTEGRATING INDEGIOUS KNOWLEDGE OF FOOD PRESERVATION FOR SCIENCE TEACHING IN ZIMBABWE"**

Permission is hereby granted. However, you are required to liaise with the Provincial Education Director Masvingo Province, who is responsible for the schools which you want to involve in your research.

You are required to provide a copy of your final report to the Secretary for Primary and Secondary Education by December 2015.

L. Mkwala
**Acting Director**: Policy Planning, Research and Development
For: **SECRETARY FOR PRIMARY AND SECONDARY EDUCATION**
cc: PED – Masvingo Province

## APPENDIX C: STUDY APPROVAL FROM THE REGIONAL OFFICE



*ALL communications should be addressed to "The Provincial Education Director for Primary and Secondary Education"*
***Telephone: 263585/264331***
**Fax: 039-263261**

ZIMBABWE

Ref: P/Mashoko Dominic
Ministry of Primary and Secondary Education
P. O Box 89
Masvingo

19 December 2014

The Head

Chongogwe Secondary School
Chinembiri Secondary School
Chibi High School

**RE: PERMISSION TO CARRY OUT AN EDUCATIONAL RESEARCH IN THE SECONDARY SCHOOLS MENTIONED ABOVE IN CHIVI DISTRICT: MASHOKO DOMINIC: UNIVERSITY OF WITWATERSRAND**

The above matter refers.

Mr Mashoko Dominic, a student at University of Witwatersrand has been granted permission to carry out research on the above mentioned secondary schools in Chivi District on,

**"INTEGRATING INDIGENOUS KNOWLEDGE OF FOOD PRESERVATION FOR SCIENCE TEACHING IN ZIMBABWE ".**

Please assist her where ever possible.

MINISTRY OF PRIMARY & SECONDARY EDUCATION
PROVINCIAL EDUCATION DIRECTOR
MASVINGO
19 DEC 2014
P.O. BOX 89, MASVINGO
ZIMBABWE
TEL : 039 - 264331
FAX : 039 - 263261

Z. M. Chitiga
**PROVINCIAL EDUCATION DIRECTOR: MASVINGO**

## APPENDIX D: STUDY APPROVAL FROM GOMOGURU SCHOOL



CHONGOGWE HIGH SCHOOL
P. O. Box 16
MASVINGO
TEL: 037-2202

TO WHOM IT MAY CONCERN

Dear Sir / Madam

PERMISSION TO CARRY OUT AN EDUCATIONAL RESEARCH AT CHONGOGWE HIGH SCHOOL: CHIVI DISTRICT: MASHOKO DOMINIC: UNIVERSITY OF WITWATERSRAND

This is to state that in line with the Provincial Education Director's Statement granting permission to Mr Dominic Mashoko to carry out an educational research at Chongogwe High School, I have duly allowed the student to carry out the research.

