THE UNIVERSITY OF NAIROBI

DEPARTMENT OF ARCHITECTURE

FACULTY OF THE BUILT ENVIRONMENT & DESIGN

UTILISATION OF BUILT ENVIRONMENT TO ADDRESS FOOD POVERTY IN PUBLIC SCHOOLS IN MOMBASA COUNTY

By

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DECLARATION

I, the undersigned, hereby declare that all information in this project report is my original work and has not been published by any organization or institution other than the University of Nairobi for academic credit. All material obtained herein from other sources is duly acknowledged.

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DEDICATION

This research is dedicated to all stakeholders involved in providing food to needy children in schools.

ABSTRACT

School feeding programmes have played a vital role in facilitating meals for many pupils in public primary and pre-primary schools in Kenya since 1980. The role of schools in the society has evolved becoming multi-sectoral through integration of education, health and nutrition. The creation of numerous new feeding programmes has increased the delivery of meals to school going pupils. These programmes have however not been complemented with the optimization of the built environment to improve facilitation of school meals. The status of infrastructure in many public primary and pre-primary schools in Kenya is insufficient and poorly maintained. Crucial spaces like kitchens, dining areas, food stores and even kitchen gardens are inadequate. This therefore jeopardizes efficiency in meal delivery and it is important that these spaces be renovated to make them sufficient. The main objective of the research was to determine morphological and spatial design strategies that could be adopted in the built environment of public primary and pre-primary schools in Mombasa County to aid in effectively facilitating school feeding programmes hence addressing the issue of food poverty. The theoretical underpinning of the research were the theory of Change and the theory of Ecological Urbanism. The research assessed 41 schools in Mombasa County out of approximately 95 schools applying purposive sampling techniques.

To mitigate the cost of facilitating school feeding programmes, it is crucial that local primary and pre-primary schools in Mombasa County implement autonomous strategies to reduce reliance on contributions from donors and the government and maximize on utility of the available limited resources. Some of these strategies include adoption of self-sufficient design techniques to ensure minimal wastage of resources and provision of low cost utilities such as electricity and water. This can be achieved through solar power, wind energy, biomass, rain water harvesting, drilling of boreholes, piping water from rivers and establishment of a water treatment plant. Schools can also build income generating structures such as lettable shops, lettable performance halls and even posho mills to generate revenue to finance the school feeding programmes. Schools should also promote farming through the establishment of not only kitchen gardens, but more gardens on any viable space. Planting of vegetables and cereals should be accompanied with keeping of livestock, poultry and practicing aquaponics. Integrated farming policies between local farmers and the schools is also important. Local farmers will aid in the implementation of the CBC system of education on matters related to farming and exchange ideas and resources with the schools. Schools play a vital role in society and if effectively optimized can become avenues for low lost cost quality meals facilitation offloading the society from the strenuous financial burden of proving meals to not only school going children but the society at large.

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List of Abbreviations

ASAL	Arid and Semi-Arid Lands
CBC	Competency Based Curriculum
ECD	Early Childhood Development
ECDE	Early Childhood Development Education
FAO	Food and Agriculture Organization of the United Nations
GOK	Government of Kenya
HGSM	Home-Grown School Meals
IDR	Import Dependency Ratio
KIHBS	Kenya Integrated Household Budget Survey
KIPPRA	Kenya Institute of Public Policy Research and Analysis
KNBS	Kenya National Bureau of Statistics
LMIC	Lower Middle Income Country
NGO	Non-Governmental Organization
NMK	Njaa Marufuku Kenya / Eradicate Hunger in Kenya
MOE	Ministry of Education
SFP	School Feeding Programme
SSA	Sub Saharan Africa
WFP	World Food Programme

Glossary

Built Environment	Any physical alteration of the natural environment through construction (Lawrence & Low, 1990)
Built Form	Building types created to shelter, define and protect activity. Specific elements of buildings or spatial subdivision of buildings (Lawrence & Low, 1990).

CHAPTER 1

Figure 1 Khadija Primary School, Mombasa. Source: Author

1.0 Background of Study

In the year 2005 the former president of America, Bill Clinton, lauded the Kenyan government for the commencement of free primary education. Free primary education meant that the poor could take their children to school without the stresses of fee payment. It gave the economically underprivileged members of the public an opportunity to gain access to education and instilled a sense of optimism for the future. This move did, however, not resolve all the issues of poverty plaguing the society. To ameliorate the stresses of food poverty, school feeding programmes complemented free primary education. According to Musolo (2020), the introduction of feeding programmes provided a safety net to assist children to remain in school and to some level increased performance of students. She however, recommended an increase in human resources, learning materials and improvement of school infrastructure. Ministry of Education Performance Audit Report (2021) defines school infrastructure as a range of physical facilities and amenities such as electricity and water that facilitates learning in a school environment. The report further reiterated that poor infrastructure in primary schools is a national problem because most schools lack sufficient and well maintained infrastructure.

According to Dowler (2014), food poverty is the incapability to partake in a sufficient quality or quantity of food in ways that are acceptable in the society or the lack of any guarantee that one will be able to do so. Food insecurity manifests due to lack of sustainable access to safe nutritious and acceptable food for a healthy productive existence (Fawole et al., 2015). Fawole et al (2015) further reiterated that in order to mitigate food poverty, appropriate steps should be taken. For instance; consistent framework for agriculture, improved infrastructure, population control, improved storage facilities and abolition of trade barriers. It is therefore paramount that the society adopts agricultural practices that increase food production and food diversity. Improved food storage facilities can also engender consistent food supply.

The effects of food insecurity vary in magnitude. According to the Food and Agricultural Organization of the United Nations (FAO), food insecurity can be classified into three main categories. These are:

i. Acute – Severe hunger and malnutrition
ii. Occasional – Due to a temporary circumstance
iii. Chronic – Consistently under threat

According to FAO (2022), following the adverse effects of the COVID -19 pandemic, world hunger rose in 2021. The economic impact of the COVID-19 pandemic was that approximately 3.9 billion people did not have the funds to access a healthy diet in the year 2020. This was an upsurge of 112 million persons compared to the previous year, 2019 (FAO,

2022). Undernourishment rose by almost 10% from 2020 to 2021. Approximately 702 to 828 million people were afflicted by hunger in the year 2021. The projections according to FAO (2022), are that close to 670 million people will be affected with hunger by the year 2030. Approximately 2.3 billion persons worldwide experienced moderate or severe food insecurity in the year 2021. Universally, 22% of children below the age of 5 were stunted, 6.7% wasted and 5.7% overweight. FAO (2022) also found that children whose parents did not have formal education especially in poorer neighbourhoods and rural areas were highly susceptible to stunting and wasting. Kids living in cities and richer backgrounds were more vulnerable to being overweight. FAO (2022) proposed that countries where agriculture was the main driver of the economy, should increase expenditure on activities that engender the growth of food and agriculture in those nations.

Approximately 25% of children under 5 years in Kenya suffer from stunted growth. Stunted growth can lead to a decline in mental and physical development of children. Moreover, 11% of children in Kenya are underweight and 4% of them are wasted. Notably, the highest rate of stunting has been witnessed in Kitui and West Pokot counties at approximately 46%. (UNICEF. n.d).

The provision of feeding programmes in Kenyan schools has revolutionized the role of schools in the society. Schools play a vital role in the society. Schools not only provide education but act as social hubs for many societies. Schools guide the physical and psychological growth of young ones and play a significant role in shaping the society. Since the 1980's, the ministry of education in collaboration with the World Food Programme has been responsible for providing meals in Kenyan public schools. The meals not only attract pupils from poor backgrounds who cannot afford frequent meals but also improve the learning experience of children. In the year 2009, Kenya introduced a Home-Grown School Meals Programme to provide meals to at least 500,000 children who had been previously fed by the World Food Programme. Furthermore, for the financial year 2018 – 2019, the government of Kenya budgeted 2.4 billion shillings for the provision of meals in schools (UNICEF. n.d). Approximately 1.6 million children in over 4000 schools in Kenya received meals through the school meals programme in 2018, all funded by the Government of Kenya (WFP, 2018). The school meals programme according to WFP (2018) witnessed a 2-4% upsurge in school turnout in arid counties and informal settlements in Kenya.

The government of Kenya through the cabinet secretaries for education, health and agriculture launched the National School Meals and Nutrition Strategy. The strategy emphasizes on coordination between the concerned ministries, planning across all crucial sectors and steady financing for effective execution of the feeding programmes. The vision of the

strategy is the development of an affordable school meals initiative that will deal with issues such as school enrolment, school retention, school transition rates, food and nutrition insecurity and health and hygiene. To effectively actualize this vision, strategies have to be put in place to ensure the provision of cost effective meals. Pertinent concerns emerge on appropriate strategies that can be adopted by schools to cut down on cost of school meals. Can policies that encourage public primary and pre-primary schools to develop their own food generating and storage mechanisms to ensure that they not only benefit from economies of scale from food bought in bulk and effectively stored but save on cost incurred on further food purchases thanks to self-generated foods, aid in achieving this goal? As part of the built environment, how does the school engender self-sufficiency through food generation? One of the probable strategies to achieve this, is the establishment of small farms and integrated agricultural techniques in schools that will enhance food production. One cannot effectively fathom the feasibility of such ideas without recognizing the transformation of the education system that public primary schools in Kenya are undergoing.

In the year 2003, Kenya saw the emergence of free primary education. The Kenyan education system further evolved from the old 8-4-4 system which had been in existence for over 32 years to the (CBC) under the 2-6-3-3 system of education in the year 2017. The rationale behind the CBC system was to introduce a flexible system of education that accommodates the needs and potential of specific learners with frameworks and parameters that adapt to the learners' demands. This new system of education is more flexible and skills based. Can the new education system which is skill based, provide the students with agricultural skills to be adopted in schools thus enabling schools generate their own foods? The concept of self-sufficiency in food production is not new. In South Africa, the government introduced the Food Security Production Intervention Programme in the year 2012 in a bid to encourage self-sufficiency and food security by encouraging local groups to cultivate their own food (FAO, 2015). The programme called Fetsa Tlala which means defeat hunger links small subsistence producers to government institutions such as schools, hospitals and prisons (FAO, 2015).

Local (NGO's) such as Food 4 Education have taken various initiatives to reduce food insecurity in public primary schools in Kenya. During the COVID-19 pandemic, they provided over 2,000,000 meals to children and their families. One of their governing ethos is hungry kids cannot learn or grow. The organization not only sources food from local farmers but has embraced technology with a lot of focus on preparing high quality meals. They have also gone further and rebuilt kitchens to quality standards (Food 4 Education, nd). School feeding programmes not only ensure meals are provided to school going children but also increase school attendance. Concerns therefore, emerge on whether poor infrastructure in public schools has affected the implementation of the feeding programmes.

1.1 Problem Statement

According to National Information Platform for Food Security and Nutrition (2021), several gaps exist in the implementation of polices on food production and food availability. The report noted that the gaps were due to insufficient resources to obtain food for low income households in rural areas and also in urban informal settlements. Furthermore, quality assurance was also minimal due to the fact that most of the food in these areas was produced in informal settings.

The government of Kenya, over time has developed various policies to reduce food poverty. In 1981, the Sessional Paper no. 4 on National Food Policy was developed fueled by programmes that promoted small scale farming to increase productivity. In the year 2004, a new policy document on Strategy for Revitalization of Agriculture (SRA) 2004 was established spearheaded by the Kitchen Garden Initiative. The year 2011 witnessed the enactment of the Kenya National Social Protection Policy under the Children Act 2001 that introduced the Expanded School Feeding, Njaa Marufuku Program which was further implemented in the year 2014 under the Kenya Health Policy 2014-2030. The Home Feeding Program was thereafter developed in 2017 through the ECD (Early Childhood Development) National Pre- Primary Education Policy 2017. These initiatives highlight the government of Kenya's recognition of the significance of schools as avenues for fighting food insecurity in the country.

Aila (2012) noted that school feeding programmes act as income transfers to families by relieving guardians the burden of providing lunch to their children thus saving money for other uses in the household. Oduya (2019) found that the main challenges faced by the administration heads in schools were inconsistent government supply of food, firewood shortages, lack of kitchen stores and limited NGO supply. The researcher observed that not all schools had permanent and lockable storage facilities and in some instances classrooms were used as stores. Poor storage facilities exposed the available food stock to pest infestation and even theft. Finan (2010) asserted that water scarcity and inadequate infrastructure had negatively affected the sustainability of school feeding programmes in ASAL areas. Oduya (2019) further noted that kitchen gardens in Isiolo County could not thrive due to unreliable water supply and livestock keeping was not effective attack due to unfenced school compounds.

Oduya (2019) and Wamaru (2012) both found that the major sources of food for the school feeding programme were the government of Kenya and NGO's. This therefore reinforces the need for alternative sources of food for schools and also self-sufficiency through self-generated food supply in public schools. This research will analyze the various aspects of the built environment in public primary and pre-primary schools to determine integrated design strategies that can be adopted

partially or holistically by relevant stakeholders to engender self-sufficiency through food generation and accommodate various feeding programmes with the ultimate goal of lessening the adverse effects of food poverty especially to children from poor economic backgrounds.

1.2 Research Questions

The research questions to be addressed in the study include:

i. What is the role of school infrastructure in implementation of school feeding programmes?
ii. What criteria can be used to assess the status of the environment in public primary and pre-primary schools in relation to food poverty alleviation?
iii. How effective is the built environment of public primary and pre-primary schools in accommodating school feeding programmes and food poverty alleviation?
iv. What morphological and integrated spatial design strategies can be adopted by public primary and pre-primary schools to enable self-sufficiency in food poverty alleviation?

1.3 Research Objectives

The key objective of the study is to determine morphological and spatial design strategies that can be adopted in public primary and pre-primary schools to aid in alleviating food poverty within the society.

The specific objectives for the study include:

i. To explain the role of school infrastructure in implementation of school feeding programmes.
ii. To develop criteria to assess the status of the built environment in public primary and pre-primary schools in relation to food poverty alleviation.
iii. To investigate the effectiveness of the built environment of public primary and pre-primary schools in accommodating school feeding programmes and food poverty alleviation.
iv. To formulate morphological and integrated spatial design strategies that can be adopted by public primary and pre-primary schools to enable self-sufficiency in food poverty alleviation.

1.4 Research Proposition

Effective design of the built environment of public primary and pre-primary schools can engender food security in the society.

1.5 Justification of the Study

The study tries to analyse the built environment of public primary and pre-primary schools focusing on spatial and morphological design strategies that can be adopted to enhance food security in the society. The role of school infrastructure is not only limited to offering education to pupils and accommodating the teaching and supporting staff but plays an important role to the society in general. Schools, especially public schools have become hubs for public engagements from acting as venues for national elections to being centers for community social engagements such as public sensitization seminars and even training programmes. The documentation and further implementation of these design strategies will enhance the efficiency of the school feeding programmes and promote a sustainable framework that may stimulate self-sufficiency of schools through food generation to complement any deficit from government and NGO supplied food. The implementation of these strategies will not only benefit school children who are the main users but all users of the school infrastructure.

1.6 Significance of the Study

This research will benefit various stakeholders. The design strategies determined in this research will provide the Ministry of Education, County Governments and various NGO's with guidelines and information necessary for construction of schools that efficiently accommodate their feeding programmes and also engender self-sufficiency in food production complementing any deficit in food supply from the government or any NGO.

The members of the public will benefit from increased food security in schools thus lessening their burden in providing certain meals to their children. Local subsistent farmers may benefit from design ideas to implement in their own local set up and also through an integrated framework, benefit from the supply of excess food to schools at a fee and vice versa.

The school children and staff who are the main users of these schools will benefit from maximum utility of the available food resources with reduced wastage and in cases of increased and extra food supply, other needy members of the society outside the school may benefit too.

The research will also benefit academia by providing vital data for further research and also stimulate important discussion on the role the built environment plays in fighting food poverty in the society.

1.7 Scope of the Study

The scope of study outlines the extent of the content to be tackled during the research both theoretically and physically.

1.7.1 Geographical Scope

The research was carried out within Mombasa County. Mombasa County has a population of approximately 1.2 million people according to the 2019 census with 393,313 aged between 0-14 years. The county boasts of six main constituencies namely; Changamwe, Jomvu, Kisauni, Nyali, Likoni and Mvita. The research will carry out research within these constituencies.

