

Evaluation and Design of a Food Safety Management System for a School Feeding Scheme in the Mangaung Metropolitan Municipality, South Africa

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Thesis submitted in fulfilment of the requirement for the degree

PHD: ENVIRONMENTAL HEALTH

in the Department of Life Sciences at the Central University of Technology, Free State

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Bloemfontein, South Africa, 2023

DECLARATION OF INDEPENDENT WORK

I, Mpou Jugen Manyatsa, Identity Number ##### and Student Number #####, do hereby declare that this research project submitted for fulfilment of the requirements for the Degree PhD: Environmental Health at the Central University of Technology, Free State is my own work, and has to the best of my knowledge not been submitted before to any institution by me or anyone else as part of any qualification.

.....

SIGNATURE OF STUDENT

10 DECEMBER 2023

DATE

I dedicate this thesis, with love, to my family.

“As much as it might be a slow process, quitting won’t speed it up.”

“Finally, brothers, whatever is true, whatever is honourable, whatever is just, whatever is pure, whatever is lovely, whatever is commendable, if there is any excellence, if there is anything worthy of praise, think about these things.

Philippians 4: 8

ACKNOWLEDGEMENTS

My sincere gratitude to the following individuals for their guidance and assistance:

- To Almighty God, for the strength I received and His guidance through it all;
- To my family, for believing, supporting and praying for me;
- To my supervisor, Prof J.F.R. Lues, for the guidance and support through the academic expedition;
- To the Central University of Technology, Free State, for registering and allowing me to complete my studies;
- To the Mangosuthu University of Technology, for financing my studies, and the Department of Environmental Health, for supporting my studies;
- To the Free State Department of Basic Education, National Schools Nutritional Programme (NSNP), for allowing me to conduct this project in their schools.

ABSTRACT

The global challenges, unemployment and food insecurity have accelerated the Corona virus (COVID-19) pandemic over the past three years. The pandemic has also impacted several companies to retrench their employees, leading to household food insecurity. Food insecurity is at the centre of the global agenda, especially the United Nations' Sustainable Development Goals. The effects of food insecurity have been seen across the globe, with developing countries enduring more impact. Within most of these developing countries, women and children are mostly affected. The effects are from malnourishment and malnutrition-related diseases, such as anaemia and hypovitaminosis A. In addition, malnourished children with nutritional deficiencies are more likely to have concentration and intellectual development problems.

Several initiatives have been implemented to control malnutrition within highly stricken countries, and one of such initiatives is the School Feeding Programme (SFP). The SFP has played a significant role in alleviating short-term hunger by providing lunch packages during school hours. The programme has also been seen as an investment in the well-being of children with long-term benefits in their nutritional status and mental development. The implementation of National School Nutrition Programme (NSNP) in South Africa as a similar programme was seen a milestone. The programme was established in 1994 by Nelson Mandela and it was aimed at strengthening the link between nutrition and education. To date, the NSNP has benefited more than 21 000 quintiles 1–3 schools. These are non-fee paying primary and secondary schools, which are in previously disadvantaged communities. The programme is funded and administered by the National Department of Basic Education (DBE), with the monitoring done by the provinces through national policies. The NSNP policy stipulates the stringent approved menu, which composes meals with starch, protein and fresh vegetables or fruit. In addition to the budget for food, the department makes provision for payment of Volunteer Food Handlers (VFHs), food preparation equipment and infrastructure. The department has also adopted a system of food delivery to schools by local corporatives. The corporative food delivery to schools has promoted local small businesses.

Unfortunately, like any other food-serving establishment, NSNP has experienced some challenges. Ensuring the safe handling of food within schools remains a concern for the programme. Several reported foodborne outbreaks have been associated with the schools participating in the NSNP. Studies have attributed foodborne outbreaks to a number of factors. These include unhygienic food handling by the food handlers, purchasing food from unsafe sources, and lacking appropriate facilities and equipment. These factors are meant to be addressed by the Prerequisite Programmes (PRPs), which are regarded as the foundation for food safety and Food Safety Management System (FSMS) such as Hazard Analysis and Critical Control Point (HACCP). Like many food establishments, schools participating in NSNP must have PRPs to provide safer food to learners.

The study aimed to determine the extent to which food safety prerequisite programmes are implemented in participating schools, and to develop a safety plan based on FSMS in NSNP within the Motheo District Municipality Free State Province (South Africa). To achieve this aim, the following objectives were incorporated in the study; providing an extensive overview of the status of the feeding programme worldwide; to evaluate the knowledge, attitudes and self-reported behaviour of food handlers; to determine the extent to which infrastructure, facilities and hygiene prerequisite programmes are implemented; to evaluate the status of the Good Manufacturing Practices (GMPs); and, lastly, to design and propose a fit-for-purpose PRP plan to serve as the foundation for an HACCP system to be applied in the NSNP and similar feeding schemes.

Referring to the objective of Chapter 3, among 265 VFH respondents, 87% were females, with 70% in the age group between 20 and 40. The regional language dominated among the food handlers (74%), with only 49% proficient in English and only 35% having either a certificate or any form of tertiary education. The knowledge of the VFH based on the five keys to safer food principles averaged 67%. The lowest level of knowledge was detected in cooking of food thoroughly (31%). As much as there is a lack of knowledge in relation to some of the principles, there was a positive attitude among the majority of the VFH (82.3%) towards the five keys to safer food, especially the keeping clean principle (95%). The usage of thermometers during food preparation was not received well by the majority of the food handlers, as about 41% showed a positive attitude towards their usage. However, 90% agreed that the soups and stews should always be boiled to ensure safety. On the other



hand, the food handlers' self-reported behaviour averaged 69.2% with both cleaning practices and usage of safe water and raw material practiced by more than 80%. The cooking of food thoroughly was seen as the least practiced key (41.5%) by VFHs. The demographic data from the KAB chapter will guide in bridging the gap in VFHs' knowledge, non-complying practices, and a negative attitude towards the five keys to safer food.

To determine the extent to which infrastructure, facilities and hygiene prerequisite programmes are implemented in schools participating in NSNP, 98 schools' facilities were evaluated. More than 50% of the facilities were compliant, although some of the critical PRPs were lacking. About 69% of the schools are located away from sources of contamination, with 52% having sound construction and being in good repair. Unfortunately, the facilities (65%) do not prevent the entry and harbouring of insects. This makes it possible for pests such as cockroaches and rodents to thrive within the food preparation facilities and contaminate the food during storage. In addition, there is a lack of some of the critical structures such as doors (24%), windows (65%), screens on the window (92%) and floor drainage (73%). From the results, the majority of the schools are prone to pest access. The hygiene-related prerequisite programmes are being undermined in most of the schools. Only 18% of the schools had hand-washing basins with a supply of hot and cold or warm running water, and 67% had either liquid soap or hand-cleansing detergent. As much as documentation and record-keeping are critical, fewer facilities (18%) are keeping records related to food safety.

The Good Manufacturing Practices (GMPs) within NSNP-participating schools are lacking, with only 39% adherence, and 43% of the schools having criteria for selecting and evaluating suppliers. As much as 93% of the food and any food contact materials supplied were subject to checks for conformance, and 36% of the schools had suppliers and services audited by Environmental Health Practitioners (EHPs). Unfortunately, the results showed that almost no food supplied (3%) are sampled for microbiological analysis. There has been an improvement from the study by Manyatsa (2007) on the raw material storage. 93% of the facilities have food products stored in a designated holding area. About 71% of these schools are storing the food above the floor area. The prevailing practice, which is still worrisome, is the concomitant storage of food with non-food items such as cleaning materials and old furniture (43%); the food product stored near the overhead structures that might

contaminate it (21%); and untidy shelves, which pose a risk of cross contamination to stored foodstuffs (36%). The inadequate food handling, processing, and monitoring of the food during delivery might present contamination of food before storage. There is limited monitoring and checking of the delivered food products within the majority of the schools (79%).

The gaps identified from the research chapters have motivated the development of the FSMS model. Chapter 6 follow the Double Diamond Design Framework to develop the FSMS model. The model discovered the gaps from a literature review as well as the results from the research chapters and define and interpret and analyse this information. Lastly, the proposed model is developed using the fragmented documents, legislation and analyzed information. The developed model forms the foundation for the implementation of a FSMS that can be implemented by Department of Basic Education. The study provides this basic information and highlights the gaps within the programme that need to be addressed. In addition, it recommends a Food Safety Management Model that must be implemented within the programme to ensure the safety of food served to learners.

Keywords:

National School Nutrition Programme; Food Safety; Prerequisites Programme; Food Safety Management System

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LIST OF ACRONYMS

CCPs:	Critical Control Points
CDC:	Centres for Disease Control and Prevention
COVID-19:	Corona Virus Disease 2019
DBE:	National Department of Basic Education
DDDFM	Double Diamond Design Framework Model
DoH:	Department of Health
FSMS:	Food-safety Management System
GHP:	Good Hygiene Practice
GMPs:	Good Manufacturing Practices
HACCP:	Hazard Analysis and Critical Control Point
HMS:	Hygiene Management System
INP:	Integrated Nutrition Programme
ISO:	International Standard Organisation
MDG:	Millennium Development Goal
NSNP:	National School Nutrition Programme
PED:	Provincial Education Department
PIC:	Person in Charge
PRP:	Prerequisite Programme
PSC:	Public Service Commission
PSNP:	Primary School Nutrition Programme
SANS:	South African National Standard
SDGs:	Sustainable Development Goals
SFP:	School Feeding Programme
SGB:	School Governing Body
SLAs:	Service Level Agreements
VFHs:	Volunteer Food Handlers
UNICEF:	United Nations Children's Fund
WHO:	World Health Organization

CHAPTER 1

INTRODUCTION AND RATIONALE

1.1 INTRODUCTION

Globally in 2020, more than 460 million adults were estimated to be underweight and 149 million children under the age of five years were stunted (World Health Organization (WHO), 2021). Zhang, Giloi, Shen, Yu *et al.* (2022) highlighted that the World Health Organization (WHO) has estimated that in South Africa malnutrition accounts for at least 18.2 million people who are living below the poverty line, with children the worst affected (South Africa, StatsSA, 2022). Notwithstanding this fact, between 2015 and 2017, the number of people living below the international poverty line decreased from 741 million to 689 million (Schoch, Lakner & Fleury, 2020). However, this upswing continued only until the 2020 due to the outbreak of the Corona Virus pandemic (COVID-19) when, according to the World Bank, an estimated 88 million people worldwide were left destitute, with developing countries bearing the brunt (World Bank Group, 2020).

Organisations such as World Hunger Education Service (2011) have emphasised the importance of short- and long-term interventions to reduce the incidence of food insecurity and the child mortality rate due to malnutrition. Joining such initiatives, several governments and development organisations have devoted substantial resources to provide free school meals to less fortunate children in both less developed and more affluent countries (McEwan, 2013). The concept of school feeding programmes (SFP) is closely aligned with the WHO's first Millennium Development Goal (MDG) to eradicate poverty and hunger and contribute to attaining the human right to a standard of living that enhances health and well-being. Such programmes also served as standard transfer programmes in developed countries as well as low-income settings owing to the educational benefits of increased classroom participation in class and improved learning outcomes (Bundy, Burbano, Grosh, Gelli *et al.*, 2009; Kazianga, De Walque & Alderman, 2014; Uduku, 2011; United Nations, 1948). There is also evidence that the SFPs increase school attendance (Adelman, Gilligan & Lehrer, 2008). School meals influence children's learning in three ways (Bundy *et al.*, 2009). Firstly, it encourages families to enrol their children in school, to enrol them sooner, and to promote regular attendance. Secondly, there is evidence that eating breakfast improves short-term

attention and memory, even if it consists only of "empty calories" (Adelman *et al.*, 2008; Bundy, Shaeffer, Jukes, Beegle *et al.* 2006; Greenhalgh, Kristjansson & Robinson, 2007; Pollitt, Cueto & Jacoby, 1998; Uduku, 2011). The third way it influences learning is that sustained exposure to nutritious food tends to prevent or lessen the effects of malnutrition and improves cognitive development or academic achievement.

In 1994 the Integrated Nutrition Programme (INP) was introduced in South Africa to reduce food insecurity leading to child mortality. One of the programmes that became part of the INP was the Primary School Nutrition Programme (PSNP), now known as the National School Nutrition Programme (NSNP). This programme was developed following the 1994 announcement by the then president, Nelson Mandela, that such a nutritional feeding scheme be implemented in every primary school in need (Bonti-Ankomah, 2001). However, since then, the NSNP has expanded its role in alleviating hunger and contributing to learning. Since April 2009, the programme's scope has been broadened to include secondary schools. During 2020/2021, it provided meals to 21 189 Department of Basic Education (DBE) primary and secondary schools nationally (South Africa DBE, 2021). In its 2010 evaluation report, the education department (South Africa DBE, 2010) stated that despite the evidence of progress, most of the provinces, particularly the Free State, were still hamstrung by several challenges. Research has indicated that among the problems are a lack of infrastructure for food preparation and storage, unhygienic conditions, and compromised food shelf life. All of these increase the risk of foodborne infections and contamination (Griffith, Cooper, Gilmore, Davies *et al.*, 2000; Lues & Van Tonder, 2007; Manyatsa, 2007; Venter, Lues, Manyatsa, Moalusi & Noe, 2003; Venter, Noe, Manyatsa & Lues, 2010).

Over the years, numerous foodborne-disease outbreaks have been reported in schools worldwide, including feeding schemes (Hutin, Pool, Cramer, Nainam *et al.*, 1999; Michino & Otsuki, 2000; Nicholas, Mackinnon, Rowe, Bean *et al.* 2002). Most incidents are associated with bacterial foodborne pathogens such as *Escherichia coli*, *Clostridium* sp., *Bacillus cereus*, *Staphylococcus aureus*, and *Salmonella* sp. (Venter *et al.*, 2003). The WHO (WHO 2013) has reported that foodborne and waterborne diseases contribute significantly to the mortality rate, mainly among children in developing countries and are responsible for 2.2 million deaths annually.

Taking into account the vulnerability of the children benefiting from feeding programmes, food safety must be ensured primarily through a pre-emptive approach (Martins & Rocha, 2014). Preventative measures include the implementation of a Food Safety Management System (FSMS) based on the principles of Hazard Analysis and Critical Control Point (HACCP) and Good Hygiene Practice (GHP). Developing or strengthening a prerequisite programme (PRP) is one of the first steps in building an HACCP system, as it is fundamental to building a solid self-control system (Henroid & Sneed, 2004; Wallace & Williams, 2001). Such programmes should include supplier control, temperature monitoring, staff hygiene standards, pest control, written specifications, proper cleaning and sanitation procedures and documented employee training. Based on the South African National Standard (SANS) 10049:2011 (South African Bureau of Standards, 2019), PRPs are the basic conditions and activities required to maintain a hygienic environment in the food chain, from primary production to the final consumer, and they ensure that food is safe for human consumption.

1.2 RATIONALE

One of the critical priorities of the South African government is to improve education and healthcare to enhance the quality of people's lives and support national development (Graham, Hochfeld, Stuart & Gent, 2015). However, the high levels of poverty in communities and the resulting nutritional deprivation increase the risk of learning being adversely affected (South Africa Public Service Commission (PSC), 2008). Despite the good intentions and successes of the NSNP in addressing hunger and poverty among learners, their families and their communities, challenges and hardship persist.

One of the significant challenges is providing quality and safe food for the learners. As noted, food safety is often compromised due to poor infrastructure, including inadequate food preparation and storage facilities (Manyatsa, 2007). These shortcomings and insufficient adherence to the programme's guidelines lead to poor food management practices (South Africa PSC, 2008). The result is an increased possibility of food contamination posing a health risk for children (Venter *et al.*, 2003). By tackling these shortcomings head-on, the NSNP has improved the infrastructure at several schools (South Africa DBE, 2021). However, ensuring food safety requires more than structural

and material improvements. It also demands that a solid self-control system be developed, and adherence to food safety guidelines be ensured. A PRP encompassing supplier control, temperature monitoring, staff hygiene, pest control, written procedures and documented employee training is key to entrenching a self-control system (Liz Martins & Rocha, 2014; Youn & Sneed, 2003).

1.3 THE AIM AND OBJECTIVES OF THE STUDY

1.3.1 Aim of the study

The study aims to determine the extent to which food safety PRPs are implemented in feeding schemes and to develop a quality management and assessment system for the schools participating in the NSNP in the Mangaung Metropole in the Free State province.

1.3.2 Objectives

The objectives of the study were to;

- Provide an overview of the status of food safety within feeding programmes worldwide and associated with the South African school feeding scheme;
- Explore the knowledge, attitudes and behaviours of the staff involved in food handling for the NSNP;
- Investigate the extent to which infrastructure, facilities and hygiene PRPs are implemented;
- Evaluate the status of the good manufacturing practices (GMPs) within the schools participating in the NSNP;
- Design and propose a fit-for-purpose PRP plan to serve as the foundation for an HACCP system to be applied in the NSNP and similar feeding schemes.

1.4 CHAPTER LAYOUT

The status of school feeding programmes locally and internationally is described in Chapter 2. Chapter 3 examines food handlers' basic knowledge, attitudes, and food handling practices, while Chapter 4 assesses existing facilities and hygiene prerequisites. Good manufacturing practices are scrutinised in Chapter 5. Chapter 6 recommends the quality management and assessment system for a NSNP. Finally, chapter 7 provides an overview of the study and highlights the recommendations for NSNP. This study lays the foundation for effectively implementing the PRPs, making it possible for participating schools to implement relevant and efficient FSMS s in preparation for creating a comprehensive HACCP at a later stage.

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CHAPTER 2

FOOD SAFETY ATTRIBUTES IN THE NATIONAL SCHOOL NUTRITION PROGRAMME IN SOUTH AFRICA: A NARRATIVE REVIEW

For submission partially or in full to:

Food Control: ISSN: 0956-7135

2.1 INTRODUCTION

This review chapter focuses on food-safety aspects and challenges related to the prerequisite programme (PRP) of the NSNP as a way to ameliorate learning problems caused by food scarcity and malnutrition due to poverty, especially in developing countries. Unfortunately, one of the factors that has marred the image of the programme has been reports on cases of food poisoning. To prevent such outbreaks and given the seriousness of foodborne diseases, implementing HACCP system based on PRPs has been proposed as an effective control measure. However, research by Manyatsa (2007) and Sibanyoni and Tabit (2019) has shown that the majority of schools participating in NSNP within South Africa lack some of the prerequisites for setting up an HACCP, including adequate infrastructure, equipment, storage, potable water and insufficient food safety knowledge and information despite food handlers receiving training before they start working.

2.2 METHODOLOGY

A narrative literature review method focusing on the background of the school feeding programme as prescribed by Munn Stern, Aromataris, Lockwood *et al.* (2018) and Page, McKenzie, Bossuyt, Boutron *et al.* (2020). The scoping covered the following:

1. the impact of poverty and malnutrition on children;
2. the alleviation of poverty among school attending children using a school feeding programme as a vehicle;
3. the challenges faced by the NSNP that are affecting food safety; and
4. possible solutions for food safety challenges.

2.3 POVERTY AND MALNUTRITION

A number of international and national policy frameworks have been developed to end poverty, including the WHO's Sustainable Development Goals (SDGs) (Aderemi, Opele, Olanipekun & Faryan, 2023; Nayak & Waterson, 2017; Sherman & Muehlhoff, 2007; United Nations, 1948). Despite substantial progress as a result of such initiatives, around 700 million people still live in extreme poverty globally with the WHO indicating that 11% of the world's population fall below the poverty line and several billion just above it (Jensen, Berens & Nelson, 2017; Olinto, Beegle, Sobrado & Uematsu, 2013). The latter is particularly vulnerable to shocks that could send them into abject poverty, or cause them to suffer particular effects of poverty, such as exclusion, powerlessness and poor health (Hertel & Lobell, 2014; Müller & Burkhard, 2012; Zhang, Wang, Yan, Glamuzina & Zhang, 2018). In many developing countries, children and women are the most affected by hunger and/or malnutrition (Sullivan & Hickel, 2023; Van Stuijvenberg & Benadé, 2000). This is particularly true of children, especially those living in sub-Saharan Africa and South Asia (Abrams, Mushi, Hilmers, Griffin *et al.*, 2003; Mallek, Awad, Ozturk & Douissa. 2024). A 2015 report by Statistics South Africa (SA DBE, 2015) reiterates that poverty is on the rise in South Africa (see Figure 2.1), having increased to 55,5% from a serious low of 53,2% in 2011. As in many sub-Saharan African countries, poverty in South Africa is considered one of the greatest threats to childhood development with over 13 million children affected. A key factor that negatively affects physical, cognitive and emotional development, and which is widespread among children of school-going age, is chronic malnutrition (Bonti-Ankomah, 2001). Bechoff, de Bruyn, Alpha, Wieringa *et al.* (2023) Sherman and Muehlhoff (2007) indicate that under-nutrition and micronutrient deficiencies impede the growth of children and reduce their capacity and motivation to learn. This leads to high drop-out rates. Other studies show that hunger can affect brain development of children hampering their chances of educational success and labour productivity later in life (Rovira, Cencic, Santos & Jakobsen, 2007). It may also lead to a range of undesirable health outcomes later in life such as a higher risk of obesity, heart disease and diabetes (Bechoff, de Bruyn, Alpha, Wieringa *et al.*, 2023; Conley & Bennett, 2000; Glewwe, Jacoby & Kinga, 2001). According to Minh, Muhajarine, Janus, Brownell *et al.* (2017) and Strauss and Thomas (1998), children born into families of low socio-economic status have, on average, poorer neuro-cognitive outcomes and educational attainment than wealthier peers. These impediments result in social ills such as inter-generational transmission of poverty and an increased risk of mortality and chronic disease (Brown & Pollitt, 1996;

Grantham-McGregor, Cheung, Cueto, Glewwe, Richter & Strupp, 2007).

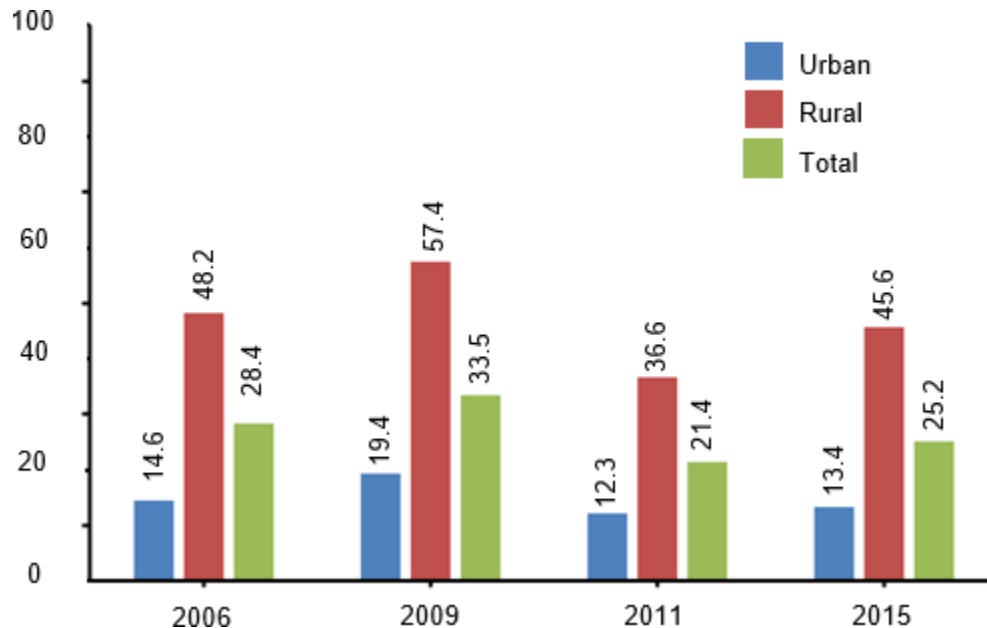


Figure 2.1: Overall changes in percentage poverty between 2006 and 2015 by settlement type (South Africa DBE, 2015)

2.4 THE POVERTY ALLEVIATION SOLUTIONS IN SCHOOLS

2.4.1 School feeding programme

World-wide, feeding programmes at schools are considered effective tools to alleviate poverty and malnutrition, and several governments and development organisations such as the United Nations Children’s Fund (UNICEF) have allocated substantial resources to it (Dei, 2014; Langsford, 2012; Manyatsa, 2007; McEwan, 2013; Venter, Lues, Manyatsa, Moalusi & Noe, 2003; Rendall-Mkosi, Wenhold & Sibanda, 2013; Sibanyoni & Tabit, 2019; Sidaner, Balaban & Burlandy, 2013) (Figure 2.1). SFPs have successfully been implemented in both developed and developing countries feeding approximately 368 million children daily worldwide (Soares, Davó-Blanes, Martinelli, Melgarejo & Cavalli, 2017; Uduku, 2011; WFP, 2013).

These programmes do not only reduce short-term hunger and allow for better energy and

micronutrient intake, but have also been shown to prevent stunting; improve weight gain; increase levels of capacity for activity and improve learning (Adelman, Gilligan & Lehrer 2008; Briggs, 2008; Gelli, 2010; Hochfeld, Graham, Patel, Moodley, Ross, 2016). According to Locatelli, Canella & Bandoni (2018), SFPs also improve punctuality and school performance as well as children's knowledge of nutrition and self-care as they are taught how and why to establish and maintain healthy eating and lifestyle habits through active participation in gardening and crop plantation in schools. Such projects also help teachers and parents develop skills to grow their own crops. Overall the SFPs contribute to long-term household food security (Mkize, 2016).

2.4.2 The establishment of a school feeding programme in South Africa

To reduce the prevalence of food insecurity and child mortality, the Integrated Nutrition Programme (INP) was introduced in South Africa in 1994. As part of this programme, the Primary School Nutrition Programme (PSNP), later renamed the NSNP, was established (South Africa DBE, 2008). In 2009 the programme was extended to secondary schools (South Africa, DBE, 2011).

The guidelines for implementing the programme in secondary schools are attached (Appendix 1). The initial budget for this programme, allocated by the National Treasury, was R472.8 million in 1994. Ten years later, in 2004, it had grown to R832.2 million. Over the last ten years, an average of five million primary school children have been fed annually through this initiative (South Africa DBE, 2011).



Figure 2.2: Learners at the SFPs participating school after the food is served

As with many similar programmes, besides serving food as a tool to combat short-term hunger and undernutrition, the NSNP also aim to improve education outcomes by enhancing active learning capacity, school attendance and punctuality (Devereux, Hochfeld, Karriem, Mensah, *et al.*, 2018; Sibanyoni & Tabit, 2019). The NSNP has three pillars that support its different objectives (Figure 2.3). The first pillar is *school feeding* aimed at providing nutritious meals for learners. The second pillar is *nutrition education and deworming programmes* for learners and the community at large. The third pillar is *sustainable food production* (SFP). The latter is intended to facilitate creating food gardens and other food production projects to establish and support food security in and around school communities (Locatelli *et al.*, 2018; South Africa DBE, 2014). In 2014, only 45% of the schools were part of the NSNP (South Africa DBE, 2014).

The three components together have brought the NSNP closer to achieving the WHO Sustainable Development Goals, including reducing child mortality, achieving universal primary education and eradicating extreme poverty and hunger by arresting malnutrition and hunger (Hall, Hahn, Farley, Quynh & Valdivia, 2007; Kimani-Murage, Norris, Pettifor, Tollman, Klipstein- Grobusch, Gómez-Olivé, Dunger & Kahn, 2011; Seoketsa, 2007; South Africa PSC, 2008; Wei, Zhong, Song & Huang, 2023). Since its inception, the NSNP has had to adjust the food menu to accommodate new challenges. At first learners were served brown bread with margarine, peanut butter, jam, and powdered milkshake fortified with vitamins, minerals and protein (Müller, 2009). Later biscuits fortified with beta-carotene, iron, and iodine were introduced (Manyatsa, 2007), and later a cooked meal including vegetables and fruits (South Africa DBE, 2010). Currently, meals supplied to learners follow the *South African Food Based Dietary Guidelines* derived from the South African Department of Health (DoH) that recommend a variety of food items including fresh vegetables and fruit (South Africa DoH, 2014) (Appendix 2). To date, the NSNP has managed to contribute to the improvement of education quality and general health through feeding learners at designated schools, enhancing active learning capacity and improving school attendance and punctuality, among others (Mawela & Van den Berg, 2020).

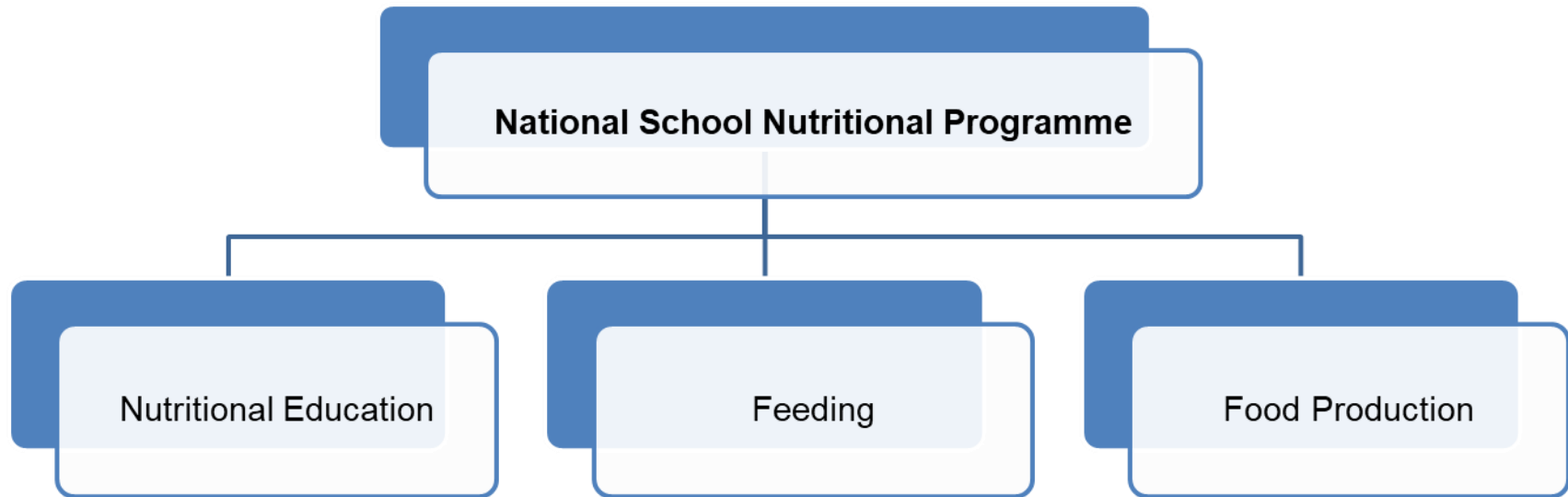


Figure 2.3: The three pillars that support the different objective of the NSNP (South Africa DBE, 2008)

2.4.3 The administrative dynamics of the NSNP

The logistics and complexity of a programme of this magnitude requires a well-structured and organised set-up. Currently, the NSNP is using two different models for procuring food. In Gauteng, KwaZulu-Natal, Limpopo, Mpumalanga, and the Western Cape it has instituted a tender system. Suppliers are contracted and paid by the Provincial Education Department (PED) for the food they deliver to the schools. These contracts are formalised in service-level agreements (SLAs). Schools receive funds to purchase fuel and pay stipends to VFHs (South Africa DBE, 2021).

On the other hand, a decentralised model is applied in the Eastern Cape, Free State, Northwest, and Northern Cape that sees each PED transfer money to schools (South Africa DBE, 2016) (Figure 2.3). In turn schools appoint service providers and sign SLAs with the DBE (South Africa, DBE 2015). Both models are based on a multi-level management and dispersed governance model involving the PEDs, the district offices of DBE, participating schools and service providers. The NSNP Directorate at DBE is responsible for co-ordinating the programme; providing leadership and support as well as allocating funds for the procurement of equipment, utensils and foodstuffs to the provincial, district office and/or schools (South Africa DBE, 2021; South Africa DBE, 2009). The provincial and district offices are responsible for training, supporting, monitoring, ensuring compliance and reporting on the NSNP activities within participating schools (South Africa DBE, 2015). Participating schools are responsible for implementing the programme; paying service providers (decentralised model) and volunteer food handlers; monitoring the processes; ensuring compliance and reporting to the districts and PED (South Africa DBE, 2015). The school principal of each school is responsible for the overall management of the programme. However, the principal may nominate an educator or administrator as the NSNP school co-ordinator to supervise the daily activities and responsibilities.