Yours faithfully

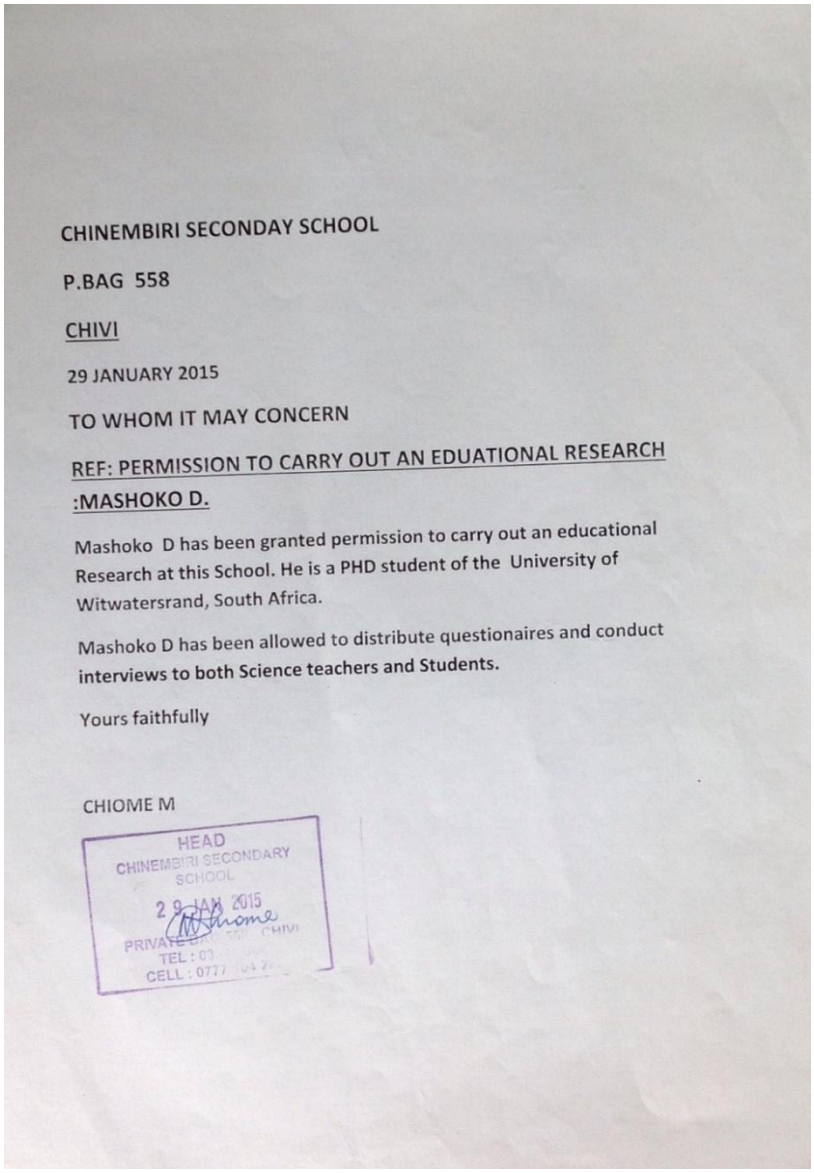
F. ZINGWE

HEAD OF STATION

THE HEADMASTER
CHONGOGWE HIGH SCHOOL
2015 -01- 29
P.O. BOX 16
MASVINGO
PHONE: 0337-2202

ALWAYS AIM HIGH

## APPENDIX E: STUDY APPROVAL FROM DZIVAGURU SCHOOL



CHINEMBIRI SECONDAY SCHOOL

P.BAG 558

CHIVI

29 JANUARY 2015

TO WHOM IT MAY CONCERN

REF: PERMISSION TO CARRY OUT AN EDUATIONAL RESEARCH :MASHOKO D.

Mashoko D has been granted permission to carry out an educational Research at this School. He is a PHD student of the University of Witwatersrand, South Africa.

Mashoko D has been allowed to distribute questionaires and conduct interviews to both Science teachers and Students.

Yours faithfully

CHIOME M

HEAD
CHINEMBIRI SECONDARY SCHOOL
29 JAN 2015
PRIVATE BAG 558 CHIVI
TEL : 03
CELL : 0777 04 2

**APPENDIX F: CONSENT FORM FOR THE SCIENCE TEACHERS**

Please fill in and return the slip below indicating your willingness to be a participant in my research project entitled**: 'Integrating Indigenous Knowledge of food preservation with school science teaching in Zimbabwe'.**

I,…….science teacher at ……secondary school agree to participate in this study by Dominic Mashoko.

**I give my consent for the following:**

**Permission to analyse documents**

I agree that science syllabus, scheme books and Ministry of Primary and Secondary Education policy directives be used for this study YES/ NO

**Permission to be interviewed**

I agree to be interviewed during the study YES/ NO

**Permission to be audio taped**

I agree to be audio taped during interview YES/ NO

I know that audio tapes will be used for this study only YES/ NO

**Informed Consent**

I agree to participate in this study

**I understand that:**

My name and information will be kept confidential and safe

Participation is voluntary

I will not be remunerated for taking part in this study

I can withdraw from the study at any time without prejudice

Interviews will be audio taped

If I have any concerns during the study, I can contact the researcher

All the data collected during the study will be destroyed within 3-5 years after report

**Signature…….Date**:……

**APPENDIX G: CONSENT FORM FOR SCHOOL LEARNERS**

Please fill in and return the slip below indicating your willingness to be a participant in my research project entitled: **'Integrating Indigenous Knowledge of food preservation with school science teaching in Zimbabwe'.**

My name is…….. I am a Form …. Student at …….secondary school. I agree to participate in this study done by Dominic Mashoko.

**I give my consent for the following:**

**Permission to be interviewed**

I agree to be interviewed during the study YES/ NO

**Permission to be audio taped**

I agree to be audio taped during interview YES/ NO

I know that audio tapes will be used for this study only YES/ NO

**Informed Consent**

I agree to participate in this study

**I understand that:**

My name and school information will be kept confidential and safe

Participation is voluntary

I will not be remunerated for taking part in this study

I can withdraw from the study at any time without prejudice

Interviews will be audio taped

If I have any concerns during the study, I can contact the researcher

All the data collected during the study will be destroyed within 3-5 years after report

**Signature…….Date**:……

**APPENDIX H: *KUBVUMA TSVAKURUDZO- SABHUKU* (CONSENT FORM FOR HEADS OF VILLAGES)**

Ndinokumbirawo kuti muzadzise zvinotevera maererano nekuchengetedzwa kwechikafu nenzira dzechinyakare. Ini,……mukuru wedunhu ……ndinotenda kuti Dominic Mashoko aite tsvakurudzo yake mudunhu mangu.