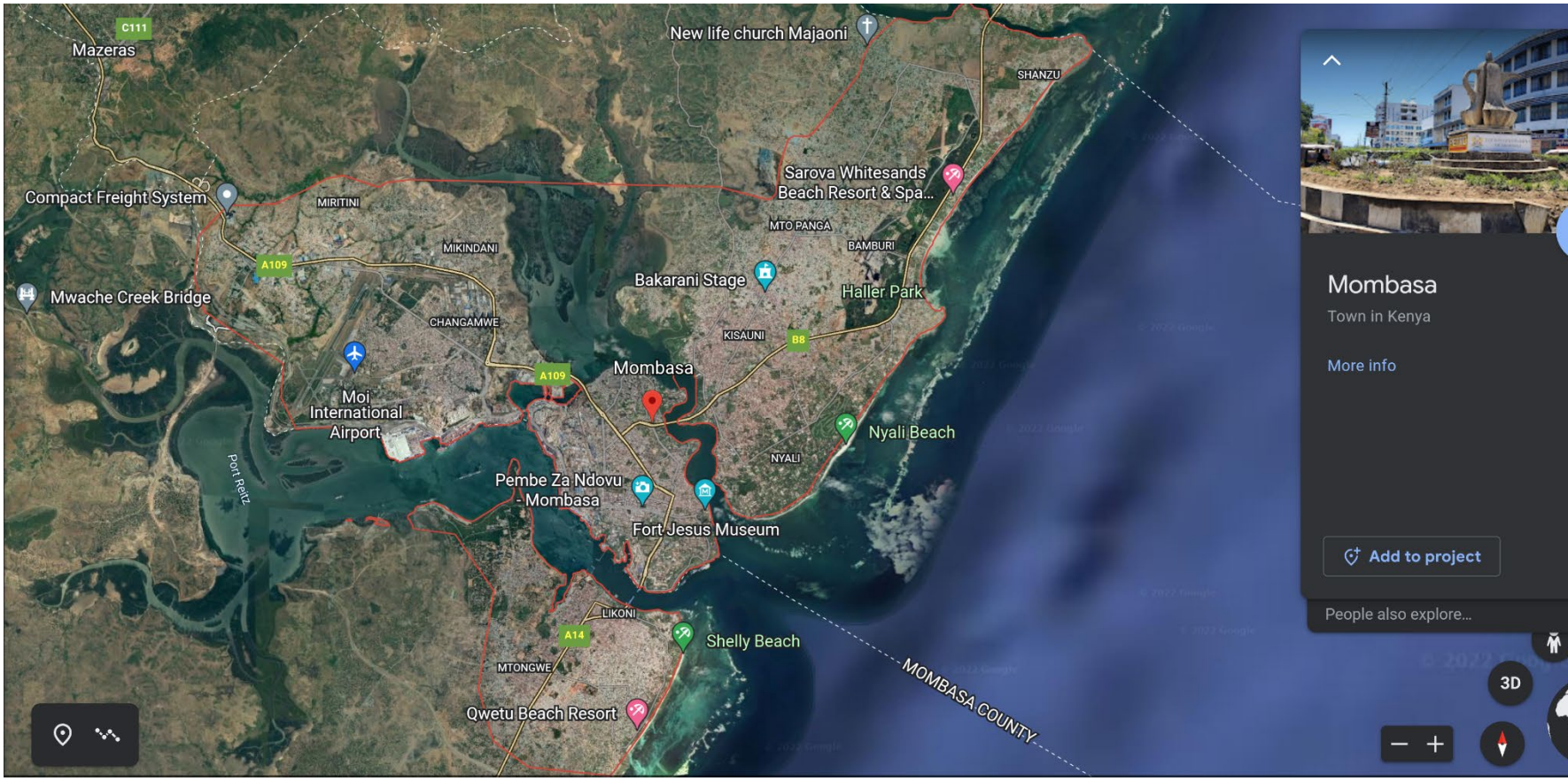


Figure 2 Picture showing Mombasa County, Source: Google earth

1.7.2 Theoretical Scope

The research explored the theory of change. The theory of change provides an explanation on how interventions are anticipated to lead to a predetermined improvement drawing on a causal analysis based preexisting evidence. The theory aids in identifying solutions to efficiently deal with the causal problems that inhibit development and guide decisions on the best tactic to be taken. The interventions in this research were the spatial and morphological design strategies adopted

on the built environment of public primary schools. The anticipated development change is optimum spatial and morphological utility to accommodate feeding programmes, improve school gardens, increase food production and generally accommodate all policies that improve food security in the schools.

The research also explored the theory on sustainable urban design by Farr (2008). Sustainable urbanisms according to Farr is characterized by easy to walk, served with a transit system cities combined with high performance buildings and infrastructure. The research also explored effective strategies that could be adopted to enhance performance of public primary and pre-primary school buildings. The research leant towards the ecological model by Williams, (2007) that recognizes that everything is related to everything. The dynamic connectivity of all these processes characterized by biological interchanges and effective energy and natural resource management. The ecological model proffers the idea of sustainability as a progression of related systems among natural to human and economic systems.

1.7.3 Methodological Scope

This research is qualitative in nature and involved a series of interview with various stakeholders. The research also involved a series of case study analysis that involved examination of various critical components of the school infrastructure. This research studied the school as a built environment and analyzed how the various aspects both morphological and spatial could be effectively utilized to engender food security within the community. The research was limited to public pre-primary, ECDE (Early Childhood Development Education) and public primary school setup. The research was carried out largely in the Coastal part of Kenya in Mombasa County.

Field work analysed different spatial aspects of the school focusing on key areas such as the kitchen, dining halls, office, healthcare room, storage spaces, fences, kitchen gardens, farming spaces and the overall layout of the school. The study also analysed the shape and structure of the schools. Key focus was on sustainable techniques such as water harvesting especially from rain water from roofs, surface runoff collection techniques, underground water collection techniques and water storage.
The study analysed best design techniques for key spaces in these schools to ensure maximum utility of resources such as fuel consumption in kitchens and energy used to supply water to the kitchens and kitchen gardens. The research also analysed various farm related structures from calf pens, rabbit hutches, fish ponds, chicken coops, bee hives etc.

1.8 Limitation of the Study

Some of the limitations of the research include:

- The research is limited to public primary and pre-primary schools.
- The research is limited to schools within Mombasa County.
- The study research is limited to the resources available to the researcher.

1.9 Delimitation of the Study

The research was specifically carried out within Mombasa County. The research does, however, not reflect the conditions of other counties within the country.

1.10 Study Assumptions

Some of the assumption of the research include:

- All feedback from the participants being interviewed was candid.
- All motives of participants were genuine.
- The secondary data utilized in this research were genuine.

1.11 Overview

The general structure of the dissertation is as follows:

Chapter 1 – Introduction

Chapter one contains the introduction to the research. It provides circumstantial information to the problem under investigation, justifies the research and breaks down the study into probable chapters.

Chapter 2 – Literature Review discusses

Food Poverty globally and in Kenya, School Feeding Programmes, The infrastructure/ built form of public primary schools, Intervention strategies to the built environment that have been adopted globally and in Kenya in dealing with food poverty and Theoretical and Conceptual framework.

Chapter 3 – Research Methodology discusses:

The approaches taken in collecting and analyzing data. It includes: Research design, Population of Study, Sample Size, Collection Instruments, Collection Methods, Data Processing, Data Analysis and Ethical Considerations.

Chapter 4 – Data Analysis, Findings and Discussions

The findings are listed concisely and objectively. The data processed is presented in accordance with study objectives and the problems met during the field investigation are highlighted.

Chapter 5 – Summary of Findings, Conclusion and Recommendation

The project report is concluded with the summary of the main findings and recommendations made.

CHAPTER 2

Literature Review

Figure 3 Children eating. Source: Author

Figure 4 shows wasting in children
Source: UNICEF, WHO, World Bank Group

2.0 Introduction

This chapter delves into the theoretical review, conceptual framework as well as identification and presentation of relevant information on food poverty, school feeding programmes, school infrastructure and appropriate architectural design strategies. It also discusses the research gaps that triggered this research. The literature was reviewed from peer reviewed journals, reports, working papers and past research studies.

2.1 Food Poverty Globally

With just seven years shy of the 2030 global nutrition targets, over 3.1 billion persons lack access to inexpensive healthy diets (FAO, IFAD, UNICEF, WFP and WHO, 2022). The side effects of the COVID -19 global pandemic are still being felt. Food prices have soared. The ongoing war in Ukraine compounded by other global issues have led to interruption in supply of agricultural produce and even increase in fuel prices. Furthermore, the erratic climatic patterns as a result of global warming and climate change has proven to be a key impediment to food supply chains particularly in low income nations.

According to FAO et al. (2022), the most heavily affected continents with hunger are Africa with 278 million people while Asia has a whopping 425 million people. Latin America and the Caribbean had 56.5 million and 20.2 million people respectively. Approximately 30% of the global population with nearly 2.3 billion people experienced moderate or severe food insecurity in the year 2021 and 350 million persons in 2019 when the COVID – 19 pandemic erupted (FAO et al., 2022). The effects of food poverty in the society is manifested in the varying levels and trends in child malnutrition. Malnutrition is the shortages, surpluses or imbalances in a person's intake of energy and nutrients. Malnutrition is a global menace affecting approximately 250 million children. An estimated 209 million children suffer from undernutrition with 159 million of them being stunted while 50 million of them being wasted. The remaining 41 million suffer from obesity and other diet related non communicable diseases (FAO et al., 2022).

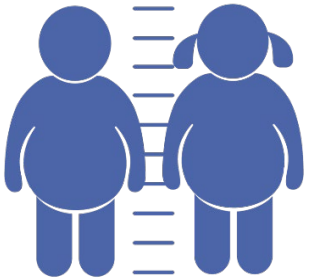


Figure 5 shows obesity in children
Source: UNICEF, WHO, World Bank Group

Stunting is exhibited in children who are too short for their age. These children are subjected to possible irreversible physical and cognitive damage due to stunted growth. Stunting can have adverse effects and even last a lifetime. Wasting on the other hand, is exhibited in children who are too thin for their height. It is as a result of speedy loss of weight or failure of young ones to gain weight. In extreme situations, children afflicted with wasting may succumb to death. Obesity refers to children who are too heavy for their height. This type of malnutrition is caused by high energy intake that exceed the children energy requirements. It may increase the risk of diet related non communicable diseases.

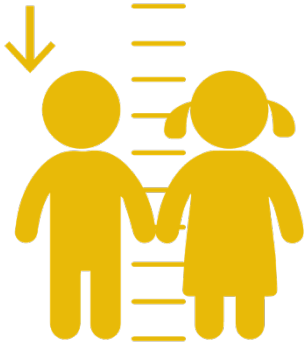


Figure 7 shows stunting in children Source: UNICEF, WHO, World Bank Group

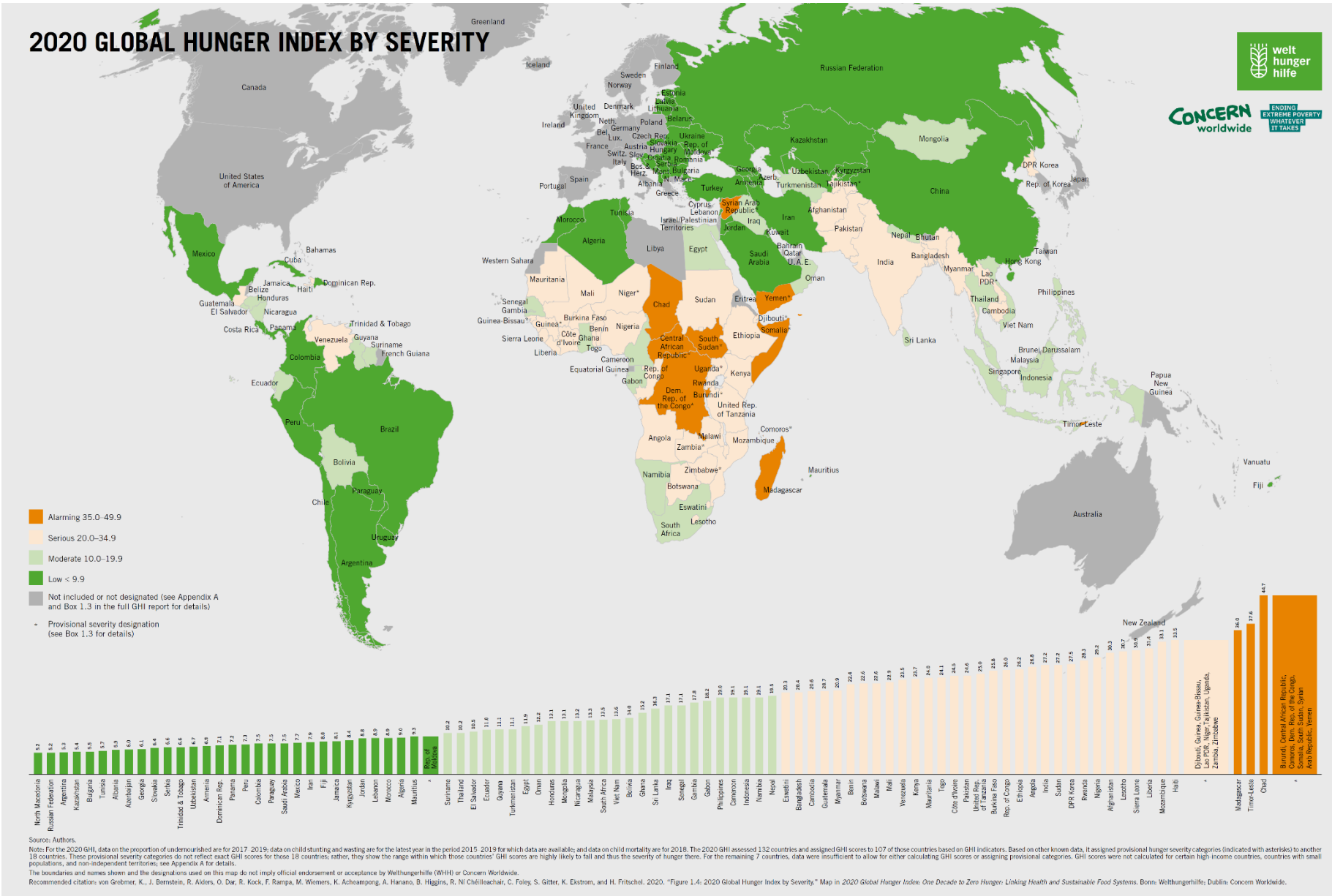


Figure 6 showing 2020 global hunger index by Severity

The 2030 Agenda for Sustainable Development has several goals. The second goal is to put to an end hunger, improve nutrition, ensure food security and encourage practice of sustainable agriculture. The document highlights key targets to be achieved by the year 2030. These include:

- Access by all, to safe food full of nutrition and adequate food all through the year.
- To put to an end of every form of malnutrition.
- Doubling the income and production of small scale farmers by enabling safe and equitable access to information, land, finances, markets, productive resources and all available opportunities.
- Implementing food systems that are sustainable.
- Preserving the genetic diversity of seeds and farm animal species.
- Increasing investment in infrastructure in rural areas, research in agriculture, growth in technology and plant and livestock gene banks.
- Preventing and rectifying trade restrictions in world agricultural markets.
- Ensure food commodity markets function properly.

There has been a notable decline in stunting globally since 2000 but there is need for accelerating progress to achieve the 2030 targets. Wasting, on the other hand is persisting at an alarming rate and will therefore need a change in trajectory to achieve the 2030 targets.

According to UNICEF, WHO, World Bank Group Joint Child Malnutrition Estimates (2021), in the year 2020, two out of five children affected by stunting under 5 years lived in Africa while more than half lived in Asia. More than one quarter of children below the age of 5 years afflicted with wasting lived in Africa and two thirds lived in Asia. More than one quarter of children under 5 years afflicted with overweight lived in Africa while almost half of all children lived in Asia.