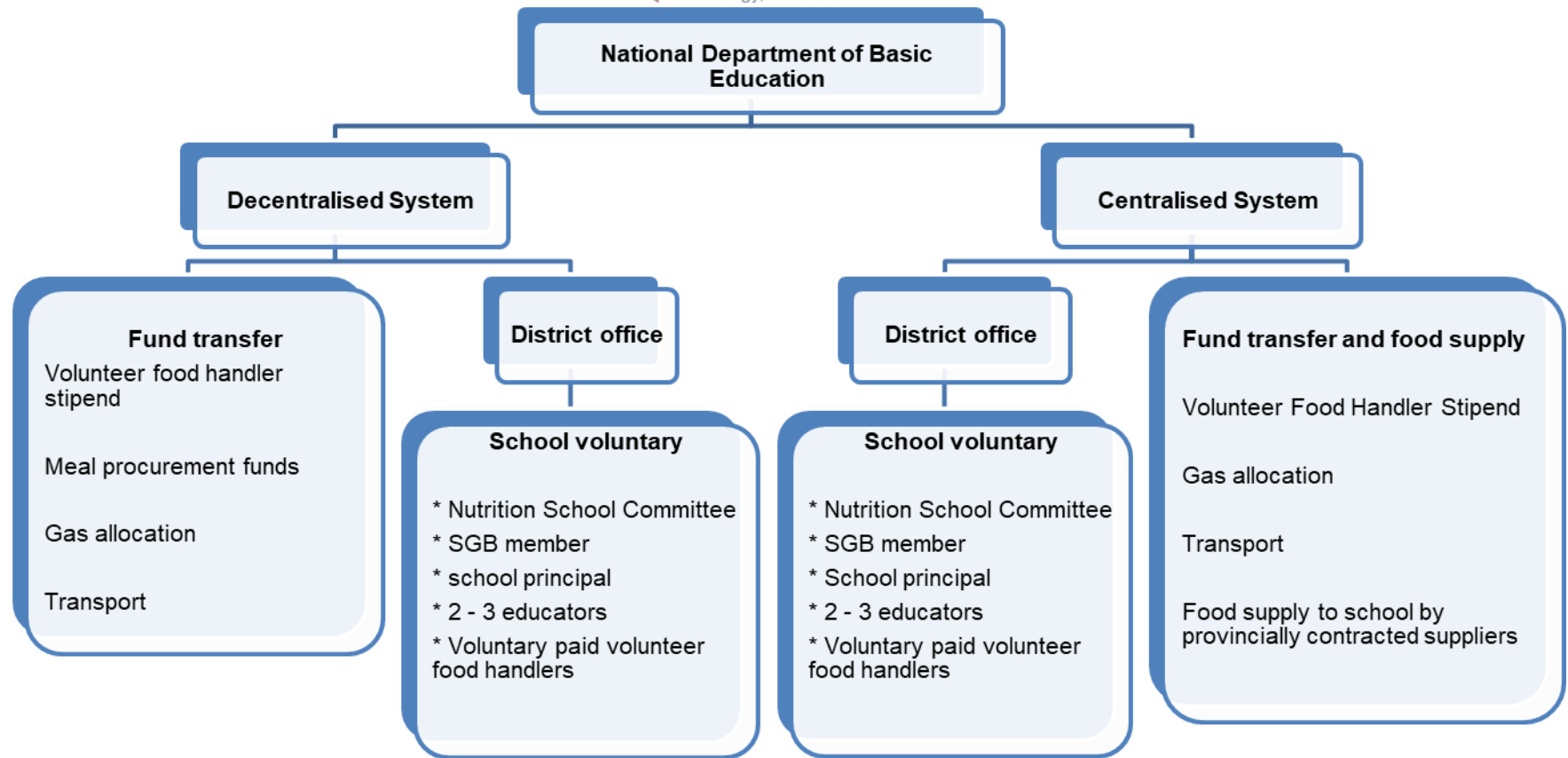


Figure: 2.4: The NSNP organogram of DBE at national, provincial, district and school level. Source: Department of Basic Education (2021)

These tasks include receiving and recording stock, maintaining and updating records of the number of learners fed per day, processing invoices, and overseeing the serving of meals (South Africa DBE, 2009; South Africa PSC, 2008). Some schools appoint a nutrition committee comprising the NSNP school co-ordinator, school management team, a school governing body (SGB) member, a food handler, and/or a food gardener (South Africa DBE, 2009). For schools to provide learners with meals that meet national nutrition standards and the DBE guidelines, school kitchens need to be adequately equipped and staff suitably trained (Table 2.1).

Table 2.1: The list of basic equipment and utensils for NSNP according to item.
Source: Department of Basic Education (2021)

ITEM	QUANTITY REQUIRED FOR 350 LEARNERS OR LESS	QUANTITY REQUIRED FOR 350 LEARNERS OR MORE
GAS BURNERS	1 x 3 plate gas burners	2 x 3 plate gas burner
QUANTITY		
GAS CYLINDER	2 gas cylinders	3 gas cylinders
STAINLESS STEEL OR ALUMINIUM HEAVY-DUTY COOKING POTS 60 LITRES	3 x 60lt pots	6 x 60lt pots
POLYPROPYLENE PLASTIC OR STAINLESS-STEEL LONG COOKING SPOONS (E.G. PAP STIRRER)	3 long cooking spoons	6 long cooking spoons
STAINLESS STEEL WORKTABLE	2 tables	4 tables
SERVING UTENSILS REQUIRED ARE DETERMINED BY NUMBER OF LEARNERS AND SERVING POINTS (AN EXAMPLE OF 500 LEARNERS PER SCHOOL AND 17 SERVING POINTS)		
STAINLESS STEEL TABLESPOONS	500 spoons	
STAINLESS STEEL PLATES	500 plates	
STAINLESS STEEL OR PLASTIC SERVING SPOONS	51 spoons (17 for starch, 17 proteins, 17 vegetables)	
STAINLESS STEEL OR PLASTIC SERVING CONTAINERS	51 containers (17 for starch, 17 proteins, 17 vegetables)	

Although much progress has been made, the DBE in its own evaluation report (South Africa DBE, 2021) admitted that there are still a number of challenges in most of the provinces.

2.5 CHALLENGES IN THE IMPLEMENTATION OF THE NSNP

The fundamental goal of the NSNP is to contribute to food security and to improve the health and nutritional status of school-going children, as well as supporting their schooling experience. By combating hunger and malnutrition, it helps improve learners' school attendance, attentiveness and educational performance. As much as the NSNP has seen a number of successes, it also faces several challenges. Initially, after three years, the Health Systems Trust (1997) evaluation report states that the programme had been hampered by a lack of capacity. This had led to too few schools being included; sub-standard food quality; meals served at inappropriate times of the day due to teachers complaining about disruption of the school day; unreliable service providers, and ineffectual fund allocation by PEDs to schools. One such might be the absence of infrastructure. In South Africa, researchers identified too few kitchens in the Eastern Cape and Mpumalanga schools as well as inadequate storage, preparation, cooking and eating facilities - most of which do not meet health and safety standards (Bundy *et al.*, 2009). In 2008 principals, teacher coordinators, circuit co-ordinators, and district co-ordinators continued to identify poor service delivery, including delayed and incomplete orders, as the main problems hampering the programme (Coetzee & Van den Berg, 2012).

As mentioned, the NSNP has been introduced to schools classified as quintiles 1, 2 and 3 or previously disadvantaged schools by the DBE. The majority of children attending these schools tend to come from poor communities and attend schools that lack adequate space for food storage and meal preparation; equipment to prepare, cook, and serve meals; and fuel required for cooking (Devereux *et al.*, 2018; Graham, Hochfeld, Stuart & Van Gent, 2015; Manyatsa, 2007; South Africa PSC, 2008). This situation is exacerbated by environmental hazards such as rat infestations as well as inadequate and intermittent training for food handlers (Rendall-Mkosi *et al.*, 2013).

According to Seaman (2010), although some food handlers may be practically competent, they often lack a contextual understanding of food preparation practices such as food safety procedures. Such knowledge should be instilled with regular and appropriate training. Water supply plays a crucial role in food preparation. Inadequate and non-existent water supply infrastructure poses a major obstacle to effectively implement the NSNP. It also impacts food safety practices such as washing hands before preparing food and eating, and after latrine use (Sibanyoni, Tshabalala, & Tabit, 2017). This poses a health risk as it can lead to diarrhoea and parasitic worm infections. Another hindrance is inadequate control processes that result in suppliers evading sanctions for inconsistent food quality and delivery services (Sibanyoni *et al.*, 2017). Unfortunately, all these factors undermine the value of a nutritional programme.

The status quo within the NSNP such as poor infrastructure and a lack of adequate food preparation infrastructure, equipment, storage facilities, utensils for food preparation and storage facilities has been reported by a number of authors (Graham *et al.*, 2015; Manyatsa, 2007; Nhlapo, 2013; Noe, 2005; Rendall-Mkosi *et al.*, 2013; Sibanyoni *et al.*, 2017; Sibanyoni & Tabit, 2019; South Africa DBE, 2016; South Africa PSC, 2008; Venter *et al.*, 2003). According to Graham *et al.* (2015), some schools are located in water catchment areas, making them unsuitable for food preparation purpose. In addition authors have highlighted that the lack of adequate resources within the NSNP could result in the provision of food with compromised safety and quality assurance (Garayoa, Viras, Díez-Leturia & García-Jalón, 2011; Government Accountability Office (GAO), 2013; Lockis *et al.*, 2011; Sibanyoni *et al.* 2017). The Department of Basic Education has acknowledged that infrastructure challenges still exist in some schools (South Africa DBE, 2016). Some of these challenges include inadequate space for food storage and preparation and poor access to water. Unfortunately, preparation and serving of nutritious meals on time is dependent on having adequate fuel, storage space, preparation space, equipment and utensils for food storage and preparation in accordance with health and safety guidelines (Adelman *et al.*, 2008; World Food Programme, 2010).

The lack of access to water is one of the most issues. In 2016 the DBE (South Africa DBE, 2016) indicated that water availability is “unreliable” in 43.7% of schools. The water impact was worse in the Northwest (68.2%), the Northern Cape (65.6%), and KwaZulu-Natal (64.3%). Better water availability was reported from the majority of schools in the Free State (76.9%), Mpumalanga (72.9%), the Western Cape (68%), and Gauteng (66.7%). The importance of water during food preparation cannot be overemphasised. There is a clear correlation between access to water and the level of cleanliness of the food storage, preparation areas, cooking equipment and serving utensils and the food handlers (South Africa DBE, 2008). The inadequate water supply and hand washing facilities within the food preparation areas can contribute to the presence of high bacteria load and pathogens on food preparation surfaces (Nhlapo, Lues, Kativu, & Groenewald, 2015; Sibanyoni & Tabit, 2019). Not all schools have water tanks or taps in the vicinity of the kitchens, inhibiting food handlers from regular hand washing (Rendall-Mkosi *et al.*, 2013).

The DBE, in their 2008 and 2016 reports, highlighted that a number of newly constructed kitchens with well-built equipment and storage facilities installed as part of improved infrastructure for use by the NSNP (South Africa DBE, 2016; South Africa DBE, 2008). The Public Service Commission (PSC) in their 2008 study reported that even though most schools visited had the kitchens for the preparation of the daily meal and storage for the ingredients, the infrastructure was not always ideal (South Africa PSC, 2008). Similar observations were also made by Langsford (2012) and Sibanyoni *et al.* (2017). The fact that some of the schools are not preparing meals in a designated kitchen constitutes a food safety hazard that could contribute to the outbreak of foodborne diseases (Kibret & Abera, 2012). It is clear that the Government does not afford the funding to improve infrastructure and provide equipment to all the schools. This challenge has seen number of schools receiving assistance from corporate donors and other partners (South Africa DBE, 2016). Some of the corporate donors have donated containers mostly to rural schools to be used as kitchens. However, during hot weather the temperature in the containers becomes unbearable (Rendall-Mkosi *et al.*, 2013).

In the case of the NSNP, its 2008 evaluation report indicate that the majority of schools' food handlers have received some training, but that less than half (41.9%) of the food

handlers themselves have received training. A study by Sibanyoni *et al.* (2017) revealed that the majority of NSNP food handlers who were interviewed lacked knowledge, awareness and a prudent attitude regarding common microbial food safety hazards. On the other hand, those food handlers and teachers with a higher level of education and those with longer duration of service in the NSNP were more knowledgeable regarding food safety hazards. These authors recommend that newly recruited food handlers should be trained on food safety procedures, and that food safety training on various aspects of microbial food safety hazards should continue on a regular basis thereafter. Nhlapo (2013) is of the opinion that all staff at schools should be included in training sessions on food safety and nutrition. The effectiveness of continuous training is supported by studies done in the United State and Brazil (Santana, Almeida, Ferreira & Almeida, 2009; Sneed & Henroid, 2007).

Food handlers but also programme managers might be more effective in translating theoretical knowledge into behavioural changes (Fuller, 2007). This notion is accommodated in the regulations governing general hygiene requirements for food premises and the transport of food. It makes it clear that each person in a supervisory capacity has to be trained either by an environmental health practitioner (EHP), or an accredited sector education and training authority (SETA) representative. Various international laws under *Codex Alimentarius* also encourage food hygiene training to ensure safety practices in a food preparation environment (Ababio, Onarinde, Taylor, & Swainson, 2016). These include some of the International Standard Organisation (ISO) and specifically ISO 22000 standards dealing with food safety. Training should furthermore be aligned with, and included in any hygiene management system (HMS) (Fernández-Segovia, Pérez-Llácer & Fuentes, 2014). Locally, the South African National Standard (SANS), a division of the South African Bureau of Standards (SABS), requires that a food preparing and serving site should follow a systematic approach to controlling food safety hazards. Such a FSMS should be based on the principles of HACCP and PRPs (South African National Standard (SANS), 2019). The FSMS also requires that appropriate training regarding the safe handling of food in accordance with food safety requirements must be conducted at the beginning of employment and be properly documented.

2.6 FOOD SAFETY IN THE NSNP

Every year, the WHO estimates that approximately 600 million people fall ill from consuming food contaminated by bacteria, viruses, parasites, toxins and chemicals, while in approximately 420,000 cases it leads to death (De Freitas, De Cunha & Stedefeldt, 2019; Garayoa *et al.*, 2011; Zanin, De Cunha, De Rosso, Capriles, & Stedefeldt, 2017). These numbers are supported by the United State Centers for Disease Control and Prevention (CDC) reviews indicating that foodborne diseases are responsible for approximately 76 million illnesses per year. The most common foodborne pathogens implicated in such outbreaks are *Campylobacter jejuni*, *Salmonella* species, *Escherichia coli* O157:H7, *Toxoplasma gondii*, and *Yersinia enterocolitica* (Gould, Walsh, Vieira, Herman, Williams, Hall & Cole, 2013; Medeiros, Hillers, Kendall, & Mason, 2001; Whited, Feng & Bruhn, 2019).

The prevalence of foodborne illnesses is considered to be higher in developing countries due to underreporting; limited surveillance data and weak control policies (Tereq, Sajjad, Zakar, Zakar & Fischer, 2018). Kidiku (2001) advances a figure as high as 70% for diarrhoeal diseases originating from contaminated food in developing countries. In 2011, in South Africa, out of 2 560 outbreaks of foodborne diseases reported, the majority (1 700) were among school-going children (South Africa StatsSA, 2014). Between January 2013 to December 2017, 327 foodborne disease outbreaks were reported, causing illness in 11 155 individuals, with 8 680 hospital visits, 494 hospital admissions and 49 deaths (Shonhiwa, Ntshoe, Essel, Thomas *et al.*, 2017). Infections and diseases caused by contaminated food remain a threat to public health globally (Havelaar, Kirk, Torgerson, Gibb *et al.*, 2015; Luo, Xu, Chen, Bai *et al.*, 2019; Notermans, Gallhof, Zweitering, & Mead, 1995; Stratev, Odeyemi, Pavlov, Kyuchukova, *et al.*, 2017; WHO, 2000). While some of the microorganisms responsible for contaminating food may not be harmful to most healthy people, in the case of children and people who are immuno-compromised, opportunistic bacteria can cause disease and even death (Mellou, Sideroglou, Potamiti-Komi, Kokkinos & Ziros, 2013; Sibanyoni & Tabit, 2019; Simon, Trost, Bender, & Fuchs, 2018). At schools, this increases the threat of disruption of learning and even death (Abushelaibi, Jobe, Al Dhanhani *et al.*, 2016; Scharff, 2012; Sibanyoni & Tabit, 2019; Toth, Bittsanszky, & Illes, 2014). A number of such outbreaks in NSNP- affiliated schools have been reported across South Africa. For example, in 2014, cases were reported in

Gauteng and Limpopo provinces which resulted in three deaths (eNCA, 2014; Sibanyoni *et al.*, 2017). In 2001, the food poisoning associated with peanut butter supplied to schools participating in the NSNP was reported (Venter *et al.*, 2003), while other foodborne diseases such as Salmonella food-poisoning have been reported too (Andersson, Weiss, Rainey & Salkinoja-Salonen, 1999; Kobayashi, Sasaki, Tamura, Suzuki, Watanabe & Agui, 1999; Venter *et al.*, 2003). In the most recent case, 203 learners were affected (Ngqakamba, 2021). These examples make the case for re-assessing this programme to ensure the well-being and safety of children.

2.7 COMMON CAUSES OF FOODBORNE DISEASES

With the increased number of food poisoning outbreaks and food contamination-related cases (Motladiile, Tumbo, Malumba, Adeoti *et al.*, 2019), there is a need for better hygiene and quality practices (De Freitas *et al.*, 2019). A number of risk factors that contribute to food being a health hazard include improper holding temperatures and food handling; inadequate cooking; contaminated equipment; cross-contamination; sub-quality food and dodgy suppliers; and poor personal hygiene (Bas, Ersun, & Kivanç, 2006; Garayoa *et al.*, 2017; Herath & Henson, 2010; Liz Martins & Rocha, 2014; Panisello & Quantick, 2001; Sanlier & Konaklioglu, 2012; Sibanyoni & Tabit, 2019).

As mentioned, programmes such as the NSNP has from its inception been grappling with problems related to inadequate food preparation infrastructure at schools, a major factor that compromises food safety (Manyatsa, 2007). This phenomenon has been documented internationally (Jomaa, McDonnell & Probart, 2011; Sibanyoni *et al.*, 2017; WHO/FAO, 2010), as well as in evaluations of the NSNP itself (Graham *et al.*, 2015; Manyatsa, 2007; Rendall-Mkosi *et al.*, 2013; Sibanyoni & Tabit, 2019; Venter *et al.*, 2003). Evidence of microbial cross-contamination as a result of ineffective cleaning and disinfecting of food contact surfaces and the use of inappropriate food preparation surfaces in NSNP-participating schools has also been documented in the literature (Nhlapo, Lues, Kativu & Groenewald, 2015; Sibanyoni & Tabit, 2019; Smigic, Djekic, Liz Martins, Rocha *et al.*, 2016).

The lack of infrastructure and equipment is aggravated by the actions and attitudes of the food handlers themselves. This is confirmed by the WHO suggesting that human actions

are the leading cause of food contamination during food preparation in food service establishments (Sibanyoni *et al.*, 2017). Furthermore, studies indicate that contamination with foodborne pathogens such as *Campylobacter jejuni*, *Salmonella* species, *Escherichia coli* O157:H7, *Toxoplasma gondii*, and *Yersinia enterocolitica* are mostly related to food handlers' practices (Gould *et al.*, 2013; Medeiros *et al.*, 2001; Whited *et al.*, 2019). The inappropriate food handling practices and the resultant food contamination and foodborne diseases threaten the health of the consumer (Greig, Todd, Bartleson, & Michaels, 2007; Howes, McEwan, Griffiths, & Harris, 1996). It is therefore imperative that food handlers adhere to formal food safety protocols and that they are aware of the consequences of breaching it, whether intentionally or unintentionally (Chen *et al.*, 2018; Greig *et al.*, 2007; Howes *et al.*, 1996). The types of violations that lead to outbreaks include food being handled by persons carrying a food-borne pathogen, bare-hand contact with food, improper hand-washing practices and insufficient cleaning of processing or preparation equipment (Greig *et al.*, 2007; Nørrung & Buncic, 2008; Smigic *et al.*, 2016).

It can therefore not be overstated how important understanding and applying personal hygiene and food handling protocols are in preventing pathogen transmission and in reducing foodborne diseases (Pragle, Harding & Mack, 2007). Implementing these processes, however, is not only important where food is being served at schools. It has to start with the supplier of foodstuffs and requires hygienic production, handling, preparation, transportation and storage at every stage. Shortcomings anywhere along the route, whether intentional or unintentional, may result in food contamination or even lead to foodborne outbreaks (Chen *et al.*, 2018). Thorough knowledge of the food chain and operation by all role players can assist in preventing possible food poisoning. Applying this principle to programmes like NSNP, it means food-safety protocols have to be adhered to from when it is delivered at the school to when it is stored and prepared on site (Graham *et al.*, 2015). This process presents several opportunities for contamination with pathogens. Garayoa *et al.* (2017) suggest that in order to ensure food safety, managers must diligently observe and supervise activities, continuously train workers and diligently monitor hygiene protocols of high-risk cross contamination surfaces.

2.8 THE IMPLEMENTATION OF A PRPs AND HACCP AS CONTROL MEASURE OF FOOD BORNE DISEASES

The success of the application of food safety measures requires the full commitment and involvement of the food handlers and management of the food establishment. It also requires a team approach and, in some instances, the appropriate expertise depending on the level of control. Some of the control measures that have received attention is the HACCP system and PRPs as its building blocks (Bou-Mitri *et al.*, 2018).

2.8.1 Hazard Analysis Critical Control Point (HACCP) as control measure

Establishing an HACCP system is one of the tools that has been proposed to ensure the quality and safety of food from the input of materials; through the production processes to packing and transporting the final products (Réglier-Poupet, Parain, Beauvais, Descamps, Gillet, Le Peron, Berche, Ferroni, 2005). The Codex Alimentarius as a collection of internationally adopted food standards commission, defines the HACCP system as an instrument to identify, evaluate and control hazards which are significant for food safety (WHO, 1997). It requires establishing critical control points (CCPs) across processes, facilities and job descriptions (Hung, Liu, Peng, Hsu *et al.*, 2015). However, although it is based on the concept of effective hygiene protocols within a food company, the HACCP system does not replace traditional hygiene measures (Untermann, 2014). It is not a stand-alone approach but forms part of the overall quality management system, and its successful implementation is determined by established PRPs (Figure. 2.4) (Fuller, 2007; Sun & Ockerman, 2005). Such PRPs form the building blocks of the HACCP and should be fully implemented before the HACCP system can be said to be in place (Agüeria, Terni, Baldovino *et al.*, 2018). It has to be noted however, that implementing an HACCP system is not mandatory in South Africa (Sibanyoni & Tabit, 2019).

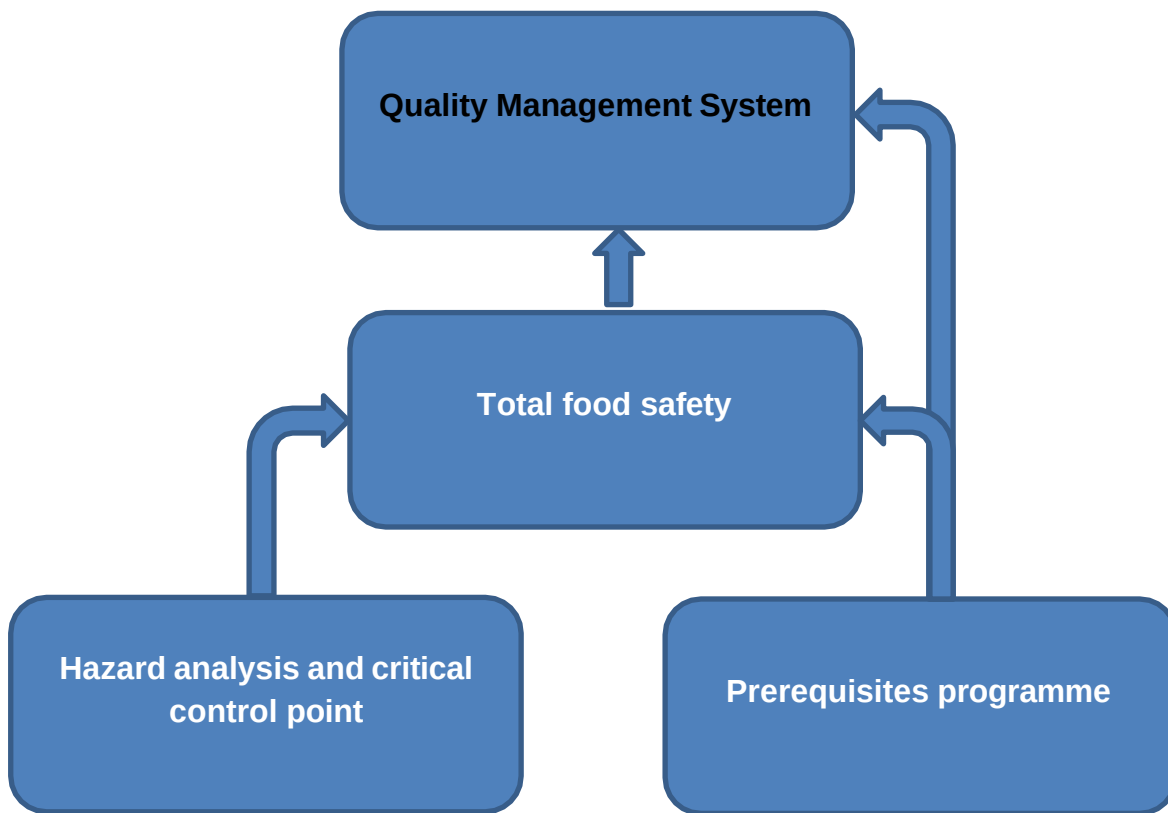


Figure 2.5: Food safety within a quality management programme

2.8.2 Prerequisite programmes as control measure

Considering the fact that prepared foods must be safe, of good quality, wholesome and served at convenient times (Bou-Mitri *et al.*, 2018), some of these basic resources are critical in maintaining safer food. The majority of laws and standards state that prerequisite programmes must be implemented within food establishments to ensure the safe handling of food. PRPs are regarded as good hygiene practices that are the basic conditions and activities necessary to maintain a hygienic environment. As the building blocks of an HACCP system, PRPs depend on effective management of the food-preparation or serving establishment (Figure 2.5). The food service provider is obligated to comply with, and monitor compliance with the regulations by implementing such PRPs (Fuller, 2007). This also applies to school feeding programmes (Jomaa *et al.*, 2011; Sibanyoni *et al.*, 2017; WHO/FAO, 2010). Furthermore, South African Regulation 638, which governs the general hygiene requirements for food premises and the transport of

food, emphasises the responsibilities of the person in charge such as ensuring that measures are taken to implement food safety measures.

Food safety assurance in food service establishments depends heavily on the availability of adequate infrastructure, appropriate management support and commitment, as well as knowledgeable and skilled food handlers (Rendall-Mkosi *et al.*, 2013). Langsford (2012) points out that even though providing and improving infrastructure is important, it is equally important to invest in the food handlers through training. Whilst the contamination of food can occur at any stage of the food chain, a high rate of foodborne diseases originates where food is inappropriately prepared or mismanaged by food handlers (WHO, 2008).

Inadequate food safety knowledge and skills relating to temperature control, personal hygiene and the prevention of cross-contamination result in unsafe food handling practices and cross-contamination in food service establishments (Afolaranmi, Hassan, Bello, & Misari, 2015; Jianu & Chis, 2012; Martins, Hogg, & Otero, 2012; McGill, Fulgoni, & Devareddy, 2015; Rahman, Arif, Bakar, & Tambi, 2012; Sibanyoni *et al.*, 2017; Sibanyoni & Tabit, 2019). Nkhebenyane (2018) raised concern about food handlers who are not specifically trained regarding food hygiene and HACCP, yet are engaged in the receipt, distribution and serving of ready-made foods. Training food handlers on the principles and benefits of PRPs and its role in an HACCP is an important strategy to improve food safety and reduce the impact of foodborne diseases (Mwamakamba, Mensah, Fontannaz-Aujoulat, Hlabana *et al.*, 2012).

The introduction of NSNP has played a major role in poverty alleviation in South Africa (Manyatsa, 2007). However, there are a number of challenges including management of the programme, limited resources, and foodborne-related cases. The NSNP-served meals have great potential for use as nutritional vehicle to malnourished children.

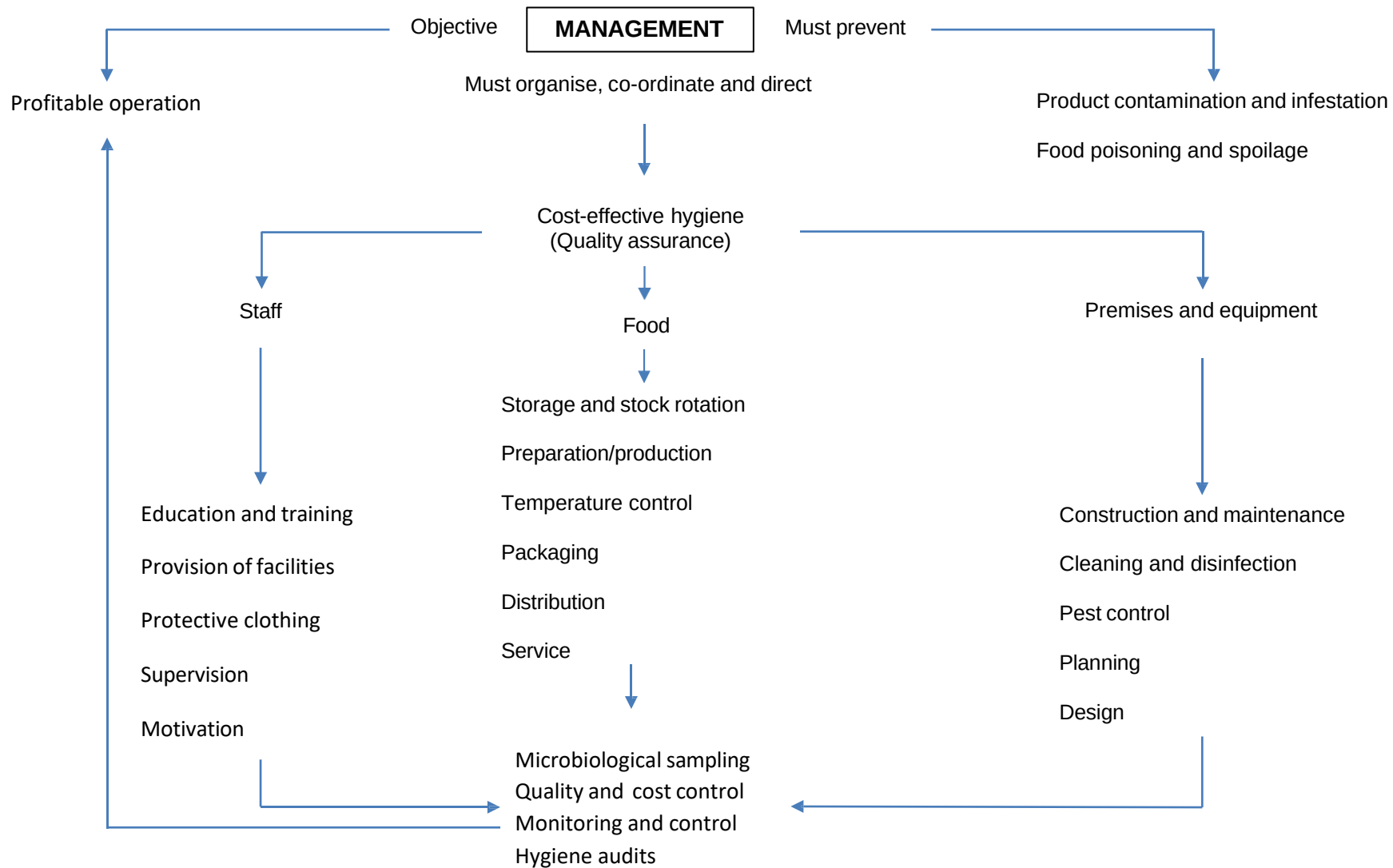


Figure 2.6: Management responsibilities in assuring food safety (Cronje, 1996)

However, like all foods served to a large number of people, it has potential physical, chemical, and biological hazards that must be controlled through food safety systems. The potential of contamination that might lead to food poisoning appeal for strict food safety control measures to be put in place. The establishment of the PRPs within food establishment has been regarded as the first step in avoiding foodborne related cases and implementation of FSMS such as HACCP.