Ndinopa mvumo yezvinotevera:

**Mvumo yokuita Tsvakurudzo mudunhu mangu**

Ndinobvuma kuti vagari vemudunhu rangu vapinde mutsvakurudzo iyi Hongu/Kwete

**Mvumo yekutapa manzwi**

Ndinobvuma kuti vagari vatapiwe mazwi munhaurirano idzi Hongu/Kwete

Ndinoziva kuti zvatapiwa izvi ndezvechidzidzo chino chete Hongu/Kwete

**Mvumo yokutora mifananidzo yekuchengetedzwa kwechikafu**

Ndinobvuma kuti mifananidzo yekuchengetedzwa kwechikafu itorwe Hongu/Kwete

Ndinoziva kuti mifananidzo iyi inoshandiswa pazvidzidzo zvino chete Hongu/Kwete

**Mvumo yandaita ndichiziva**

Ndinobvuma kuti vagari vemunharaunda mangu vapinde mutsvakurudzo iyi.

**Ndinenzwisiso yokuti**:

**Zita redunhu rangu nezvawanikwa zvichachengetedzwa zvakanaka**

Kupinda mutsvakurudzo iyi haisi manikidzo

Vagari vemunharaunda mangu vanogona kubuda mutsvakurudzo iyi pasina chinonetsa kwavari

Nhaurirano idzi dzichatorwa nemuchina unotapa mazwi.

Vachapinda muzvidzidzo izvi havabhadharwi.

Mifananidzo yemachengeterwo echikafu ichatorwa.

Kana ndine zvandinoda kuziva maerano netsvakurudzo iyi ndichavhunza mutsvakurudzo.

Zvawanikwa mutsvakurudzo iyi zvichachengetwa kuYunivesiti ye Witwatersrand,

zvozoparadzwa makore ari pakati pematatu kusvika mashanu Tsvakurudzo yapera.

**Kusaina…….Zuva…….**

**APPENDIX I: *KUBVUMA TSVAKURUDZO- MUGARI WENZVIMBO* (CONSENT FORM FOR COMMUNITY ELDERS)**

Ndinokumbirawo kuti muzadzise zvinotevera maererano nekuchengetedzwa kwechikafu

nenzira dzechinyakare. Ini,……mugari wedunhu ……ndinotenda kuti

Dominic Mashoko aite tsvakurudzo yake neni.

Ndinopa mvumo yezvinotevera:

**Mvumo yokuita Tsvakurudzo mudunhu neni**

Ndinobvuma kupinda mutsvakurudzo iyi Hongu/Kwete

**Mvumo yekutapa manzwi**

Ndinobvuma kutapiwe mazwi munhaurirano idzi Hongu/Kwete

Ndinoziva kuti zvatapiwa izvi ndezvechidzidzo chino chete Hongu/Kwete

**Mvumo yokutora mifananidzo yekuchengetedzwa kwechikafu**

Ndinobvuma kuti mifananidzo yekuchengetedzwa kwechikafu itorwe Hongu/Kwete

Ndinoziva kuti mifananidzo iyi inoshandiswa pazvidzidzo zvino chete Hongu/Kwete

**Mvumo yandaita ndichiziva**

Ndinobvuma kupinda mutsvakurudzo iyi.

**Ndinenzwisiso yokuti**:

**Zita redunhu rangu nezvawanikwa zvichachengetedzwa zvakanaka**

Kupinda mutsvakurudzo iyi haisi manikidzo

Ndinogona kubuda mutsvakurudzo iyi pasina chinonetsa kwandiri

Nhaurirano idzi dzichatorwa nemuchina unotapa mazwi.

Vachapinda muzvidzidzo izvi havabhadharwi.

Mifananidzo yemachengeterwo echikafu ichatorwa.

Kana ndine zvandinoda kuziva maerano netsvakurudzo iyi ndichavhunza mutsvakurudzo.

Zvawanikwa mutsvakurudzo iyi zvichachengetwa kuYunivesiti ye Witwatersrand,

zvozoparadzwa makore ari pakati pematatu kusvika mashanu tsvakurudzo yapera.

**Kusaina…….Zuva…….**

**APPENDIX J: INTERVIEW PROTOCOL-INDIGENOUS KNOWLEDGE OF FOOD PRESERVATION AND ITS TEACHING IN SECONDARY SCHOOL SCIENCE**

Major Question: How do you preserve your food using indigenous methods at home?