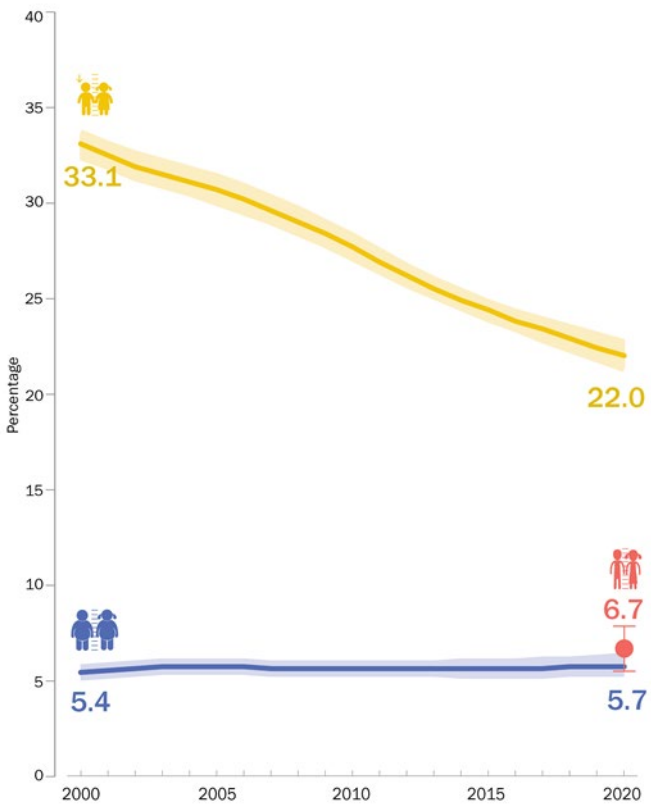


Figure 8 Percentage of children under 5 affected by stunting, wasting and overweight, global, 2000–2020 Source: UNICEF, WHO, World Bank Group*

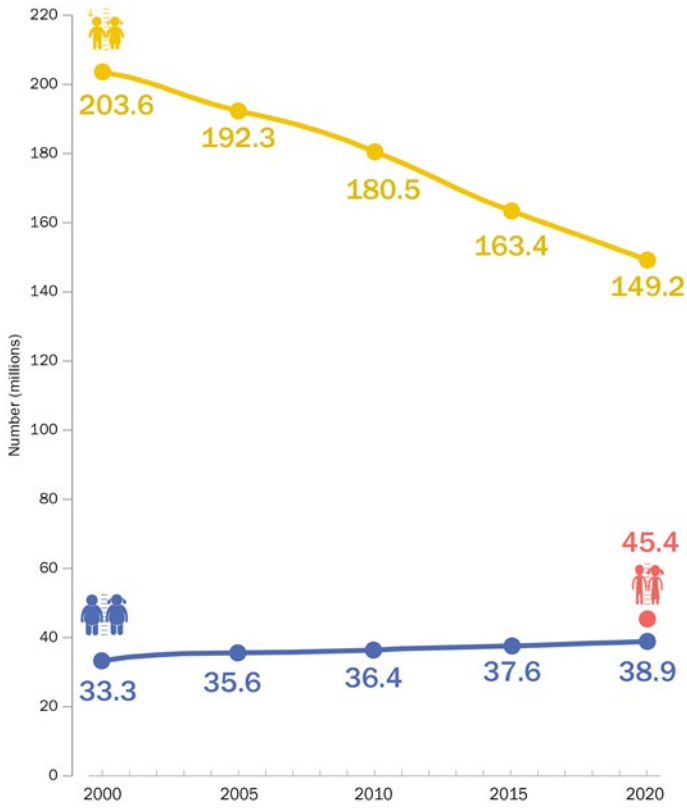


Figure 9 Number (millions) of children under 5 affected by stunting, wasting and overweight, global, 2000–2020 Source: UNICEF, WHO, World Bank Group*

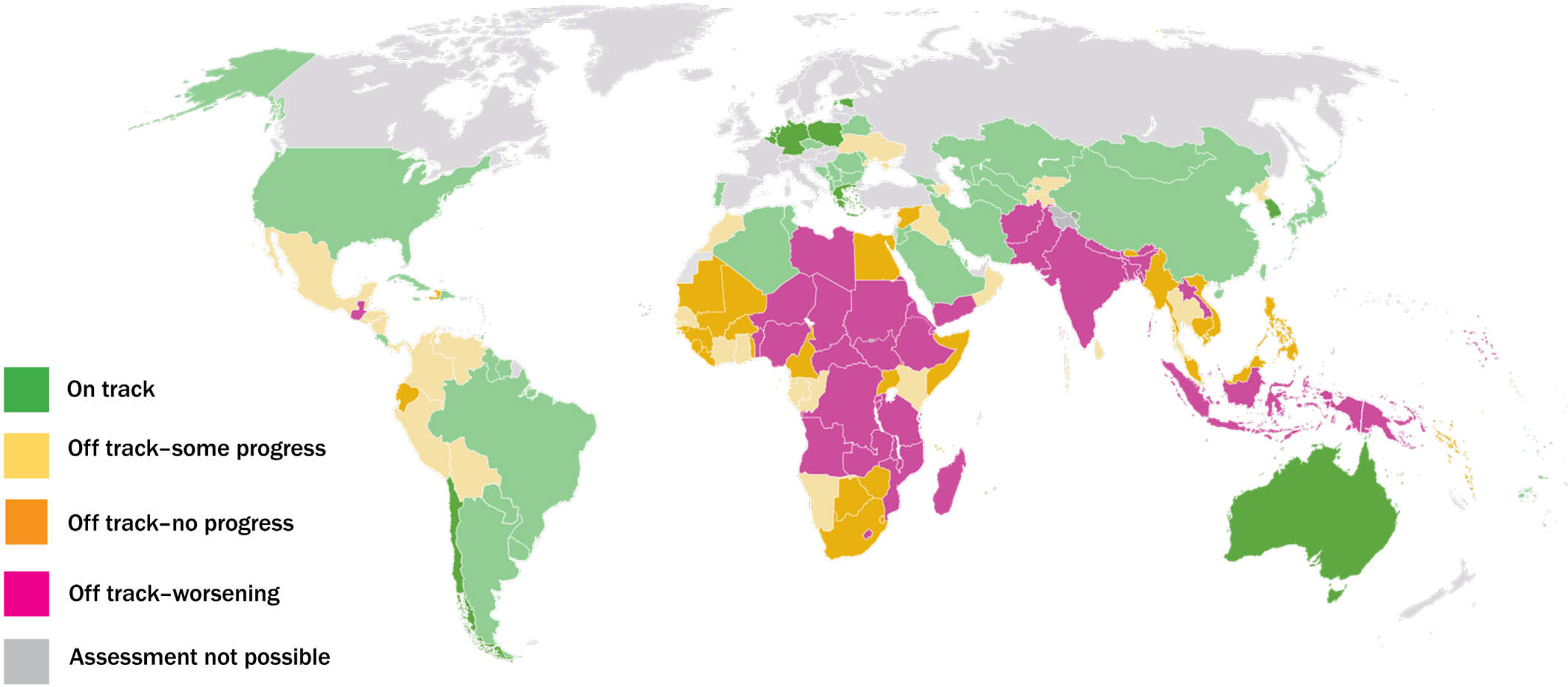


Figure 10 Percentage of children under 5 affected by stunting, by country, 2020 Source: UNICEF, WHO, World Bank Group

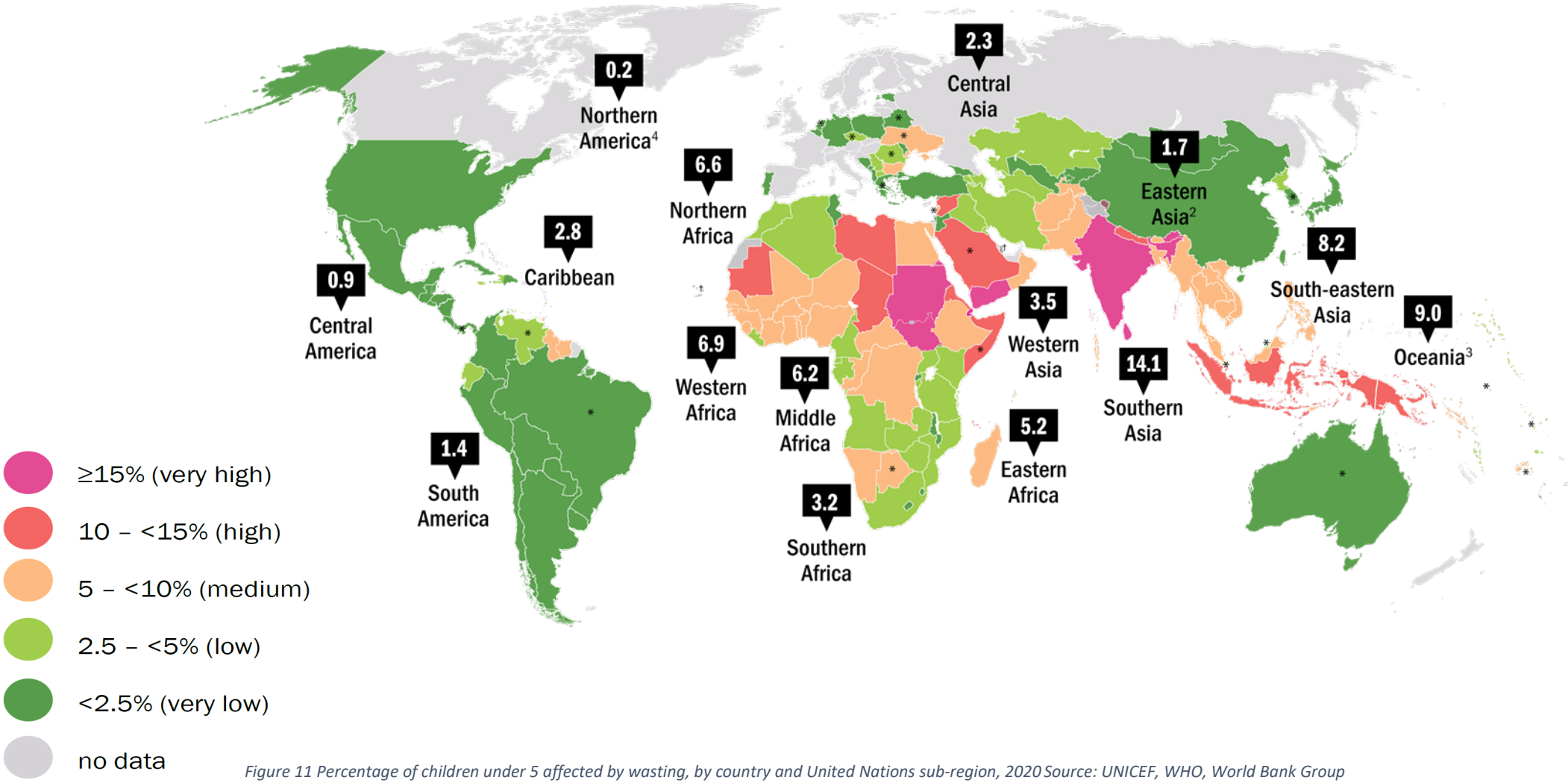


Figure 11 Percentage of children under 5 affected by wasting, by country and United Nations sub-region, 2020 Source: UNICEF, WHO, World Bank Group

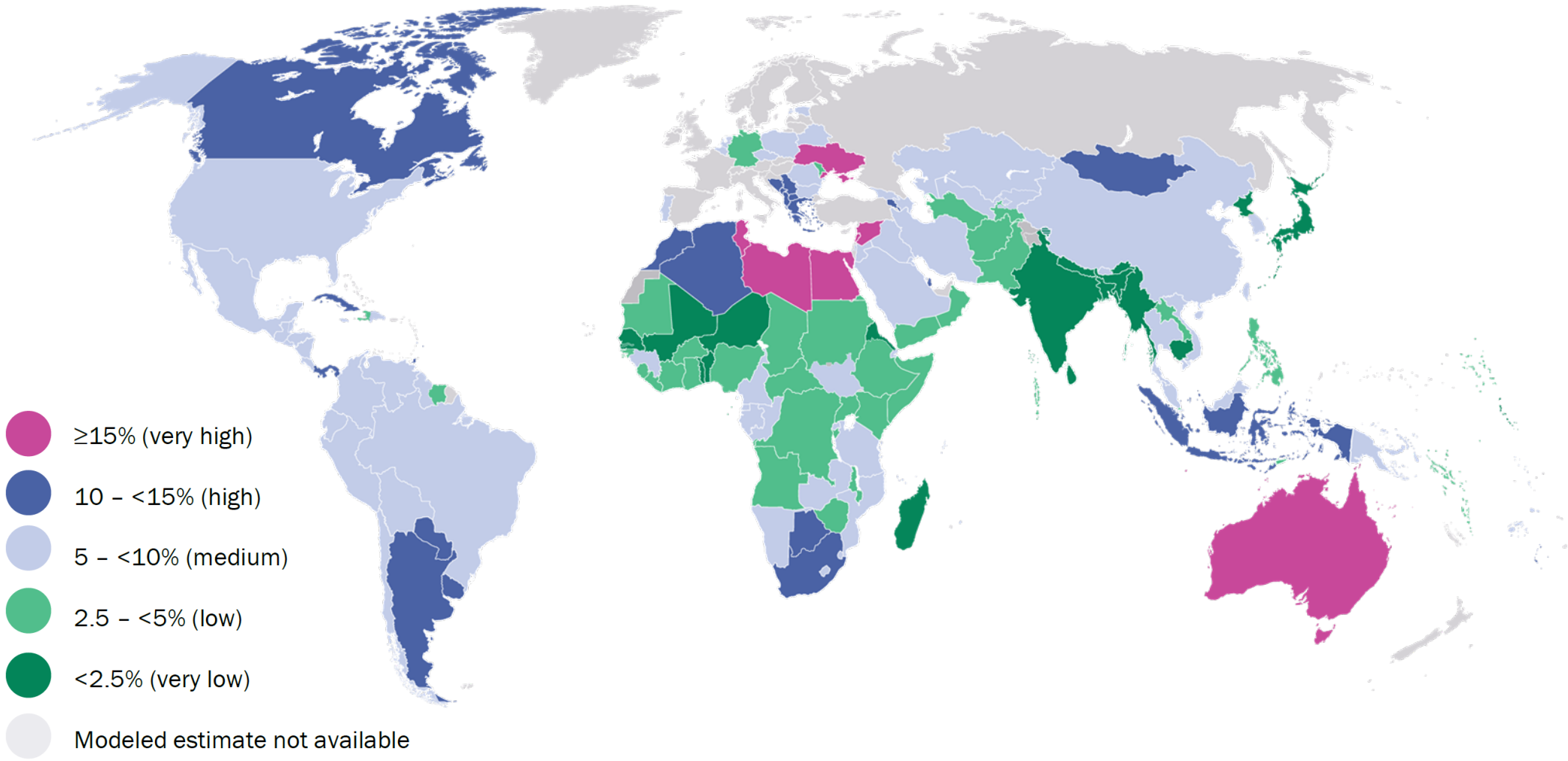


Figure 12 Percentage of children under 5 affected by overweight, by country, 2020 Source: UNICEF, WHO, World Bank Group

Globally, the occurrence of stunting in children less than the age of 5 years has reduced from approximately 33.1% (201.6 million) in 2000 to 22% (149.2 million) in the year 2020 (FAO, 2022). Moreover, according to FAO (2022) the frequency of wasting in children under the age of 5 years was almost 7% (45.4 million) in 2020 which is twice the 2030 goal of below 3%. Overweight in children less than the age of 5 years has also been on the rise globally due to increase in insufficient physical activity in children and increased provision of highly processed foodstuff. Internationally, the presence of overweight children below the age of 5 years experienced an upsurge from at least 33 million in the year 2000 to almost 40 million in the year 2020 (FAO, 2022).

Africa witnessed an increase of 50 million people affected by hunger in two years from 2019 to 2021 (FAO, 2022). Data on the Prevalence of undernourishment show that Northern Africa was the least affected in 2021 with 6.9% while Middle Africa and Eastern Africa were the highest affected with 32.8% and 29.8% respectively (FAO, 2022). Southern Africa had 9.2% while Western Africa had 13.9%. The amount of undernourished persons in Africa was 17.4 million in Northern Africa and 260.6 million in Sub-Saharan Africa in the year 2021. Eastern Africa had 136.4 million people, Middle Africa 60.7 million, Southern Africa 6.3 million and Western Africa 57.3 million (FAO, 2022).

Some of the notable key steering causes of food insecurity globally have been war, climatic extremities, economic fluctuations and rising inequalities. It is of paramount importance that low income countries intensively invest in agrifood systems to enhance food security for their inhabitants (FAO, 2022). It is important that the most cost effective policies are adopted to ensure efficient use of the limited resources available. Agrifood systems are very high risk averse in terms of investments requiring governments to spearhead such investments since high-risk-low-reward spectrum is not enticing to many stakeholders in the private sector (FAO, 2022).

Many countries globally should repurpose their policies on food and agriculture to ensure that all aspects of food security, environmental sustainability and social equity are adhered to ensure that the price of healthy diets is affordable to all.

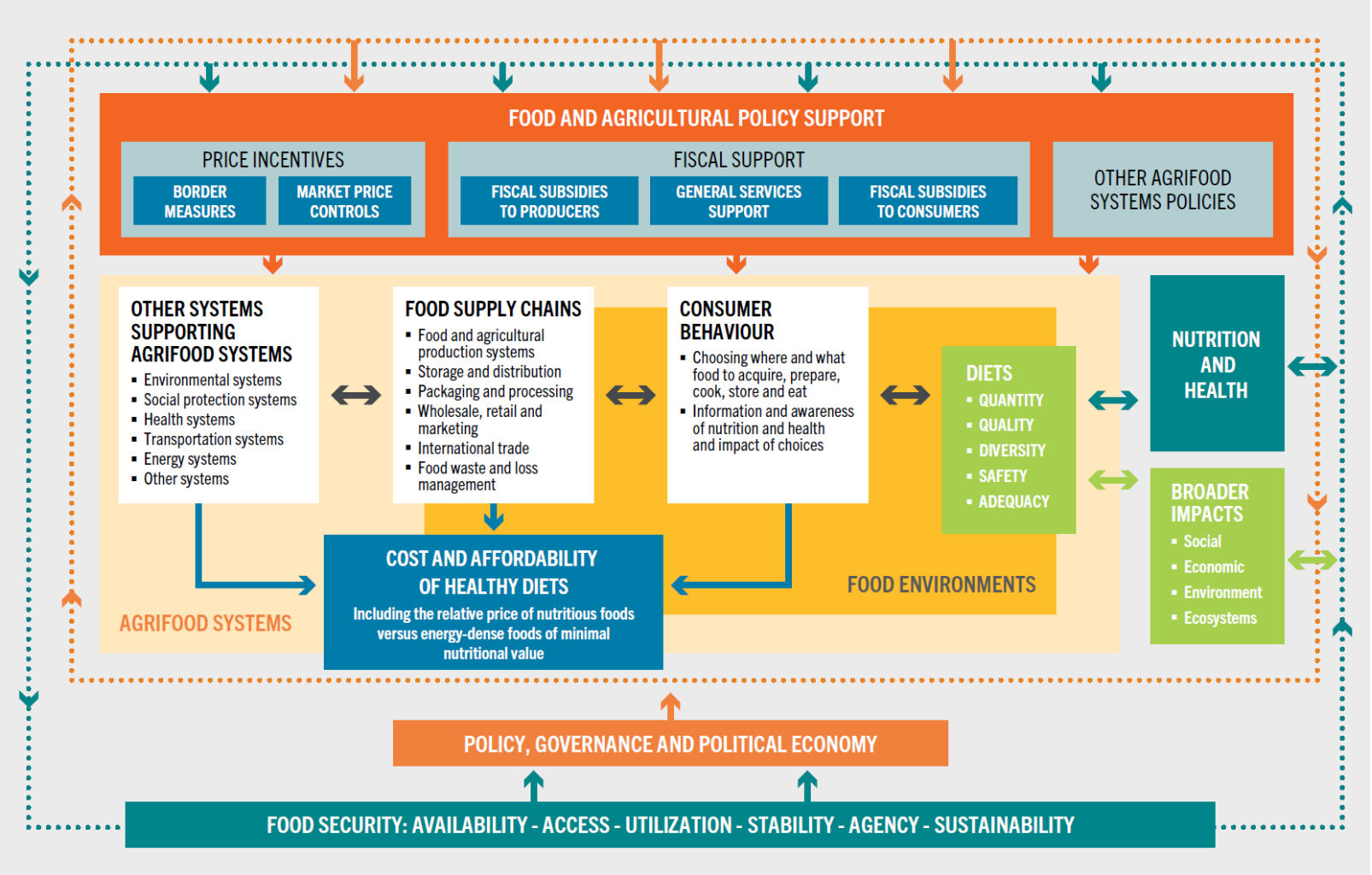


Figure 13 Source: Adapted from FAO, IFAD, UNICEF, WFP & WHO. 2021

2.2 Food Poverty in Kenya

Food security is characterized by sustainable proximity to safe food that possesses adequate quality and adequate quantity of energy, proteins and micronutrients for a healthy existence. Poverty has crippled the urban poor with inadequate finances to access sufficient food. The poor in rural areas lack adequate resources and access to markets to produce adequate food and access diverse foods that they do not produce (National Information Platform for Food Security and Nutrition [NIPFN], 2021).