2.9 CONCLUSION

This chapter has highlighted the overview of the school feeding programme with a focus on the NSNP. The literature review focused on the impact of poverty and malnutrition among children; school feeding programmes as a method to alleviate poverty among school-attending children with attention of NSNP; the challenges faced by the programme that are affecting food safety; and some of the possible solutions to be implemented. Some intervention strategies towards improved food handling practices within school feeding programmes. In the next chapter, the knowledge, attitudes and practices of VFH within NSNP in Central South African schools are investigated. Other factors GHP and hygiene related practices are playing a major role. From this chapter, it is clear that there is a need for implementation of food safety management system that will assure the safety of food provided to learners within NSNP.

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CHAPTER 3

KNOWLEDGE, ATTITUDES AND SELF-REPORTED FOOD HANDLING PRACTICES AMONG STAFF OF A SCHOOL FEEDING SCHEME IN MANGAUNG

For submission partially or in full to:
Journal of Environmental Health: ISSN: 220892

3.1 ABSTRACT

Several research studies have linked the origins of foodborne illnesses with the actions and attitudes of volunteer food handlers. To counteract this, great emphasis has been placed on the need for training and many workshops have been designed and presented. However, these initiatives have not had much success primarily, it seems, because the lived experience of volunteer food handlers have been ignored. This includes aspects such as their prior knowledge of and views on food safety as well as their personal and cultural food-preparation styles and practices. The aim of this study was to evaluate the knowledge, attitudes, and self-reported behaviour of NSNP volunteer food handlers in the Mangaung Metropole in the Free State Province of South Africa. During face-to-face interviews with 265 volunteer food handlers a questionnaire-based survey was conducted to assess five key factors in food-safety based on the WHO guidelines, such as keeping clean, separating raw and cooked food, cooking food thoroughly, keeping food at a safe temperature and using safe water and raw materials. The study indicated that, even though NSNP volunteer food handlers have adequate knowledge regarding general cleanliness, only 57% demonstrated food-safety specific knowledge such as the possibility of items like unclean cutting boards contributing to contamination. The general attitude towards the five food-safety factors was positive with a mean score of 82.3%. However, this was inconsistent with self-reported behaviour indicating inattention to some of the critical requirements and procedures for preparing food safely. These results highlighted the need for more and better training and the importance of instilling a willingness among volunteer food handlers to be trained. This study created the foundation for designing a training tool for NSNP volunteer food handlers incorporating English and Southern Sotho.

3.2 INTRODUCTION

Despite various studies on food safety and more stringent control measures implemented within the food industry, cases of foodborne illnesses continue and the impact on economic and public health worldwide remains severe (Gandhi & Chikindas, 2007; Havelaar, Brul, Jong, Jonge *et al.*, 2010; Sudershan, Rao, Rao, Rao, *et al.*, 2008). The WHO has estimated that foodborne and waterborne diarrhoeal diseases combined leads to approximately 2.2 million deaths annually. Of these, 1.9 million are children (Food and Agricultural Organisation (FAO), 2012). In addition, WHO estimated 600 million people (almost 1 in 10 people in the world) fall ill after eating contaminated food and 420 000 die every year (WHO, 2022). This raises concern for vulnerable groups such as infants, young children, the elderly and those with compromised immune systems. It has led to demands for better hygiene and quality-control practices to counteract food mishandling and contamination along the food chain from production to consumption (Ababio & Lovatt, 2015; Lagerkvist, Amuakwa-Mensah & Tei Mensah, 2018; Lagerkvist, Hess, Lagerkvist, Hess, Okello, Hansson & Karanja, 2013; Omari, Frempong & Arthur, 2018). Food contamination and foodborne disease are in most cases the consequence of non-adherence to GHPs including personal hygiene (Sibanyoni *et al.*, 2017). Other factors that may cause foodborne diseases are food procured from unreliable sources, inadequate and insufficient cooking methods, contaminated equipment and a lack of temperature control (Egan, Raats, Grubb, Eves *et al.*, 2007; Greig, Todd, Bartleson, Michaels *et al.*, 2007; Howes, McEwan, Griffiths & Harris, 1996; Rosset, Cornu, Noel, Morelli, & Poumeyrol, 2004; Smigic, Djekic, Liz Martins, Rocha *et al.*, 2016; Zanin *et al.*, 2017). Stringent food handling practices protect consumers from foodborne diseases (Whited, Feng & Bruhn, 2019).

The same food-safety management failings have also been reported in the NSNP programmes leading to an increase in the possibility of food poisoning (Manyatsa, 2007). Literature has shown that food contact surfaces in food preparation facilities of NSNP schools is prone to microbial cross-contamination due to ineffective cleaning and disinfecting (Cunningham, Rajagopal, Lauer & Allwood, 2011; Djekic, Smigic, Kalogianni, & Rocha, 2014; Nhlapo, Lues, & Groenewald, 2015; Sibanyoni & Tabit, 2019). The role

of volunteer food handlers to ensure food safety and preventing food contamination throughout the chain of production, processing, storage and preparation, is therefore key (Bou-Mitri *et al.*, 2018; Campos, Cardonha, Pinheiro, Ferreira, Azevedo and Stamford, 2009; Lee, Hishamuddin, Thong, & Chai, 2017; Zain & Naing, 2002). Despite recognising their contribution, studies have indicated that in many food service establishments, the volunteer food handlers often lack basic food safety knowledge specifically related to temperature control, personal hygiene and the prevention of cross- contamination (Afolaranmi, Hassan, Bello, & Misari, 2015; Jianu & Chis, 2012; Martins, Hogg, & Otero, 2012; Sibanyoni, *et al.*, 2017). However, as important as training is, knowledge is not always transferred into practice (Bai, Wang, Yang & Gong, 2019; Park, Kwak & Chang, 2010). The theory-practice gap can be bridged by integrating safe and proper food preparation knowledge and skills to foster a deep understanding and positive attitude that prevent food contamination and foodborne outbreaks (Angelillo, Viggiani, Rizzo & Bianco 2000; Bou-Mitri *et al.*, 2018; Sharif & Al-Malki, 2010). Assessing the success of the planning and outcomes of training has to take into account knowledge, skills and attitudes (Zanin *et al.*, 2017). This aligns with the objective of this study - namely to evaluate the knowledge, attitudes and self-reported behaviour of volunteer food handlers within a school feeding scheme in the Mangaung Metropole in the Free State province of South Africa.

3.3 METHODS

The choice of methodology was guided by the aim of the study, namely, to explore, by way of face-to-face but structured interviews, the level of knowledge, understanding and application of food safety as well as the lived experience of volunteer food handlers at NSNP schools. As a cross-sectional quantitative study is observational and descriptive in nature, it was deemed appropriate for this study which required recording information collected at a particular time across a pre-defined subset of the population. The sample included volunteer food handlers at schools involved in feeding schemes in the Mangaung Metropole in the Free State Province of South Africa (Figure 3.1). It included a total of 265 people of which 98 were in supervisory positions (31% of the staff) and the balance working as general volunteer food handlers. These participants served food at 98 different (45% participants) schools in the quintiles 1, 2 and 3 range or lower income schools.

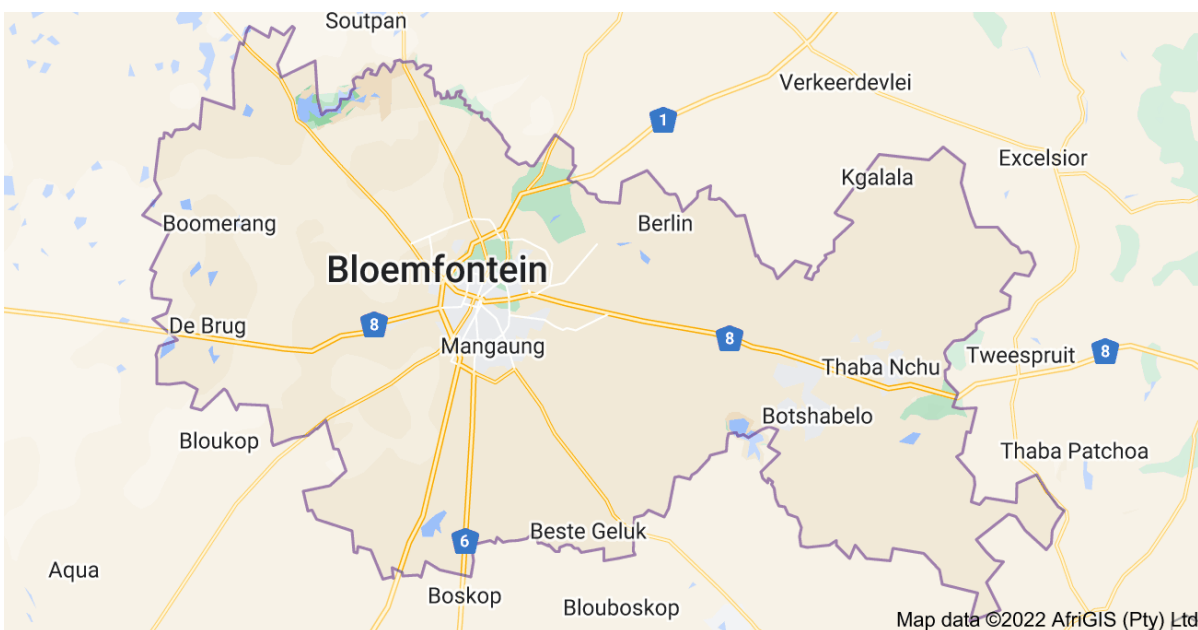


Figure 3.1: A map showing Mangaung Metropole within the Free State Province in South Africa. Source: <https://municipalities.co.za/map/8/mangaung-metropolitan-municipality>

3.3.1 Questionnaires

The questionnaires on staff PRP were based on the South African National Standards 10049 and Regulation 638 which are regulations governing general hygiene requirements for food premises, the transport of food and related matters. In addition, the KAP questionnaire was modified based on the WHO's *Five Keys to Safer Food Manual* (Appendix 3.1) (WHO, 2018). The questionnaires were developed using English but were administered in the home language of the respondents such as Southern Sotho and others on request and reported in English. The items were divided into three sections covering: 1) training; 2) protective clothing; and 3) personal hygiene and effects. The KAP-section of the questionnaire was divided into four sections: 1) demographic characteristics (Bas *et al.*, 2006); 2) theoretical knowledge; 3) attitudes and 4) self-reported behaviour (appendices 3.2, 3.3, 3.4 and 3.5).

3.3.2 Pilot study

The questionnaire and the interview procedures were piloted at 5 randomly selected schools to confirm question clarity, identify response options and estimate the likely interview duration. Considering suggestions and difficulties, grammatical modifications were made, and some terms were changed to improve clarity. Questions relating to practices that do not relate to the activities within the food preparation area were also excluded. The revised version was used for the data collection. The schools selected for the pilot were not included in the actual study.

3.3.3 Data collection

The study was considered by the Department of Basic Education (Motheo District) and the approval was given for the study to take place. The sample inclusion criteria were defined as all persons involved in food handling, food procurement and supervision roles for the school's NSFSSs. The researcher was accompanied by the DBE representative and the approval was given by the principal of the participating school. The face-to-face interview was carried out using the pre-prepared structured questionnaires consisting of a set of pre-defined questions. To ensure data reliability, each participant was asked the same questions in the same order (Cheung, 2014). In addition, the respondents were asked using their home language and questions were read aloud to the respondents during the interview and they were given adequate time to answer each question. The collection of data was carried out between February and December 2017.

3.3.4 Data analysis

The data obtained were recorded and analysed using Microsoft 365 Excel. The response frequency and percentages in each category were calculated and tabulated. The t-test and correlation (confidence interval 95%) were used to compare selected variables such as educational level and employment status with selected questions about knowledge, attitudes and practices. A one-point score was attributed to the correct answer for every question, and a null score was attributed to an incorrect answer. In all analyses, differences were considered statistically significant at $p \leq 0.05$.

3.4 RESULTS AND DISCUSSION

Keeping in mind that the literature indicates that human actions and non-adherence to GHPs are the leading cause of food contamination during food preparation in foodservice establishments (Egan *et al.*, 2007; Greig *et al.*, 2007; Howes *et al.*, 1996; Sibanyoni *et al.*, 2017; Smigic *et al.*, 2016), this study focused on the knowledge skills and attitudes of NSFS volunteer food handlers. The results of exploring the implementation of PRPs and minimum requirements as prescribed in Regulation 638 respectively, and related to training; protective clothing and personal hygiene and effects are reported in Table 3.1 and Figure 3.1. On the whole, according to the respondents feedback, food safety practices are supported by training, availability of protective clothing, an emphasis on hygiene, and proper management of personal effects.

The vast majority of volunteer food handlers at participating schools (86%), had received training; however, only 43% had been trained at the beginning of their employment. This is in contravention of generally accepted food safety standards, including Regulation 638 which states that all volunteer food handlers are obliged to be trained on food safety practices prior to starting employment. Furthermore, only 14% had been assessed after completing training and had records to confirm that they had undergone training. Only 7% indicated that they have been periodically evaluated by a supervisor or a representative of DBE monitoring the NSNP. This might be explained by the high rate of supervisors themselves showing a lack of food safety knowledge (29%).

Despite schools being obligated to supply protective clothing to volunteer food handlers (DoH, 2018) only 79% of the schools had made provision for their employees. Of these schools only 21% had made available more than one set personal protective clothing for each volunteer food handler (Figure 3.2). Moreover, only 36% of the protective clothing that had been supplied, complied with guidelines for use in a kitchen. An example is the lack of enclosed and non-absorbent footgear. The importance of wearing suitable and clean protective clothing to ensure food safety cannot be overstated (Wambui, Karuri, Lamuka & Matofari, 2017). Yet, in 64% of the participating schools, there was no clear policy on provision, storage or monitoring of protective clothing (Table 3.1). Before anyone

is allowed to handle food in a public space such as a school, the Department of Health's guidelines for the management and health surveillance of volunteer food handlers require that a *health interview* be carried out (DoH, 2000). During the face-to-face encounter, the interviewer should visually assess the appearance and cleanliness of the prospective volunteer food handler,

Table 3.1: The prerequisite programme requirements for staff engaged in the handling of the food product within the school participating within the NSNP ($n = 98$ schools)

Training	Frequency (%)
Formal food safety training for volunteer food handlers	86
Appropriate training at the beginning of employment	43
Test at the end of the training	14
Periodic assessments of training programmes	7
Records of training being carried out	14
Managers' knowledge of food hygiene principles and practices	29
Protective clothing	
Personal protective clothing provided	79
Appropriate protective clothing	36
Employees' protective clothing restricted to food handling facility	14
Enough protective clothing provided for changing	21
Clean protective clothing appropriately stored	14
Footgear fully enclosed and of non-absorbent material	36
Personal hygiene and personal effects	
Appropriate health interviews before employment	7
Employees' hands free from cut, an injury, an infected wound or skin irritation	64
Warm water and an acceptable liquid soap or hand-cleaning detergent	36
Hygiene facilities are suitably maintained in a functional state	29
Containers used in food preparation are not used for any other purpose	57
Staff's personal effects stored away from food handling facility	0
Pets not permitted on the premises of a food handling organisation	79

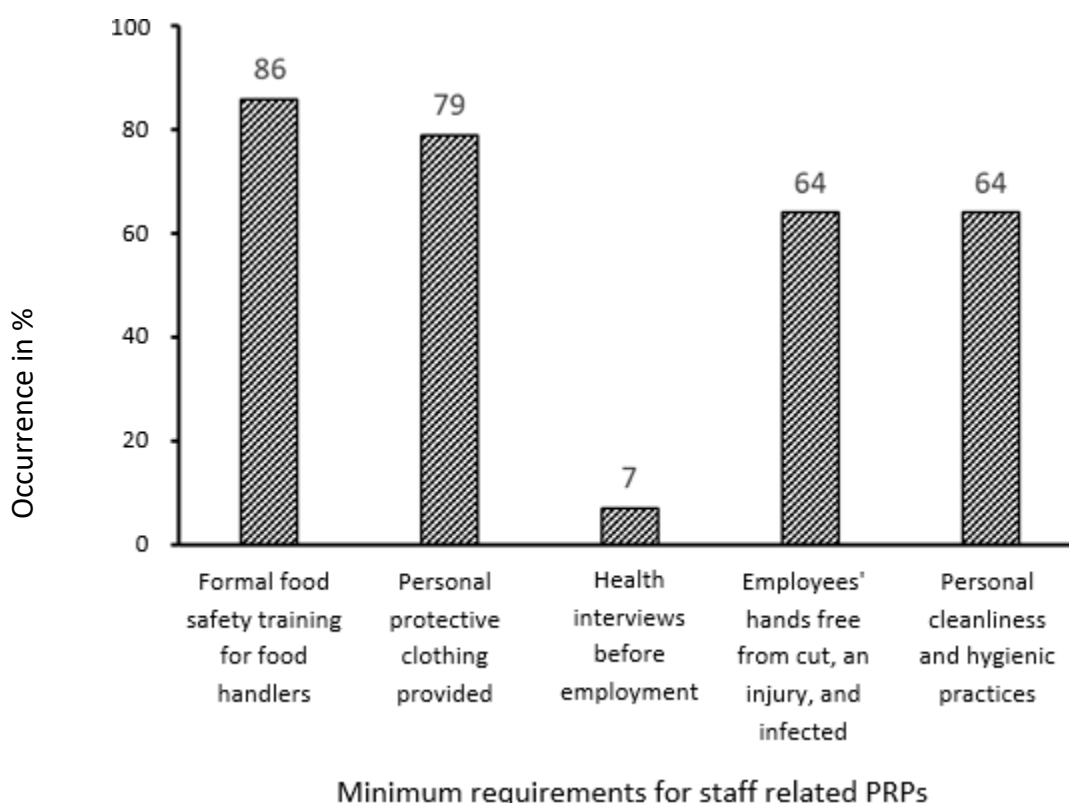


Figure 3.2: Highlights of how the minimum staff requirements for food establishment in accordance with regulations governing general hygiene requirements for food premises, the transport of food and related matters are met (n = 98 schools).

In addition, the interviewer should elicit information that illustrates the person's knowledge on organisms affecting food safety. This study reflected that most schools (93%) had not met their duty of conducting a health survey when appointing volunteer food handlers. This can be linked to only 64% of participants reporting compliance to cleanliness and hygienic practices such as not working with cuts, injuries or infected wounds on their hands. Neglecting to instill these food safety principles from the onset can contribute to contamination and food poisoning cases, as most of the foodborne pathogens can survive on hands with or without cuts and bruises (Pérez-Rodríguez, Garcia-Gimeno & Zurera-Cosano, 2013). Supplying sanitation products and facilities for volunteer food handlers have also been disregarded by the majority of schools. Only 36% of the participants were supplied with warm water and soap, while 29% had access to well-maintained and hygienic bathroom facilities, including toilets.

Standard requirements such as storing water in containers for cooking and washing up, poses potential risk, especially in cases where the containers are used for storing other liquids also, a practice that was reported in more than 40% of the schools. A further possible source of contamination is pets such as dogs and cats having access to the cooking facilities in 21% of the schools. This is in contravention of Regulation 368 stating that no pets are allowed within a food preparation area, unless it is a guiding dog, as it might directly or indirectly pose a risk of contamination of food.

3.4.1 Demographic profile of respondents

The Department of Basic Education (2008) defines a volunteer food handler as either a parent or a community member who volunteers to offer services in the preparation, cooking and serving of meals to learners, in return for a monthly stipend. A total of 265 people comprising 181 volunteer food handlers and 84 co-ordinators (supervisors) from 98 NSNP schools participated in this study (Table 3.2). Results showed that of the respondents, 230 (87%) were females with 185 (70%) between the ages of 20 and 40. These results were higher than national demographic figures (51.3% females and 43.8% between the ages 18 and 44). The study by Devereux *et al.* (2018) has also indicated similar results from their study. Contextually speaking, this is not unusual as it is common practice for females to be responsible for food preparation (Green *et al.*, 2005). Green *et al.* (2005) further highlight that older volunteer food handlers are likely to be more experienced when it comes to food safety, and their knowledge leads to safer food preparation. While studies have indicated that food hygiene perception scores tended to be higher in women than men (Çakiroglu and Uçar, 2008), it could not be verified due to the small number of male participants in this study. The study also investigated the employment status of volunteer food handlers. Five provinces (Eastern Cape, KwaZulu-Natal, Limpopo, Mpumalanga and Western Cape) have increased the monthly stipend for volunteer food handlers in 2009. This has raised the national average from R420 in 2008/09 to R522 during the reporting period, and R640.00 for Free State volunteer food handlers (South Africa DBE, 2021).

**Table 3.2: Demographic profile of the volunteer food handlers
(coordinators and ordinary workers) within the NSNP**

		Number (n=265)	Frequency (%)
Gender	Male	35	13
	Female	230	87
Age	18 – 20 years	0	0
	20 – 30 years	60	23
	30 – 40 years	125	47
	40 <	80	30
Race	Black	260	98
	Coloured	5	2
	White	0	
Home language	Southern Sotho	195	74
	Xhosa	45	17
	Afrikaans	5	2
	Tswana	20	7
English proficiency	Poor	25	9
	Fair	110	42
	Good	130	49
Employment status	Permanent	90	34
	Volunteer	175	66
Salary	Less than R500.00	2	1
	R500.00 - R1 000.00	91	34
	More than R1 000.00	172	65
Education	Below Grade 3	3	2
	Grade 4 – 7	19	7
	Grade 8 – 10	62	23
	Grade 11 – 12	88	33
	Certificate or Tertiary Education	93	35

Currently, the stipend for VFH is R1 640 nationally. The permanently employed group among the participants make up 34% with some of them having other functions such as landscape or cleaning or teaching (supervisors). A third of the respondents indicated that they earn less than R1 000.00 (35%). Despite the guidelines in some schools, the honoraria is determined by either the school principal or the governing body. Among the ones earning more than R1 000, the majority are permanent employees such as supervisors, administrators and teachers. These people hold dual positions supervising the volunteer food handlers and procuring food, as well as teaching. Having dual responsibilities leads to divided attention. According to Alrawahi, Sellgren, Altouby and Alwahaibi *et al.* (2020) employment status and salary acts as an incentive and if mismanaged may lead to an indifference regarding critical food safety principles.

The home language of the majority of the volunteer food handlers interviewed, was Southern Sotho (74%), while 49% of them proved proficient in English. This is based on the geographical structure of the Free State, as the majority of the people in the province speak South Sotho. However, this cannot undermine the fact that most of the volunteer food handlers are speaking other language such as Xhosa and Setswana. Only 35% of the respondents have attained a post-matric qualification, certificate or a tertiary education qualification. A third (33%) have a grade 11 qualification. These findings affect the design of the proposed food safety training material as it suggests that training material can be written in English and presented in both Southern Sotho and English.

However, the proposed training must accommodate VFH with poor educational background (9%) by using less or no unfamiliar scientific terms (Bou-Mitri *et al.*, 2018). Training duration also needs to be fit-for-practice, as most VFH are either on a one-year or a two-year contract. In short, the demographic data indicate that effective and appropriate training has to be multi-lingual; designed to accommodate limited levels of education; and take the form of a short course.

3.4.2 Food safety knowledge of the respondents

To get a baseline of volunteer food handlers' existing food-safety knowledge and skills they were probed using questions based on the WHO's *Five keys to safer food*-model (Tables 3.3 and Figure 3.3) (WHO, 2018). The knowledge on the importance of cleanliness, separating raw and cooked foodstuffs, the dangers of undercooked food, storing food at safe temperatures, and using safe water and raw and material were tested. Every single participant (100%) showed evidence of knowing the importance of washing their hands before handling food as well as rinsing fruit and vegetables prior to preparation and consuming it. By contrast, not everyone (6%) was aware that wiping cloths can spread microorganisms. Also, only 57% were cognisant of the dangers that utensils and cutting boards hold for cross contamination. These findings align with Sibanyoni and Tabit's (2019) recommendations that volunteer food handlers be specifically trained in how to use cleaning materials and how to develop cleaning protocols.

The majority of respondents (91%) were aware that raw food should be stored separately from cooked food to avoid cross contamination. Regarding appropriate temperature settings, most respondents answered correctly that cooked food should be kept very hot before serving (80%) and refrigerating food only slows bacterial growth (64%). This is reassuring as controlling the quality of raw material and ingredients is regarded as a critical key to keeping food safe. Not adhering to the temperature control guidelines threatens consumer safety (Domenech, Escriche, & Martorell, 2008; Lee & Greig, 2010; Liz Martins & Rocha, 2014). Less than half (40%) of the respondents thought that cooked meat could be left at room temperature overnight to cool before refrigerating. However, about 23% of the participants incorrectly answered or was not aware that cooked food needs to be thoroughly re-heated or that it was important to cook meat thoroughly (38%). These findings suggest that training should pay particular attention to the impact of temperature control, including the correct ways of thawing raw and pre-cooked food; following guidelines for cooking and storing food. Of the participants, 27% indicated that safe water as well as most fresh and processed food products can be identified by the way it looks. This, according to the WHO (2018) is an important first step in avoiding food

poisoning. Regulation 638 identifies safe food and safe water as purchased from an approved source. Potable water according to the South African National Standard 241 is water that is safe to drink or to use for food preparation. According to Garayoa *et al.* (2017) volunteer food handlers need close supervision of their activities and behaviours in order to reduce the risk.

Table 3.3: Correct responses to knowledge on 5 keys to safer food in the NSNP

No.	Questions (<i>answers</i>)	Correct responses (valid <i>N</i> %)			
		Question types	Overall (<i>n</i> = 265)	%	Average %
1.	Keep clean				
1.1	It is important to wash hands before handling food. (<i>True</i>)	True/False	265	100	
1.2	Wiping cloths can spread microorganisms. (<i>True</i>)	True/False	249	94	97
2.	Separate raw and cooked				
2.1	The same cutting board can be used for raw and cooked foods provided it looks clean. (<i>False</i>)	True/False	151	57	
2.2	Raw food needs to be stored separately from cooked food. (<i>True</i>)	True/False	240	91	74
3.	Cook thoroughly				
3.2	Cooked foods do not need to be thoroughly reheated. (<i>False</i>)	True/False	60	23	
3.3	Proper cooking includes meat cooked to 40 °C. (<i>False</i>)	True/False	100	38	30.5
4.	Keep food at safe temperatures				
4.1	Cooked meat can be left at room temperature overnight to cool before refrigerating. (<i>False</i>)	True/False	158	60	

4.2	Cooked food should be kept very hot before serving. (<i>True</i>)	True/False	211	80	
4.3	Refrigerating food only slows bacterial growth. (<i>True</i>)	True/False	169	64	68
5.	Use safe water and raw materials				
5.1	Safe water can be identified by the way it looks. (<i>False</i>)	True/False	72	27	
5.2	Wash fruit and vegetables. (<i>True</i>)	True/False	265	100	63.5

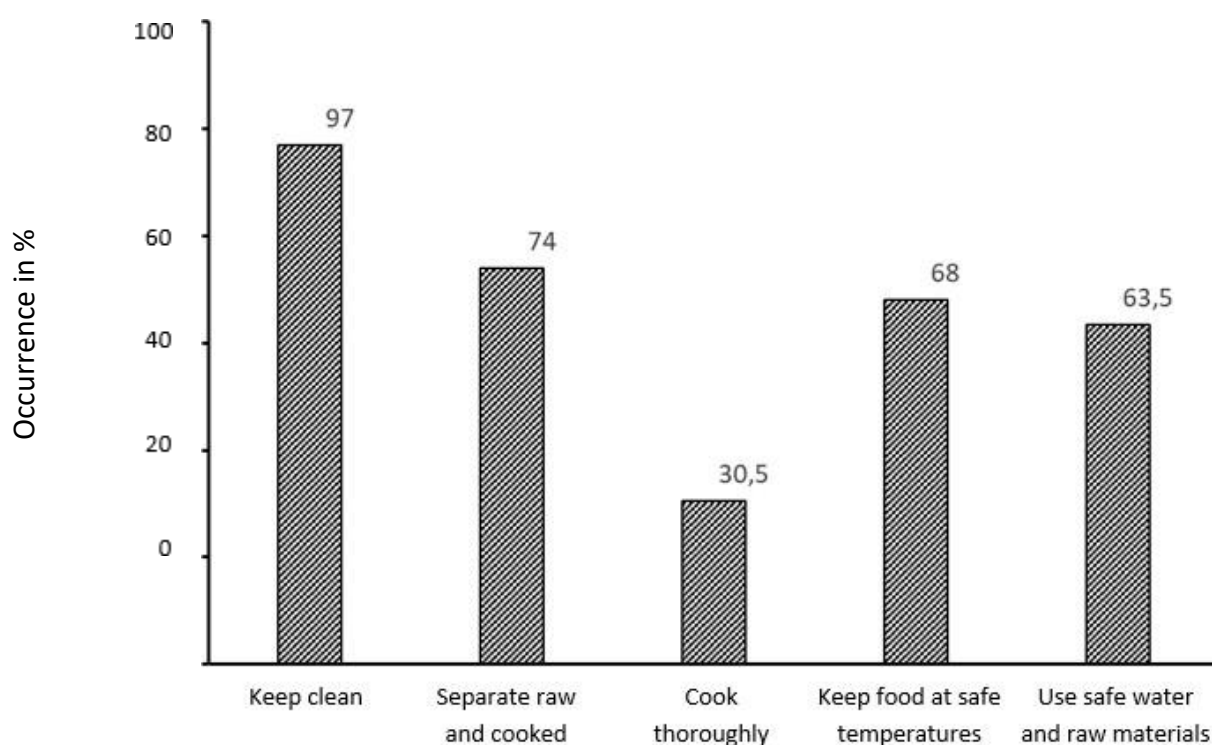


Figure 3.3: Average knowledge of the volunteer food handlers (n = 265)

3.4.3 Food safety attitude of the respondents

Attitude is a measure of the degree to which a person has favourable or unfavourable evaluation towards behaviour (Angelillo *et al.*, 2000; Bou-Mitri *et al.*, 2018). It is also a crucial factor influencing food safety practice, and as such it directly or indirectly increases or decreases the risk of foodborne diseases (Sani & Siow, 2014). In this study (Table 3.4

and Figure 3.4) participants demonstrated positive attitudes to all five keys to safer food with a mean score of 82.3%. Respondents concurred that it is worth the time spent on frequent hand-washing during food preparation (98%) and that keeping kitchen surfaces clean reduces the risk of illness (94%). Such attitudes establish a solid foundation for consistent and continuous cleanliness in the NSNP facilities at schools. Participants' answers in this section of the questionnaire reiterated findings in similar knowledge-testing questions, for example that it is important to keep raw and cooked food separate (91%), and that using different knives and cutting boards for raw and cooked foods is worth the extra effort (89%). As pointed out earlier, this is reassuring since food contact surfaces in school feeding programme preparation facilities hold a threat of microbial cross-contamination if food contact surfaces are not effectively cleaned and disinfected (Cunningham *et al.*, 2011; Djekic, Smigic, Kalogianni, & Rocha, 2014; Nhlapo, Lues & Groenewald, 2015; Sibanyoni & Tabit, 2019). The risk is aggravated by inadequate facilities at the majority of schools (Manyatsa, 2007). The problem of cross contamination must be addressed in training and volunteer food handlers' sustained awareness thereof must be fostered.