(Open conversations on indigenous methods of food preservation)

| Phase | Issue |
|---|---|
| 1 | Tell me about keeping food fresh at home i) What types of foods do you preserve? ii) How do you preserve these foods? iii) How is food kept fresh at home? iv) Who preserves food? v) Are there any food preservation artefacts in the communities? vi) What are the reasons for preserving food that way? |
| 2 | How do people learn about food preservation in your community? Are there any stories, games (riddles), idioms, sayings, zviyera, madimikira related to food preservation in the communities? |
| 3 | Tell me about the roles of women and men in the communities related to food preservation. |
| 4 | Consider traditional and commercially-based methods of food preservation. Which is better one? |
| 5 | Tell me about teaching the topic 'food preservation' in school science lessons. i) How do you involve learners in class? ii) What language do you use to develop the concepts in class? iii) Where does the teacher draw examples of methods of food preservation from? |

**APPENDIX K: *MIBVUNZO YENHAURIRANO* (CONVERSATION QUESTIONS)**

Mivhunzo yembonano- nzira dzepasichigare dzokuchengetedza chikafu nemadzidzisirwo adzo muzvidzidzo zveSainzi Muzvikoro zveSekondari.

Mubvunzo Mukuru: Munochengetedza sei chikafu muchishandisa nzira dzepasichigare kumba?

(Nhaurirano yakasununguka pamusoro penzira dzepasichigare dzokuchengetedza chikafu)

| Danho | Nyaya |
|---|---|
| Rokutanga | Ndiudzewo nezvokuchengetedza kwechikafu kuti chisaore i) Imhandoi dzechikafu dzamunochengetedza? ii) Munochengetedza sei chikafu ichi? iii) Chikafu chinochengetedzwa sei kuti chisaora mumisha? iv) Ndiani anochichengetedza? v) Kune here zvimwewo zvechinyakare zvaishandiswa pakuchengetedza chikafu vi) Ndezvipi zvikonzero zvekuchengetedza chikafu? |
| Rechipiri | Vanhu vanodzidza sei nezvekuchengetedza chikafu munharaunda dzavagere? Kune here nyaya, mitambo (zvirahwe), madimikira, zvirevo kana zviyera zvine chokuita nekuchengetedzwa kwezvikafu mumamisha? |
| Rechitatu | Ndiudzewo mabasa evarume nevakadzi maererano nekuchengetedzwa kwezvikafu |
| Rechina | Cherechedza machengetedzerwo echikafu nenzira dzechinyakare nedzamazuva ano. Ndeipi nzira iri nane? |
| ReChishanu | Ndiudze nezvekudzidzisa chidzidzo chekuchengetedzwa kwechikafu nenzira dzechinyakare muzvidzidzo zvesainzi. i) Unopinza sei vadzidzi muzvidzidzo izvi? ii) Unoshandisa mutauro upi kuumba pfungwa yekuchengetedza zvikafu kana uri muchikoro? iii) Mudzidzisi anotorepi mienzaniso yenzira dzokuchengetedza nadzo chikafu? |

## APPENDIX L: DOCUMENT ANALYSIS PROTOCOL

1. What content, rationale, pedagogy, and language for science teaching and learning is the document emphasizing?

2. What does the document suggests as sources or examples needed for science teaching and learning?

## APPENDIX M: IDENTIFICATION CODES FOR COMMUNITY ELDERS

| Name | Code |
|---|---|
| Moyo | VaMaMoyo |
| Musaigwa | VaMusaigwa |

## APPENDIX N: IDENTIFICATION CODES FOR TEACHERS AND LEARNERS

| Name | Code |
|---|---|
| Teacher Chinamatira | Mr. Chins |
| Learner Macheka | Macs |

# APPENDIX 0*:* A SUMMARY OF WHERE ACCESS FOR THE STUDY WAS SOUGHT

| Phase | Where and Timeline | What access | By whom | Conditions for access |
|---|---|---|---|---|
| 1 | Education Head Office, November to December 2014 | Initial approval | Ministry of Education Officials | Visiting regional directorate to start approval process |
| 2 | Education regional directorate, December 2014 | Initial access to the research process in Zimbabwe | Provincial Education Director and Regional Research Officer | Ethics letter from Wits University and research instruments approval by Regional research officer |
| 3 | Education Head office, December 2014 | Research approval at national level | Director: Policy Planning Research and Development | Approval at provincial level and to provide report for the study when completed |
| 4 | Education Regional directorate (Masvingo), December 2014 to January 2015 | Permission to go to schools, access to Ministry of Education policies | Provincial Education Director, Regional Research Officer and District Education Officer | Liaison with heads of schools |
| 5 | Villages, December 2014 | Research permission in villages | Community leaders: Ward counsellor and village heads | No political interferences, research should be educational only |
| 6 | Villages, December 2014 to January 2015 | Research permission from community elders | Community elders | Research approved by community elders |
| 7 | Schools, January 2015 | At school level | Heads of schools | Research should not be disruptive to school business |
| 8 | Schools, January 2015 | At school level | Teachers and learners | Research approved by teachers and learners |