In an attempt to meet the World Health Assembly 2025 targets, Kenya has committed to strive to reduce prevalence of stunting in kids under the age of 5 years by 40%, maintain child wasting at less than 4% and prevent any upsurge in obesity (NIPFN, 2021). According to the Kenya Integrated Household Budget Survey (2015), At least 29% of stunted children reside in rural areas while at least 20% in city centers. Stunting is at approximately 26% countrywide (KDHS, 2014). Certain counties such as Meru, Bomet, Bungoma and Tharaka Nithi had rates above the national average. Counties that don't generate their own food are more food insecure while families with limited income experience inadequate nourishment. The level of stunting increases after 2 years when most children stop benefiting from being breast fed. The prevalence of stunting is at 22% in girls and much higher in boys at 30% (NIPFN, 2021).

To ensure food security, it is imperative that all households have adequate access to food for nourishment. The government of Kenya should accommodate within its budget, various initiatives that will provide appropriate infrastructure including food preservation facilities to mitigate losses from food harvests. Food production can be increased through improved animal rearing, improved fishing and improved cultivation of crops (NIPFN, 2021). The government of Kenya should therefore address key issues that affect food production. Some of the issues include enhanced production in the agricultural sector, provision of access to inputs, enhanced funding, improved management of farm animals and effective promotion of agricultural products (NIPFN, 2021).

According to NIPFN (2021), local production of food is fundamental and in cases where local production doesn't meet national demand, imports offset the food deficits. The Import Dependency Ration (IDR) is utilized as a parameter to show the extent of reliance on imports. In 2018, the IDR in Kenya increase from 15.4% to 16.4% in 2019 (NIPFN, 2021). On the other hand, SSR (Self Sufficiency Ratio) indicates the nation's reliance on self-generated food resources. From the year 2018 to 2019, the Kenyan SSR increased by 0.7% points and around 1.5% points for vegetables and fishery products respectively (NIPFN, 2021).

Table 1 Proportion of Undernourished Children (6-59 Months) by Residence, Age, Sex and County Source: KIHBS 2015/2016

Residence / county	Height-for-Age		Weight-for-Age		Weight-for-Height		Number of Children ('000)
	Percentage below -2SD	Percentage below -3SD	Percentage below -2SD	Percentage below -3SD	Percentage below -2SD	Percentage below -3SD	
National	**29.9**	**11.4**	**13.0**	**2.5**	**6.7**	**2.6**	**4,839**
Rural	**32.4**	**12.2**	**14.5**	**2.8**	**6.8**	**2.8**	**3,297**
Urban	**24.5**	**9.6**	**9.8**	**2.1**	**6.3**	**2.4**	**1,542**
Sex							
Male	32.8	12.5	13.7	3.0	7.2	3.0	2,447
Female	26.9	10.2	12.3	2.1	6.1	2.3	2,392
Age							
6-11 months	14.6	5.5	8.3	1.1	8.5	3.8	417
12-23 months	30.8	12.8	11.8	3.3	9.0	3.5	1,056
24-35 months	37.0	13.5	13.4	2.3	5.7	2.6	1,039
36-48 months	32.5	13.3	14.1	2.6	6.1	2.4	1,136
48-59 months	25.7	8.5	14.4	2.4	5.3	1.8	1,191
County							
Mombasa	26.6	11.9	10.4	2.5	9.7	2.6	95
Kwale	35.5	13.9	10.2	2.5	3.4	0.4	109
Kilifi	29.9	10.8	17.4	1.4	4.8	1.3	175
Tana River	24.6	11.4	14.7	6.0	8.2	1.6	39
Lamu	30.9	10.5	17.7	4.3	8.8	1.5	14
Taita / Taveta	24.8	10.4	12.1	0.8	7.1	1.9	35
Garissa	8.3	5.0	13.9	4.7	27.6	16.6	50
Wajir	24.7	8.3	16.1	1.8	11.6	2.6	72
Mandera	47.6	18.5	43.8	5.8	17.2	6.2	102
Marsabit	33.0	16.1	30.9	11.5	25.0	11.5	44
Isiolo	22.8	10.5	18.4	5.3	30.0	11.5	19
Meru	36.0	15.3	13.5	4.3	4.7	0.7	144
Tharaka-Nithi	39.7	14.3	15.5	3.8	6.3	0.6	36
Embu	33.0	8.5	16.8	5.3	3.5	0.4	50
Kitui	29.3	10.4	12.9	1.1	6.3	1.4	112
Machakos	39.8	16.9	7.5	1.7	2.7	0.0	98

Makueni.....	28.9	6.6	9.4	1.8	3.2	0.8	94
Nyandarua.....	39.2	13.3	10.3	2.6	9.9	4.7	63
Nyeri.....	27.6	8.0	4.1	1.0	6.0	2.4	68
Kirinyaga.....	28.3	13.2	7.1	0.6	0.7	0.7	38
Murang'a.....	20.1	3.0	3.8	1.0	5.0	3.2	94
Kiambu.....	26.0	8.2	8.7	5.7	4.0	2.6	149
Turkana.....	25.3	7.8	25.5	4.7	27.4	15.9	150
West Pokot.....	41.2	14.8	32.8	7.8	15.4	7.1	92
Samburu.....	33.1	14.9	32.1	11.9	25.3	12.2	47
Trans Nzoia.....	37.0	10.5	14.7	2.0	1.7	0.7	114
Uasin Gishu.....	28.0	8.1	12.6	2.1	4.4	1.2	116
Elgeyo / Marakwet...	32.2	11.7	17.8	1.2	5.3	0.9	47
Nandi.....	31.1	12.4	10.4	2.2	6.3	1.1	108
Baringo.....	30.0	9.9	21.6	4.8	8.1	1.6	82
Laikipia.....	33.1	18.2	20.6	11.5	6.2	2.7	46
Nakuru.....	33.4	9.0	11.1	1.8	1.4	0.4	216
Narok.....	39.4	18.4	17.1	2.2	4.3	1.5	162
Kajiado.....	25.0	13.5	9.8	1.0	4.8	1.1	73
Kericho.....	32.3	11.0	12.0	2.4	4.0	1.2	91
Bomet.....	33.0	15.2	13.7	2.9	7.2	3.6	102
Kakamega.....	27.6	11.1	8.7	0.7	2.0	0.7	219
Vihiga.....	22.4	5.8	6.1	0.0	2.6	0.6	62
Bungoma.....	33.3	13.6	8.2	1.8	2.7	0.9	188
Busia.....	29.5	10.7	9.1	0.2	3.7	0.7	99
Siaya.....	30.4	8.1	7.1	0.2	3.1	0.6	117
Kisumu.....	23.9	6.0	5.2	0.5	5.5	2.2	114
Homa Bay.....	32.1	13.4	10.1	2.6	4.4	3.0	149
Migori.....	26.5	11.5	7.6	1.1	8.0	2.8	121
Kisii.....	27.6	13.6	11.0	0.7	6.8	4.1	139
Nyamira.....	23.2	5.5	5.6	0.9	3.5	2.7	72
Nairobi City.....	21.4	11.8	10.2	1.6	5.6	1.8	410

2.3 Food Policies in Kenya

To alleviate the adverse effects of food insecurity, various steps should be taken such as strengthening of equity on access to credit facilities and empowerment of the marginalized. Diversity of foods within the country should be enhanced to ensure maximum utility of available nutrition. Adequate investments should be made in infrastructure to aid in achieving effective storage and preservation of foods that go bad easily. Transport infrastructure should be improved and appropriate technology embraced. Transparency in state involved markets should be enhanced to prevent illegal levies and disproportionate profits from intermediaries because of monopolistic tendencies. Moreover, it is vital that cultural and social considerations in nutrition be adopted to support nutrition improvement.

The government of Kenya throughout the years has initiated various policies to address the menace of food poverty. Some of the policies are as shown in figure 14 and figure 15.

Period	**Policy Documents**	**Legislative Framework**	**Regulatory Framework**	**Institutions**	**Programmes**
1981	Sessional Paper No.4 of 1981 on National Food policy. Kenya First National Food Policy	Agriculture Act	Agriculture regulations	Agriculture	Small scale farming increasing productivity
1994	Sessional Paper No. 2 of 1994 on Kenya second National Food policy)	Agriculture Act	Agriculture regulations	Agriculture	Improved seed and animals and technology in production initiatives
2004	Strategy for revitalizing Agriculture (SRA) 2004	Agriculture Act	Agriculture development regulations	Agriculture	kitchen gardens initiative
2008	National Livestock policy,2008	Livestock Act	Livestock regulations	agriculture	Improved breeding, disease free zones
2008	National Oceans and Fisheries Policy ,2008	Fisheries Act 2012	Fisheries quality regulations	Agriculture	Economic stimulus eat fish &farming
2011	Kenya National Food and Nutrition Security Policy 2011	Health Act 2017	National Nutrition Action Plan 2018-2022	Health, agriculture	Vitamin supplementation
2011	Kenya National Social Protection Policy,2011	The Children Act 2001	Child protection framework	Social protection	Expanded school feeding, Njaa Marufuku Kenya program
2012	The National Agricultural Sector Extension Policy (NASEP)2012	Agriculture Act	Dairy industry regulations	Agriculture	Improved breeds production
2012	Implementation Framework for securing breastfeeding friendly environment	Breast milk substitutes Act,2012	Marketing and distribution of Breast milk substitutes (Control regulations)	health	Point of use fortification training manuals, biofortification

Figure 14 Food Policies. Source: NIPFN (2021).

2013	National Maternal, Infant and Young Child Nutrition Policy ,2013	Health Act	Implementation Framework for securing a breast-feeding friendly environment at the workplaces 2020-2024	health	Vitamin A Supplementation and Micronutrient Deficiency Control
2014	Kenya Health Policy 2014-2030	Health Act,2017	Kenya Reproductive, Maternal, Newborn, Child and Adolescent Health (RMNCAH) Investment Framework,2016	Education, health, agriculture, social services	Expanded school feeding, Njaa Marufuku Kenya program
2017	ECD National Pre-Primary Education Policy 2017	Education Act,2016	Kenya policy Framework for Education,2012	education	Home grown feeding program
2017	Food nutrition security policy implementation framework 2017-22	Health Act,2017	Kenya National Nutrition Action Plan 2018-2022	health	Beyond Zero First Lady Initiative

Figure 15 Food Policies. Source: NIPFN (2021).

2.4 School Feeding Programmes Globally

One of the earliest recorded school feeding programmes was carried out in Munich, Germany in 1790 where meals and schooling were provided to children who worked part time in exchange (Gunderson, 2003). High income countries where the school feeding programmes became widespread early in the 19th Century would later on in the 20th Century see the SFPs (School Feeding Programmes) as techniques of lessening short-term hunger (Bundy et al 2018). SFPs are implemented in various forms in almost all countries globally (World Bank 2018b).

Approximately, over 368 million children of which 305 million are from LMICs (Lower Middle Income Countries) benefit daily from up to 75 billion US dollars expended annually for school feeding meals. However, only 18% of children in low income countries benefit from the free meals while 83% of the resources are from donor funds (WFP 2013). The earliest WFP school meals project was carried out in Central and Norther Togo in 1963.

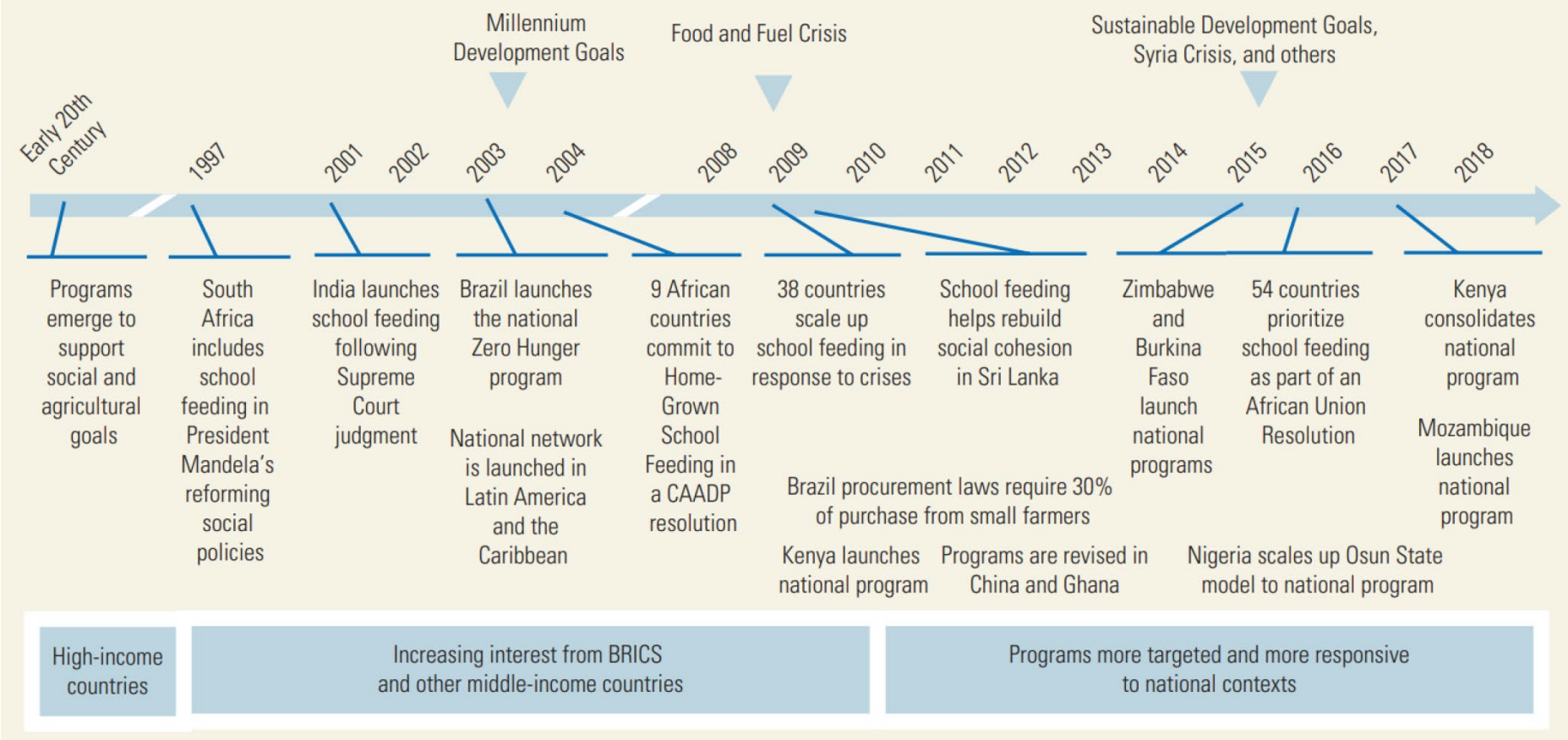


Figure 16 The Evolution of School Feeding Programs SOURCE: Bundy et al., (2018).

WFP earliest target in its implementation of SFP through Food Aid was alleviation of hunger which changed in the 1990's when the focus shifted to Food for Education. In early 2020, WFP established the WFP School Feeding Strategy 2020-2030 (WFP 2020). In this ten year strategy, WFP intends to champion school feeding intentions as a vital pillar with an integrated multi-sectoral school, health and nutrition response.