Questions related to food preparation elicited vital information. Only 41% of the respondents appreciated the importance of using a meat thermometer to ensure that it is cooked properly, while 22% were not sure and 37% disagreed. These numbers may be explained by the fact that volunteer food handlers in this community do not own or is unfamiliar with equipment such as food thermometers. The majority, (90%), were confident in their understanding that soups and stews should always be brought to the boil to ensure safety. Considering that temperature treatment is frequently cited as a critical control point of the cooking process (Gomes-Neves *et al.*, 2007), participants' positive attitudes towards it can be considered encouraging. So is their grasp of safe food temperatures, with 80% of the participants agreeing that it is safer to thaw food in a cool place. However, only 67% agreed that it was unsafe to leave cooked food out of the refrigerator for more than two hours, while 27% was unsure and 6% disagreed. Again the answers to this particular question may be related to the fact that most of the schools do not have refrigerators. However, other studies have also reported a general lack of

knowledge on correct refrigeration temperatures (Angellilo, Viggiani, Greco, Rito & the Collaborative group, 2001). Parry-Hanson and Kunadu *et al.* (2016) suggest that volunteer food handlers may not feel the need to carry out this practice as they are unable to recognise what constitutes an unsafe temperature.

Table 3.4: Frequencies of responses to attitude questions asked on 5 keys to safer food to volunteer food handlers within NSNP

Question No.	variable	Respondents <i>n</i> (%)		
		Agree	Not sure	Disagree
Keep clean				
1.1	Frequent hand-washing during food preparation is worth the extra time	261 (98)	-	4 (2)
1.2	Keeping kitchen surfaces clean reduces the risk of illness	249 (94)	6 (2)	10 (4)
Separate raw and cooked				
2.1	Keeping raw and cooked food separate helps to prevent illness	242 (91)	23 (9)	-
2.2	Using different knives and cutting boards for raw and cooked foods is worth the extra effort	236 (89)	21 (8)	8 (3)
Cook thoroughly				
3.1	Meat thermometers are useful for ensuring food is cooked thoroughly	108 (41)	58 (22)	99 (37)
3.2	Soups and stews should always be boiled to ensure safety	238 (90)	8 (3)	19 (7)
Keep food at safe temperatures				
4.1	Thawing food in a cool place is safer	211 (80)	41 (15)	13 (5)
4.2	I think it is unsafe to leave cooked food out of the refrigerator for more than two hours	177 (67)	72 (27)	16 (6)

Use safe water and raw materials

5.1	Inspecting food for freshness and wholesomeness is valuable	239 (90)	27 (10)	-
5.2	I think it is important to throw away foods that have reached their expiry date	221 (83)	44 (17)	-

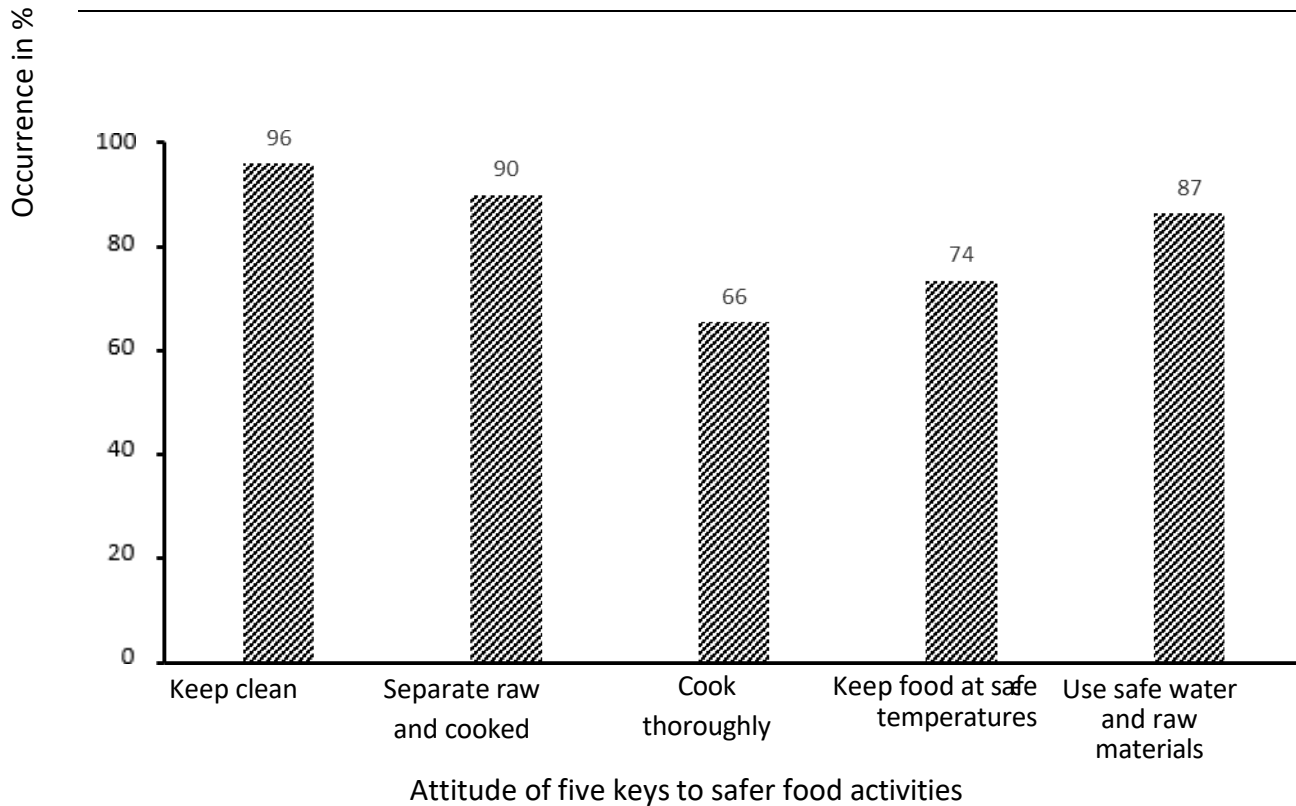


Figure 3.4: Average attitude of the volunteer food handlers with schools participating in NSNP (n = 265)

A high average percentage of respondents (86.5%) demonstrated a positive attitude towards using safe water and raw food with 90% recognising the importance of inspecting food for freshness and wholesomeness prior to cooking and serving. Also, 83% thought it was important to get rid of food that had reached its expiry date. Considering that there are several stakeholders involved in the food production and supply chain from farmland to plate, any problem at any stage of production may lead to sub-standard food (Liu, 2018). The right attitude of volunteer food handlers can prevent such foodstuffs from reaching the plates of school children.

3.4.4 Association between selected demographics, knowledge and attitudes of the volunteer food handlers

It is not useful viewing the results in isolation. Table 3.5 and Table 3.6 reflect the correlations among selected demographics and the levels of knowledge and attitudes. This is aligned with other such studies (Bou-Mitri *et al.*, 2018; Egan *et al.*, 2007; Garayoa *et al.*, 2017; Green *et al.*, 2005; Greig *et al.*, 2007; Sibanyoni & Tabit, 2019) that employ the KAP approach. However, unlike in some of these studies, this exploration indicates a weak linear relationship (≤ 0.5) between English proficiency, education and the knowledge of the five keys to safer food. Sani and Siow (2014) agree that volunteer food handlers' know-how cannot be associated with a specific demographic background. What has become clear is that there is a strong relationship between the earning capacity of a volunteer food handler and their attitude. In a study by Megeirhia, Ribeiro and Woosnam (2020) a high level of cynicism and negative attitude were associated with lower income of the workers. A similar situation might also be depicted from the study in question.

Table 3.5: Association between selected demographic and knowledge of the volunteer food handlers

			Keep clean	Separate raw and cooked	Cook thoroughly	Keep food at safe temperatures	Use safe water and raw materials
<i>Questions</i>			2.1	2.2	3.2	4.2	5.1
			94%	91%	23%	80%	27%
Demographics	Total	%	P. Value				
English proficiency	130	49	0,027	-0,148	0,010	0,009	-0,022
Grade 11 – 12	88	33	0,044	0,036	0,078	-0,021	0,020
Tertiary education	93	35	0,087	0,021	-0,077	0,097	0,084

Table 3.6: Association between selected demographic and attitude of the volunteer food handlers

				Keep clean	Separate raw and cooked	Cook thoroughly	Keep food at safe temperatures	Use safe water and raw materials
				2.1	2.2	3.2	4.2	5.1
				94%	91%	23%	80%	27%
Demographics	Total	%	P. Value					
Employment	Permanent	90	34	-0,0189	0,0134	-0,0643	0,0265	-0,0618
	Volunteer	175	66	0,0204	-0,0117	0,0617	-0,0239	0,0589
Salary	More than R 1000.00	2	1	0,0221	-0,1210	0,0570	-0,0641	0,0448
	R500.00 - R1 000.00	91	34	-0,0836	0,0703	-0,1444	0,0699	-0,0665
	Less than R500.00	172	65	0,9989	0,9987	0,9933	0,9984	0,9942

3.4.5 Food safety self-reported behaviour of the respondents

Food safety practices form the basis of any programme aimed at the prevention of foodborne illnesses. Table 3.7 indicates the responses of the respondents regarding their food safety practices with averages reflected in Figure 3.5. It was found that 69.2% of the respondents always apply the five keys to safer food during food preparation activities. The remaining 30.8% indicated that they do it most of the time (15.2%); some not often (5.4%); a few said sometimes (3.7%); and some stated that they never apply the five keys (6.5%). Yet, hygiene and sanitation or cleanliness are high on their list of priorities (83.5%).

The majority (81%) of the respondents reported that they always wash their hands before and during food preparation, with only 14% saying they sometimes do not. The same applies to cleaning surfaces and equipment and utensils used for food preparation, prior to re-using it for other food (86% = Always; 10% = Most of the time). These findings are supported by a study conducted by Parry-Hanson and Kunadu *et al.* (2016).

Despite the fact that more than 80% of the participants regularly wash their hands, the threat of spreading foodborne diseases to consumers through their unwashed hands remains a given and something that has to be emphasised in training (De Freitas, De Cunha & Stedefeldt, 2019). Regarding the issue of using separate utensils and cutting-boards when preparing raw and cooked food, the results showed a wide distribution with 52% saying always; 12% answering most of the time; 24% saying not often; 7% saying sometimes and 5% admitting to never doing it. Moreover, 96% of the respondents declared that they always separate raw and cooked food when storing it. Prevention of cross contamination is important to avoid the risk of foodborne illnesses.

Table 3.7: Respondents' self-reported behaviour based on 5 keys to safer food

	Always <i>n</i> (%)	Most of the time <i>n</i> (%)	Not often <i>n</i> (%)	Sometime <i>n</i> (%)	Never <i>n</i> (%)
Keep clean					
I wash my hands before and during food preparation.	214 (81)	38 (14)	-	13 (5)	-
I clean surfaces and equipment used for food preparation before re-using on other food.	227 (86)	26 (10)	-	12 (4)	-
Separate raw and cooked					
I use separate utensils and cutting-boards when preparing raw and cooked food.	137 (52)	32 (12)	64 (24)	18 (7)	14 (5)
I separate raw and cooked food during storage.	254 (96)	9 (3)	-	-	2 (1)
Cook thoroughly					
I check that meats are cooked thoroughly by ensuring that the juices are clear or by using a thermometer.	113 (43)	83 (31)	14 (5)	3 (1)	52 (20)
I reheat cooked food until it is piping hot throughout.	107 (40)	65 (25)	24 (9)	26 (10)	43 (16)
Keep food at safe temperatures					
I thaw frozen food in the refrigerator or other cool place.	194 (73)	53 (20)	6 (2)	4 (2)	8 (3)
After I have cooked a meal, I store any left-overs in a cool place within two hours.	146 (55)	48 (18)	28 (11)	14 (5)	29 (11)

Use safe water and raw materials

I check and throw away food beyond its expiry date.	226 (85)	23 (9)	7 (3)	9 (3)	-
I wash fruit and vegetables with safe water before eating them.	214 (81)	27 (10)	-	-	24 (9)

Workers who demonstrate positive attitudes tend to exhibit positive behaviours and take responsibility for the safety of the food produced and for the implications to the health of consumers (De Freitas, De Cunha & Stedefeldt, 2019).

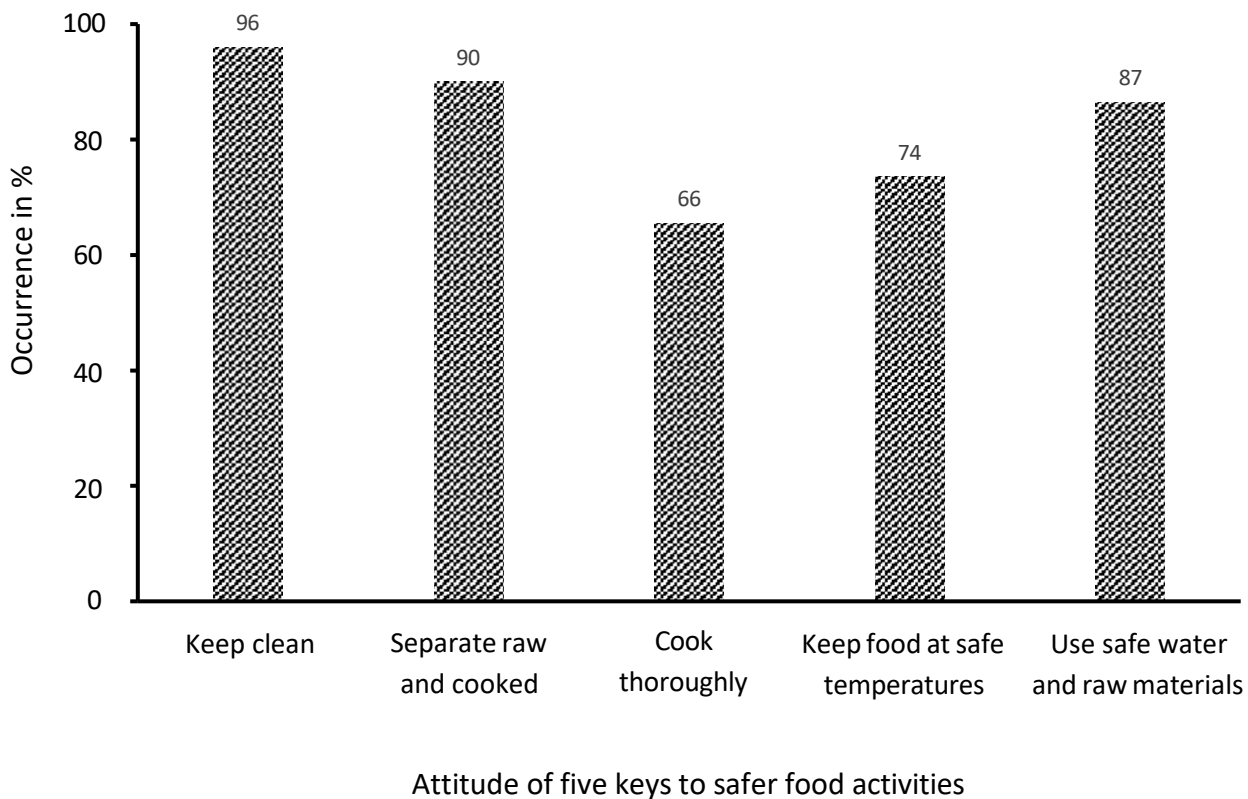


Figure 3.5: Averaged practice of the volunteer food handlers with schools participating in NSNP (n = 265)

Of concern is that only 43% of respondents always made sure that the juices they serve, were safe; used a thermometer to accurately determine temperature; and re-heated cooked food until it is piping hot throughout (40%). The percentages of volunteer food

handlers who would reliably (most of the time) check that meat had been cooked properly and who would re-heat cooked food to boiling point, were 31% and 25% respectively. The ones who did not do it often were 5% and 9% respectively; while 1% and 10% stated that they sometimes did. The ones who never applied those two principles of safer food preparation made up 20% and 16% respectively. Considering the fact that cooking is mostly seen as a critical point, this is worrying and requires intervention by way of training. However, at the same time, their access to equipment such as thermometers have to be considered too.

Also disturbing is that only 73% of the respondents reported that they always thaw frozen food in the refrigerator or in a cool place. In addition, 55% indicated that they always store any left-overs in a cool place within two hours after they have cooked it. For the rest, 18% stated they do it most of the time; 11% stated not often; 5% indicated that they sometimes do; and 11% declared that they never do. Reasons for neglecting to keep food safe may indicate that the volunteer food handlers are unaware of the risks associated with this practice or may be constrained by inadequate infrastructure and equipment (Parry-Hanson & Kunadu *et al.*, 2016). It is vital that volunteer food handlers be informed about safer ways to defrost food, and that the microbial danger zones and related constraints are identified and addressed. A high percentage of volunteer food handlers (85%) stated that they always check and if necessary, dispose of food beyond its expiry date, while 81% of the respondents indicated that they wash fruit and vegetables with safe water before cooking or serving it. These practices are part of the WHO's five keys to food safety, insisting that raw materials, including water and ice must be procured from an approved source to avoid pathogenic and chemical contamination (South Africa Department of Health, 2018).

3.5 CONCLUSION

This study investigated the demographics, knowledge, attitudes and self-reported behaviour of NSNP volunteer food handlers in the Mangaung Metropole in South Africa, with the aim of laying the foundation for developing training materials to mitigate the system weaknesses that threaten food safety.

In summary, the findings indicated that more than 85% of the staff involved in food handling within the selected schools were female. In addition, 70% of the volunteer food handlers are falling between the ages of 20 and 40 years. This is key information when designing a training programme. The study has also highlighted particular gaps in the knowledge of staff handling food that influence their attitude towards food safety and which is evident from their self-reported behaviour. One such example is being aware of the dangers of serving food that has not been cooked properly.

Although on the whole the participants were conscious and had a positive attitude towards the importance of cleanliness, a lack of knowledge regarding certain aspects could translate into a negative attitude and negligence. Although the reasons for these divergences had not been explored, it is fair to say that inadequate training, or the absence of training might be a reason. The results from this study pave the way for designing a training tool that is based on the WHO's Five Keys to Safer Food programme and, which is aligned with legal mandates governing general hygiene requirements for food premises and the transport of food (South African Department of Health, 2018). At the same time, the results of this study highlight the need for training that is fit-for-purpose, aligned with the participants' levels of formal education, and can be reinforced through effective and consistent assessment. Equally important is making sure that volunteer food handlers have the facilities and equipment they need to serve children healthy and safe meals.

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CHAPTER 4

THE EVALUATION OF FACILITIES AND HYGIENE PREREQUISITES IN THE NATIONAL SCHOOL NUTRITION PROGRAMME IN SOUTH AFRICA

For submission partially or in full to:
British Food Journal: ISSN: 0007070X

4.1 ABSTRACT

The prevalence of poverty has increased in recent times, especially in rural areas of developing countries, and thus increasing food insecurity. This has had a severe impact on children from needy communities. The South African Department of Basic Education's NSNP, as part of an Integrated Nutrition Programme (INP), was introduced to reduce food insecurity and the child mortality rate in South Africa. Even though the programme has seen some success, it also faces challenges regarding food safety. This descriptive study examined the level of adherence to prerequisites related to food-preparation facilities and hygiene operating guidelines at 98, randomly selected schools within the Mangaung Metropolitan using a customised inspection checklist. The study highlighted challenges facing the NSNP at these schools such as inadequate and poorly maintained infrastructure (18%) and food preparation facilities (59%), and a lack of storage facilities (43%). The situation is aggravated by deficient adherence to hygiene operating requirements such as appropriate facilities for water storage, managing hazardous substances and pest control. The lack of these requirements increases the risk of financial loss due to reducing the shelf-life of foodstuff, food contamination and the outbreak of foodborne diseases. The non-adherence to food safety requirements portrayed in Chapter 3 has little to do with food handlers' attitude, rather as the results of lack of resources necessary for food safety, lack of maintenance of the vandalised equipment and facilities and inadequate initial and continuing training. The results show that although the focus was given to basic infrastructure such as location and structures; other requirements such as maintenance of such structures, food preparation equipment and hygienic operating prerequisites still needed attention.

4.2 INTRODUCTION

There has been an increase of food-borne disease cases especially in industrialised and developing countries (Agüeria, Terni, Baldovino & Civit, 2018; Macheka, Manditesra, Ngadze, Mubaiwa, *et al.*, 2013; Wilcock, Ball, & Fajumo 2010). With more than 200 cases reported per day worldwide, it has led to increased health and financial costs as well as loss of life (Cates, Muth, Karns, Penne, *et al.*, 2009; Garayoa, Abundancia, Díez-Leturia & Vitas, 2017; Medeiros, Hillers, Chen, Bergmann, *et al.*, 2004; Scharff, McDowell, & Medeiros, 2009; Senior, 2009; WHO, 2007;). In particular it affects vulnerable groups such as infants, pregnant women, the sick and the elderly (Agüeria *et al.*, 2018). As children's immune systems are still maturing up to the age of eight years, the effects of foodborne diseases on them may be devastating (Scallan, Mahon, Hoekstra & Griffin, 2013; Sibanyoni & Tabit, 2019).

It has become imperative for governments and companies to find ways to counter-act the risk of foodborne diseases. One such way is to increase effective control, both externally (legislation) and internally (developing and overseeing operational procedures) (De Oliveira *et al.* 2016). As in other countries, the external control responsibility falls on the shoulders of the health authorities, and in South Africa it is set out in the 1972 Foodstuffs, Cosmetics and Disinfectants Act, and specifically Regulation 638. These regulations were promulgated in 2018 and govern general hygiene requirements for food premises, the transport of food and ready-to-eat food establishments. All such facilities are compelled to have a certificate of acceptability (South African Department of Health (DoH), 2018). In accordance with these regulations, health authorities on national, provincial and local government level are obliged to protect the consumer by ensuring that all foods conform to safety requirements during production, handling, storage, processing, and distribution. Yet, despite official direction, it remains evident from literature that at times food safety is still being compromised and that it is necessary to develop more effective ways to monitor production processes that will counter-act health hazards (Untermann, 2014).

As discussed in Chapter 2, a key aspect of ensuring food safety is the establishment of PRPs. It forms the foundation for a comprehensive and effective FSMS such as HACCP and encompasses guidelines for the facility's location, building structures, and all related equipment (National Advisory Committee on Microbiological Specifications for Foods (NACMCF), 1997; Walker, Pritchard and Forsythe, 2002; Hung, Liu, Peng, Hsu, *et al.*, 2015). However, as effective as an HACCP system may be in ensuring food safety, the demands it places on human, technological and financial resources often result in managers resisting its implementation (Popelka, Turek, Nagy & Marcinčák 2005; Toropilová & Bystrický, 2015). The efficacy of the HACCP system also relies heavily on the support of top management and well-trained staff. However, key to its success are well-established and sustained PRPs (Garayoa *et al.*, 2017; Garayoa, Vitas, Díez-Leturia, & García-Jalón, 2011; Jevšnik, Hlebec, & Raspor, 2009; Shih & Wang, 2011; Sneed, Strohbehn, & Gilmore, 2004; Wallace, Holyoak, Powell & Dykes, 2014; Worsfold, 2001; Yang, Wei and Pei, 2019). Small and medium-sized enterprises in particular battle to execute and monitor the HACCP system effectively. Some of the reasons are the wide variety of dishes that are prepared, limited human resources, low education and skills levels of employees and inadequate infrastructure (Garayoa *et al.*, 2017; Seward, 2000; Sun & Ockerman 2005; Taylor, 2006). Most importantly, it is not possible to implement the HACCP system as they have not created any or comprehensive PRPs. This also applies to schools participating in the NSNP (Bas, Ersun & Kivanç, 2006; Fotopoulos, Kafetzopoulos & Gotzamani, 2011; Manyatsa, 2007). The fact that these schools have been included in the programme implies that they are situated in underprivileged areas further suggesting that they lack the resources to institute PRPs and the HACCP.

Earlier studies have highlighted the challenges that feeding programmes face, including inadequate infrastructure for food preparation and storage which heightens the risk of reducing the shelf-life of foodstuffs and heightens the risk of potential food contamination and foodborne disease outbreaks (Griffith, Cooper, Gilmore, Davies & Lewis, 2000; Lues & Van Tonder, 2007; Manyatsa, 2007; Venter, Lues, Manyatsa, Moalusi, *et al.*, 2003; Venter, Noe, Manyatsa & Lues, 2010). The aim of the study is to determine the extent to which infrastructure, facilities and hygiene prerequisites have been implemented in schools participating in the NSNP within the Mangaung Metropolitan, Free State Province (South Africa).

4.3 MATERIALS AND METHODS

4.3.1 Sample selection

A random sample of 98 schools (48.5%) participating in the NSNP within the Mangaung Metropolitan in the Free State Province, South Africa, were included in this descriptive study of the level of implementation of PRP at schools participating in the NSNP. Low-income schools (quintiles 1, 2 and 3) were randomly selected from NSNP-participating schools. The schools included primary, intermediate and secondary schools categorised under the quintiles 1, 2 and 3. The sampled schools represented an even distribution of schools in the urban and rural areas of the region (202 schools).

4.3.2 Data collection and analysis

The approval was given by the DBE (Motheo District) to carry out the study and the principal of the participating school was notified. The data was collected between February and December 2017. The data collection method was adopted from Liz Martins and Rocha (2014) using a structured inspection checklist adapted to accommodate the *South African National Standards 10049: Food safety management — Requirements for pre-requisite programmes (PRPs)* (SABS 2019) and Regulation 638 (South African Department of Health, 2018). It included 85 statements relating to implementing the PRP at the selected schools as it relates to infrastructure (facilities and buildings), equipment and utensils; waste management and sanitation; and storage. Each statement required a *yes* or *no* response by ticking the appropriate box. The checklist had previously been tested in five schools also participating in NSNP; however, these schools were not included in the final sample. The following classifications were used to evaluate the level of implementation of the PRP: 1) facilities; 2) equipment for handling food; and 3) hygienic operating requirements. Data were analysed using Microsoft Excel, and the results were tabulated and expressed in percentiles and averages.

4.4 RESULTS AND DISCUSSION

The results obtained from the technical investigations are presented in tables 4.1, 4.2 and 4.3. Since the initial design of the majority of schools had not included areas to serve food to learners, the potential impact of the makeshift cooking and serving structures on food safety is significant. The majority of the schools observed were not initially designed for feeding the learners, hence most were using non-complying facilities and equipment. The existing structures such as classrooms, bookstores and old equipment storage rooms were used either for food preparation and/or food storage. As much as there were some adjustments in some of the structures to comply with Regulation 638 as a requirement, less was done for some of the schools.

The buildings of the assessed NSNP-participating schools provide reason for concern. The facilities are not free from contaminants such as odour and dust, and not of sound construction and in good repair state. These has made the possibility of food contamination to be maximised. The outside environment has also been neglected in the majority of the schools. These include drainage and fence around the facilities and dealing with dusty areas around the kitchen. Most of the conditions are also encouraging harbouring of insects and vermin. Lack of maintenance has also exposed the sewage and effluent lines to pose contamination of the portable water and soil around the kitchens, especially during flooding. Out of the 98 schools assessed, more than 50% met the PRP requirements for location, size, hygienic design and conditions. However, as a result of the lack of maintenance done at schools, many NSNP facilities are not in a good condition (Table 1). This study shows that more than 70% of the facilities at the schools audited fell short of the requirements for safely processing and storing of foods products.

Having an area that is free from odours, smoke, dust and other contaminants was recorded at 69% of the schools. Just over 50% of schools could report that the site that

the NSNP had been allocated, was a sound construction and in good condition. Almost as many (48%) needed proper maintenance (Table 4.1) (Figure 4.1). Inadequate and deficient areas in which to cook and serve food tend to promote the build-up dust and pathogens like bacteria, fungi and fungal spores in the kitchens. In addition, with vandalism and the absence of ceilings in some of the schools, building up of dust and pest infestation are encouraged. This is exacerbated by poor pest control measures, with 65% of the schools having stated that insects and vermin can get into NSNP facilities (Figure 4.2). Only 8% have screens in front of windows, leaving the majority vulnerable to invasion of pests. Despite legislation and national standards requiring it (SABS 10049), only 43% of the schools had an area with a hard-wearing surface like concrete or lawn.

Table 4.1: Percentage adequacy of inspected facilities within the NSNP ($n = 98$ schools)

Facilities within school nutrition programme	Percentage (%)
Location, size, hygienic design and conditions	
Buildings are free from odours, smoke dust and other contamination	69
Buildings are of sound construction and in good condition	52
Building minimises food contamination and cross-contamination	76
Premises are well drained and adequately fenced	59
Outdoor have a permanent surface of concrete or are covered by lawn	43
Facility designed to prevent undue delay of processing of raw materials	59
Facility prevents the entry and harbouring of insects and other vermin	35
Buildings are located away from areas subject to flooding and prone to infestations of pests and waste	54
Sewage and effluent lines are constructed to avoid contamination of potable water supplies and food areas	51
Roofs and ceilings	
Roofs are weatherproof and made of non-absorbent material	92
Roofs and ceilings fit tightly and allow free movement	67
Walls, windows and doors	
Walls, windows and doors are weatherproof and impermeable to water	76
Walls are smooth, corrosion resistant, light coloured, washable	76

Walls are protected from damage by moving equipment	59
Doors and frames are smooth, light-coloured and water-impermeable	35
Doors are wide enough to prevent contamination of the product	43
Doors into food handling areas are rodent-proof, provided with air screens, fitted with self-closing devices	67
External doors prevent the entry of rainwater into the food handling area and are kept closed when not in use	59

Floors and drainage

Floors constructed of concrete or any other material that is water-impermeable	92
Drainage channels are of the open type with, where necessary, removable covers	27
Floor drains or channels are of hygienic design suitable to the food handling operation	27
Drains are vented to the atmosphere outside the food handling area, before entering the sewer	43

Illumination

Appropriate natural or artificial lighting with sufficient intensity	84
Artificial illumination, if used, does not alter the colour of the product	100
Suspended luminaires over food are so protected to prevent contamination	43
Lights are easy to clean and maintain	84

Ventilation

Ventilation and extraction systems in the facility are sufficient to prevent condensation and manage temperature	2
Ventilation located to avoid the intake of contaminated air and filtered where appropriate	1
Windows that are used for ventilation are screened	8

Provided at entrance of food processing facility

Sufficient number of hand-wash basins with supply of hot and cold or warm (40 °C to 50 °C) running water	18
Liquid soap or hand-cleaning detergent and hand drying towels	67

Separation of processes and facilities

Separate rooms or well-defined areas of acceptable size for different activities	59
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Storage facilities

Food handling area is not used for storage purposes	43
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Storage facilities are clean, dustproof and vermin proof	59
Dry storerooms are provided for the storage of packing and packaging materials	27
Pesticides and harmful substances are stored in a room or cupboard away from foodstuffs	43
All substances used for cleaning and disinfection are prominently labelled	43

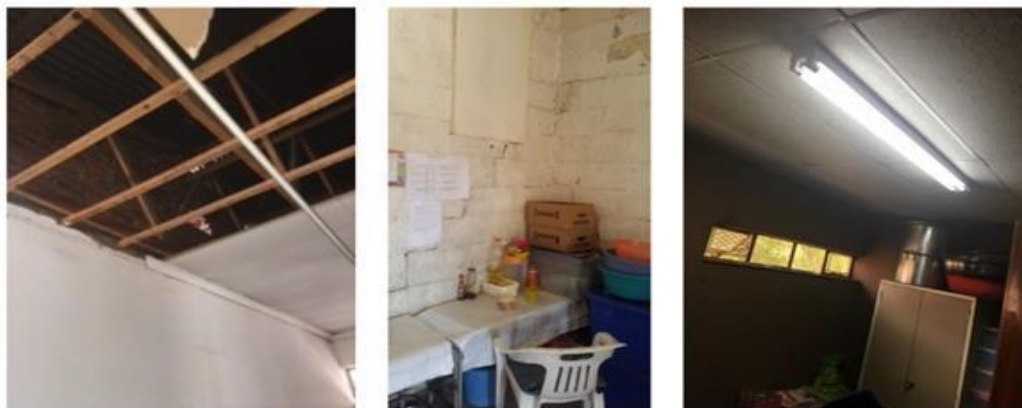


Figure 4.1: The pictures showing shortfalls in roofs, ceiling and light maintenance in some of the schools

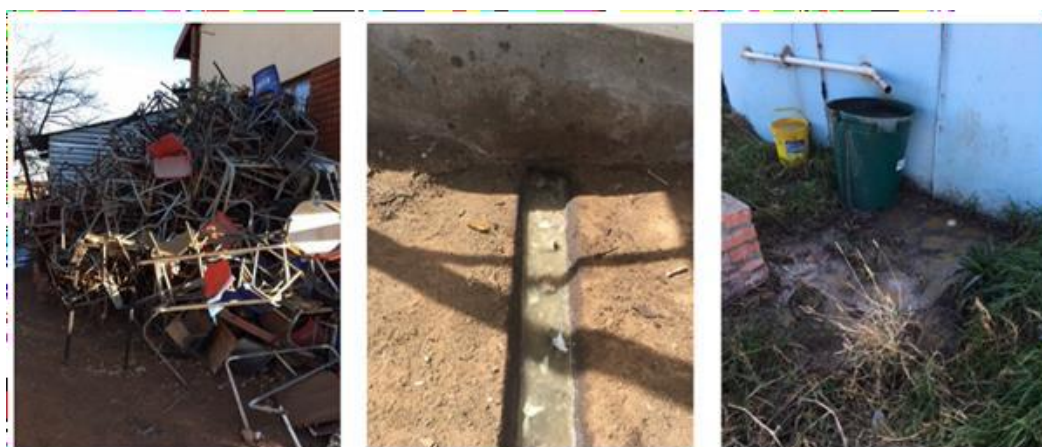


Figure 4.2: Washing facilities and conditions that encourages the harbouring of pests around the food preparation outside food preparation area within NSNP-participating schools

The requirements mandate that interior walls in areas where food is prepared and served should be painted in a light colour; be smooth and resistant to corrosion. Furthermore, doors have to be rodent-proof, be fitted with an air screen and closing devices. Only 35% of schools showed evidence of windows that conformed to the guidelines while the doors at 76% of schools fit the requirements. For the majority (84%), the food preparation areas had sufficient natural/artificial lighting, making it possible for food handlers to perform their activities efficiently. Twenty-seven per cent (27%) of the schools had properly designed and constructed floor drainage suitable for food handling. Only 67% of the schools were having ceilings that are tightly fitting to avoid the pests from harbouring and dusting building up. Unfortunately, a lack of ceilings in some of the schools might encourage the pests to end up contaminating the food stored or prepared.