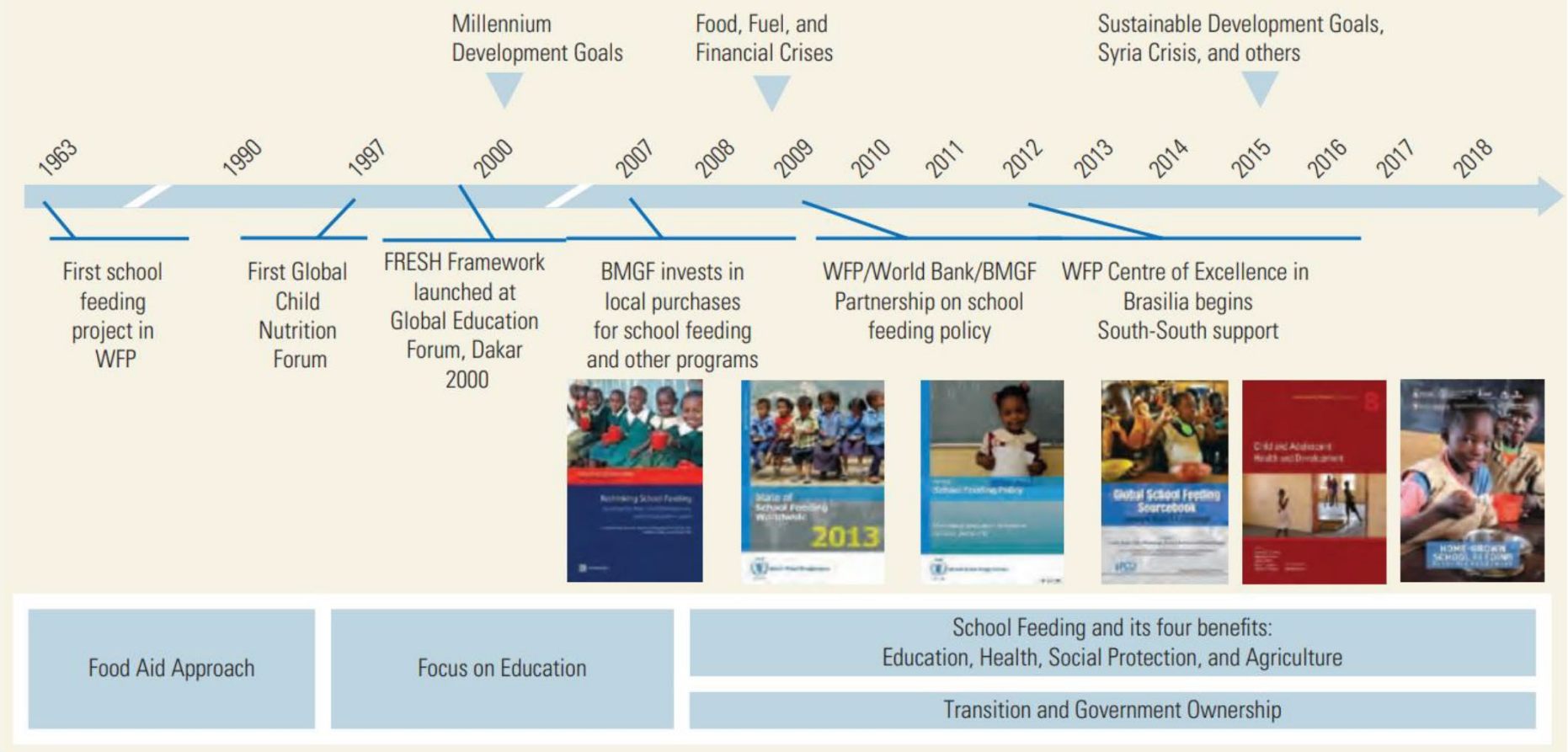


Figure 17 The Evolution of School Feeding Policies and Programmes. Source: Bundy et al. 2018.

2.5 School Feeding Programmes in Kenya

One of the earliest notable initiatives by the government of Kenya that utilized the school as a tool to curtail food poverty was the Njaa Marufuku Kenya programme (NMK). Njaa Marufuku means eradication of hunger. The Njaa Marufuku Kenya Programme was started in Kenya in the year 2005 in three pilot districts of Narok, Murang'a and Butere Mumias (WFP, 2018). One of its key objectives was to support community nutrition and community based school-meals programmes.

World Food Programme (WFP) in collaboration with the MOE, has provided nutritious meals to school children since 1980. In 2009, the government of Kenya initiated a government led only programme known as the Home Grown School Meals programme (HGSM). Food was bought from local farmers thus helping stimulate local economies in various parts of Kenya.

The NMK programme funding is broken into 3 year periods where 100% of the food funding is covered by the programme in the first year. In the following year it reduces to 75% and 50% in the third year (WFP, 2018). The parents of the benefiting schools cover the percentage deficit. This is aimed at creating a sense of ownership by the parents. Some of the funding from the NMK programme is also channeled to school gardens which not only provide some food to the schools but act as demonstration plots for appropriate agricultural technology to local farmers and the society in general (WFP, 2018).

Various stakeholders are involved in the school feeding programmes in Kenya. The key ministries involved are the ministry of Education, Agriculture, Health and Science and Technology. The NMK programme is led by the ministry of Agriculture while the HGSM programme is led by the Ministry of Education, Science and Technology (WFP, 2018).

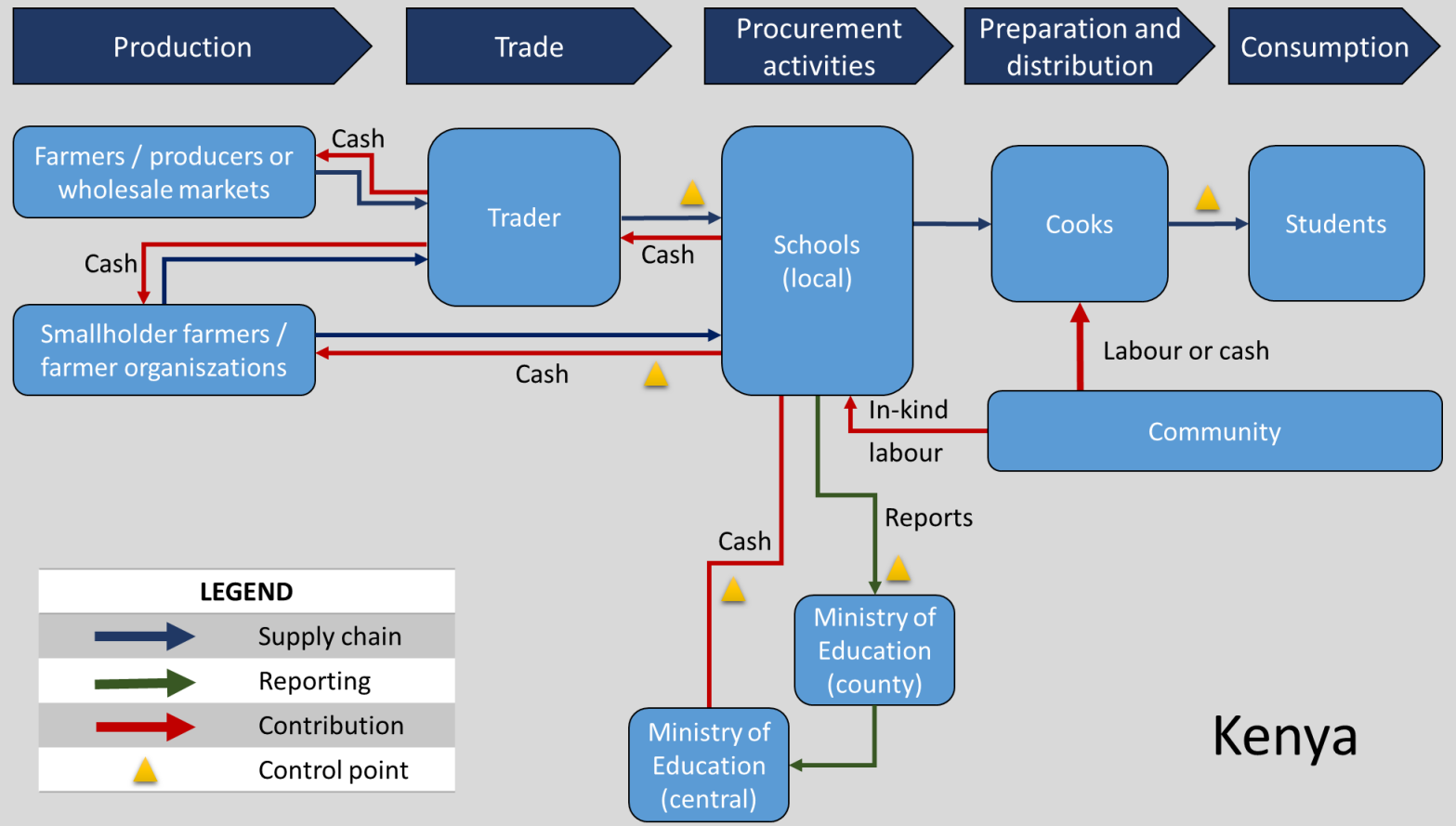


Figure 18 Supply Chain for Kenya's Decentralized Operating Model Source: WFP 2018

Small holder farmers are key actors in the HGSM programme since they provide meals directly to schools or through trader exchange for cash. A school meals committee in collaboration with the schools undertakes the procurement process. Cash through the programme is channelled to schools on a biannual basis (WFP, 2018). The ministry of Education, Science and Technology in collaboration with its development partners not only monitors the flow of funds from the

ministry to schools but also the hygiene and sanitation of the kitchens, toiles and food stores and even the examination of food

2.6 The built Environment of public primary and pre-primary schools

Infrastructure plays a vital role in schools. The provision of infrastructural facilities provides an ideal environment for various activities in order to achieve targeted goals and objectives. School feeding programmes facilitate schools with meals. So as to provide adequate meals in schools, different types of infrastructural facilities have to be provided. These facilities include buildings that will aid in provision of meals such as kitchens, kitchen stores and dining spaces. There is also need to provide adequate clean water to service the kitchens and the pupils so as to provide hygienic meals. Electricity is also an important resource since it provides energy to power kitchens and other spaces such as offices and dining spaces that process relevant documents to feeding programmes and amiable spaces to partake in school meals. School infrastructure such as playing fields allow for children to exercise especially those afflicted with health issues such as obesity. Health rooms also aid in addressing malnutrition issues that have arisen due to food poverty. Infrastructure provision in public pre-primary schools is the responsibility of the county governments. It is also prudent that county governments provide a sustainable feeding programme. In the year 2018, the national government of Kenya through the ministry of education developed several guidelines on the design of classrooms, toilets/latrines, kitchens, food stores and dining areas. The guidelines are as in the table below.

Table 2 Infrastructure design guidelines for pre-primary schools. Source: National Pre-Primary Education Policy Standard Guidelines 2018 pg. 11.

SPACE		DESCRIPTION	STANDARD	SIZE
Classroom				
	a	Space should be adequate for all children	Maximum 25 children	8 x 6 meters (minimum 1m2) per child
	b	Universal design of spaces. Provide ramps, railings, and low level door handles to accommodate children living with disabilities.		
	c	Spaces such as classrooms should be well lit and properly ventilated.		

	d	Children should be protected from adverse environmental conditions. Some of these conditions include heat, rain, dust and wind. This can be achieved by provision of roofs, window, doors and floors properly designed		
	e	Fenestrations such as windows and doors should open outwards.		
	f	Fixed grills should not be provided on windows		
	g	Furniture should be ideal for children of various ages and those living with disabilities.		
	h	Sleeping room should be provided separate from other rooms.		
	i	Each teacher shall be provided with a table and chair. A lockable cabinet for storage of materials shall also be provided.		
	j	All classrooms and furniture should be painted with appropriate colours. (primary colours)		
Toilets or Latrines				
	a	All users should be provided with adequate toilets or latrines.		
	b	Toilet-Child Ratio	Girls ratio is 1:10 and Boys ration is 1:30 including a urinal	
	c	Aperture	The aperture should not be more than 200mm by 150mm. This prevents children from falling.	
	d	Depth	Minimum depth should be 6000mm	
	e	Distance to water supply	Should be located at least 50 feet from water points such as boreholes and wells as per health regulation.	
	f	Frequent disinfection of pit latrines.		
	g	Toilets for teachers should be separated to accommodate the various genders		

	h	Toilets should be located at a minimum of 100000mm from the classrooms.		
	i	Latrines should be located opposite the flow of wind to prevent bad odours from spreading		
	j	Specialized latrines should be provided for children living with disabilities.		
Kitchen				
	a	Should have adequate space and be properly ventilated.		
	b	Should be located away from waste disposal areas.		
	c	Should be sited away from tuition buildings at a safe distance.		
	d	Should be provided with waste handling equipment that are hygienic.		
	e	Should have access to clean water for use.		
	f	Should have kitchen counter, floors and surfaces that are easy to maintain. They should also be easy to clean.		
	g	Should have storage areas that are well ventilated and hard to contaminate.		
	h	Should have close proximity to food stores.		
	i	Should have adequate storage area for cutlery and crockery.		
	j	Should have a servery.		
	k	Should have fire safety measures with appropriate equipment and first aid kits.		
	l	Should be hygienic.		
Food Store				
	a	Should be adequate in space and have proper ventilation.		
	b	Should be safe from theft, vandalism and contamination.		
	c	Should have racks that are raised. The racks should also not be in direct contact with walls.		
	d	Should have adequate space for spread of foods that can go bad easily.		

	e	Should have proper documentation of store records		
Dining Area				
	a	Should have adequate space and be properly ventilated.		
	b	Should have a servery		
	c	Should have appropriate furniture for small children		
	d	Should have furniture that is easy to clean and maintain.		
	e	Should have an appropriate food plan with proper documentation.		

Health and nutrition is a crucial aspect of service provision for all pre-primary schools. The table below shows a checklist used as a tool for monitoring standards in pre-primary schools.

Table 3 Monitoring tool for quality assurance and standards in pre-primary schools Source: National Pre-Primary Education Policy Standard Guidelines 2018

ITEM	DESCRIPTION	YES	NO	REMARKS
Physical facilities				
	Is there a building for learning?			
	Is the building permanent?			
	Are the building in decent conditions?			
	Is there proper ventilation?			
	Is there adequate lighting?			
	Are the classrooms of standard size?			
	Do the classrooms have doors that can be locked?			
	Do the classrooms have doors that are opening outwards and can be locked?			
	Are the indoor spaces adequate?			
	Are learning corners available?			
Roof design (tick as appropriate)		YES	NO	
	Is it made of Iron?			
	Is it thatched?			
	Are tiles present?			

	Are there alternative materials? If so, specify.			
	Is the roof in an acceptable condition?			
Wall design (tick as appropriate)		**YES**	**NO**	
	Is it made of mud?			
	Is the wall plastered?			
	Is the wall made of timber?			
	Is the wall made of Iron sheet?			
	Is the wall made of brick?			
	Is the wall made of stones?			
	Are there alternative materials? If so, specify.			
	Are the walls in an acceptable condition?			
floor designs (tick as appropriate)		**YES**	**NO**	
	Is it an earthen floor?			
	Is the wall cemented?			
	Are there alternative materials? If so, specify.			
	Is the floor in an acceptable condition?			
Toilets and ablution blocks		**YES**	**NO**	
	Are there toilets for members of staff?			
	Are there toilets for children?			
	Are there different toilets for specific genders?			
	Are there appropriate apertures in the toilets?			
	Do the number of toilets for boys meet the standard ratios?			
	Do the number of toilets for girls meet the standard ratios?			
	Are the toilets in an acceptable condition?			
Health and Nutrition		**YES**	**NO**	
	Are Growth Monitoring & Promotion Services provided?			
	Do all pupils have health cards?			
	Is there collaboration between teachers and closest local health centre to provide Growth Monitoring & Promotion Services?			

	Do parents from the local community benefit from immunization and other services offered by Growth Monitoring & Promotion Services?			
	Are the children healthy?			
	Are the children energetic?			
	Do the children exhibit any malnutrition symptoms?			
	Do the cooks have heath certificates?			
	Do the children benefit from deworming services offered in school?			
	Are deworming tablets provided to children by personnel from nearby health centres?			
	Is deworming performed biannually? If not, give reasons.			
	Do parents get notified when their children fall sick in school?			
	Do parents provide consent for their children to be taken to hospital in case of an emergency?			
	Are there first aid kits available?			
Feeding Programme		**YES**	**NO**	
	Does the school have a feeding programme?			
	Is the food prepared in school?			
	Are there storage racks to store food brought from home?			
	Is there a kitchen to prepare food in the pre-primary school?			
	Does the kitchen possess doors and windows that can be locked?			
	How effective is the kitchen ventilation?			
	Is the kitchen roof well water proofed?			
	Does the kitchen have drying racks?			
	Are the cooks hygienic?			
	Are children provided with snacks at 10 AM?			

	Is the porridge provided enriched and if so, with what nutrients?			
	Are the children provided with lunch?			
	Is the lunch of a balanced diet?			
	What measures have been taken to accommodate children with special needs such as allergies or other food related needs?			
	Are utensils provided of proper hygiene?			
	Are the children fed in an appropriate and orderly manner?			
	Do the children have unrestricted access to the kitchen?			
Resting/sleeping spaces		**YES**	**NO**	
	Is there a designated space for children to rest?			
	Are the resting spaces provided with appropriate bedding or sleeping materials?			

2.7 Theoretical Review

This section of this chapter focuses on theories that were used to underpin the research. The theories adopted in the research included the theory of Change and the theory of Ecological Urbanism.

2.7.1 Theory of Change

As defined by Weiss (1995) theory of Change is the explicit practice of strategizing and documenting how an intervention is expected to work, reasons that will make it work, who the anticipated beneficiaries are and the circumstances for success. The theory provides an explanation on how an intervention is anticipated to engender a developmental change based on a causal analysis on preexisting evidence. This research studies the built environment of public schools employing appropriate architectural design strategies that can be adopted to better performance in facilitation of school meals and food production. The implementation of the theory of Change commences with first identifying the desired outcome. It is from there that the main causes of the high level change to be dealt with are identified. One possible approach is the development of a problem tree that highlights the problems to be addressed. The problem tree aids in the creation of a solution tree which is then linked to the problem tree.

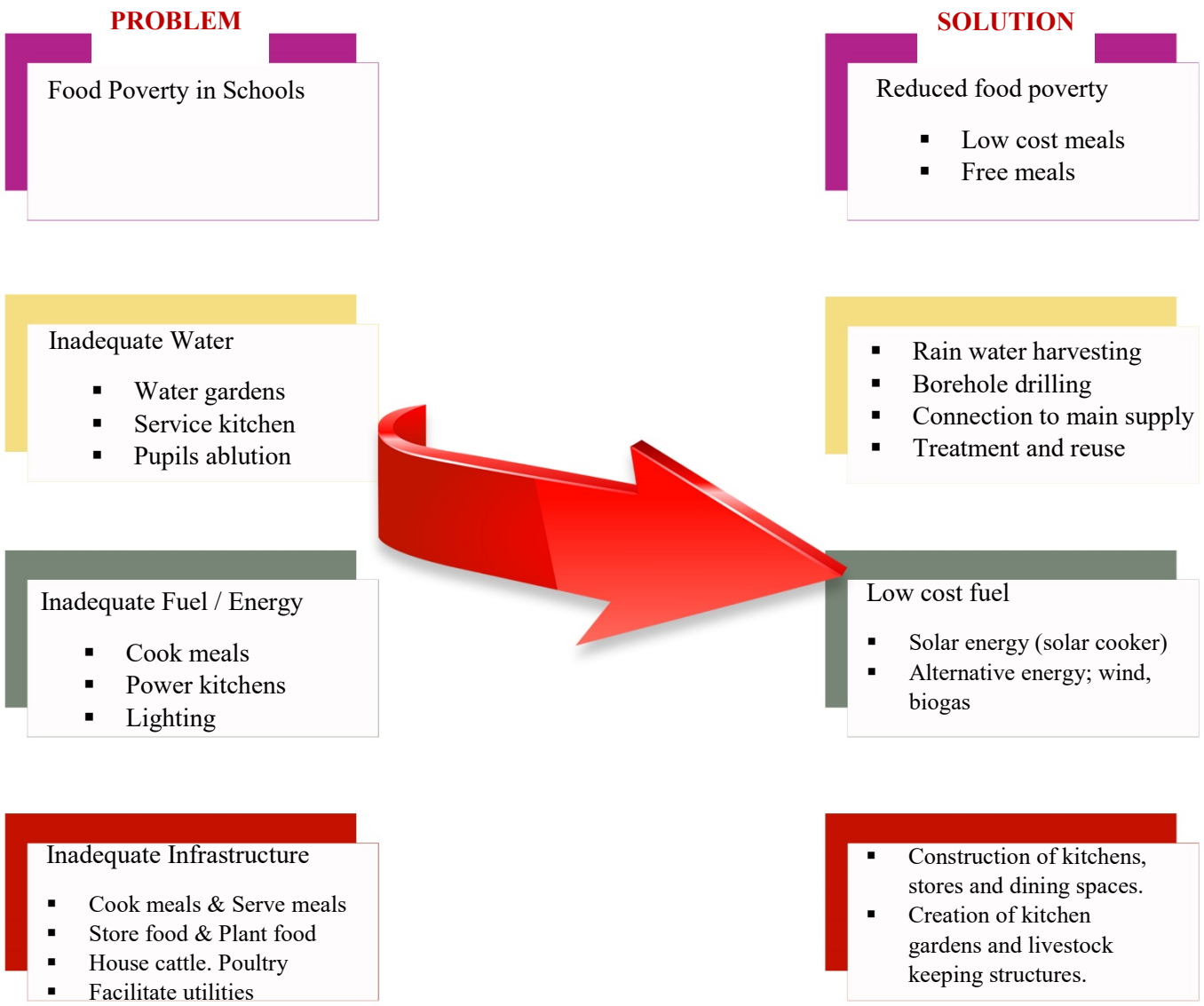


Figure 19 Problem tree and solution tree. Source: Author

One of the major tools for effectively implementing a theory of Change is stakeholder engagement. The main stakeholders in this research are: all children and personnel in public schools, the County government and national government, the neighbouring community and NGOs. These stakeholders will be key respondents in the implementation of this research. A theory of Change identifies remedies to resolve various causes of problems that deter development guiding choices on the best tactic to be adopted. Interventions, however, don't guarantee a specific result due to the complexity of various intervening factors. The theory of Change recognizes this and helps identify the underlying risks and assumptions that may be taken through a specific intervention.

Jones and Rosenberg (2018) further noted that this theory is typically developed during the design stage of any program based on available evidence, local beliefs and assumptions. This theory is also characterized by a description of strategies, actions to be taken, conditions and resources that enable change to achieve a desired outcome. The theory of Change underpins several key stages. To begin with, define situation and desired results. The underlying situation in this research is that the available school infrastructure and spatial utilization in public primary and pre-primary schools does not optimize the facilitation of school feeding programmes and food production. The desired result is an augmented school infrastructure that optimizes the facilitation of feeding programs. Secondly, establish program boundaries. The proposed research intervention is restricted to architectural design strategies on the built environment of public primary and pre-primary schools in Mombasa County, Kenya. Thirdly, explore potential solutions. The research explores the implementation of appropriate architectural design strategies such as rain water harvesting, solar power installation, creation of adequate spaces for meal facilitation, provision of school kitchen gardens etc. Finally, articulate assumptions. The assumption taken in this research is that the schools will become self-sufficient in meal facilitation once they adopt these strategies and the cost of meal facilitation will drop thus positively impacting the society in the reduction of household expenses on school meals thus improving household purchasing power on other commodities.

Figure 20 Key Stages Source: Author

2.7.2 Theory of Ecological Urbanism

The end of the 20th Century witnessed the emergence of Ecological Urbanism. Stan Allen (1997) recognized that contemporary urbanism should be more cognizant of the current environmental crises; attention should be paid on change and adaptation recognizing the varying complexities of the natural and social ecologies present in cities. Miguel Ruano in 1999 published a book that seems to be the earliest use of the term Ecological Urbanism describing it as sustainability planning. Ecological Urbanism is a line of ecological subfield that engages the built environment literally and figuratively (Hagan, 2014). Projects designed should meet performative environmental targets.

Ecological Urbanism aims to create a manmade system of the city that possesses the same interdependent efficacies and life sustaining redundancies similar to those exhibited in natural ecosystems. Moreover, it also aims to create a balanced connection between cities and the environment focusing on the adaptive process which centers on living with rather than living over. According to Spirn (1998), the survival of humanity depends on adaptation of cities in sustainable ways, recognizing the connections to earth, water, air and to each other; this helps us recognize these connections in a sustainable and artful way. Several key concepts and principles underpin the theory of ecological urbanism. These principles include:

- Cities are part of the natural world
- Cities are habitats
- Cities are ecosystems
- Urban ecosystems are connected and dynamic
- All cities have a deep structure of enduring context
- Urban design is a great tool for adaptation

The desired goal is to ensure that urban projects are designed from the potential and limitations of existing resources. The theory focusses on not only the structure but the landscape as an element to benefit the structure e.g. through water retention or treatment (Akinaga, 2022). According to Farr (2022) ecological urbanism sets out five basic guidelines. These guidelines include; densification through releasing soil and decreasing displacements, creation of sustainable transport corridors and creation of ecological neighbourhoods. One of the other two key guidelines is access to nature through the creation of green spaces such as parks, squares and community gardens. Finally, the last guideline is creation of high performance buildings and green architecture. This involves the creation of infrastructures that have low energy consumption with integration of sustainable design techniques such as rain gardens, afforestation, bioswales etc.

The research will lean more towards the last guideline with a focus on the school infrastructure and green architectural techniques. The study seeks to determine strategies that can be adapted into the infrastructure of public primary and pre-primary schools to maximize on the facilitation of school feeding programmes and food production sustainably.

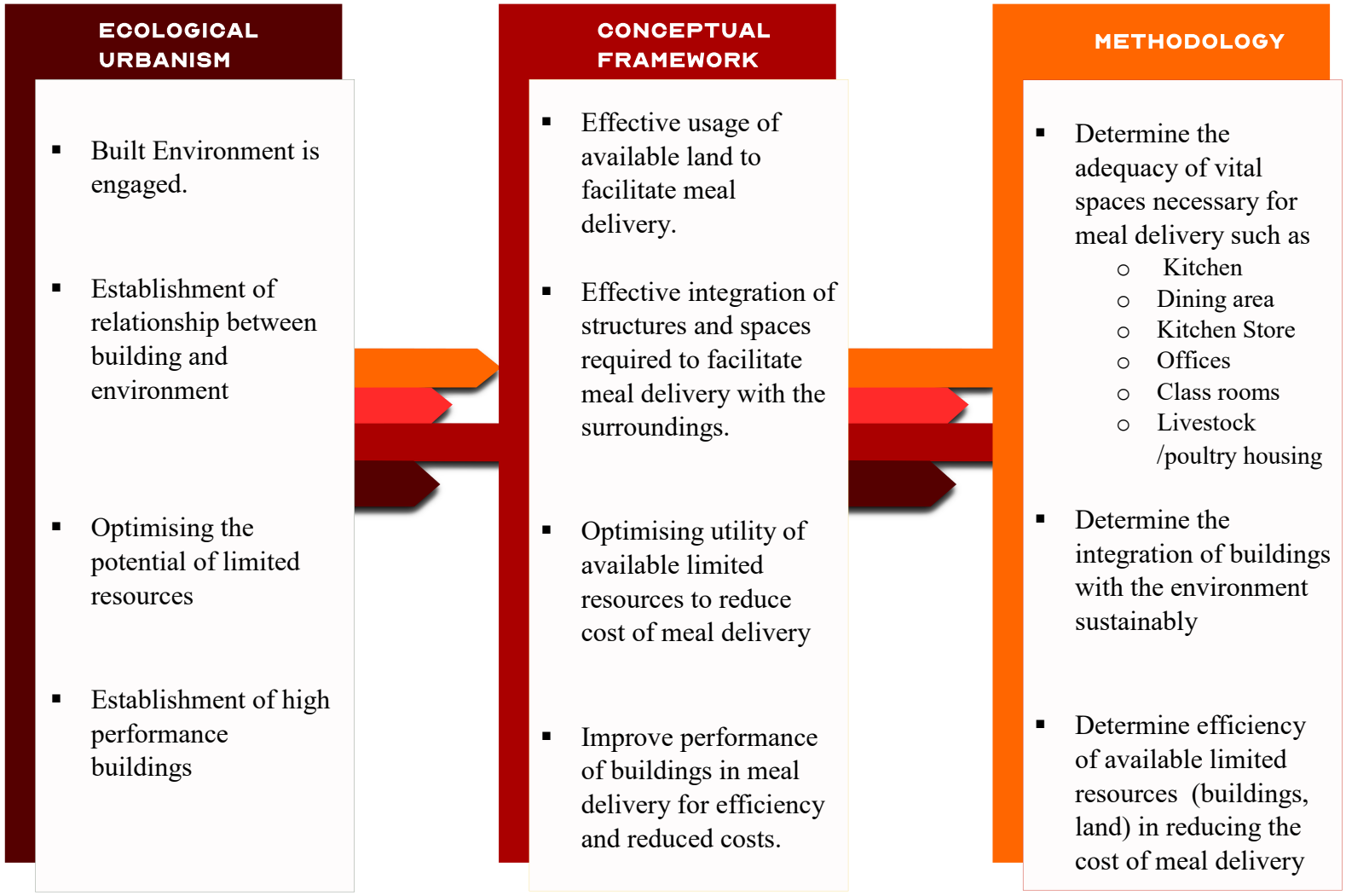


Figure 21 Shows how theory of Ecological Urbanism informs conceptual framework and methodology. Source: Author

2.8 School Intervention Strategies to the Built Environment

2.8.1 Self-sufficiency

The core objective of this study is to determine morphological and spatial design strategies that can be adopted in public primary and pre-primary schools to aid in alleviating food poverty within the society. A fundamental way of achieving this is by reducing the cost of school meals and improving the efficiency of meals facilitation within schools. One strategy of attaining this objective is self-sufficiency. Self-sufficient projects such as homes often do not fully depend on public services and utilities and provide their own water, electricity, waste management and cultivate their own food. This attribute of self-sufficiency reinforces the concept of high performance buildings as underpinned in the theory of Ecological Urbanism since it creates buildings with low carbon footprints. The available natural resources are utilized in an optimum and sustainable manner.

To cut down the cost of electricity, it is beneficial for projects to switch to renewable energy. This can be done through installing a solar system that includes solar panels, a charger, controller, inverter and a battery bank. These panels can be installed on top of roofs, infused on glazed surfaces with photovoltaic cells or on elevated platforms. A biogas system can also be built to generate clean and energy-efficient gas. The gas is then distributed through a system of pipes and used for heating and cooking in kitchens. Wind turbines can also be installed to feed into the solar system or as a stand-alone system. These turbines can be installed on roof tops, in open spaces and even on facades. Alternative cooking systems can also be adopted using a solar oven. The kitchen appliances should also be flexible to allow for possible connection to a myriad of power systems e.g. gas appliances, wood fuel, solar powered electricity etc.

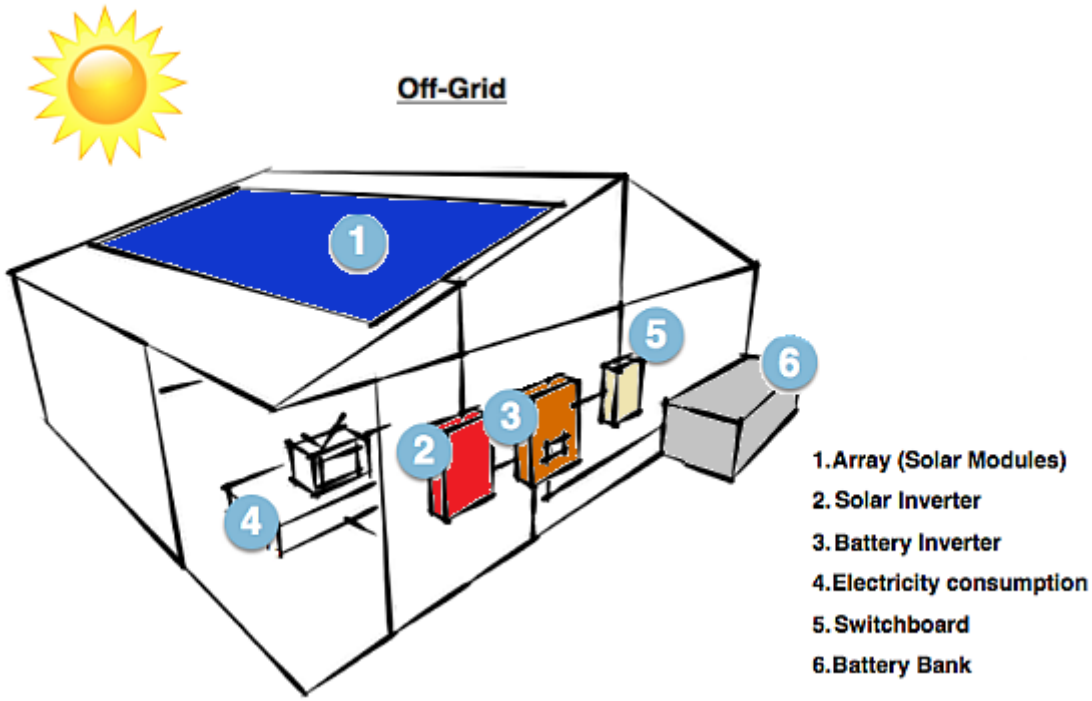


Figure 22 Off grid solar system. Source: Clean Engergy Reviews

Water is a fundamental commodity to be used in kitchens and toilets/bathrooms in most schools. Clean water is essential for human health. Depending on climatic, geographic and infrastructural restrictions, various options may be adopted when it comes to the use of on-site water. Some of these options include rain water harvesting. Installation of a rainwater harvesting system involves installation of gutters, downpipes, water storage tanks, water pipes, water treatment plant and a pumping system. Moreover, other strategies include drilling of wells and boreholes, piping water from nearby rivers, lakes and streams. The collected water can be treated or filtered using techniques such as reverse osmosis, UV sterilization, boiling and bleaching. Proper tests should be done to ensure that the water collected is fit for use.

Growing your own food is also a vital aspect of self-sufficiency. Planting vegetables, fruits and grains will reduce reliance on purchasing food items. Keeping livestock also complements food grown in the kitchen gardens. Some of the livestock to be kept include chicken for eggs and meat, cows for meat, milk and manure to be used as fertilizer in the gardens. The livestock to be kept can range from ducks, rabbits, goats, sheep, turkeys etc. The diversity of the livestock kept will depend on location, climate and availability. Depending on the availability of a sufficient amount of water, fish farming may also be practiced. Waste management is a crucial aspect of self-sufficiency. Effective waste management will ensure maximum use and re-use of collected water. This can be achieved through:

i. Using a grey water recycling system or permaculture filtration system to clean waste water.
ii. Waste separation so that recyclables e.g. plastics may be separated from organic matter such as food waste.
iii. Adopting sustainable waste disposal techniques.