A major deficit exposed by the survey is the lack of hand-washing basins, hand soap and sanitizer, a key preventative measure for food contamination and spreading foodborne disease. Only 18% of the schools had hand-washing basins with hot and cold running water in, or easily accessible to, the kitchens. Food handlers are forced to use portable washing basins and water for washing their hands. On the other hand, 67% of the schools had liquid soap or hand-cleansing detergent and hand-drying towels available. Regulations also stipulate that the working space should be large enough to allow separation of processes such as preparing, cooking and washing up. However, only 59% of the schools' NSNP facilities complied. This heightens the risk of cross contamination. Storage is often a headache for NSNP supervisors (Venter *et al.*, 2003; Manyatsa, 2007). Less than 60% of the schools audited had sufficient and appropriate storage facilities, leaving them vulnerable to stock losses and possible food contamination attributable to pest infestation.

When it comes to equipment, most of the schools' cooking utensils and other tools were in good condition (92%) (Table 4.2). On the other hand, the maintenance of these equipment unfortunately has not been documented (67%). Only 18% of the schools maintain clear records. Usually the maintenance is carried out by the person employed by the school as a general worker. However, they are not necessarily au fait with food

safety requirements, contributing to the risk of contamination. As mentioned before, most schools (98%) do not have temperature-controlled storage either cold or warm, with thermostats. This means the food cannot be kept at the appropriate temperature (WHO, 2018).

Table 4.2: Adequacy of inspected equipment for food handling within the NSNP (n = 98 schools)

	Percentage (%)
Equipment for food handling within school nutrition programme	
Conditions of equipment for food handling	
Equipment allows free movement of workers to facilitate cleaning	92
Food handling equipment and utensils are smooth-surfaced, light-coloured	84
Machinery and equipment are suitable for food handling processes	59
Equipment and utensils for food handling are of hygienic design with no open joints	59
Food handling surfaces are not painted	76
Design and materials of food contact surfaces are hygienic, appropriate and cleanable	51
Equipment prevents the ingress of unwanted fluids into the food product	59
Equipment are either installed away from the walls and ceilings or above the floor	76
The area where equipment sunk into the floor is well drained	43
Copper, lead and other metals or materials are not used in the construction of equipment	67
Maintenance of equipment	
Effective maintenance programme is implemented	53
Records of maintenance are kept by the person in charge	18
Maintenance is carried out by suitably trained staff	84
Monitoring of measuring devices	
Equipment or processes that are critical to food safety are identified and have appropriate measuring devices	2
There are monitoring procedures for the control of measuring devices	4
Appropriate action is taken against non-conformance	2
Records of devices and their calibration status are maintained	2
Verification is conducted and records are maintained	2
Equipment used for the monitoring are suitable for the intended application	2

To optimally institute hygiene and sanitation requirements (Table 4.3) within schools, demands access to water. Whereas potable water is supplied to NSNP facilities, at some schools the staff resorts to storing water for later use. This practice may lead to sully the water, especially if it is stored for long periods or the tap or hose used for collecting the water is dirty. Incidents of the hose used for collecting water for the kitchen in the dust were recorded. However, it was found that at 67% of the schools assessed, appropriate facilities for water storage for later usage were available (Figure 4.3). Proper documentation and record-keeping tended to be lacking at all the NSNP-participating schools. Only 2% of the schools could show evidence of having recorded their cleaning and disinfection schedules for the premises, equipment and containers. Moreover, only 10% of schools had formal emergency procedure guidelines, and only 18% had guidelines for dealing with accidental food contamination. Management and control of hazardous substances were also shown to be neglected. It is not uncommon for minors to ingest chemicals in cases where there are no proper management and storage thereof, leading to death in many cases (Alghadeer, Alrohaimi, Althiban, Kalagi, Balkhi & Khan, 2018). This intensifies the need for control and safe storage of chemical cleaning materials at schools, but also for products used to control pests.



Figure 4.3: Some of the inconvenience methods use to collect water within schools participating in NSNP

Table 4.3: Percentage of adequacy of inspected hygienic operating requirements within the NSNP ($n = 98$ schools)

Hygienic operating requirements within school nutrition programme	Percentage (%)
Water	
Water used comply with the requirements of SANS 241	100
Appropriate facility for the storage and distribution of water is provided	67
Flexible water hoses are made of a suitable material for food safety and reels for their storage are provided	18
Environmental temperature and humidity control	
Equipment used for the monitoring are suitable for the intended application	18
Cleaning and disinfection	
The food handling areas are maintained in suitable state of cleanliness at all times.	67
There is a documented cleaning and disinfection programme for the premises, equipment and containers	2
Management and control of hazardous substances	
Hazardous substances are handled by authorized and properly trained staff	9
Care is taken to avoid the contamination of food during handling	49
Hazardous substances are clearly labelled and identified	35
There are emergency procedures for dealing with the accidental contamination of food	10
Appropriate PPE for staff handling hazardous substances is provided	18
Management and control of pests	
All food handling areas are pest-free	51
Effective pest control programme is documented and implemented	18
Pesticides are not used in food handling areas while preparation is in progress	27
Registered pesticides are used in accordance with the manufacturer's instructions	18
Pest control operator is suitably qualified and trained	18
Pesticides and cleaning chemicals are stored away from containers and the food product	27
The room in which pesticides are stored is always locked	18
Bait stations are of a lockable type, and are not placed in food handling areas	2
Pest control records are well maintained and complying	18
Records of verifications are kept and available on request	18

More than half (51%) of the schools visited had no problems with pests. However, only 18% had implemented formal pest-control programmes. The same schools were also using approved pesticide operators and the pesticides were stored in the lockable cabinet. The pest control procedures could not be verified by documented records as only 18% of the school complied. In contrast, it is worrying to have more than 80% of the schools lacking procedures for pest control. All these schools are vulnerable to pest infestation and possible food contamination, especially if the food is not stored properly (Chapter 5). The significance of pest infestations is frequently not recognised until an outbreak of food-borne infection occurs, despite being common within food handling facilities. In most cases, it is the result of a lack of management, control and vandalism. This is the case with the majority of the food handling facilities with the NSNP.

4.5 CONCLUSION

As much as 76% of the schools' buildings had bigger venues, most of them were also used as classes. On the other hand, 40% of the schools were not of sound construction. Hence, only 35% of the schools were able to prevent entry and harbouring of pests. Structures such as ceilings have also been lacking in more than 30% of the schools. There seems to be a similar problem as reported by Manyatsa (2007) with the storage facilities (57%). Both studies are reflecting on the dual storage of foodstuff with chemicals and cleaning equipment. Besides the preservation of the organoleptic property and integrity of the food, the objective of proper PRPs is to protect food from pests and other contaminating elements such as microbiota. In an environment where GMPs and proper storage practice is not possible due to a lack of infrastructure, special care regarding the kind of food stored and packaging material used should be taken to ensure food safety. An environment that typifies the former is reflected within the schools participating in feeding programmes. The use of water hoses should be discouraged as it might contaminate the working area, being further used for gardening activities outside as observed during the study. From the results it could be concluded that though the facilities at the schools in question are, in terms of all technical data, not suitable for food preparation, some schools have set a trend for food safety. Factors such as infrastructure including vandalised structures, lack of handwashing and storage facilities as well as

hygiene operating requirements, amongst others, pose a potential risk to prepared food within the NSNP. The management and control of hazardous substances are among factors that need attention, as it increases these potential risks. It is therefore advisable that the PRPs be upgraded as to pave for the implementation of a Hygiene Management System. The results presented in this study confirmed that intervention is required. It is therefore vital that all activities be documented to allow proper management of food safety.

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CHAPTER 5

ADHERENCE TO OPERATIONAL REQUIREMENTS FOR GOOD MANUFACTURING PRACTICES (GMPs) IN THE SOUTH AFRICAN NATIONAL SCHOOL NUTRITION PROGRAMME

For submission partially or in full to:
British Food Journal: ISSN: 0007070X

5.1 ABSTRACT

While the aim of the NSNP is to provide the learners with meals, it is also obliged to provide nutritious and safe food. Compliance with hygiene standards and good manufacturing practices (GMP) is key and should be included in the pre-requisite programmes (PRPs). The main objective of this chapter was to determine whether GMPs are adhered to at the schools participating in the NSNP in the Motheo District of the Mangaung Metropole, South Africa. This descriptive study was conducted among 98 randomly selected, quintile 1, 2 and 3 schools participating in the NSNP between February and December 2017. The survey was performed using a structured checklist based on the South African National Standards requirements for food safety management, PRPs, and monitoring procedures. While the majority of participating schools showed evidence of compliance in most categories, including checks for conformance, identifiable product materials during storage, release of food products by authorised staff, usage of the appropriate containers used for the storage of food and adherence to the first-in-first-out (FIFO) rule, they were revealed as areas of non-adherence leaving feeding programmes vulnerable to cases of foodborne diseases. Non-conformities relating to suppliers of the food products occurred among the majority of the schools participating in NSNP. In addition, as much as all the food products stored had approved labelling, suppliers have less control. Unfortunately, the majority of the schools are struggling with good storage practices of the food products. Some storage practices might encourage cross-contamination or decrease food product quality. Evaluating suppliers and monitoring the incoming products is critical in ensuring the safe products within the schools. Suppliers play a significant role in the food chain; therefore, their credibility is crucial in ensuring food quality. On the other hand, the storage of food products needs to be monitored and documented. Among others, concomitant storage of food and chemicals must be avoided.

5.2 INTRODUCTION

The WHO (1997) defines good manufacturing practices (GMP) as a sub-section of a quality assurance procedure. These practices aim to guarantee that food products are uniformly manufactured and safe for human consumption. It is a globally accepted way of ensuring quality and effectively managing manufacturing food products. The GMP covers all aspects of the process, including planning and design, documentation, production, quality control, product delivery, storage and validation of products (Ngwa, 2017). Poor management or the absence of GMP has been linked to breaches of food safety regulations and improper food handling causing contamination and disease (Motarjemi, Käferstein, Moy & Miyagawa *et al.*, 1996). Food handlers' role in ensuring food safety and preventing food contamination throughout the production, processing, storage and preparation chain is therefore key (Lee, Hishamuddin, Thong, & Chai, 2017; Zain & Naing, 2002). Yet schools in poverty-stricken and rural areas often lack basic resources hampering food handlers' ability to effectively apply their food-safety knowledge (Bou-Mitri Mahmoud, El Gerges & Abou Jaoude, 2018; Gilling, Taylor, Kane, & Taylor, 2001).

While it is not possible to guarantee that food will never pose a risk to any consumer, thanks to the myriad of stakeholders and processes involved in the food supply chain from farmland to plate, GMP can help mitigate the risk (Blaauboer, Boobis, Bradford & Cockburn *et al.*, 2016; De Boer & Bast, 2018; Liu, 2018). Yet, effective food safety assurance in food-service establishments depends on adequate infrastructure, appropriate management support and food handlers' knowledge, skills and commitment (Rendall- Mkosi, Wenhold & Sibanda, 2013; Sibanyoni & Tabit, 2019). Although the same applies to food-service establishments at schools that incorporate feeding scheme programmes and, despite their noble intentions to combat short-term hunger by providing learners with free meals, it is clear that they face enormous challenges (Aliyar, Gelli, & Hamdani, 2015; Sibanyoni & Tabit, 2019; Soares, Davó-Blanes, Martinelli, & Melgarejo, 2017; World Food Programme (WFP) 2013).

When taking into account the strategic position of schools in promoting health and healthy eating habits, incidences of food poisoning and other foodborne diseases undermine this goal and the state of public health in general, making food-related conditions one of the most widespread public health problems in the contemporary world (Notermans, Gallhof, Zweitering, & Mead, 1995; Sanlier & Konaklioglu, 2012; Locatelli, Canella & Bandoni, 2018, WHO, 2000). Children receiving food from the NSNP have unfortunately not been spared this fate. Reasons are most often related to a lack of food safety inadequate resources to support the proper implementation of food safety systems (Bas, Ersun & Kivanç, 2006; Fotopoulos, Kafetzopoulos, & Gotzamani, 2011; WFP, 2013). This is the case particularly with schools in rural areas and informal settlements. Most of these lack basic services such as electricity and a potable water supply (Manyatsa, 2007; Sibanyoni & Tabit, 2019). This contributes to food not being properly cooked (Bai, Wang, Yang & Gong, 2019; Collins 1997) and heightens the risk for food contamination. The study aimed to determine the status of adherence to GMPs within the schools participating in the NSNP in South Africa by way of a sample from the Motheo District in the Free State.

5.3 MATERIALS AND METHODS

5.3.1 Sample selection

For this study, 98 quintiles 1, 2 and 3 schools (48.5%) participating in the NSNP in the Mangaung Metropolitan Municipality in the Free State Province, South Africa were randomly selected. The sample were randomly selected from all low-income schools (quintiles 1, 2 and 3) from NSNP-participating schools (202 schools). The schools included primary, intermediate and secondary schools under the mentioned quintiles. The samples were even distributed and included both schools from the urban and rural areas of the Metropole. The study was authorised by the DBE (Motheo District) and the principal was informed and the permission was granted.

5.3.2 Data collection and analysis

Each school was evaluated by using a structured checklist as a collection tool based on the SANS 10049 regulations to test for compliance with GMP and administered by the researcher. The checklist was made up of five sections covering 1) six questions on purchasing; 2) two questions on the control of customer-supplied products; 3) six questions on food product ingredients; 4) 13 questions related to storage of food product materials; and 5) seven questions on food handling, processing and monitoring. Each item required a *yes* or *no* answer indicating whether or not the school complied with GMP. The results were tabulated and expressed in percentages. Data were analysed using Microsoft 365 Excel, and the results were tabulated and expressed in percentiles and averages.

5.4 RESULTS AND DISCUSSION

The results from this chapter emphasised various shortfalls with reference to the purchasing, receiving and storage of the foodstuffs within NSNP-participating schools. As much as there are other prerequisites programmes complying, unfortunately the documentation and records are lacking. Overall results indicated that GMPs relating to purchasing were not being adhered to at the schools participating in the NSNP with the average of 39% (Table 5.1a). From the above average, the established documented purchasing requirements for products or services used for the handling of food and conforming to those requirements was the only one with more than 50% adherence (64%). Detailed documents were compiled by the Department of Basic Education (DBE) and completed by the suppliers (Department of Basic Education, 2008). However, some of the decisions regarding purchasing are left to either the school administration or its governing body. This contributes to the low average of 43% of schools that had clear criteria for selecting and appraising suppliers.

Almost all participants (93%) indicated that all food contact materials are subjected to inspections for conformance. Although this is encouraging, vetting suppliers beforehand can contribute to more effective monitoring of food standards and safety decreasing the risk of foodborne diseases further. The regulations governing food establishment make it clear that environmental health practitioners (EHP), employed by local authorities, are

responsible for monitoring the safe transportation, handling, storage and preparation of food stuff earmarked NSNP schools (South African Department of Health, 2018). Only 36% of the respondents indicated that their suppliers and service providers had been audited by these officials. Less than a third (29%) of the schools were in possession of evaluation records of suppliers and service providers relating to non-delivery of products, damaged products and/or supplying unsuitable products.

Table 5.1: Percentage of adequacy of inspected Good Manufacturing Practices (GMPs) requirements within the NSNP ($n = 98$ schools)

Procurement aspect	Frequency (%)
Purchasing	
Established documented purchasing requirements for products	64
Criteria for the evaluation of suppliers and the list of suppliers documented	43
Suppliers and services are audited by the food handling organisation	36
Potential hazards associated with purchased items are identified and documented	21
Control of customer-supplied products	
Food that are supplied are subjected to the checks for conformance	93
The records of the evaluations of suppliers are kept	29
Receiving food product ingredients	
There is a structured and well-controlled receiving of food products ingredients	43
Food products received are sampled and routinely screened for basic food safety parameters	3
The records of verification of inspection, tests or conformity requirements are kept maintained	5
Non-conforming is identified and segregated to avoid possible cross-contamination	14
Storage of food product materials	
Stored food product materials are easily identifiable and there is an effective stock control	100
Food products are stored in a designated holding area until released by authorised staff	93
Food product materials are stored in such a way that cleaning can be effectively carried out	57
Materials are not stored directly on the floor	71
There are separate storage facilities for food product received in-process materials and the finished food product	57
The top layer of the stored food product is not making contact with the overhead structures	79
Shelves are clean and maintained in such a manner that will not pose a risk of contamination	64

Hazardous substances and other materials are stored separately from food	57
Appropriate containers are used for the storage of food	100
Waste is so stored as to avoid the contamination of food or of the environment	71
Special storage conditions such as temperature is provided where appropriate	29
Records of the control of such environmental storage conditions are maintained	7
Food product materials are stored in such a way that the first-in-first-out (FIFO) rule is possible	86

Food handling, processing and monitoring

Effective food handling is established and recorded to verify conformity requirements	14
There is established, documented and maintenance procedures for the handling, storage, processing, packaging, and delivery of the final food products	7
Food is handled and processed in such a way that contamination and cross-contamination is prevented (workstations)	79
The food handling organisation has storage areas available to prevent deterioration of the food product pending delivery	29
Areas used to store the food product are free from cross-contamination	29
Special requirements regarding the permitted duration or conditions of storage (or both) are established, monitored and checked	21
The condition of the food product in stock is assessed periodically	21

A mere 21% of the schools kept detailed reports on food stuff associated with potential hazards that they had received from their suppliers. Not complying with these requirements leaves them vulnerable to serving food of inferior quality and compromising food safety. The literature stresses that the credibility of the supplier is key to ensuring the quality of food. Pathogenic contamination of food is often the result of contaminated raw materials used to produce it (Mosupye & von Holy, 1999; WHO, 2018). Yet, only 43% of the respondents had instituted a structured and controlled system for receiving the raw material used as ingredients in the dishes. The picture is even bleaker when it comes to the sampling and routine screening according to basic food safety parameters, with only 3% adhering to this requirement. As few as 5% of the schools kept records verifying that inspections and tests had indicated that food supplies adhered to requirements. No analyses of such statistics were available at any of the schools that did keep record. Fourteen per cent of the participating schools had instituted a formal system for identifying and separating sub-standard ingredients to prevent cross-contamination and stop food

handlers from inadvertently using it. The audit indicates that the practice of formally documenting the quality control of raw materials as well as what was rejected and how it had been discarded safely seemed not to be a priority. Food handlers can be considered the final gatekeepers protecting the children from food contamination. As De Oliveira *et al.* (2016) posit, it is particularly important to keep food safe throughout all the stages of food production, but in particular when receiving raw materials. This requires stringent inspection and control processes.

With reference to storage (Table 5.1), all the participating schools had labelled food products in such a way that it was easily identifiable, making stock control and overall traceability effortless. This process is supported by the clear and detailed specifications from the education department (Department of Basic Education, 2008). The majority of schools (93%) showed evidence of designated holding areas where food products can be stored until released by authorised staff. However, only 57% of these had the food stored in such a way that cleaning and pest control can be effectively carried out (Figure 5.1). Seventy-one per cent was able to store food stuffs above floor level. More than half (57%) had well-organised storage facilities with designated areas for receiving and processing materials, as well as the finished food product. In the case of the remaining 43%, the possibility of cross-contamination continues unless the storage space is reorganised (Figure 5.2). This is corroborated by research showing that inadequate infrastructure may make it difficult to assign areas for different purposes, but that in such cases special care should be taken when organising storage and using proper packaging material (Department of Basic Education, 2016; Graham, Hochfeld, Stuart & Van Gent, 2015; Manyatsa, 2007; Nhlapo *et al.*, 2015; Public Service Commission (PSC), 2008; Rendall-Mkosi *et al.*, 2013).

It was observed that 79% of the schools had the food product stored away from the overhead structures such as ceiling and roofs. The shelving of 64% of the respondents were deemed to be clean and well-maintained, reducing the risk of contamination (Figure 5.1). Yet, at 43% of the schools, food products were stored with hazardous substances such as cleaning detergents and pesticides and other items not intended for cooking food

including gas cylinders and garden tools (Figure 5.2). Not separating edibles and chemical supplies increases the risk of cross-contamination (Manyatsa, 2007). However, this can be mitigated by the use of sealed containers. The results of this survey show the extent of the positivity relating to containers used for the storage of food (100%) that can prevent contamination.



Figure 5.1: Structured and organised storage within schools participating within NSNP



Figure 5.2: Dual storage and disorganised storage at schools participating within NSNP

Separating garbage from food products is also important to prevent contamination. The majority of schools (71%) showed evidence of appropriately storing waste safeguarding not only the foodstuff but also protecting the environment. However, some compliance lapses regarding storage that were observed, related to the monitoring of temperature, humidity and atmospheric conditions (71%) as well as keeping record of the control processes (93%) (Figure 5.3). This opens the way for an increased risk of contamination, microbial growth and food deterioration. However, adherence to the first-in-first-out (FIFO) rule was observed in 86% of the cases. This is in alignment with the views of Vulicevic, Abdel-Aal, Mittal, and Lu (2004) that heeding the shelf life of the food product during storage is an important factor in preventing contamination.



Figure 5.3: Examples of storing of vegetables at schools participating in the NSNP

The final set of questions related to food-safety procedures and control during handling and processing. The study revealed deficiencies in this regard at 71.4% of schools under evaluation. Only 14% could be observed to have set up efficient procedures for the handling, storage, processing, packaging, and delivery of food products, while 17% had accompanying records verifying it. This confirms the general trend noted that the majority

of the NSNP-participating schools in this study do not have proper documentation and do not diligently keep records. According to Hung, Liu, Peng, Hsu *et al.* (2015) documentation and record-keeping for analysing hazards and to log verifications and modifications relating to food safety are important. Neglecting to note vital information has also been addressed in the literature. A study by Jevšnik, Hlebec and Raspor (2009) confirms that the perception of the majority of people involved in food handling is that record-keeping during food processing is unnecessary. Underscoring the significance of thorough and regular record-keeping and keeping documentation to support food safety during training are essential.

At most schools the handling, processing and monitoring of food when being delivered could be described as inadequate. Less than 30% had designated and well-organised storage areas for delivery of goods (29%) that were safeguarded against possible cross-contamination (29%). Only 21% had set specific requirements for the duration of delivery and for monitoring and checking the delivered food products. The same percentage of schools periodically assessed products in stock for freshness. These observations again highlight the insufficient monitoring, this time while food is delivered, leaving the school exposed to financial loss due to spoilage and damage as well as food safety protocol breaches. Quality control from reception to serving is the cornerstone of any programme to keep food safe (Hansen, 2018).

5.5 CONCLUSION

Since food handlers at the NSNP schools serve as the final gatekeepers in the process of serving healthy, nutritious and safe food to the learners, it is vital that their GMP is well planned, established and documented. This starts with assessing and certifying suppliers and verifying the food quality and follows through to proper storage practices. The overall impression from this study is that schools complying with proper guidelines for purchasing, controlling and receiving food products and ingredients is 32%. Furthermore, only 54% had proper facilities for food storage, handling, processing and monitoring. The area of concern was sampling and analysis of the food products, where only a few schools

complied with the requirements. Weaknesses in these aspects could lead to letting through food that is sub-standard or already contaminated and then serving these meals to the children. On the upside, the majority of schools showed evidence of having procedures in place to assess products being delivered, effective stock control systems and designated holding areas. However, insufficient record-keeping undermines these positive aspects. Despite templates of the documentation to appoint suppliers that are available from DBE (DBE, 2008), school feeding programmes seem careless in using these. Emphasising the implications of not doing this has to be addressed during training.

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CHAPTER 6

TOWARDS A NOVEL QUALITY MANAGEMENT AND ASSESSMENT SYSTEM FOR A NATIONAL SCHOOL NUTRITION PROGRAMME

For submission partially or in full to:
International Journal of Food Microbiology: ISSN: 07400020, 10959998

6.1 INTRODUCTION

This chapter synthesises what has been gleaned from the literature review in Chapter 2 and the findings from the research chapters (chapters 3, 4 and 5). The aim is to develop a model that will guide the National Schools Nutrition Programme (NSNP) Management, participating schools and environmental health practitioners tasked with upholding the official regulations to evaluate the hygiene status of the participating schools and implement the prerequisites programmes (PRPs). The developed model is based on the Double Diamond Design Framework (DDDF) and employs information from fieldwork, legislation, and policy documents related to the NSNP and food safety. The thorough evaluation of schools against the set standards as gap analysis and the implementation of the rest of the PRPs will lead to the first step to implementing Hazards Analysis and Critical Control Point (HACCP).

6.1.1 Aspects of an effective food safety system and the impact of the absence of one

According to WHO (2000), millions of people worldwide suffer from foodborne diseases and illnesses annually caused by eating contaminated food. Among the common foodborne pathogens that have made headlines during the past 20 years are responsible for such as *salmonellosis*, *listeriosis*, and *Escherichia coli* 0157 infection. These microorganisms have led to some of the world's most widespread public health problems (Notermans, Gallhof, Zweitering, & Mead, 1995). The US Centers for Disease Control and Prevention (CDC) estimate that foodborne diseases are responsible for about 76 million cases, resulting in 325 000 hospitalisations and 5 000 deaths annually (Gandhi & Chikindas, 2007). The media hype has seemingly made the public distrustful of the food they consume (Bas, Ersun, Kivanc 2006).

Furthermore, the WHO (2015) proposes that the incidence rate in developing countries might be even higher than the global average but that it is difficult to ascertain as a result of inadequate surveillance data and the lack of control policies. The impact of foodborne illnesses is more severe among vulnerable groups such as children, the elderly and immunosuppressed individuals (Albrecht and Nagy-Nero, 2009; Liz Martins & Rocha, 2014). Therefore, ensuring food safety for these groups during food preparation is critical.

However, it is challenging to achieve for small-scale and newly established food preparers (Walker, Pritchard & Forsythe, 2002). This also applies to schools participating in feeding schemes such as the NSNP.

The findings discussed in the previous chapters align with earlier research signifying that the main challenges for NSNP schools range from proper and well-maintained infrastructure to facilitating food preparation and storage (Manyatsa (2007). Osaili, Al-Nabulsi, Allah Krasneh (2018) explained that inadequate infrastructure causes improper food handling and preparation; inappropriate storage conditions; poor personal hygiene and sanitation; inadequate cooking; and cross-contamination. This may ultimately lead to the spread of foodborne pathogens (Chapter 5). The literature also refers to the danger of poor personal hygiene and improper practices as a vehicle for transferring foodborne pathogens during food preparation and handling (Bou-Mitri, Mahmoud, El Gerges & Abou Jaoud 2018; Osaili *et al.* 2018). These pathogens are said to be responsible for up to 97% of foodborne illnesses in settings where food is prepared and served (Egan, Raats, Grubb, Eves *et al.* 2007). This stresses the importance of establishing effective PRPs, especially when dealing with general management procedures related to the staff and when monitoring production chains (Chapter 3) (De Oliveira *et al.* 2016).

Preventing the spread of foodborne pathogens and cross-contamination is the priority for food safety (Bou-Mitri *et al.*, 2018). Also, it is a legal obligation to implement preventative measures as part of an overall FSMS based on the principles of HACCP and GHP. However, not all establishments can afford the human effort and financial outlay to implement systems such as the HACCP.

6.1.2 Schools as formal food service establishments

According to regulations governing general hygiene requirements for food premises, food transport, and related food preparation matters (South African Department of Health, 2018), facilities are obligated to implement the HACCP and are expected to be equipped with adequate food preparation facilities. The same applies to schools participating in feeding schemes such as NSNP (Sibanyoni & Tabit, 2019) since the food handling, preparation and serving processes are no different from commercial kitchens (Figure 6.1). It has been reported that more than 19 300 schools participated in this programme during 2019 and 2020 (Department of Basic Education, 2019). However, very few schools have purpose-built kitchen facilities. Many have had to re-purpose existing infrastructure to store and prepare food for learners.



Figure 6.1: The NSNP food flow process steps resembles a typical formal food processing establishment.

6.1.2.1 Receiving

The food is delivered to schools by one or more of the 4 400 DBE-appointed suppliers and received by either the appointed teacher or one of the volunteer food handlers.

6.1.2.2 Storage

The food is then stored until required for preparation and serving to learners (Figure 6.2). From this and previous studies on the topic, storage and food-preparation areas remain two of the main areas of non-compliance with food safety guidelines (Manyatsa, 2007).