2.8.1.1 Rongai Agricultural and Technical Secondary School

Figure 24 Cow shed in Rongai Agricultural and Technical Secondary School. Source: Fscdena

Rongai Agricultural and Technical Secondary School was established in Kenya in the year 1973 by the Brothers of the Christian Schools. The school offers secondary education from form one to form four. The school applies an element of self-sufficiency through food production. The school maintains its own farm producing its own food. The students in the school are taught how to grow vegetables and cereals. The school also keeps poultry, raises pigs and cows.

Students in the school are taught farm management skills and computer technology. The school also has a posho mill that is run by the students. Farm responsibility is distributed among the students. Form one students take care of the animals while form two students take care of the farm. On the other hand, form three students are tasked with farm management duties while the form four students in their final year are excluded from farm related responsibilities.

Figure 23 Farm related activities at Rongai Agricultural and Technical Secondary School. Source: businesstoday

2.8.2 International Interventions

Numerous international organisations have adopted various strategies to aid in the alleviation of food poverty in different societies globally. In the year 2021, MANNI Group, in collaboration with Young Architects Competition launched an international architectural design competition dubbed Ghana Innovation Farm. MANNI Group is a company that provides systems, solutions and skills for dry construction in the steel industry. The company specializes in sustainable design.

Young Architects Competitions on the other hand is an association that aims to promote architectural competition amongst young designers. The Ghana Innovation Farm was a design competition that sort design proposals that addressed global food shortage through the design of and innovation school. The design requirements for the school included:

i. A meeting point where administration technicians, farmers and the community at large could meet to exchange ideas on farming techniques.
ii. The use of sustainable energy and construction techniques with minimal carbon foot print.
iii. The adoption of hygiene and health requirements to international standards.

As stipulated in the theory of Ecological Urbanism, a building with low carbon footprint integrates positively with the environment. The project brief required adoption of green building design techniques through the use of sustainable energy and construction techniques. The project proposal was phased into various structures including; a large refrigerated warehouse, a food processing and packaging plant and the Innovation Farm. The Innovation Farm was composed of classrooms, a cafeteria, toilets, offices, a workshop for electronic training, a workshop for mechanical training and a food handling plant. The project capitalized on the social significance of schools in uniting the community and the possible inclusion of farming into the school to engender food production and generally reduce food poverty in the region. Some of the design proposals included the following two finalist projects; one from the author and the other from the winner of the competition. The author integrated learning with farming as stipulated in the brief and introduced other farming projects such as fish farming. The proposed project by the author also adopts sustainable design techniques such as rain water harvesting and the use of photovoltaic cells to augment power supply.

Figure 25 Fish Pond SOURCE: Author

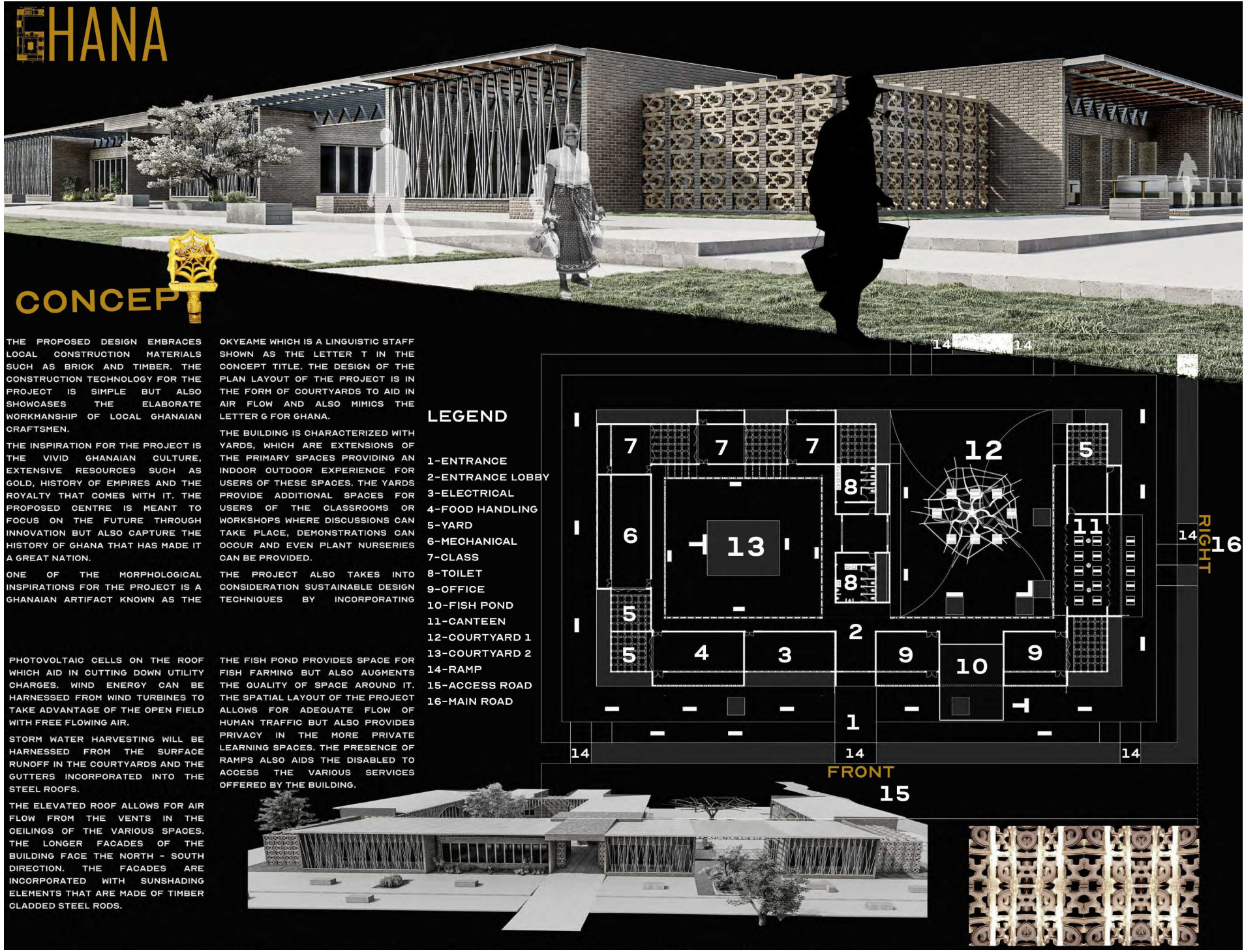


Figure 26 Finalist Project
Source: Author

Figure 27 Finalist Project Source: Author

Figure 28 Winners project design SOURCE: young architects competitions

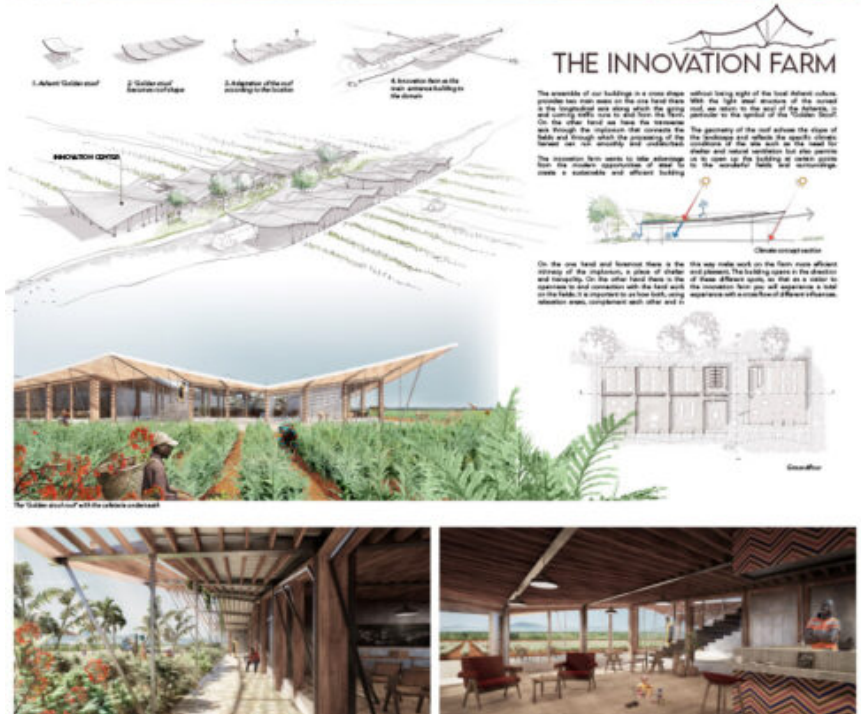


Figure 29 Winners project design Source: young architects competitions

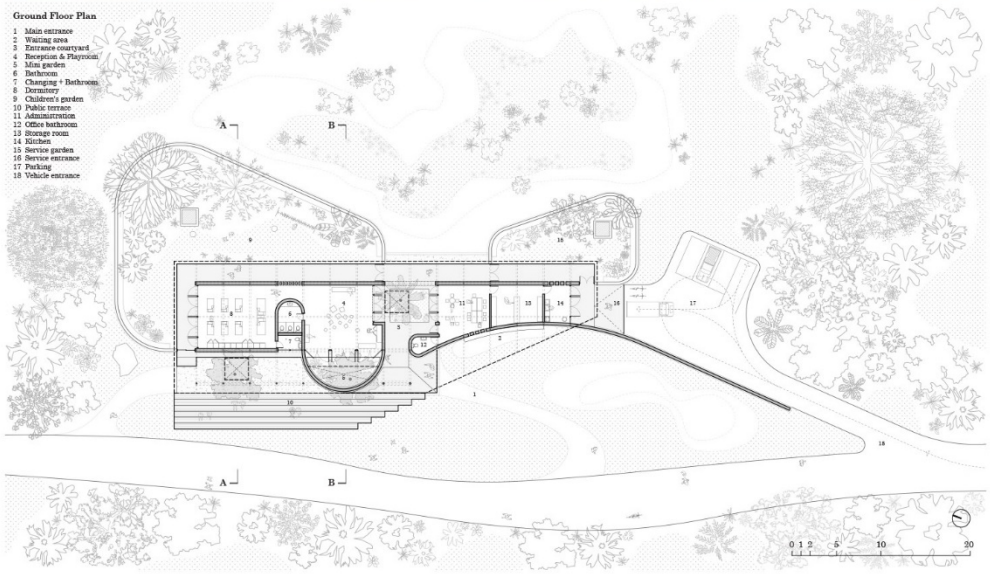
Another notable international design competition is the Children's House competition organized by Kaira Looro. Kaira Looro is an organization that organizes architectural competitions using ideas that adapt to sustainable architecture models for humanitarian purposes to improve life conditions in developing countries. The design brief for the 2022 competition was focused on designing a children's house that protected the health of the children and prevented malnutrition. The site for the competition was located in the South of Senegal in an area known as Tanaff Valley, Baghere village. The proposed children's home was intended to be a place for children to be provided with nutritional material, a place with developed hygiene and health facilities and a place to nurse at risk children threatened with malnutrition. Some of the spatial requirements for the project included an administration area, storage space, nursing area and children playing area.

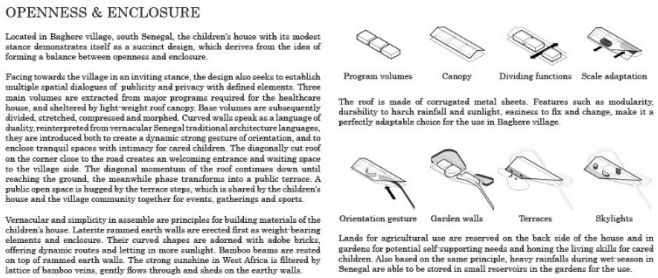
Some notable design submissions included the following two projects; one from the author and the other from the competition winning project. The author's project had sustainable design techniques such as photovoltaic cells to capture solar power and rain harvesting techniques infused to the proposed structure. The project also had nurseries for seedlings and was surrounded by a farm for food production.

The first project shown below adopted some self-sufficient principles. The central courtyard was designed to collect rain water from the roof and the surface runoff channeled to an underground water reservoir and pumped for use in the plant nurseries and farming spaces around the building. The provision of photovoltaic cells was installed to aid reduce electric bills. The children's house was surrounded by farmed land to provide fresh vegetables to aid revitalize the heath of the malnourished children.

Figure 30 Farmed land Source: Author

Figure 31 Source: Author





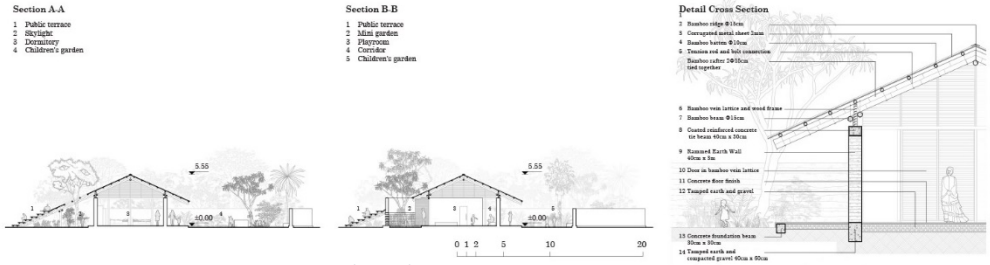


Figure 32 Winners project. Source: kaira looro

2.9 Green School Bali

Figure 33 Photo Voltaic cells in Green School Bali Source: Green school Bali.

Green school Bali is located in a village called Sibang Kaja in Bali Indonesia. The school was opened in the year 2008. The institution is a recipient of the Zayed Future Energy Prize. The school has implemented a system for renewable energy production and storage. The project known as Operation Rain or Shine (OROS) benefits the school through the provision of a resilient and reliable supply of energy throughout the year. The school also created an energy hub that enables students to visually learn how the school generates and stores its own power, monitors equipment and transfers energy between different states.

Rain water harvesting is also an integral part of the school. Rain water catchment systems have been integrated in the school's buildings in both the old and the new buildings. The school also adopted other strategies such as:

- Installation of 10 kWp Photo Voltaic system to increase electricity production
- Integration of a hybrid smart grid
- Expansion of clean energy to surrounding communities in Bali

Figure 34 Children planting crops in Green School Bali School Source: Life and soul magazine

Green School Bali also promotes self-sufficiency in food production. The primary source of food in the school is the school gardens. The food consumed is however, supplemented by food sourced from the surrounding communities as an initiative by the school to support local enterprises. The school's governing ethos is to promote cost effective food policies such as supply of food from within the schools such as the school and classroom gardens, aquaponics gardens, Bamboo Village gardens and the Green Camp gardens. The children in the school grow food crops such as rice, fruits and vegetables which they consume. They use the wilting vegetation and dirt as compost. Some of the rooms in the school are used to produce compost from organic waste. Green school Bali has a shrimp pond and a cattle farm. The school also apportions lunch offering to members of the community of varying age groups to minimize wastage of excess food.

The built environment of the school in Bali is substantially engaged. The school has maximized on the potential of the available natural resources and utilized the resources to positively impact the school creating a high performance built environment. These key attributes exhibited by the school align with the key principles of Ecological Urbanism.

2.10 Makthar Boarding School

Makthar boarding school is located in Tunisia, 100km southwest of the capital Tunis. The school applies many of the principles of self-sufficiency. The school has installed over 50 solar water heaters and 140 photovoltaic panels. The solar water heaters enable the students to take hot showers regularly. The photovoltaic panels installed on the roofs produce four times the power consumed by the school. The school sells the excess energy to the national power company in Tunisia raising funds for the school to pay its previous debts and fund site improvements and extra-curricular activities such as a basketball court for the students. The school also donates extra power to three nearby schools for free.

Food autonomy in the school is enhanced by the presence of an eight hectare farm that grows food. The school utilizes only 10 percent of the produce from the farm and the excess 90 percent is sold and the profits generated help in bolstering the school's finances. The school employs some previously jobless parents who work in the farm. The school possesses self-sufficient attributes since it produces its own food and electricity. The built environment is engaged with the inclusion of farming area and there is reduced carbon footprint due to the use of clean energy. The school therefore, to a degree aligns with the principles governing the theory of Ecological Urbanism.

Figure 36 Solar panels installed on the roofs of the school. Source: FETHI BELAID AFP

Figure 35 Farmers harvesting pepper Source: FETHI BELAID AFP

2.11 Research Gaps

Numerous studies have been carried out locally in Kenya and internationally on school feeding programmes, school infrastructure and food poverty within the society. Musolo (2020) noted that school feeding programmes had a positive impact on school going children in ASAL areas by increasing their retention and performance. Aila B. (2012) found that school feeding programmes aided in alleviating poverty within the society by acting as income transfers to families by relieving guardians the burden of providing lunch to their children thus saving money for other uses in the household. Aila B. (2012) researched on the impact and challenges of school feeding programmes in enhancing access to primary education in Kibera in Nairobi. Oduya A. (2019) on the other hand, found that poor infrastructure characterized with issues such as lack of kitchen stores was one of the major issues plaguing feeding programmes in pre-primary schools in Isiolo County. Finan (2020) also asserted that water scarcity and inadequate infrastructure has negatively affected the sustainability of school feeding programmes.

This research addresses the deficiencies in infrastructural performance in schools in facilitating school feeding programmes and meals facilitation as identified by previous researchers. The research also connects improved infrastructural performance in facilitating school feeding programmes and self-sufficiency in food generation to reduced food poverty within the society.

2.12 Conceptual Framework

The conceptual framework below shows the interrelationships of a number of variables of the research.