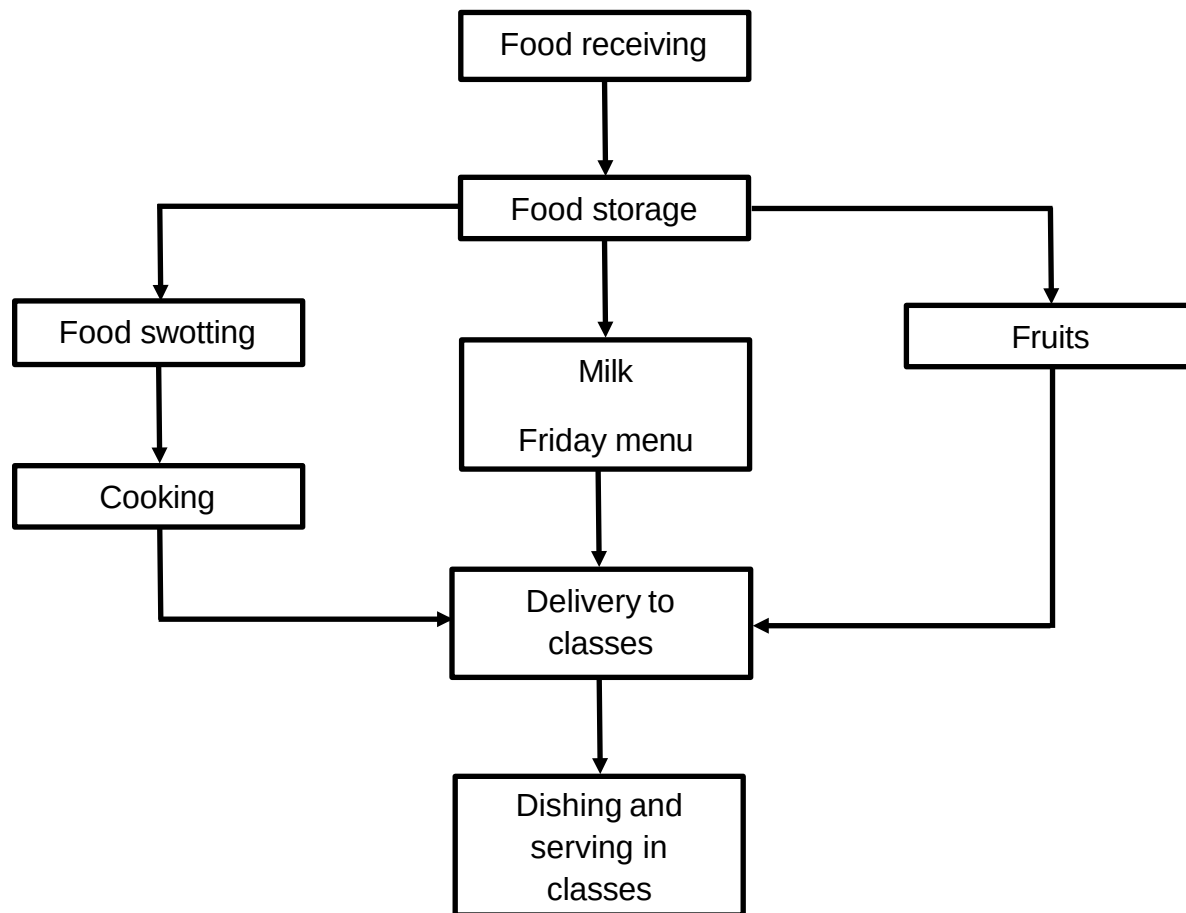


Figure 6.2: The NSNP food flow process resembles a typical formal food processing establishment

6.1.2.3 Processing

Due to the magnitude of the programme, each school is responsible for food processing. This requires effective organisation and dedication as the DBE employees are involved in the project. This includes the principal, the teachers and support staff, and members of the school governing body (SGB), who are expected to go beyond their standard job descriptions to oversee and manage the feeding scheme. Teacher coordinators with the school principals and the assigned SGB members supervise and coordinate the programme and their share of the more than 5 000 volunteer food handlers employed (Department of Basic Education, 2018; Department of Basic Education, 2019). Most

volunteer food handlers are learners' parents and are responsible for preparing the meals and serving the learners. On appointment, they receive training from the DBE, but often the volunteers have to make do with inadequate infrastructure and resources. This situation has the potential to undermine food safety.

6.1.2.4 Serving

Once prepared, the food is served to learners according to a schedule to avoid interfering with teaching and learning activities. The DBE supplies all tableware, beakers, cutlery, utensils and equipment. The absence of effective monitoring of food-safety-related activities within NSNP has encouraged the number of foodborne disease cases. Some of these cases are inspired by the deficiency of PRPs. Based on the research chapters, the school or Department of Basic Education did not fully address PRPs, including staff requirements, hygienic operating requirements, and food handling equipment. As much as staff requirements such as training voluntary food handlers are addressed, it is poorly structured. According to Regulation 638, the person in charge (food handler) must be trained in the principles and practices of food safety and hygiene, and the training must be accredited or conducted by an inspector (Environmental Health Practitioner). This is not the practice within NSNP. Conversely, research chapters reflected the number of infrastructures and equipment compliance even though most schools are not fully compliant. This chapter aims to develop a model that addresses the weaknesses in the food safety and quality management and assessment process of the NSNP.

6.2 METHODOLOGY

The model is based on the results from this study's research chapters expressing the lived experience of volunteer food handlers and on-site observations, appropriate food safety legislation and directives, education department policies and South African National Standard (SANS) 10049. The model is based on the Double Diamond Design Framework Model (DDDFM) and describes the required steps to resolve the issues rather than specific methods and tools (Ball, 2019). The DDDFM is a process-focused framework appropriate for designing a problem-solving model (UK Design Council, 2005; Clune and

Lockrey, 2014) (Figure 6.3). The process consists of four stages: 1) finding information (*Discover*); 2) interpreting and analysing the information (*Define*); 3) exploring possible solutions to the problem (*Develop*); and 4) conveying the most feasible idea to the user (*Deliver*).

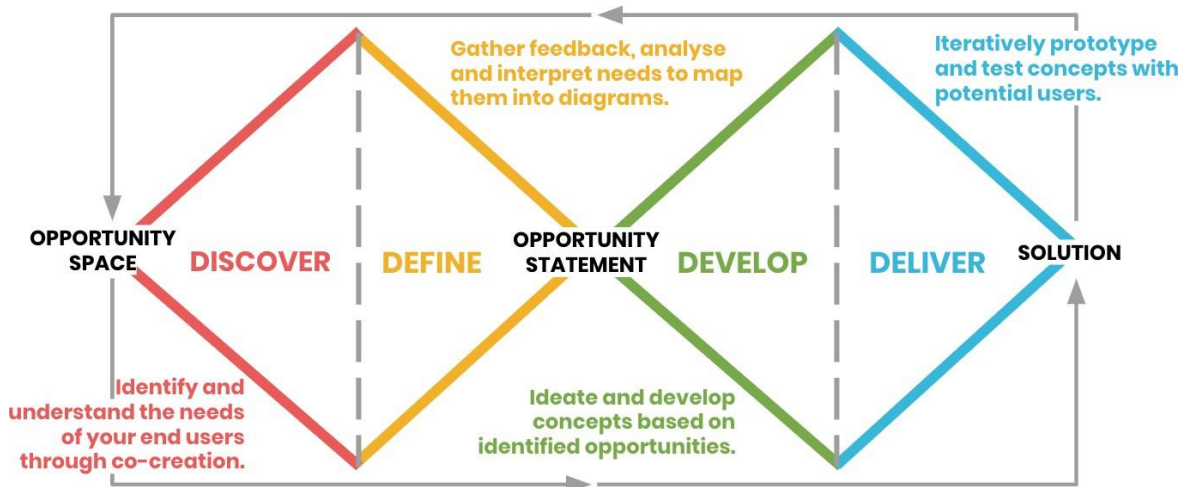


Figure 6.3: The Double Diamond Design Framework process

The **Discover stage** explores all available information about the current situation. This is an opportunity to enquire and engage with the user, or the person experiencing the problem, to learn more about them, what and how they do what they do, and to establish what problems they face. It is vital to see the picture from their point of view and not make assumptions. The **Define stage** is about sense-making. This is when the data that had been collected about the current situation are being interpreted and analysed to make evidence-based decisions that will lead to a sustainable solution to the problem. During the **Develop stage**, the researcher explores possible solutions for the user by probing the feasibility of one or more probable remedies. These options might be tested, and the cycle repeated if necessary. Finally, in **the delivery stage**, the most workable and feasible model or idea is conveyed to the user for input. Depending on their feedback, it is either a case of going back to the drawing board to improve the idea or implementing the model (Ball, 2019).

6.2.1 Statistical analysis and health risk evaluation

As part of the development stage, the selected results were tabulated in Microsoft Office Excel spreadsheets and were analysed for absolute and relative frequencies. The correlation was calculated for the significant correlations between the data related to different PRP requirement attributes gleaned from Chapter 4. Two-tailed and statistical significance was set at the conventional cut-off of $p < 0.05$. Based on the availability of PRPs in the NSNP schools, the health risk was done with an adapted method by Stedefeldt, Cunha, Silva Junior, Silva *et al.* (2013). The classification was done using data from chapters 4 and 5. The data from the checklist were divided into four thematic blocks relating to 1) building and facilities; 2) equipment; 3) volunteer food handlers; and 4) suppliers and receiving (De Oliveira *et al.* 2016). To establish the degree of risk to food safety, each block question was graded by assigning a value range from 0 to 8 to test compliance with (*no*) scoring a 0 and compliance (*yes*) an 8. Each item was classified according to its significance for upholding food safety. A score of 8 was assigned to a question that represented conditions that prevented the multiplication of microorganisms, a 4 was assigned to items that prevented the survival of organisms, a 2 to items that prevent cross-contamination via direct contact with food, and a 1 was assigned to items that blocks cross- contamination without direct contact with food. The sum of each block was tabulated in percentile and categorised: 0-20% was classified as *very high risk*, 21-40% as *high risk*, 41-60% at *moderate risk*, 61-80% at *low risk* and 81-100% as *very low risk*.

6.3 RESULTS AND DISCUSSION

The study reflected the perilous status within some schools participating in NSNP. This status presents food hazards and possible food poisoning to children benefiting from NSNP. Chapter 6 follows the DDDM with reflection from chapters 1 and 2 as background, and chapters 3, 4 and 5 research chapters present the PRPs status of the NSNP. The chapters above have discovered and defined the status that needs coordination and implementation of structured PRPs. Hence, the third stage in this section focuses on

developing and recommending the management system addressing a food safety requirement within NSNP.

6.3.1 Discover stage

Together chapters 1 and 2 serve as the exploration stage of the DDDM model by way of a literature review. This investigation indicates that hunger and malnutrition are humanity's most severe and intractable threats. Often poverty and malnutrition prevent the youth from fulfilling their potential as productive adults (United Nations, 2022). To counteract this situation, both developed and developing states have successfully implemented school feeding programmes within their communities.

The NSNP has proved itself as one of the successful school feeding programme. That is despite administrative and operational challenges such as finding the optimal menu, being moved from the health department to DBE, and lacking school infrastructure. These shortcomings and governance dynamics have sometimes contributed to more serious problems such as mismanagement and food poisoning. Several menu changes have been made to balance the lack of infrastructure, the need for food safety and providing nutritious food since the inception of the NSNP.

The current menu consists of cooked meals that include porridge, rice, vegetables, canned fish, milk and fresh fruit. This type of meal requires appropriate dry storing and reasonable care when purchasing, ordering, receiving, storing, preparing and serving to avoid food poisoning. Furthermore, it has to comply with some control measures that ensure food safety such as the Foodstuff, Disinfectants and Cosmetics Act (1977) and its regulations governing general hygiene requirements for food premises and for transporting food (R638); SANS 10049; and the NSNP's own policies. Unfortunately, these mandates are seldom applied in an integrated manner, and are sometimes not followed. The aim of this chapter is to incorporate all of these guidelines and obligations to develop a more efficient food safety system for the schools participating in NSNP using the DDDM method.

6.3.2 The Define stage

Chapters 3, 4 and 5 served as the data capturing stage to explore the 1) volunteer food handlers' prerequisites and basic knowledge, attitudes, and self-reported food handling practices; 2) level of adherence to prerequisites related to food-preparation facilities and hygiene operating guidelines; and 3) whether GMPs are adhered to at the 98 participating NSNP schools in the Mangaung Metropole in the Free State. The data collection interrogated the existing PRPs to expose the gaps within these low-income (quintile 1, 2 and 3) schools.

6.3.2.1 Chapter 3 - getting to know the volunteer food handlers

With more than 85% of the staff involved in food handling within the NSNP-participating schools being females, 70% falling between the ages of 20 and 40 years, and 68% having Grades 11 - 12 or tertiary education. It would make sense to design the proposed food safety training programme with this demographic profile in mind when planning, managing and coordinating volunteer food handlers.

The fact that more volunteer food handlers are females and young people helps the government's reparation mission to uplift the previously disadvantaged (females) and create jobs for young people (youths). According to Regulation R638, anyone working with food should be suitably qualified or adequately trained in food safety and hygiene principles and practices, either by an environmental health practitioner or any other suitable person. The training should cover food safety and hygiene principles and practices. The learning programme should be registered and aligned with the South African Qualification Authority's National Qualification Framework (SAQA NQF) for quality assurance purposes (Table 6.1) (SAQA, 2008).

Table 6.1: South African Qualification Authority's National Qualification Framework (SAQA NQF)

NQF LEVEL	DESCRIPTION
NQF: ONE	Grade Four to Grade Nine (Standard two to Standard Seven)
NQF: TWO	Grade Ten (Standard Eight)
NQF: THREE	Grade Eleven (Standard Nine)
NQF: FOUR	Grade Twelve (Standard Ten / Matric)

Based on the data, the training material can be written in English and presented in both South Sotho, as dominant language in the area, and in English. However, volunteer food handlers with lower levels of education (9%) must also be accommodated. Pertinent information regarding the demography of the volunteer food handlers captured before employment is critical to guide the training to be offered (example of the form – see Appendix 3). The basic training for food handlers can also be aligned with other existing training.

The SETA responsible for the food and beverages industry (FoodBev) has registered a training course on applying GMP as part of a food safety system (US ID 20403) at NQF Level 2 (Grade 10). This also includes instructing the supervisor or overseeing the volunteer food handler. This course offers an opportunity to undergo formal training and be certified under approved standards. Furthermore, the volunteer food handler is able to add on courses on related standards, and in that way can earn a qualification. The training unit standard covers the following learning areas:

- Cleaning and sanitising.
- Personal health and hygiene practices.
- Control of pests and waste materials.
- Location, design, construction and maintenance of buildings and equipment.
- Adequate supporting services (water, air, steam and ice).
- Transport and distribution of foodstuffs.

- Storage and handling.
- Process control.
- Supplier quality assurance.
- Standard operating procedures and related records.
- Training, among others.

Other resources available to guide the design of a comprehensive school feeding scheme food safety training programme, is the WHO's *Five Keys to Safer Food* manual (WHO, 2018). This training tool is designed for anyone working in a food processing chain. It can be adapted to any particular food sector and its volunteer food handlers' knowledge and skills level. However, the manual is not registered as a SAQA unit standard but must be presented by a knowledgeable person. While the content remains the same, the presentation is tailored to the knowledge level of each group of volunteer food handlers. The core topics and the rationale for including in the proposed model are presented in Table 6.2. The content and training methods of the FoodBev SETA aligned training and the WHO's *Five Keys to Safer Food* manual can be integrated to improve knowledge and skills levels and influence the attitudes of volunteer food handlers (Figure 6.4). In general, the implemented training must be continuous, presented in both English and the locally dominating language and most of all, the food handlers' practices must be monitored continuously.

Table 6.2: Five keys to safer food core information and content (WHO, 2018)

Key 1: Keep clean	
Core information - Wash your hands before handling food and often during food preparation - Wash your hands after going to the toilet - Wash and sanitise all surfaces and equipment used for food preparation - Protect kitchen areas and food from insects, pests, and other animals	Why While most microorganisms do not cause disease, dangerous microorganisms are widely found in soil, water, animals, and the human body. These microorganisms are present on hands, wiping cloths, and utensils, especially cutting boards, and the slightest contact can transfer them to food and cause foodborne diseases.
Key 2: Separate raw and cooked	
Core information - Separate raw meat, poultry and seafood from other foods - Use separate equipment and utensils such as knives and cutting boards for handling raw foods. - Store food in containers to avoid contact between raw and prepared foods	Why Raw food, especially meat, poultry and seafood and their juices, can contain dangerous microorganisms which may be transferred onto other foods during food preparation and storage.
Key 3: Cook thoroughly	
Core Information - Cook food thoroughly, especially meat, poultry, eggs, and seafood - Bring foods like soups and stews to boiling to make sure that they have reached 70°C. For meat and poultry, make sure that juices are clear, not pink. Ideally, use a thermometer - Reheat cooked food thoroughly	Why - Proper cooking can kill almost all dangerous microorganisms. - The cooking food to a temperature of 70°C can help ensure it is safe for consumption. - Foods that require special attention include minced meats, rolled roasts, large joints of meat and whole poultry.
Key 4: Keep food at safe temperature	
Core information - Do not leave cooked food at room temperature for more than two hours - Promptly refrigerate all cooked and perishable food (preferably below 5°C) - Keep cooked food piping hot (more than 60°C) prior to serving - Do not store food too long, even in the refrigerator - Do not leave frozen food at room	Why - Microorganisms can multiply very quickly if food is stored at room temperature. By holding at temperatures below 5°C or above. 60°C, the growth of microorganisms is slowed down or stopped. Some dangerous microorganisms still grow below 5°C.
Key 5: Use safe water and raw material	
Core information - Use safe water or treat it to make it safe - Select fresh and wholesome foods - Choose foods processed for safety, such as pasteurised milk - Wash fruits and vegetables, especially if served raw - Do not use food beyond its expiry date	Why Raw materials, including water and ice, may be contaminated with dangerous microorganisms and chemicals. Toxic chemicals may be formed in spoilt and mouldy foods. Care in selection of raw materials and simple measures such as washing, and peeling may reduce risk.

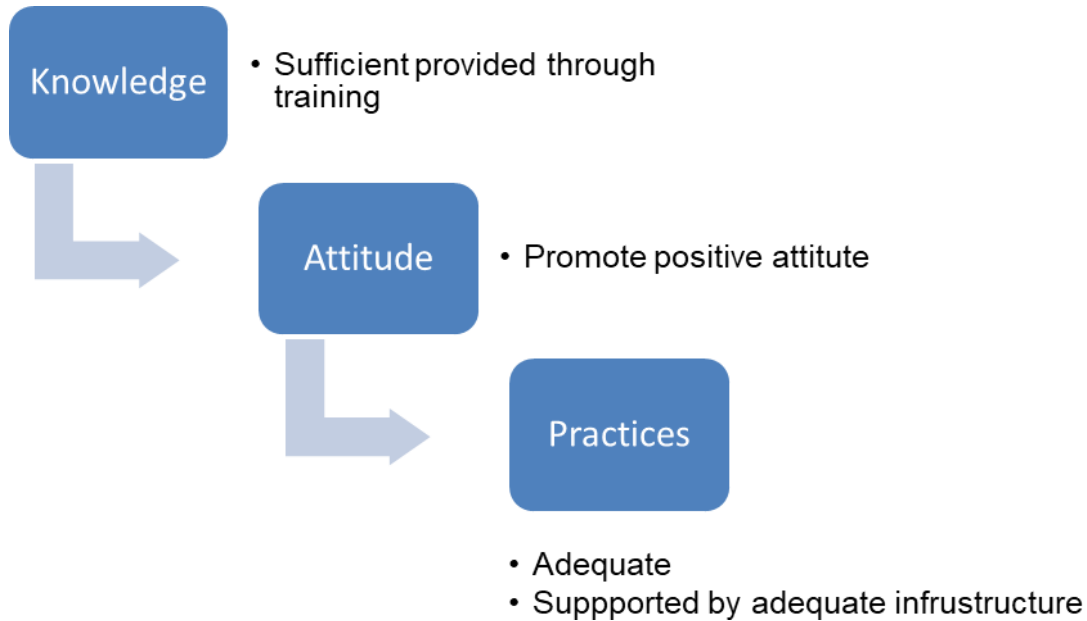


Figure. 6.4: Application of knowledge, attitudes and practices for efficient training (Zanin, Cunha, Rosso, Capriles *et al.*, 2017)

6.3.2.2 Descriptive and inferential alignment (Chapters 4 and 5)

In chapters 4 and 5 the investigation results into the status of basic infrastructure, including location and food preparation structures at participating NSNP schools. According to the literature, this was necessary as inadequate structures and insufficient facilities interconnect to increase the risk of food contamination and possible food poisoning cases. In addition, the maintenance of such facilities, food preparation equipment and hygienic operating prerequisites still needed attention. Although most feeding schemes showed evidence of implementing some form of FSMS, there is room for improvement. Implementing an effective management system, however, is hampered by most not originally having been designed to accommodate serving food to learners. At these schools, the NSNP has had to make do with make-shift and very basic structures

for food preparation and storage facilities, hindering the implementation of effective PRPs. This, in turn, undermines any attempt at instituting a HACCP.

An efficient HACCP is contingent on the PRPs being in place, but implementing the latter in sub-standard structures and inadequate facilities poses a big challenge. The overview presented in this study may assist policymakers and the persons implementing the NSNP at schools to prioritise implementing some of these structures (Table 6.3). Table 6.4 and Figure 6.5 illustrates the health risks posed by different structures and facilities at participating schools. The rationale behind determining the relationship between PRPs and health risks is to indicate that a shortcoming in one PRP influences other PRPs and weakens the whole system. For example, there is a strong uphill linear relationship (p -value = 0,86) between buildings of sound structure and smooth, corrosion-resistant finishing prescribed by a number of standards and regulation. The evenness and ability of surfaces to not react chemically to substances safeguards against contamination and harbouring pests.

On the other hand, the calculations showed a weak downhill correlation between easy-to-clean floors and odour-free facilities (-0,45), and a weak uphill correlation between food handling areas being used as storage and the walls being in good condition (0,40). Also the correlation between food handling equipment and either separate rooms, or having designated spaces showed a weak positive relationship (0,40). The same with labelled hazardous substances being labelled and impermeable walls and windows (0,45). The pest-free areas seem to have a moderate downhill relationship (-0,48) with both hand-washing basins and functionally designated facilities.

Some of the factors that appear to show a correlation with one another comes as a surprise such as untidy floors and the odours emanating from food preparation that lead to stuffiness in the kitchens and storage areas. This might even lead to a severe situation such as biofilm formation and contamination of food. According to DBE guidelines, all PRPs have to be implemented, as the failure to do so undermines food safety (DBE, 2008). In Table 6.5 and Figure 6.5, the current health risks profile of the school that had been assessed, is presented. The table and figure classify the NSNP-participating schools according to the health risks posed by identifying whether one or all of the following need to be attended to: buildings and facilities, equipment, volunteer food handlers; suppliers, and

receiving areas. This could be helpful for policymakers, NSNP officials, and the people implementing the feeding scheme at their schools.

Buildings, facilities and equipment all play a major role in food safety; hence the emphasis on the SANS 10049 and Regulation 638. On average, the health risk posed by buildings and facilities is an average of 55%, with 15% posing a low risk. Although only 2% presented a very high risk, 26% posed a very high risk, and 26% an unacceptably high rate. The same applies to the safety of equipment (very high = 4%, high = 18%, moderate = 60.2%, low = 17.3 and very low = 0) At most schools, volunteer food handlers find it difficult to apply good food storage practices increasing the risk of cross-contamination and food spoilage.

Table 6.3: Correlations amongst various prerequisites programmes

	A.	B.	C.	D.	E.	F.	G.	H.	I.	J.	K.	L.	M.	N.	O.	P.
A.		-0,20	0,34	-0,20	-0,45	-0,04	-0,03	-0,22	-0,19	-0,29	-0,32	0,15	-0,07	-0,03	-0,09	0,07
B.			0,44	0,86	-0,34	0,09	0,14	-0,18	0,26	-0,13	-0,21	-0,21	0,22	0,30	0,09	0,04
C.				0,35	-0,18	0,08	0,27	-0,16	0,40	-0,25	-0,35	-0,04	0,42	0,15	0,03	0,13
D.					-0,27	0,09	0,14	-0,18	0,26	-0,13	-0,13	-0,21	0,14	0,30	0,02	0,04
E.						0,12	0,12	0,37	0,26	0,38	0,47	-0,19	0,15	-0,18	-0,05	-0,12
F.							-0,14	0,11	0,12	0,13	0,13	0,05	0,02	0,14	-0,02	0,03
G.								0,04	0,12	-0,29	-0,18	-0,12	-0,07	-0,48	0,23	0,15
H.									0,33	0,40	0,14	0,23	0,20	-0,48	-0,07	0,04
I.										0,38	-0,14	-0,19	0,67	-0,06	-0,14	0,13
J.											0,16	-0,31	0,26	-0,05	-0,08	-0,05
K.												-0,21	-0,27	0,10	-0,04	-0,25
L.													-0,04	-0,20	-0,04	0,06
M.														0,11	-0,09	0,20
N.															-0,23	-0,18
O.																0,23

A) Odours, smoke and dust-free ; **B)** Sound construction and spacious; **C)** Weatherproof and impermeable walls, windows and doors; **D)** Smooth, corrosion resistant walls; **E)** Water impermeable, corrosion-resistant, and easy-clean floors; **F)** Screened windows; **G)** Hand-wash basins with hot and cold running water ; **H)** Separate rooms or well-defined areas; **I)** Food handling area not used for storage purposes; **J)** Food grade food handling equipment and utensils; **K)** Appropriate facility for the storage of water; **L)** Food handling areas are maintained in cleanliness; **M)** Hazardous substances clearly labelled and identified; **N)** Pest-free food handling areas; **O)** Materials not stored directly on the floor; **P)** Separate storage facilities for food product materials

The DBE as the NSNP administrator and the body that controls school property must ensure the compliance of the buildings and facilities and equipment used for food preparation. In addition, all activities must be documented to allow proper management of food safety. This aspect has been shown to be a serious weakness in the process from the supply to receiving deliveries.

The result is that the health risks posed by school feeding schemes fall into the high to very high range. Also, as the study results indicate, most suppliers do not comply with guidelines when purchasing, transporting and delivering goods. It underscores possible flaws in the appointment procedures. The elevated risks this pose is further exacerbated when the procedures at the receiving side are not in place. That is why this stage in the food-serving process is regarded as key to food safety management. Despite it being addressed in the guidelines for feeding schemes compiled by DBE, implementing these recommendations have to be prioritised.

Although the important responsibility of volunteer food handlers in maintaining food safety is often raised in the literature, this study has found that rather than being supported by the food safety practices, the work of volunteer food handlers is undermined by the absence thereof. This is reflected in figures related to volunteer food handlers raising the health risks that ranges from average to very high. The percentage of schools where volunteer food handlers' own actions pose a high risk to food safety is 62.2% and those posing a very high risk at 16.3%. The lack of knowledge, skills and attitudes leading to these statistics can however be addressed during training before certification.

Table 6.4: The distribution of NSNP-participating schools according to health risk classifications

	Block health risk				
	Very high	High	Average	Low	Very low
Building and facilities	2 (2,0%)	26 (26,5%)	55 (56,1%)	15 (15,3%)	0
Equipment	4 (4,1%)	18 (18,4%)	59 (60,2%)	17 (17,3%)	0
Volunteer food handlers	16 (16,3%)	61 (62,2%)	21 (21,4%)	0	0
Suppliers and receiving	67 (68,4%)	31 (31,6%)	0	0	0

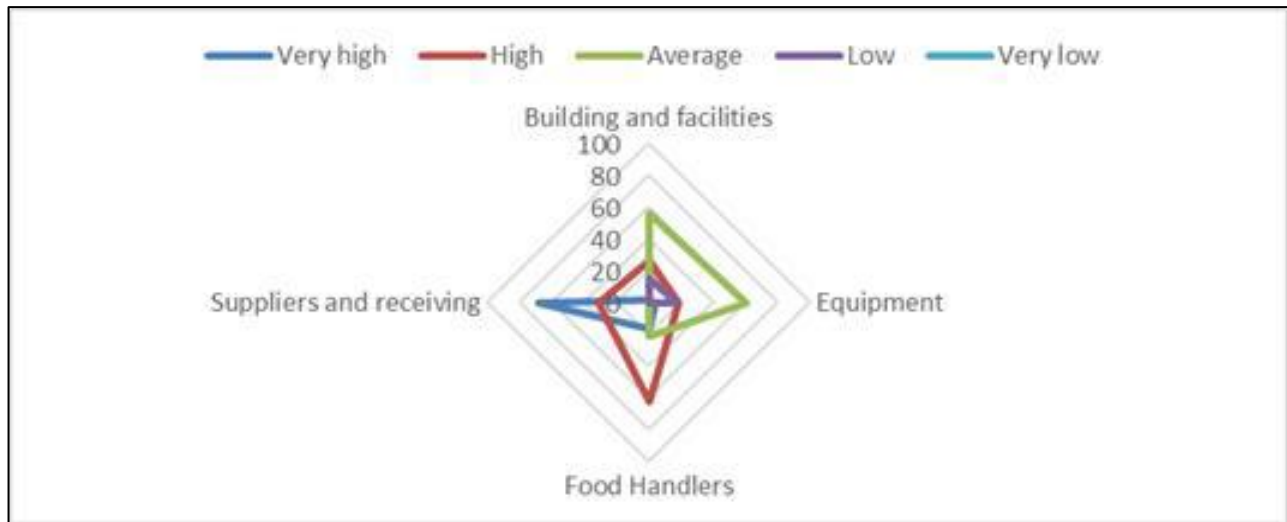


Figure 6.5: The spider web representation of the health risks of the school participating within the NSNP

6.3.3 Development stage: The proposed FSMS Model for schools participating in NSNP

Considering all the data collected in the previous stages, the next step is to develop a comprehensive system for the schools participating in NSNP to manage food safety effectively. This system encompasses all relevant legislation and guidelines and provides the necessary documents, a list of required PRPs and the inspection checklist. The goal is to provide schools participating in school feeding programmes with a comprehensive tool to guide them towards establishing a food-safe environment through PRPs that support an effective HACCP. Each school will be able to develop and document its PRPs that can be monitored and verified against a particular regulation or standard. The school can also appoint or nominate a designated person who will be responsible for the development and evaluation of its PRPs. The following section describes the proposed FSMS Model for schools participating in NSNP and comprises the sub-sections.

6.3.3.1. Point of reference

This proposed programme is based on the following:

- Results from the research done
- Literature review resources
- South African National Standards (SANS) 10049 (South African Bureau of Standards, 2019)
- South African Department of Health's norms and standards for environmental health in South Africa Feb 2013 (Appendix 5)
- National School Nutrition Programme's guidelines for schools (Appendix 1)
- Foodstuffs, Cosmetics and Disinfectants Act, 1972 (Act No. 54 Of 1972): Regulations Governing General Hygiene Requirements for Food premises, the Transport of Food and Related Matters No. 638 (Appendix 6)

6.3.3.2 Legislation

The following list includes but is not limited to the legislation, standards, policies and compulsory specifications consulted to compile the documents:

- Related local authority by-laws
- National School Nutrition Programme's guidelines for schools
- South African Department of Health's norms and standards for environmental health in South Africa (Feb. 2013)
- Foodstuffs, Cosmetics and Disinfectants Act, 1972 (Act No. 54 Of 1972): Regulations Governing General Hygiene Requirements for Food Premises, the Transport of Food and Related Matters No. 638
- South African National Standards (SANS) 10049
- South African National Standards (SANS) 241 (drinking water)
- South African National Standards (SANS) 5763 (efficacy of cleaning plant, equipment and utensils: swab technique)
- National School Nutrition Programme's guide for implementation and reporting (2004)
- National School Nutrition Programme's guide for secondary schools (2009)
- The National School Nutrition Programme's safety directory (no date)
- Mnandi For Sure, A recipe book for the National School Nutrition Programme (no date).
- Approved NSDP menus - Approved 2010/11 Provincial Menus (2010e)
- National School Nutrition Programme guide for equipment and utensils (2011b)
- National School Nutrition Programme's guidelines for developing a nutrition education strategy (no date)
- National School Nutrition Programme's guidelines for establishing and sustaining food gardens (no date)
- National School Nutrition Programme's guidelines for managing and conducting health surveillance of volunteer food handlers

6.3.3.3 Documentation and records keeping

All forms completed to document processes as part of the feeding programme need to be recorded and kept safe as prescribed by SANS 10049 and Regulation 638. The following records should be kept:

- DBE NSNP food and recipe specifications.
- Supplier information and conditions of food products delivered.
- Reports on all the external and internal monitoring done including the inspection checklists.
- Certificate of acceptability issued by the NSNP and other related certificates of approval such as safety certificate for gas stove installation.
- Training-related documents including attendance registers, course information and copies of certificate issued.

All documents must be reviewed before being filed for non-conformance and analysed per documented procedures.

6.3.3.4 Control of documents and records (documentation)

All documents and records must be kept in a secure area controlled by the school principal and the NSNP supervisor (SABS, 2019). Documents have to be managed as follows:

- i. All documents, reports and checklists that have been completed must be dated and signed by the assigned person and approved by either the principal or the assigned teacher.
- ii. All processes and procedures must be aligned with the latest versions of policies and legislation. Documents must, as soon as possible, be updated after changes to policies and legislation have been announced. All processes and procedures must be reviewed annually or whenever anything related to the specific facility changes - also when a new food preparation facility is introduced.

6.3.3.5 Management responsibilities

6.3.3.5.1 Responsibilities and authority

- *The National and Provincial Departments of Basic Education*
 - Develop and submit a food safety policy document to provincial and district offices of Departments of Basic Education.
 - Evaluate and approve food safety reports generated by provincial and district offices of Departments of Basic Education and submit to the South African Department of Health.
 - Manage, monitor and support food safety programme implementation in provinces.
 - Ensure compliance with Regulation 368 and NSNP guidelines.
 - Monitor and provide support to districts and schools with regard to facilities and equipment promoting food safety.
 - Develop a monitoring and evaluation plan for food safety within the NSNP-participating schools.
 - Provide human resources to promote food safety capacity at all relevant levels and earmark the funding to promote food safety in schools.
- *Responsibilities of the district*
 - District officials must conduct food safety inspections by visiting schools at least once or twice per quarter, and more regularly if needed.
 - The monitoring tool indicated that the school was spending more than allocated through the NSNP and serving meat portions not budgeted for in the provincial menu.
 - The district officials therefore had to investigate and assist the school to complete the monthly report accurately based on using NSNP funds only.
 - To ensure accountability, a school has the responsibility to keep copies of all documents submitted to the district office.

- *The NSNP Coordinator: Management representatives*

The provincial and the district offices are tasked with appointing NSNP coordinators who, in turn, are responsible and are mandated to:

- Ensure that the PRP are established, implemented, maintained and continually improved in accordance with the requirements of this standard.
- Report on the effectiveness and suitability of the PRP to the both the district and provincial offices of DBE.

- *The school principal serves as the accounting officer*

As the person carrying the final responsibility for the effective operations in the NSDP in a school, the principal:

- Is responsible for the overall implementation and management of PRPs.
- Must nominate an educator or administrator as the coordinator of the NSNP in the school.

- *NSNP School Coordinator*

- Must assume operational responsibility for the food safety of the NSNP.
- Supervise the programme's day-to-day activities, including receiving and recording stock, keeping updated records of all PRPs; recording all meals served and carrying out and documenting inspections.
- Ensure that all volunteer food handlers attend food safety training workshops.

- *Caretaker*

The appointed caretaker must:

- Monitor the volunteer food handlers during preparation and cooking, when serving meals and cleaning the cooking area and tableware afterwards.

- Ensure that a high level of personal hygiene is maintained.
 - Carry out regular inspections.
-
- *Volunteer food handlers*
Volunteer food handlers are responsible for everything related to food, including safe:
 - preparation,
 - cooking,
 - serving of meals, and
 - cleaning the cooking area.

The volunteer food handlers are expected to maintain a high level of personal hygiene.

6.3.3.5.2 Resources

The DBE must provide competent and adequately trained staff to serve as volunteer food handlers (SABS, 2019). In addition, the food establishments must be adjusted and renovated to handle food safely. While some of the newly-built facilities meet the required status for food handling facilities, classrooms have had to be converted in some cases. These need to be adapted and brought up to standard (figures 6.6, 6.7 and 6.8).

Although furnished with the necessary equipment and tableware by the department, additional equipment such as hot-handling and cold storage needs to be provided. A diagram of a proposed new floor plan for classrooms used as kitchens illustrates alterations such as separate storage areas for food and non-food items and water basins.

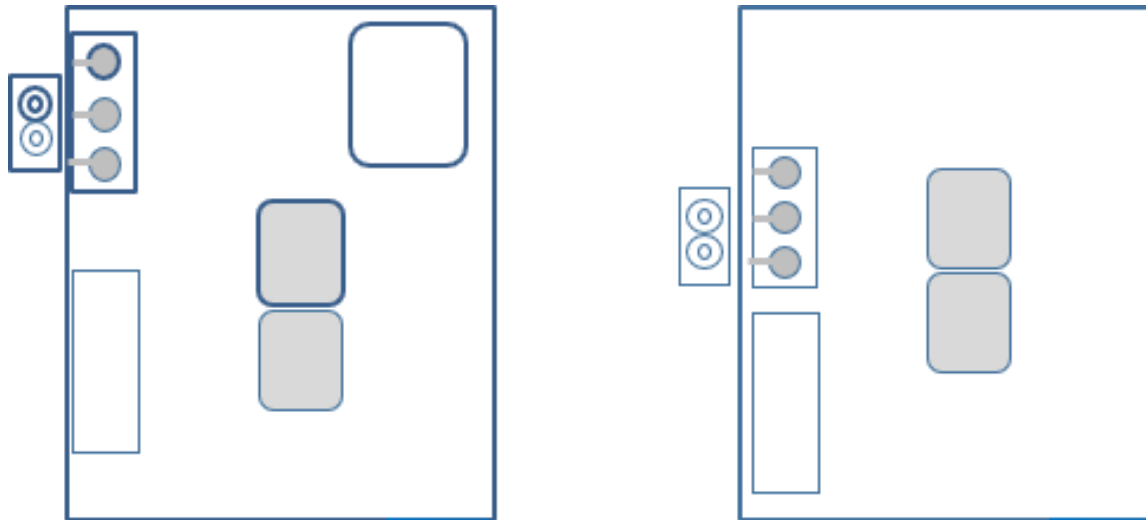


Figure 6.6: Typical classroom-turned-into-kitchen layout to accommodate the NSNP



Figure 6.7: Typical layout of a newly-built kitchen for the NSNP

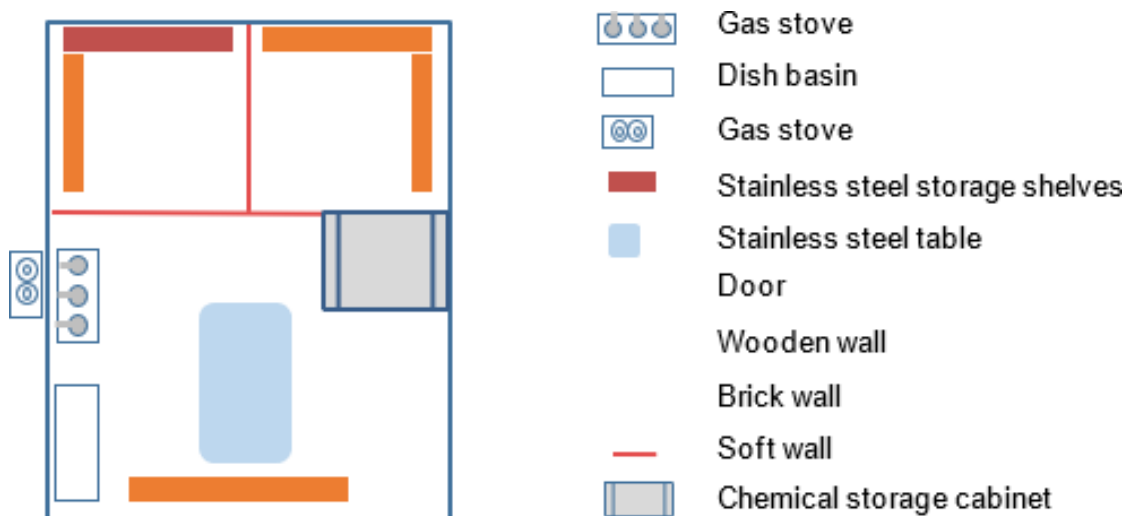


Figure 6.8: Proposed modifications to the layout of a classroom that is used as a kitchen for the NSNP by the researcher

6.3.3.5.3 Management review

The DBE and NSNP-participating school must review the food safety programme; when:

- the new school year starts;
- significant changes occur in the operational procedures;
- changes to the policy are announced; and
- changing of the menu, infrastructure or the supplier occurs.

6.3.3.6 Prerequisites Programme Requirements (PRP)

The PRPs should be fully implemented and monitored daily, weekly, and monthly (Table 6.5). During the inspection, attention should be paid to possible pest infestation and hazards, and those should be reported.

Table 6.5 Audits / inspections plan describing the audit programme's area, frequency, responsibility, and documentation

Monitoring	Area / items	Frequency	Responsible person	Documentation	Evidence
School self-inspections	Kitchen	Daily	Voluntary food handler	Inspection checklists	Daily report
	Storage	Before preparation			
	Kitchen	Weekly	Caretaker	Inspection checklists	Weekly report
	Storage				
	Kitchen, storage	Monthly and annual	Caretaker / NSNP school coordinator	Inspection checklists	Monthly report
	Waste storage				
	Surrounding area				
Environmental Health: Regulatory inspection	Food preparation areas, (to include analysis of food risks); water, waste, sanitation and hygiene practices	Bi-annually (not less than twice in a year)	Environmental health practitioner	R638	Certificate of acceptability
Supplier audits	Establishment/ storage and documentations	Bi-annually (not less than twice in a year)	Environmental health practitioner	R638	Certificate of acceptability
	Incoming goods	Received goods inspection	Voluntary food handler Caretaker	Received goods inspection checklists	Delivery receipt Monthly report
Departmental audits / inspection	Location, facility kitchen, storage and equipment	Annually	NSNP school coordinator	NSNP implementation guidelines	NSNP authorisation
	Kitchen, storage and equipment	Monthly	NSNP school coordinator	Departmental inspection checklist	School status quo report

Table 6.6 depicts the PRP requirements and the assigned responsibilities. As much as some of these PRPs already exist, their monitoring is still critical. Each establishment must rework and adapt the criteria to their specifications and in the context of local regulation.

Table 6.6 The Prerequisite Programme (PRP) for food safety in NSNP-participating schools

PRP	Description	Responsibility
Location and layout of the food preparation area	• The location of the school kitchen and food storage space is kept free from sources of contamination • The school kitchen and food storage space are of sound construction, in good repair, and large enough • The school kitchen and storage space are well-drained and adequately fenced • Outdoor work areas on the premises have a permanent surface made of durable material • The school kitchen, storage space and equipment are designed to allow prompt processing of raw materials • The school kitchen and food storage space are so constructed as to prevent the entry and harbouring of pests, rodents and birds • The school kitchen and food storage space are located away from areas subjected to flooding, infestations and contact with microorganisms • Sewage and effluent lines are so constructed to avoid the contamination of potable water supplies, food handling areas, food ingredients, and food products	Department of Basic Education

Table 6.6 (Continued): The Prerequisite Programme (PRP) for food safety in NSNP-participating schools

PRP	Description	Responsibility
Roofs and ceilings	- The school's kitchen and food storage space's roofs are weatherproof and made of non-absorbent material - The school's kitchen and food storage space's roofs prevent contamination and build-up of dampness indoors - The roofs and ceilings of the school's kitchen and food storage spaces fit securely to the walls - The roofs and ceilings of the school's kitchen and food storage space are at least 2.4 m above the floor - The roofs and ceilings of the school's kitchen and food storage space are at least 300 mm above any moving equipment - The ceilings in the school's kitchen and food storage spaces are dustproof, light-coloured and constructed from impermeable material	Department of Basic Education
Illumination	- The school's kitchen and food storage space have access to natural light and are furnished with artificial lighting of sufficient intensity - The lights are covered to protect against dust and steam	Department of Basic Education
Ventilation	- The ventilation and extraction system of the school's kitchen and food storage space is sufficient to prevent condensation and control the temperature - Air entering the school's kitchen and food storage space is free from noxious fumes, vapours, dust and contaminating aerosols - The windows of the school's kitchen and food storage space are designed for ventilation and have fly screens	Department of Basic Education Participating school

Table 6.6 (Continued): The Prerequisite Programme (PRP) for food safety in NSNP-participating schools

PRP	Description	Responsibility
Walls, windows and doors	• The exterior walls of the school's kitchen and food storage space are weatherproof and water impermeable • The interior walls of the school's kitchen and food storage spaces are smooth, washable, corrosion-resistant, light coloured and water-impermeable • The interior walls of school's kitchens and food storage spaces have a height of at least 2 m above the floor • The ledges of the inside walls and windowsills of the school's kitchen and food storage space are sloped towards the floor at a 45° angle • The school's kitchen and food storage space have glass and are protected from any breakage • Openings in walls for pipes and vents are smoothed out and sealed • The doors and door frames of the school's kitchens and food storage space are made from corrosion-resistant, smooth, seamless, water-impermeable and light-coloured material • The passages door to the school's kitchen and food storage spaces are wide enough to allow traffic flow and easy movement of equipment • The doors of the school's kitchen and food storage spaces have to be rodent-proof, tight fitting, and have self-closing mechanisms • The doors of the school's kitchen and food storage spaces should open from the outside and have effective air screens or should be self-closing	Department of Basic Education

Table 6.6 (Continued): The Prerequisite Programme (PRP) for food safety in NSNP-participating schools

PRP	Description	Responsibility
Floors and drainages	• The floors of the school's kitchen and food storage spaces are constructed from concrete or material that are water-impermeable, corrosion-resistant and easy to clean • The floors of the school's kitchen and food storage spaces are smooth but not slippery, crackfree • The floors of the school's kitchen and food storage space are sloped to allow draining into gullies, sumps and sewers exterior to the buildings • The outlets on the floors of the school's kitchens and food storage spaces have traps that prevent rodents from accessing • The drainage channels of school's kitchen and food storage spaces are accessible and have removable covers • If any, the school's kitchen and food storage gully traps are fitted with easily removable strainers • The drains or channels in the floors of the school's kitchen and food storage space are designed to allow easy maintenance and cleaning and they empty effectively • The drain vents of the school's kitchen and food storage space emit to the atmosphere before joining a sewer	Department of Basic Education
Storage facilities	• Storage facilities for edible products, equipment and food-preparation materials are vermin-proof, dry and free from any source of contamination • Storage facilities for cleaning and disinfection materials do not contain foodstuff and food handling equipment ,and they are labelled • Food storage is separated from other facilities • The food is stored above the floor	Department of Basic Education Participating school Volunteer food handlers

Table 6.6 (Continued): The Prerequisite Programme (PRP) for food safety in NSNP-participating schools

PRP	Description	Responsibility
Hand-washing facilities	• The school's kitchen's hand-washing facility is readily available • The school's kitchen's hand-washing facility is supplied with hot and cold potable running water • The school's kitchen's hand-washing facility has a supply of unscented liquid soap, hand-cleaning detergent, or hand disinfectant • The school's kitchen's hand-washing's is supplied with single-use, disposable paper towels or a clean cloth towel • The school's kitchen's hand-washing facility is made of corrosion-resistant, water-impermeable, easy-to-clean and smooth material • The school's kitchen's hand-washing facility drains directly to drainage channels	Department of Basic Education Participating school Volunteer food handlers
Comfort facilities	• Change rooms, toilets, hand-washing basins are situated away from food handling areas • Toilets are situated separate from change rooms and is equipped with its own hand-washing basins • There is hot and cold running water, nailbrushes, unscented liquid soap, hand detergent and disposable paper towels available in the toilet facilities • Toilet facilities are kept clean and tidy, has refuse bins and is adequately ventilated	Department of Basic Education Participating school Volunteer food handlers
Waste facilities	• Waste facilities are provided inside and outside the food handling facilities • Waste facilities are cleaned daily • Waste facilities are designed to prevent any form of contamination	Department of Basic Education Participating school Volunteer food handlers

6.3.3.7 Equipment for food handling within schools

The equipment supplied to NSNP-participating schools must allow free movement of the food handlers and be easy to keep clean and maintained. In addition, maintenance of the equipment and monitoring of measuring devices, if any, should take place (Table 6.7).

Table 6.7. Prerequisite Programme (PRP) for food safety in NSNP-participating schools

Standard	Description	Responsibility
Conditions of equipment for food handling	- Food handling equipment and utensils that come in contact with the food must be smooth, light-coloured and of a suitable corrosion-resistant, non-absorbent food grade material - Machinery and equipment must be suitable for food handling processes and prevent the contamination of the food product during operations - Surfaces with which the food comes into contact must be easy to clean and should not be painted - Equipment must be installed away from the walls and ceilings or high enough above the floor to allow access for cleaning and inspection	Department of Basic Education
Maintenance of equipment	- The person in charge must keep maintenance records - Maintenance must be carried out by suitably trained staff	Department of Basic Education Participating school Volunteer food handlers

Table 6.7 (Continued): Prerequisite Programme (PRP) for food safety in NSNP participating schools

Standard	Description	Responsibility
Monitoring of measuring devices	- There must be monitoring procedures and schedules for measuring devices such as thermometers for measuring the heat and cold - Appropriate action must be taken against non-conformance - Records of devices and their calibration status must be maintained - Verification must be conducted and records are maintained	Participating school Volunteer food handlers

6.3.3.8 Hygienic operating requirements

Table 6.8 highlights the hygiene operating requirements as required within schools participating in NSNP. Each school must implement and monitor these requirements. All the documentation and record-keeping must be in place.

Table 6.8 Hygienic operating requirements for NSNP-participating schools

Standard	Description	Responsibility
Water	- Water used in the food handling area must comply with SANS 241. - Appropriate facility for the storage and distribution of water must be provided - Flexible water hoses must be made of a suitable material for food safety and reels for their storage should be provided	Department of Basic Education Participating school

Table 6.8 (Continued): hygienic operating requirements for NSNP-participating schools

Standard	Description	Responsibility
Environmental temperature and humidity control	Appropriate facilities for preparing, heating, cooling, refrigerating, freezing and storing food must be available with devices for monitoring time and pressure	Participating school
Cleaning and disinfection	- The food handling areas must be maintained in an appropriate and suitable state of cleanliness at all times - A documented cleaning and disinfection programme for the premises, equipment, containers, and vehicles must exist	Participating school Volunteer food handlers
Management and control of hazardous substances	- Hazardous substances must be handled by authorised and properly trained staff or by persons under strict supervision of trained staff - Care must be taken to avoid food contamination and the environment during handling - Hazardous substances must be clearly labelled and identified - There must be emergency procedures for dealing with the accidental contamination of food, of staff and of the environment as a result of spillage of hazardous substances during handling - Appropriate personal protective equipment (PPE) for staff handling hazardous substances must be provided	Participating school Volunteer food handlers

Table 6.8 (Continued):hygienic operating requirements for NSNP-participating schools

Standard	Description	Responsibility
Management and control of pests	• All food handling areas must be pest-free • An effective pest control programme must be documented and implemented • Pesticides must not be used in food handling areas while preparation, processing and packaging are in progress • Only registered pesticides must be used in accordance with the manufacturer's instructions • Pest control operator must be suitably qualified and trained. There must be a certified copy of the pest control operator's qualification held by the food handling organisation • Pesticides and cleaning chemicals must be stored away from wrapping material, containers, raw materials or the food product • Bait stations must be of a lockable type and are not placed in food handling areas where food could be contaminated • Pest-control records must be well-maintained and up-to-date • Records of verifications must be kept and available on request	Department of Basic Education Participating school Volunteer food handlers

6.3.3.9 Personal hygiene for NSNP-participating schools' volunteer food handlers

The adherence of voluntary food handlers to food safety principles plays a critical role in maintain food in good condition for the learners. The adherence of VFH to food can be followed through standard operating procedure (SOP). Below is the personal hygiene SOP relevant for food handlers within NSNP (SABS, 2019).

PURPOSE: To prevent contamination of food-by-food handlers.

PROCEDURES:

1. Adhere to the directives of the NSNP food safety policy and all relevant regulations.
2. Report to work in good health, clean, and dressed in clean and appropriate attire.
3. Change the apron when it becomes soiled. Never take aprons into restrooms.
4. Wash hands properly, frequently, and at the appropriate times.
5. Keep fingernails trimmed, filed, and maintained so that the edges are easy to keep clean and not rough.
6. Do not wear artificial fingernails or fingernail polish at any time while working in food service.
7. Do not wear any jewellery except for a plain ring, such as a wedding band and stud earrings.
8. Treat and bandage wounds and sores immediately. When hands are bandaged, use single-use gloves over the bandaged area.
9. Cover a lesion with a bandage. If the lesion is on a hand or wrist, cover with an impermeable cover such as a finger cot or stall, and a single-use glove.
10. Consume food and drink, and use tobacco, or chew gum only during designated break times and never in areas where there is contact.
11. Always wear an effective hair restraint while working.
12. Before working in the production area:
 - a. Hair should be neatly arranged and a hair restraint worn.
 - b. Check that clothing and apron are clean.

6.3.3.10 The appointment of the supplier, receiving of the products and the storage of goods

The appointment of suppliers plays an important role as first stage of assuring food safety. The compliance of suppliers must be documented and adhered to. During delivery, there must be monitoring before receiving and storing food products. Table 6.9 details the requirements of the appointment of suppliers, receiving and storing food products.

Table 6.9. The appointment of the suppliers, receiving of the products and the storage of goods (DoH, 2018; SABS, 2019)

Supplier specification	Receiving of goods	Storage	Preparation	Serving
• The supplier must have a certificate of acceptability • Food, food ingredients, semi-finished food products, food additives and any food contact materials that are supplied must be subjected to the checks for conformance • The records of the evaluations of suppliers and services and the results of evaluations and any necessary actions arising from customer property loss, damage or unsuitable for use, must be kept	• There must be a structured and well-controlled receiving of food product ingredients • Food product ingredients received must be sampled and routinely screened for basic food safety parameters in accordance with the food safety specification before being processed • The records of verification of inspection, tests or conformity requirements must be kept and maintained • Documents must be detailed and convey essential information (purchase order, seal number, date and the name of the person who inspected the vehicle when it left the supplier) • Non-conforming ingredients must be identified, segregated where practical, and handled in such a manner which will ensure that they are prevented from unintended use or possible cross-contamination.	• Stored food product materials must be easily identifiable, and there has to be effective stock control and overall material traceability • Food product materials must be stored in a designated holding area until released by authorised staff • Materials must not be stored directly on the floor • The top layer of the stored food product must not be in contact with the overhead structures to prevent contamination • Shelves must be clean, disinfected, and maintained in such a manner that will not pose a risk of contamination to items being stored • Hazardous substances and other materials must be stored separately from food to avoid the potential of handling errors and contamination • Records of the control of such environmental storage conditions must be maintained • Food product materials must be stored in such a way that it is easy to follow the first-in-first-out (FIFO) rule	• Effective food handling, processing and monitoring methods must be established and recorded to verify conformity with food safety requirements • Food must be handled and processed in such a way that contamination and cross-contamination between the food being handled, other foodstuffs in the food handling areas and the environment is prevented (work stations) • The possibility of cross-contamination must be avoided during preparation • In order to detect deterioration, the condition of the food product in stock must be assessed periodically	• Approved containers must be used to take the food to the classes • The time between delivery of food to classes and serving must be shorter • The containers and the dishes of learner must be clean before used • All containers and dishes must be cleaned after completion

6.3.4 Deliver stage

This model proposes that the NSNP office of the Free State Provincial Department of Basic Education should take responsibility for the delivery logistics.

6.4. STRENGTHS AND WEAKNESSES OF THE MODEL

Chapter 1 and 2 has introduced the benefits and challenges within NSNP. In addition, fragmented legislation, policies and guiding documents focusing on safe food preparation within NSNP have been highlighted. Furthermore, chapters 3, 4 and 5 indicated the prerequisites required to maintain food safety. Hence, in Chapter 6 the Double Diamond Design Framework Model has incorporated all fragmented documents and recommendations from the research papers and designed Food Safety Model based on the PRPs. The strength of this model is that it highlights the responsibility of maintaining the food safety of each stakeholder within a NSNP. The model also focuses on the food chain from the appointment of the supplier, purchasing of goods, delivery, receiving, storage, preparation and serving of food to learners.

Moreover, training of the volunteer food handlers is tailored around the demographic data, existing knowledge, and their attitude towards staff-related PRPs. All of the above are unique, especially within NSNP-participating schools. On the downside, the model's successes will be based on the adjustments of the existing systems, such as criteria for the appointment of the suppliers. The model has not considered the top management of the NSNP approval in adjusting some of the processes. Some of the processes might lead to the model's failure when implementing recommendations. It is still critical to test the model by implementation in some of the participating schools. The model's testing does not fall within the scope of this study; however, it might be considered for future research.

6.5. CONCLUSION

The research chapters have highlighted the gap that showed the potential contaminations that might lead to food poisoning. The results and recommendations from the research papers paved the development of the model development chapters. Hence, this chapter aims to develop the FSMS. The Double Diamond Design Framework was followed to develop the FSMS model. The model started with **discovering** the gaps through a literature review and the results from the research chapters. There are fragmented documents that focus on food safety. As much as there have been several foodborne-related cases within NSNP, less has been done to uplift the infrastructure within the participating schools. The current situation within NSNP presented opportunities for the study of which it let to **define** and make sense by interpreting and analysing. Most of the missing infrastructures, facilities, and staff-related PRPs are critical in avoiding possible contamination and foodborne cases. It is then vital that the FSMS be developed and implemented. Within the **developmental stage**, all the fragmented documents and legislation are brought together and incorporated within a FSMS aligned with SANS 10049 and Regulation 638. The system covers the food from purchasing, delivery, storage, preparation, and serving to learners. As much as testing of the model was not part of this document, the recommendation will be given to the Department of Basic Education as part of the **delivery stage**. The implementation of this study must be implement in alignment to the PRPs. It is also critical that the implementation and PRPs be monitored for better results.

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CHAPTER 7

CONCLUSION

7.1 INTRODUCTION

Food security is considered a major challenge facing the world, especially in developing countries. Among the global population, malnutrition is predominantly affecting vulnerable groups such as children, impacting on their health and development over the long term. Research has shown that it hampers their ability to concentrate in class, affects their ability to learn and apply knowledge. This has prompted many initiatives to curb malnutrition among learners, including feeding schemes and specifically school lunch programmes. The aims of such programmes are broad; from attracting learners to schools to reducing absenteeism rates and improving school progression. In South Africa, a publicly funded NSNP was initiated primarily to enrich the educational experience of indigent learners by alleviating short-term hunger.

In any food handling establishment, ensuring food safety is key. However, in school feeding programmes the challenge is enormous. This also applies to NSNP-participating schools. It has been estimated that 420 000 people die from foodborne disease annually, including 125 000 children under the age of 5 years (Zanin, De Cunha, De Rosso, Capriles *et al.*, 2017). The risk of foodborne illnesses is assumed to be higher in developing countries due to, amongst others, under-reporting. This makes the implementation and upholding of food safety measures and hygiene practices in schools essential (De Freitas, De Cunha & Stedefeldt, 2019).

As Bou-Mitri, Mahmoud, El Gerges and Abou Jaoud (2018) explain, to attain food safety standards requires food to be prepared from good-quality and wholesome ingredients, and meals served at convenient times and access to basic resources such as food preparing equipment. The latter, however, is often lacking in NSNP schools causing the other two components to be compromised, too. The major inadequacies are sub-standard infrastructure for meal preparation and storage; insufficient equipment and utensils and deficient access to water. These constraints also affect basic operational processes leading to long-term consequences for planning, scheduling and control. For example, when stock is delivered to the schools but it is not inspected, there are no written records

to keep suppliers accountable; no data for effective scheduling or processing of such for long-term planning. Furthermore, food stored in inappropriate storage areas and kept for prolonged periods lead to spoilage and waste, and may increase the risk of foodborne disease – as does preparing food in unhygienic conditions resulting from inadequate training and insufficient personal hygiene of volunteer food handlers.

Implementing a hazard analysis and critical control programme (HACCP) has been shown to improve food safety as well as consumer confidence. As a result Sibanyoni and Tabit (2019) have advised that the HACCP should be implemented in all NSNP food service facilities to improve food safety assurance. The prerequisites for programmes (PRP) including for infrastructure, GHPs, equipment, water and training of volunteer food handlers are considered the building blocks of HACCP and should be fully established before the programme can be implemented. A lack of these PRPs has been found to be the most important obstacles in the implementation of food safety programmes.

As the people at the coalface, volunteer food handlers play a key role in ensuring food safety by implementing and maintaining PRPs throughout the chain of production, processing, storage and preparation. According to Nkhebenyane (2018), by adjusting the practices of volunteer food handlers and improving their skills and knowledge through regular provision of food safety training, it is possible to prevent food contamination. This emphasises the importance of training for newly recruited volunteer food handlers as well as continued training in food safety, including aspects of microbial food safety hazards (Sibanyoni, Tshabalala & Tabit, 2017). Equally important is making sure that the learning experience and material are appropriate for the average volunteer food handler and that it takes into account demographic information such as age, level of education and work experience.

Yet, knowledge does not automatically lead to responsible behaviour. It also requires upskilling and adopting a positive attitude towards food safety (Sharif & Al-Malki, 2010).

7.2 CONCLUDING REMARKS

7.2.1 Chapter 3

This chapter provides valuable information about both the demographic data and the lived experience of volunteer food handlers and other people in NSNP-participating schools in the Mangaung Metropolitan, Free State. It also reveals their levels of knowledge, skills and practices followed and their attitudes to food safety. In accordance with the widely held cultural convention that women are responsible for food preparation, more than half of the respondents were females between the ages of 20 and 40 years. The data are useful when planning training sessions for participating schools.

The majority of the volunteer food handlers who responded indicated that they always practise the WHO's five key requirements for safely preparing food, namely keep clean, separate raw and cooked food, cook food thoroughly, keep food at a safe temperature, and use safe water and raw materials (WHO, 2018). The data also indicated that while volunteer food handlers were aware of the importance of food safety and the role of personal hygiene in it, they lacked technical food safety knowledge regarding micro-organisms and cross-contamination. Their level of knowledge and consequent attitude was however negatively affected by factors such as not having the access to the appropriate equipment and therefore not having the skills to use it. Examples are the lack of thermometers and cutting boards that increase the risk of spoilage and cross contamination. Another factor affecting volunteer food handlers' attitudes is their employment conditions and salary status. This lowers their levels of motivation contributing to them disregarding critical food safety principles.

The data revealed in Chapter 3 provide the foundation for designing a training tool for NSNP staff that is appropriate (keeping in mind the demographic data), fit for purpose (improving knowledge, skills and attitudes towards food safety) and which is based on globally accepted principles (The WHO's five keys to safer food).

7.2.2 Chapter 4

In Chapter 4 the challenges faced by volunteer food handlers and supervisors regarding the facilities and the lack of resources within the NSNP were investigated in greater detail. Among the difficulties they mentioned were inadequate maintenance; factors hampering pest control; a lack of floor drainage in kitchens; inadequate hand-washing facilities; limited access to potable water; inadequate temperature control and fit-for-purpose storage facilities; and a lack of instruments such as thermometers. Many of the flaws may be explained by the fact that the majority of schools make do with makeshift kitchens. Very few schools have been designed with facilities to serve food to learners. However, for the sake of keeping food safe and learners healthy, the schools using repurposed buildings, need to be supported to improve their facilities. The DBE should be encouraged to comply with their own maintenance requirements. By doing so, effective PRPs can be established and the HACCP implemented.

7.2.3 Chapter 5

Having identified the specific weaknesses that NSNP schools experience in Chapter 4, this section assessed adherence to operational requirements and good manufacturing practices (GMPs). As in any food preparation chain, NSNP schools' food suppliers act as the starting point of the process, but also of the food safety chain. Careful selection and evaluation of suppliers by the schools are critical. However, the results from this study reflect that this very first link in the chain is often flawed with less than 45% of the participating schools having clear criteria for the picking suppliers. This is exacerbated by the fact that stock that is supplied is frequently not inspected on delivery and the information not recorded. As it is the mandate of the local authority's environmental health practitioners to ensure food served to the public is safe for consumption, they are also legally responsible to evaluate NSNP schools. On the whole, this function tends to be disregarded by the EHPs, while some NSNP schools themselves do not always adhere to these regulations. Even when EHPs do visit schools, it is not recorded properly. In general the participating schools showed evidence of adhering to the DBE's guidelines

for serving food such as labelling for stock control and traceability despite inadequate storage facilities and pest control. Again, the lack of control systems and proper recording and documenting processes should be addressed during training.

7.2.4 Chapter 6

Chapter 6 reflected on the existing food safety guiding documents such as policies and legislations as well as other related requirements. The latter include volunteer food handlers' knowledge, attitudes and practices which are regarded as vital for the training. In addition, the knowledge that volunteer food handlers must possess must be supported by staff related PRPs such as training, protective clothing as well as personal hygiene and personal effects. This chapter is also reflecting on all the PRPs such as GHPs and Good Manufacturing Practices and fill the identified gaps. Using the Double Diamond Design Framework, the study designs the PRPs to be implemented as foundation for a FSMS. Through the processes, it was reported in Chapter 6 – as discovered and documented in chapters 2, 3, 4 and 5 - that there are a number of factors that need improvement within the NSNP. Secondly, Chapter 6 defined the current situation within the participating schools. Thirdly, a model was developed that forms the foundation for the implementation of a FSMS. Lastly, the study is opening the possibility of researching on the implementation and testing of the model during the delivery stage of the report.

7.3 RECOMMENDATIONS

The aim of this study was to determine the extent to which food-safety PRPs are implemented in feeding schemes, and to develop a FSMS for the schools participating in the NSNP within the Mangaung Metropolitan. In light thereof recommendations are made, based on the following:

- The results of the study
- Literature review
- DBE's terms of reference for the NSNP
- Legislation
- Department of Health (DOH). 2018. R.638. 2018. Regulations governing general hygiene requirements for food premises and the transportation of food. Government Gazette
- Department of Health (DOH). 2010. R 146. Regulations relating labelling and advertising of foodstuff
- Department of Health (DOH). 2010. R 146. Environmental health practitioners' scope of practice
- Department of Health (DOH). 2013. National Norms and Standards For Environmental Health In South Africa
- Department of Health (DOH). (ACT 61 OF 2003). 2003. Regulations relating to Environmental Health Investigations and Inspections
- WHO: Five Keys to Safer Food manual

7.3.1 Recommendations to NSNP policy creators

The following recommendations are made to address the unsatisfactory aspects identified in this study:

- A clear food safety policy should be developed by the DBE and a concerted effort made to transfer this information to the knowledge base, skills set and attitudes of

the volunteer food handlers and supervisors. This should be in addition to giving NSNP schools additional support by way of improved infrastructure and equipment that will help them effectively implement PRPs for food safety.

- The role of the local authority's environmental health department should be made clear to all involved and formalised in a memorandum of understanding to build reciprocal relationships that support food safety.
- An effective monitoring system of food safety procedures as well as incidences of food-related illnesses is required for NSNP schools to implement.
- The DBE must ensure that all NSNP management representatives, staff and volunteer food handlers are trained in food safety as prescribed in policy documents and regulations governing general hygiene requirements for food premises and the transportation of food.
- Clear criteria for the appointment of the food suppliers, based on ensuring food safety for learners, needs to be developed.

7.3.2 Recommendations made to food suppliers

In relation to food suppliers, the following recommendations are made:

- Food suppliers to NSNP schools should be registered with both the DBE and the local authority's environmental health office in order to be awarded a certificate of acceptability as directed in the regulations governing general hygiene requirements for food premises and the transportation of food.
- Suppliers should be able to show evidence of having purchased from an approved source.
- Food delivered to NSNP schools have to be done in accordance with food safety legislation.
- The suppliers have to keep proper documentation to show evidence of effective control for food safety, and these records have to be filed safely for later reference.

7.3.3 Recommendations made to environmental health practitioners (EHPs)

The following are recommendations made for environmental health practitioners:

- As part of the scope of practice of an EHP, they need to collaborate with the DBE and perform inspections as prescribed in the South African national norms and standards for environmental health in schools.
- EHPs need to verify the information supplied by food suppliers once they have applied for a certificate of approval from DBE.
- Suppliers should also be trained in food safety by EHPs.
- No less than two inspections per annum should be conducted at school kitchens as directed by the regulations.
- The EHPs must be included when volunteer food handlers receive training as prescribed in regulations.
 - Environmental health practitioners should participate with NSNP supervisors in:
 - Sampling foodstuffs for microbiological and chemical tests;
 - Investigating outbreaks of foodborne illnesses;
 - Risk profiling food preparation area premises and analysis.

7.3.4 Recommendations to schools participating in the NSNP

The recommendations for schools participating in the NSNP are as follows:

- The volunteer food handlers and supervisors at NSNP schools need to improve their knowledge base, skills set, commitment to food safety in general and the legislation and DBE policy specifically to efficiently adhere to the requirements thereof.
- Each school must appoint a management representative (either a teacher or an administrative official) to oversee food safety measures and to report all relevant information to NSNP co-ordinators, school management and DBE.
- The schools participating in the NSNP should implement the PRPs as part of a GFMS.

- School management needs to oversee and assure the training of the management representative and newly appointed volunteer food handlers prior to being appointed, and regularly (at least annually) thereafter.
- School management needs to oversee and assure the appointment of complying food suppliers and ensure continuous monitoring of the goods delivered.
- The management representative, should, on behalf of the school management, monitor the PRPs related to the delivery, storage, processing of foodstuff and serving of food.
- School management must document, control and record all the activities relating to delivery, storage, processing of foodstuffs and feeding of learners.

7.4 LIMITATIONS OF THE STUDY

Whereas the ideal is for a study such as this to depict the situation at NSNP schools nationally, financial and time limitations led to the investigation being restricted to the Mangaung Metropolitan region in the Free State province. Although this limits the *generalisability* of the study, the rich data obtained via the phenomenological study as well as the researcher's observations painted a clear picture of the strengths and weaknesses to be considered when training for improved food safety. Furthermore, the findings of this study were supported by similar studies on the influence of resources, infrastructure and training issues on food safety practices.

7.5 FINAL SYNTHESIS AND CONCLUSION

The impact of poverty on communities in developing countries has compelled states to introduce school feeding programmes. As much as the NSNP has contributed to curbing malnutrition among learners, it has not been spared negative publicity as a result of cases of food contamination and even fatalities. As food contamination can originate at any point along the food preparation chain, and in particular where people are involved with food handling, it makes sense to focus on training to curb food contamination with training programmes. The aim of this research study was to contribute in this regard by

investigating the lived experience of the people involved, and to effectively improve the food safety knowledge, skills and attitudes of NSNP food handlers through observation.

In addition, the study highlighted the status of the facilities, hygiene PRPs and operational requirements that have a direct effect on the safety of the food served to learners in the Mangaung Metropole. Addressing these issues and committing to its own policies will go a long way towards food safety assurance within the DBE's food programme. The current policies are clear and explicitly make provision for improving and maintaining infrastructure at participating schools. Proper documentation and control systems at the schools related to the inadequate facilities contributing to food safety can become useful instruments to hold the DBE accountable. Finally, the study served to underscore the importance of effectively establishing PRPs to form the basis for an HACCP - a system that has proved itself in effectively securing food safety.

7.6 REFERENCES

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APPENDICES

Appendix 1 (Data collection instruments)

Evaluation and Design of a Food Safety Management System for a School Feeding Scheme among urban and peri-urban schools in Central South Africa

A survey of PRP (staff) compliance of NSNP at selected Central South African schools

***The biographical profile and the knowledge, attitude and self-reported behaviour of food handlers
from NSNP***

DEMOGRAPHIC PROFILE

▪

Gender	Male	
	Female	
Age	18 – 20 yrs	
	20 – 30 yrs	
	30 – 40 yrs	
	40 <	
Race	Black	
	Coloured	
	White	
Home language	South Sotho	
	Xhosa	
	Afrikaans	

English proficiency	Poor	
	Fair	
	Good	
Employment status	Permanent	
	Volunteer	
Salary	Less than R500.00	
	R500.00 - R1 000.00	
	More than R1 000.00	
Education	Below Grade 3	
	Grade 4 – 7	
	Grade 8 – 10	
	Grade 11 – 12	
	Certificate or Tertiary Education	
Additional Training	Yes	
	No	

The food handlers working with ready-to-eat foods from NSNP and the influence of food safety training based on biographical profile.

	True	False
KNOWLEDGE OF THE FOOD HANDLER		
▪		
1. Keep Clean		
A. It is important to wash hands before handling food.	☐	☐
B. Wiping cloths can spread microorganisms.	☐	☐
2. Separate raw and cooked		
A. The same cutting board can be used for raw and cooked foods provided it looks clean.	☐	☐
B. Raw food needs to be stored separately from cooked food.	☐	☐
3. Cook thoroughly		
A. Cooked foods do not need to be thoroughly reheated.	☐	☐
B. Proper cooking includes meat cooked to 40 °C.	☐	☐
4. Keep food at safe temperatures		
A. Cooked meat can be left at room temperature overnight to cool before refrigerating.	☐	☐
B. Cooked food should be kept very hot before serving.	☐	☐
C. Refrigerating food only slows bacterial growth.	☐	☐
5. Use safe water and raw materials		
A. Safe water can be identified by the way it looks.	☐	☐
B. Wash fruit and vegetables.	☐	☐

ATTITUDE OF THE FOOD HANDLER

▪

1. Keep Clean			
A.	Frequent hand-washing during food preparation is worth the extra time.	☐	☐
B.	Keeping kitchen surfaces clean reduces the risk of illness.	☐	☐
2. Separate raw and cooked			
A.	Keeping raw and cooked food separate helps to prevent illness.	☐	☐
B.	Using different knives and cutting boards for raw and cooked foods is worth the extra effort.	☐	☐
3. Cook thoroughly			
A.	Meat thermometers are useful for ensuring food is cooked thoroughly.	☐	☐
B.	Soups and stews should always be boiled to ensure safety.	☐	☐
4. Keep food at safe temperatures			
A.	Thawing food in a cool place is safer.	☐	☐
B.	I think it is unsafe to leave cooked food out of the refrigerator for more than two hours.	☐	☐
5. Use safe water and raw materials			
A.	Inspecting food for freshness and wholesomeness is valuable.	☐	☐
B.	I think it is important to throw away foods that have reached their expiry date.	☐	☐



SELF-REPORTED BEHAVIOUR OF THE FOOD HANDLER

1. **Keep Clean**

A. I wash my hands before and during food preparation.

B. I clean surfaces and equipment used for food preparation before re-using on other food.

2. **Separate raw and cooked**

A. I use separate utensils and cutting-boards when preparing raw and cooked food.

B. I separate raw and cooked food during storage.

3. **Cook thoroughly**

A. I check that meats are cooked thoroughly by ensuring that the juices are clear or by using a thermometer.

B. I reheat cooked food until it is piping hot throughout.

4. **Keep food at safe temperatures**

A. I thaw frozen food in the refrigerator or other cool place.

B. After I have cooked a meal, I store any left-overs in a cool place within two hours.

5. **Use safe water and raw materials**

A. I check and throw away food beyond its expiry date.

B. I wash fruit and vegetables with safe water before eating them.

Always Most of times Not often Sometimes Never

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Staff engaged in the handling of the food product

Training	Compliance			
	Yes	No	Not applicable	Comments
Staff engaged in the handling of the food product has been given the formal food safety related training.				
Appropriate training was conducted at the beginning of employment.				
The competency was tested at the end of the training.				
Periodic assessments of the effectiveness of training programmes are carried out.				
Records of experience, expertise, educational qualifications and training of the employees concerned are maintained.				
Managers and supervisors have the necessary knowledge of food hygiene principles and practices, as well as of the relevant food safety requirements to enable them to judge potential hazards and to take the necessary action(s) to remedy non-conformities.				
Protective clothing	Compliance			
	Yes	No	Not applicable	Comments
Management provides sufficient and suitable protective clothing for all staff and maintains them in good repair.				
Protective clothing provides appropriate coverage to prevent personal clothing, hair and perspiration from causing the contamination of the food product.				

Employees are not removing protective clothing from the food handling organisation.				
Protective clothing is changed as often as is deemed necessary and are hygienically laundered.				
Laundered protective clothing are appropriately stored before use.				
Gloves, if used, are made from impermeable material and of the disposable type.				
When not in use, protective clothing is kept in the changing rooms and is not removed from the premises except for laundering under hygienic conditions.				
All protective clothing is of hygienic design, no external pockets, in good repair and don't constitute a source of contamination to the food product.				
Footgear used in food handling and processing areas are fully enclosed and of non-absorbent material.				

Personal hygiene and personal effects	Compliance			
	Yes	No	Not applicable	Comments
All employees (food handlers) have passed an appropriate medical examination to ensure that they are free from communicable diseases.				
There are appropriate systems in place to proactively manage the health of all food handlers.				
An appropriate medical record of each employee is kept and a medical certificate submitted by an employee of a food handling organisation is available for inspection.				
No employee suffering from a cut, an injury, an infected wound or an infected skin irritation can come into contact with the food products or food contact surfaces.				

Appropriate first-aid equipment is provided and trained first-aid staff are available on site.				
Food handling staff maintain a high degree of personal cleanliness and conform to hygienic practices while on duty.				
There is warm water and an acceptable unscented liquid soap or hand-cleaning detergent for food handling staff to wash hands before starting work, after each absence from the food handling areas, at regular intervals during food handling or at any time when necessary.				
Hygiene facilities are suitably maintained in a functional state and supplied with soap, soap dispensers, drying equipment and waste receptacles at all times.				

	Compliance			
	Yes	No	Not applicable	Comments
Containers used in the preparation, processing or packaging of the food product are not used for any other purpose.				
Neither staff's personal effects (personal clothes) nor their food is present in any area where the food product, its ingredients and packaging materials are handled and stored.				
Pets are not permitted on the premises of a food handling organisation.				

Evaluation and Design of a Food Safety Management System for a School Feeding Scheme among urban and peri-urban schools in Central South Africa

PRP (infrastructure) compliance of NSNP at selected Central South African schools

Facilities in School Nutrition Programme

Location, size, hygienic design and conditions	Compliance			
	Yes	No	Not applicable	Comments
Property and adjacent land kept free potential sources of contamination, dust, smoke, insects, rodents, etc.				
Buildings are of sound construction, in good repair, and large enough to prevent crowding.				
Premises are well drained and adequately fenced.				
Facility designed as to permit the processing of raw materials without undue delay.				
Sewage and effluent lines are constructed to avoid contamination of potable water supplies, food handling areas, materials and products.				

Roofs and ceilings				
Roofs and ceilings are weatherproof, tightly fitted and made of non-absorbent material.				
Walls, windows and doors				
	Yes	No	Not applicable	Comments
Walls, windows and doors are weatherproof and impermeable to water.				
Walls are faced with a smooth, corrosion-resistant, light-coloured, washable, water-impermeable, and impact-resistant material.				
Walls are protected from damage by moving equipment.				



Doors and frames are faced with a smooth, corrosion-resistant, light-coloured, washable, water-impermeable, and impact-resistant material.				
Doors that lead into exposed food handling areas are rodent proof, tight fitting, fitted with self-closing devices or an internal lobby with a self-closing door.				

Floors and drainage				
Floors are constructed of concrete or any other material that is water-impermeable, corrosion-resistant and easy to clean, and laid to an even surface that is smooth but not slippery and is free from cracks and open joints.				
Floor drains or channels are of hygienic design suitable to the food handling operation and are discharged appropriately.				
Drains are vented to the atmosphere, outside the food handling area, before entering the sewer or joining any sewer.				

Illumination				
Appropriate natural or artificial lighting, of sufficient intensity, are provided to enable staff to operate in such a way that food safety can be ensured.				
Luminaires suspended over food in any stage of handling are of the safety type or otherwise so protected as to prevent contamination of food in the event of breakage of a luminaire or lamp.				
Lights are easy to clean and maintain.				

Ventilation				
Ventilation and extraction systems throughout the facility are sufficient to prevent condensation and manage temperature.				
Located so as to avoid the intake of contaminated air and filtered where appropriate.				
Windows that are used for ventilation are screened.				

Hand-washing facilities	Compliance			
	Yes	No	Not applicable	Comments
There is a sufficient number of hand-wash basins with an abundant supply of hot and cold or warm portable running water, in the temperature range 40 °C to 50 °C.				
There is a sufficient supply of unscented liquid soap or hand-cleaning detergent and hand-drying towels.				

Separation of processes and facilities				
Separate rooms or well-defined areas of acceptable size are provided for:				
a) the receipt and storage of raw materials, b) preparatory operations of the food, c) food handling and processing operations, d) packaging, and e) the storage of the food.				

Storage facilities				
The food handling area of the school is not used for storage purposes.				
Storage facilities are clean, dustproof and vermin proof.				
Dry storerooms are provided for the storage of packing and packaging materials.				
Pesticides and other poisonous and harmful substances are stored in a room or cupboard in which no foodstuff, food handling equipment, packaging material or food containers are stored and are kept locked.				
All substances used for cleaning and disinfection are prominently labelled.				

Equipment for food handling

Conditions of equipment for food handling	Compliance			
	Yes	No	Not applicable	Comments
Equipment allows free movement of workers to facilitate cleaning and the maintenance of both hygiene and food safety.				
Food handling equipment and utensils that come in contact with the food are smooth-surfaced, light-coloured and of a suitable corrosion-resistant, non-absorbent food grade material.				
Machinery and equipment are suitable for food handling processes and they can prevent the contamination of the food product during operations.				
Surfaces with which the food comes into contact are not painted, hygienic and construction of food contact surfaces and non-food contact surfaces are appropriate to the requirements of the food handling process and cleanable.				
Equipment are either installed away from the walls and ceilings or high enough above the floor to allow access for cleaning and inspection.				



Maintenance of equipment	Compliance			
	Yes	No	Not applicable	Comments
Records of maintenance are kept by the person in charge.				
Maintenance is carried out by suitably trained staff.				

Monitoring of measuring devices				
All equipment or processes that are critical to food safety are identified and have appropriate measuring devices.				
There are monitoring procedures for the control of measuring devices.				
Appropriate action is taken against non-conformance.				
Records of devices and their calibration status are maintained.				
Verification is conducted and records are maintained.				
Equipment used for the monitoring of measuring devices are suitable for the intended application.				

Hygienic operating requirements

Water	Compliance			
	Yes	No	Not applicable	Comments
Water used in the food handling area comply with the requirements of SANS 241.				
Appropriate facility for the storage and distribution of water is provided.				
Flexible water hoses are made of a suitable material for food safety and reels for their storage are provided.				

Environmental temperature and humidity control				
Appropriate facilities for the preparation, heating, cooling, refrigerating, freezing and storage of food is available with devices for monitoring time and pressure.				

Cleaning and disinfection				
The food handling areas are maintained in an appropriate and suitable state of cleanliness at all times.				
There is a documented cleaning and disinfection programme for the premises, equipment, containers, and vehicles.				
Management and control of hazardous substances				
Hazardous substances are handled by authorised and properly trained staff or by persons under strict supervision of trained staff.				
Care is taken to avoid the contamination of food and of the environment during food handling.				
Hazardous substances are clearly labelled and identified.				

There are emergency procedures for dealing with the accidental contamination of food, of staff and of the environment as a result of spillage of hazardous substances during handling.				
Appropriate personal protective equipment (PPE) for staff handling hazardous substances is provided.				

All food handling areas are pest-free.				
An effective pest control programme is documented and implemented.				
Pesticides are not used in food handling areas while preparation, processing and packaging are in progress.				
Only registered pesticides are used in accordance with the manufacturer's instructions.				
Pest control operator is suitably qualified and trained. There is a certified copy of the pest control operator's qualification held by the food handling organisation.				
Pesticides and cleaning chemicals are stored away from wrapping material, containers, raw materials or the food product.				
The room in which pesticides are stored is always locked.				
Bait stations are of a lockable type, and are not placed in food handling areas where food could be contaminated.				
Pest control records are well maintained and complying.				
Records of verifications are kept and available on request.				



Evaluation and Design of a Food Safety Management System for a School Feeding Scheme among urban and peri-urban schools in Central South Africa

A survey of PRP (products) compliance of NSNP at selected Central South African schools

Food products within School Nutrition Programme

Purchasing	Compliance			
	Yes	No	Not applicable	Comments
The food handling organisation has established documented purchasing requirements for products or services used for the handling of food and conform to them.				
Criteria for the selection, evaluation and re-evaluation of suppliers are documented.				
The food handling organisation has at its disposal, a current list of suppliers that meet food safety requirements.				
Suppliers and services are audited by the food handling organisation.				
The records of the evaluations of suppliers and services and the results of evaluations and any necessary actions arising from these evaluations are kept.				
Potential hazards associated with purchased items, their use and the possibility of cross contamination are identified and documented.				

Control of customer-supplied products				
Food, food ingredients, semi-finished food products, food additives and any food contact materials that are supplied are subjected to checks for conformance.				
The records of the evaluations of suppliers and services and the results of evaluations and any necessary actions arising from customer property loss, damage or unsuitable for use are kept.				

Receiving food product ingredients	Compliance			
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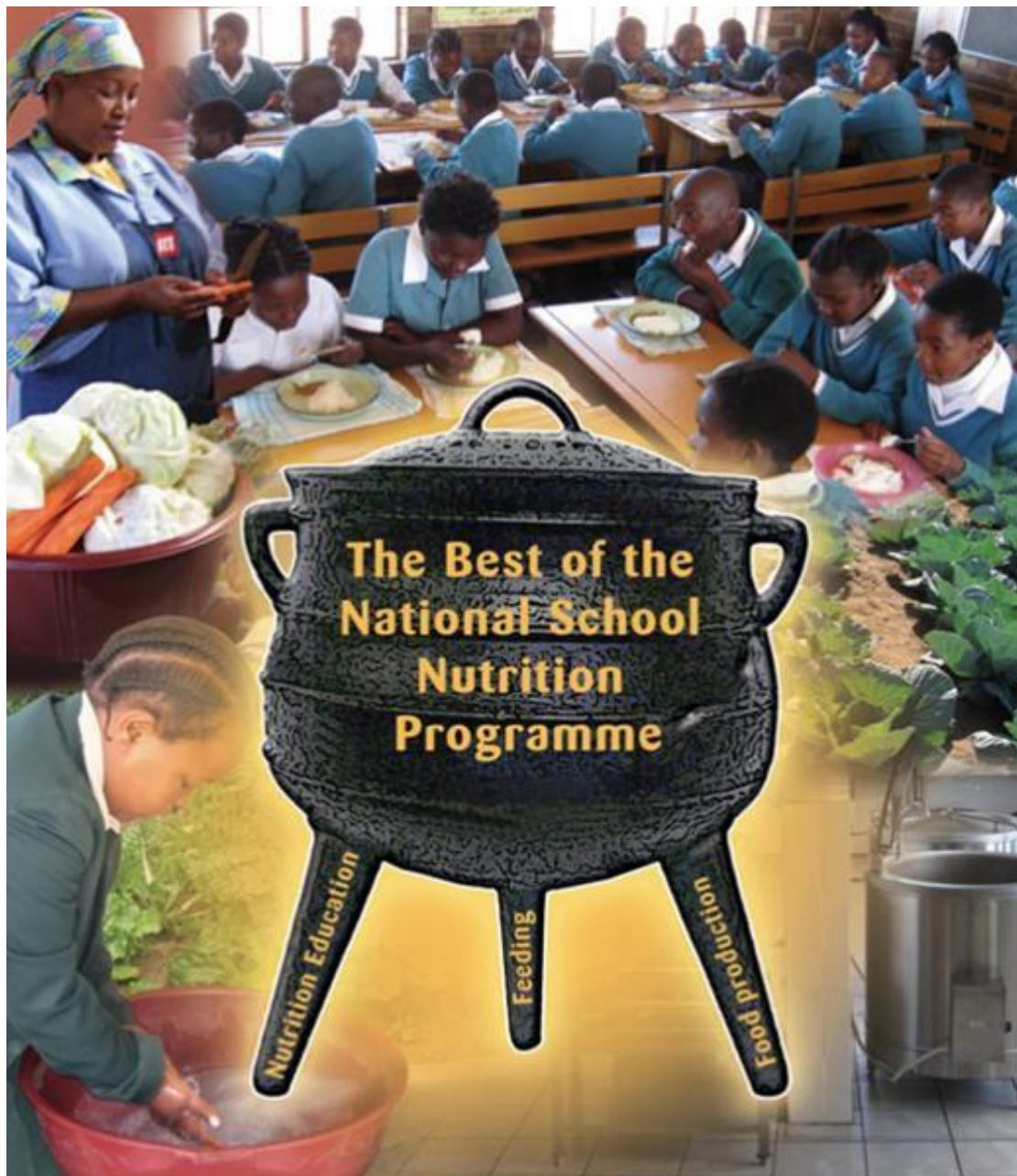


	Yes	No	Not applicable	Comments
There is a structured and well-controlled receiving of food product ingredients.				
Food product ingredients received are sampled and routinely screened for basic food safety parameters in accordance with the food safety specification before being processed.				
The records of verification of inspection, tests or conformity requirements are kept maintained.				
Food safety is verified by analysis.				
Documents are well detailed with essential information (purchase order, seal number, date and the name of the person who inspected the vehicle when it left the supplier.)				
Non-conforming ingredients are identified, segregated where practical, and handled in a manner that will ensure that they are prevented from unintended use or possible cross-contamination.				

Storage of food product materials	Compliance			
	Yes	No	Not applicable	Comments
Stored food product materials are identified in such a way that they are easily identifiable, and there is an effective stock control and overall material traceability that can be ensured.				
Food product materials are stored in a designated holding area until released by authorised staff.				
Food product materials are stored in such a way that cleaning and pest control can be effectively carried out.				
Materials are not stored directly on the floor.				
There are appropriate, ideally separate storage facilities for food product materials received, in-process materials, the finished food product and the food product on display.				
The top layer of the stored food product does not make contact with the overhead structures to prevent contamination.				
Shelves are clean, disinfected, and maintained in such a manner that will not pose a risk of contamination to items being stored.				
Hazardous substances, pesticides and other materials not intended for use in food are stored separately from food to avoid the potential of handling errors and contamination.				
Appropriate containers are used for the storage of food and are such that contamination or deterioration is prevented.				
Waste is so stored as to avoid the contamination of food or of the environment.				

	Compliance			
	Yes	No	Not applicable	Comments
Special storage conditions such as temperature, humidity or atmosphere, is provided where appropriate.				
Records of the control of such environmental storage conditions are maintained.				
Food product materials are stored in such a way that it is easy to use the first-in-first-out (FIFO) rule.				
Food handling, processing and monitoring				
Effective food handling, processing and monitoring methods are established and recorded to verify conformity with food safety requirements.				
The food handling organisation has established, document and maintain procedures for the handling, storage, processing, packaging, and delivery of the final food products.				
Food is handled and processed in such a way that contamination and cross-contamination between the food being handled, other foodstuffs in the food handling areas and the environment is prevented (<i>workstations</i>).				
The food handling organisation has storage silos or storage areas available to prevent damage or deterioration of the food product pending delivery.				
Silos and areas used to store the food product are free from cross-contamination.				
Special requirements regarding the permitted duration or conditions of storage (or both) for certain food product ingredients is established, monitored and checked.				
In order to detect deterioration, the condition of the food product in stock is assessed periodically.				

Appendix 2 (Selected regulations and infographics relating to safety under the South African NSNP)



basic education

Department:
Basic Education
REPUBLIC OF SOUTH AFRICA

GOVERNMENT NOTICES • GOEWERMENTSKENNISGEWINGS

DEPARTMENT OF HEALTH

NO. 638

22 JUNE 2018

FOODSTUFFS, COSMETICS AND DISINFECTANTS ACT, 1972 (ACT NO. 54 OF 1972)

REGULATIONS GOVERNING GENERAL HYGIENE REQUIREMENTS FOR FOOD PREMISES, THE TRANSPORT OF FOOD AND RELATED MATTERS

The Minister of Health has, in terms of section 15 (1) of the Foodstuffs, Cosmetics and Disinfectants Act, 1972 (Act No. 54 of 1972), made the Regulations in the Schedule.

NB: The isiZulu and Sesotho sa Leboa versions will be published in due course.

SCHEDULE

DEFINITIONS

1. In these Regulations a word or expression to which a meaning has been assigned in the Act bears that meaning and, unless the context otherwise indicates –

“abattoir” means a facility used for the slaughtering of animals of which the meat and meat products are intended for human consumption, which is approved and registered in terms of section 8 of the Meat Safety Act, 2000 (Act No. 40 of 2000);

“animal” means a member of the animal kingdom;

“available” means also available elsewhere than on the food premises in question;

“batch” means a volume or quantity of milk that is stored under controlled temperature and time frame or period, when offered for sale to a consumer, as stipulated in regulation 6(7)(a);

“best available method” means a method which is practicable and necessary for the protection of food against contamination or spoilage, having due regard to–

- (a) local conditions and circumstances whether at or on food premises or elsewhere;
- (b) the prevailing extent of established practice and the financial implications thereof;



NUTRITION PROGRAMME

Portfolio Committee on Basic Education Meeting

01 September 2020



OVERVIEW

- Mandate of NSNP
- Responsibilities: National and Provincial Education Departments (PEDs)
- Programme, Plan and Implementation
- NSNP Database by Province
- Department's Response to COVID-19 pandemic
- Plans Implemented
- NSNP Delivery Models and Feeding Modalities
- Challenges and Mitigation
- Conclusion

DID YOU KNOW?



Cooked meals or food parcels must right now be provided to every learner that received a meal at their school before the lockdown, even if that learner is not yet back at school!

Where to lodge a complaint about the NSNP?

1

Make sure that the school management is aware of the problem.

2

If no action is taken to fix the problem, report it to the district office, or NSNP provincial office, or call the Department of Basic Education's toll free number **0800 20 29 33**.

FREQUENTLY ASKED QUESTIONS



What is the National School Nutrition Programme (NSNP)?

It is the government programme that provides at least one nutritious meal everyday to over nine million learners in all quintile one, two and three primary and secondary schools, and to learners in some quintile four and five schools. The NSNP has been celebrated as one of the government's most effective projects for supporting poor communities and for its ability to reach a large number of the most vulnerable children in South Africa.



What is the main aim of the NSNP?

To provide nutritious meals to learners to support their health and to improve their ability to learn. The programme also teaches learners and parents about living a healthy lifestyle, and promotes the development of school vegetable gardens.



What does a nutritious school meal consist of?

A protein (soya, fish, eggs, milk, sour milk, beans or lentils), a fresh fruit and vegetable, and a carbohydrate/starch. A variety of protein should be served per week, and soya should not be served more than twice a week. A fresh vegetable or fruit should be served daily.



What is the budget of the NSNP?

The NSNP is paid for by the Department of Basic Education (DBE), through a conditional grant of over R7 billion. A conditional grant means that the money is especially put aside for the NSNP and cannot be used for anything else.



Did the National School Nutrition Programme resume?

Yes, the programme restarted in June for learners back at school.

From the **end of August**, learners enrolled on the programme were receiving meals whether they were at school or not.

If there are challenges getting meals to learners, people can report problems with the NSNP on the Department of Basic Education's free line: **0800 202 933**.



**SCHOOL FEEDING
DURING THE PANDEMIC**



Five keys to safer food



Keep clean

- ✓ Wash your hands before handling food and often during food preparation
- ✓ Wash your hands after going to the toilet
- ✓ Wash and sanitize all surfaces and equipment used for food preparation
- ✓ Protect kitchen areas and food from insects, pests and other animals

Why?

While most microorganisms do not cause disease, dangerous microorganisms are widely found in soil, water, animals and people. These microorganisms are carried on hands, wiping cloths and utensils, especially cutting boards and the slightest contact can transfer them to food and cause foodborne diseases.



Separate raw and cooked

- ✓ Separate raw meat, poultry and seafood from other foods
- ✓ Use separate equipment and utensils such as knives and cutting boards for handling raw foods
- ✓ Store food in containers to avoid contact between raw and prepared foods

Why?

Raw food, especially meat, poultry and seafood, and their juices, can contain dangerous microorganisms which may be transferred onto other foods during food preparation and storage.



Cook thoroughly

- ✓ Cook food thoroughly, especially meat, poultry, eggs and seafood
- ✓ Bring foods like soups and stews to boiling to make sure that they have reached 70°C. For meat and poultry, make sure that juices are clear, not pink. Ideally, use a thermometer
- ✓ Reheat cooked food thoroughly

Why?

Proper cooking kills almost all dangerous microorganisms. Studies have shown that cooking food to a temperature of 70°C can help ensure it is safe for consumption. Foods that require special attention include minced meats, rolled roasts, large joints of meat and whole poultry.



Keep food at safe temperatures

- ✓ Do not leave cooked food at room temperature for more than 2 hours
- ✓ Refrigerate promptly all cooked and perishable food (preferably below 5°C)
- ✓ Keep cooked food piping hot (more than 60°C) prior to serving
- ✓ Do not store food too long even in the refrigerator
- ✓ Do not thaw frozen food at room temperature

Why?

Microorganisms can multiply very quickly if food is stored at room temperature. By holding at temperatures below 5°C or above 60°C, the growth of microorganisms is slowed down or stopped. Some dangerous microorganisms still grow below 5°C.



Use safe water and raw materials

- ✓ Use safe water or treat it to make it safe
- ✓ Select fresh and wholesome foods
- ✓ Choose foods processed for safety, such as pasteurized milk
- ✓ Wash fruits and vegetables, especially if eaten raw
- ✓ Do not use food beyond its expiry date

Why?

Raw materials, including water and ice, may be contaminated with dangerous microorganisms and chemicals. Toxic chemicals may be formed in damaged and mouldy foods. Care in selection of raw materials and simple measures such as washing and peeling may reduce the risk.