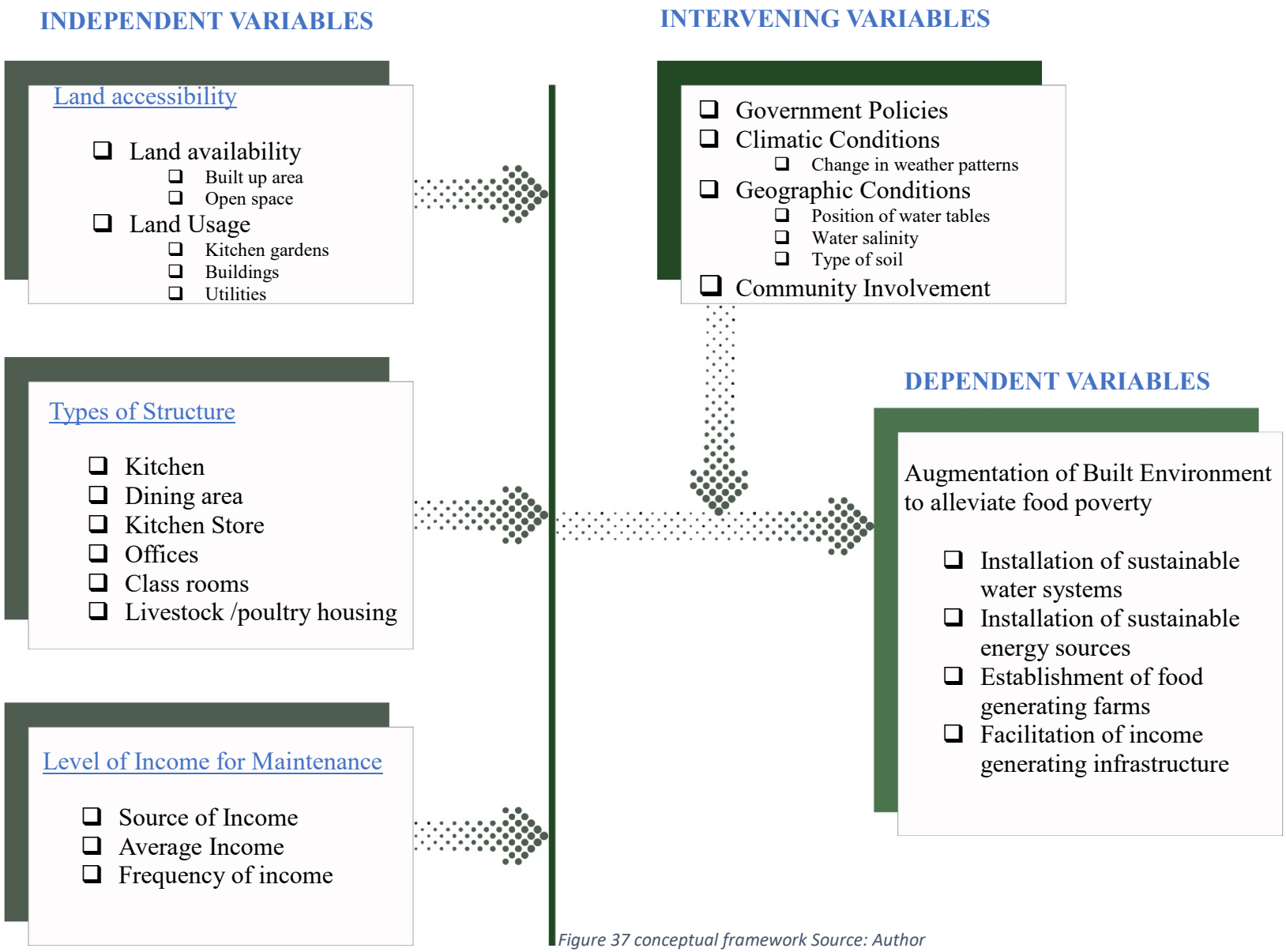


Figure 37 conceptual framework Source: Author

2.13 Summary

Food poverty is a global menace that has mostly affected the continents of Asia and Africa. The key drivers of food poverty globally are war, climatic extremities, economic shockwaves and increasing inequalities. The government of Kenya has, over the years, initiated various policies to alleviate the adverse effects of food insecurity nationally. Some of the notable policies include the Expanded School Feeding, Njaa Marufuku Kenya program under the Kenya National Social Protection policy, 2011 and the Home Grown Feeding program under the ECD National Pre-primary Education policy, 2017. Through these policies the government recognized the importance of integrating feeding programs in schools as a strategy in responding to the problem of food insecurity nationally.

The responsibility of providing infrastructure in public pre-primary schools falls on the respective county governments while that of public primary schools falls on the central government under the MOE. The MOE has not prioritized infrastructure in public primary schools leaving public primary schools with limited resources to expand or improve infrastructure (M.O.E, 2021).

Self-sufficiency can be a strategy to improve the performance of school infrastructure. Improved infrastructure performance is a key guideline in the theory of Ecological Urbanism. Self-sufficiency of public primary and pre-primary schools will enable schools to have minimal or no reliance on public utilities such as water, electricity, waste management and even enable them to cultivate their own food.

CHAPTER 3

Research Methodology

3.0 Introduction

Research methodology is the strategic way data is collated and analyzed to meet definite objectives of the matter being investigated (Oates, 2006). In this chapter, the author outlines the research techniques used to carry out the research. This chapter discusses the research design and also the target population. Furthermore, the chapter also addresses the sampling technique, sample size and methods of data collection. Data collection instruments and data analysis and presentation techniques are also discussed. The author, in this chapter, delves into the methodology of determining morphological and spatial strategies that can be adopted in public primary schools to aid in alleviating food poverty within the society.

3.1 Research Design and Approach

Research design is the outline for a research used as a guide in accumulating and analyzing data (Pandey M & Pandey P, 2015). Research design focusses on four crucial areas; what question to study, what data are appropriate for the study, what data is collected and ways to analyse the findings (Philiber, 1980). Moreover, Orodho (2003), defines research design as a reference to the scheme outline that is used to produce answers to research questions.

The research is qualitative in nature. Myer and Avison (1997) defines qualitative research as the systematic study of social science phenomenon that enables persons performing research to comprehend various aspects that relate with people and their social and cultural problems. The research is also descriptive in nature. Descriptive research or survey research is a method of investigation that involves direct observation of a phenomenon; it is also a systematic collection of data from a population that involves application of personal contact and interviews in situations where sufficient information about certain issues is not available in records or other sources (Pandey, M et al., 2015). Descriptive research produces new concepts while also recognizing and reviewing earlier researched work.

3.2 Target Population

Population is the whole mass of observation; it is the main group from which a sample is to be generated (Pandey, M et al., 2015). In this study, the target population are the primary and pre-primary schools in Mombasa County. A large number of public pre-primary schools in Mombasa County are housed within public primary school compounds. The researcher therefore targeted schools with both public primary and pre-primary schools with a shared compound. The table below show the public pre-primary schools in Mombasa County and the respective constituencies they reside in.

CONSTITUENCY	CHANGAMWE	JOMVU	KISAUNI	NYALI	LIKONI	MVITA
SCHOOLS	Changamwe	Mreroni ECD	Shimo la Tewa	Mlaleo	Consolata	Kaloleni
	Mwingo	Jomvu ECD	Kiembeni Estate	Kisauni	Likoni Muslim	Buxton
	Kipevu	Miritini W/B	Kashani	Kadzandani	Likoni Ecd	Makupa
	St. Luwanga	Mikindani	Digirikani	Khadija	Mwangala	Bahari
	Mikadini	Kwashee	Majaoni	Free Town	Puma	Serani
	Mogongo	Amani	Baraka Voroni	Azar Shariff	Inspiration	Tom Mboya
	Chaani	St. Mary	Utange ECD	Ziwa La ngo'mbe	Mweza	Ziwani Boys
	Kwa Hola	Maganda	Concordia	Kengeleni	Longo	Ganjoni
	Mwijabu	Badi Twalb	Bedzimba	Kongowea	Mtongwe	Kikowani
	Gome	Miritini old	Mtopanga	Pentrose	Vijiweni	Sacred Heart
	Bomu Ecd		Bamburi	Maweni	Shikaadabu	Makande
	Umoja		Mwakirunge	Fadhil Adhim	Jamvi la Wageni	Mombasa Pr.
	Portreitze		Marimani		Mrima	Mary Clif
			Maunguja		Vyemani	Burhania
			Magogoni		Pelelezi	Central Girls
					Likoni Vi	Kaa Chonjo
					Maji Safi	Spark

						Mvita
						Tudor
						Mbheni
						Bondeni
						Mbaraki
						Gur Nanak
						Majengo
						R.G Ngala
						St. Augustine
						Fahari
						Tom Mboya
TOTAL	13	10	15	12	17	28
	95					

The research targeted schools that had feeding initiatives both self-financed and externally financed. Some of the notable externally financed initiatives included HGSMP, NMK and Food 4 Education. The research focused on the various aspects of the infrastructure of the targeted schools that aided and complemented the feeding initiatives. Infrastructural components such as water harvesting building elements, kitchen, store and dining areas and support spaces such as health rooms, offices, classrooms were also targeted. The research also focused on green technology solutions adopted to various aspects of the school infrastructure that were used to reduce the cost of utilities such as water, electricity and fuel which play a large impact on the cost of school meals in these public primary and pre-primary schools.

3.3 Sampling Technique and Sampling Size

According to Pandey, M. et al (2015), sampling can be defined as a process involving the selection of a smaller part of the main group that provides a representation of the entire universe. Moreover, a sample can be defined as a subset of the entire population under investigation whose attributes will be used to generalize the whole population (Bless, Higson, Smith and Sithole, 2013). According to Sotsha (2013), the reasons for sampling is to lessen the cost incurred when collecting information from a population by collecting data from a smaller group instead of the whole population. The key objective of sampling is to achieve precise and reliable results about the universe with minimum time, minimum cost and minimum energy; it also enables the setting out of limits of accuracy of the estimates provided.

The research adopted the Nachmias & Nachmias (1992) formula in calculating sample size from the population of 95 schools with the assumption of a 95% confidence level;

n= (z*z) (p*q)N

e*e(N-1)+(z*z)(p*q) where;

n= sample size

z= standard deviation at 95% confidence level (in this case 1.96 worked from tables showing areas under normal curve)

p= % of target population assumed to have similar characteristics (taken as 95% for this study)

q= 1-p

N= population size

e= margin of error at 95% confidence level (1-0.95=0.05)

Therefore, the sample size, n, for the public primary and pre-primary schools is;

$$n = \frac{(1.96*1.96)\,(0.95*0.05)\,(95)}{(0.05*0.05)(94) + (1.96*1.96)\,(0.95*0.05)} = \frac{17.33522}{0.417476} = 41 \text{ respondents}$$

The responsibility of constructing and maintaining the infrastructure of public primary schools lies with the Government of Kenya (GOK). The design of government schools in Kenya is standardized. The construction and maintenance of public pre-primary schools in Kenya falls under the docket of the County Governments. With regards to this, the researcher applied stratified sampling in carrying out the study. Stratified sampling involves dividing the population into groups based on certain characteristics and then from these smaller homogenous groups predetermined number of entities are generated. The population was divided based on the constituencies present in Mombasa County. Mombasa County is composed of six main constituencies namely; Changamwe, Jomvu, Kisauni, Nyali, Likoni and Mvita. The selection of number of schools per constituency was done on a pro-rata basis as shown in the table below:

CONSTITUENCY	CHANGAMWE	JOMVU	KISAUNI	NYALI	LIKONI	MVITA
Total number of schools	13	10	15	12	17	28
Percentage value on total schools in county	14%	10%	16%	13%	18%	29%
Value of percentage on sample size of 41 schools	6	4	7	5	7	12

The selection of the determined number of schools per each constituency was then determined through purposive sampling for analysis. Purposive sampling is a type of non-probability sampling method that is characterized by the selection of units that possess desired characteristics and is also called judgmental sampling. The researcher relied heavily on recommendations from county and national government officers who had greater insight on the local schools in the region. The research also adopted snowballing sampling technique. The interviewees provided recommendations for schools to visit based on their understanding of the schools within the region.

3.4 Methods of Data Collection

Data is information gathered throughout the course of the research (Polit and Hungler, 1999). The researcher administered questionnaires as a method of collecting data. A questionnaire is a systematic accumulation of questions submitted to a sampling of questions from which information is to be obtained (Pandey, M et al 2015). Moreover, observation techniques were also adopted in the collection of data. The researcher, professionally trained as an architect focused on key sustainable features in the observation of the infrastructure of the schools being studied. Interviews were also carried out between the researcher and the relevant stakeholders such as school head teachers who provided great insight on the successes and failures in the provision of meals in their schools with regard to the effects of the available school infrastructure. According to Pandey (2015), all formalities set aside in interviews opening up the gate for delivery into the mind, feelings and subconscious stimulations of the person being interviewed.

3.4.1 Data Collection Instruments

The research was geared towards collecting data to demonstrate how the built form of public primary and pre-primary schools can be used to fight food poverty. The researcher developed questionnaires. The structured questionnaires were composed of a combination of close and open ended questions. The close-ended questions aided in providing an easy analysis of the data collected and were also cost effective. The open-ended questions on the other hand, provided greater insight on the subject matter because the respondents provided an in-depth explanation on their take on the questions asked. Appendix 2 contains a sample of the questionnaire. The questionnaire was generally structured as follows: the various spaces found within the schools and the roles they play in the provision of school meals. Some of these spaces highlighted in the questionnaire included classrooms, kitchens, food stores, dining areas, offices, health rooms and kitchen gardens. The questionnaire delved into the uses of these spaces as pertaining to meal provision, their efficiency and the sustainable or green design features they possessed or lacked. Some of these key design features included elements such as gutters, downpipes and water tanks which are fundamental for rain water harvesting and water storage. The questionnaire also scrutinized the presence of alternative sources of energy used mainly in the kitchen and dining areas such as wind energy and solar energy. The questionnaires were issued to the respondents and feedback collected on the day of issuance. The interviewer filled the questionnaire based on the response of the interviewees to expedite the data collection process. The researcher realized during the trial run carried out that the respondents were hesitant to fill the questionnaire due to its lengthy nature and the technicality of the research.

The researcher also performed interviews. The interviews gave clarity on the status of the infrastructure being assessed, their uses in school meals facilitation and the circumstances that either aided or impeded the development or dilapidation of the infrastructure. The interviews were carried out with the available stakeholders such as head teachers, school teachers, cooks and even county officials monitoring meals being supplied.

The researcher also used observation as an instrument for collecting data. The researcher observed students in their element as they got served food or collected their meals, settled in their allocated spaces and partook in the provided school meals. The researcher also observed the cooks as they prepared food in the kitchen and served the food.

3.5 Validity and Reliability of Research Instruments

According to Ghauri and Gronhaugi (2005), validity provides an explanation on how the data collated effectively covers the area of investigation. Reliability on the other hand, can be defined as the degree to which the measurement of phenomena leads to consistent results (Carmines and Zeller, 1979). This research heavily relies on observation, questionnaires and interviews as tools for collecting data. Validity of the research instruments was ensured through appropriate vetting of the content of the questionnaires and literature review by the supervising professionals who ensured that the questionnaires were precise, clear and objective.

Content validity is characterized by the assessment of new survey instruments so as to guarantee that they contain all crucial items, eliminating unnecessary items to a specific construct domain (Lewis et al, 1995). The judgmental approach to establish content validity for this research was obtained from the literature review and the panel of professional architects supervising the researcher.

The researcher used interrater reliability measure, also known as inter-observer reliability measure, to measure the consistency of the results. A substantial aspect of data collection for this research involves observing the infrastructure of the schools being assessed. Interrater reliability measures the degree of agreement between people observing or assessing similar things. The researcher made follow up visits to respective schools to validate responses received from the questionnaires regarding the school infrastructure to ascertain the authenticity of the feedback. The researcher also recruited the aid of a graduate architect and water engineer who also collected data from the same schools so as to compare the data collected. The researcher also performed a test-retest reliability measure which involved the researcher revisiting the schools where initial data had been collected and verifying the consistency of the data collected.

3.6 Data Analysis and Presentation Techniques

Data analysis involves making clean, structuring, inferring the findings and publishing in order to meet the research goals (Connaways and Powel, 2010). All the data collected from the data tools in form of questionnaires, interviews and observation was collated and subjected to statistical analysis. The collected data was processed into a format that could be inferred and coded using numerical indices. Data collected from the questionnaires was presented in charts, graphs and tables which aided in analyzing the findings, supporting conclusions and stating recommendations. To analyse the data collected, Microsoft Excel was used.

3.7 Ethical Considerations

According to Bhandari (2022), ethical considerations are principles guiding research practices and research designs. Ethics in research guarantee scientific honesty, human rights, dignity and partnership between the society and science. To guarantee adherence to research ethics, the researcher informed all participants that all feedback received was on a voluntary basis and consent was mandatory before divergence of any information by the participants. Moreover, the researcher did not disclose the identities of the participants and all information provided was considered confidential. The research was also carried out in a safe manner free from physical, social and psychological harm to all participants and other members of the society. Finally, the researcher ensured that the research work was free from plagiarism, research misconduct and accurately represented the researcher's findings.

CHAPTER 4

Data Analysis, Findings and Discussions

4.0 Introduction

The main objective of the research was to determine morphological and spatial design strategies that can be adopted in public primary and pre-primary schools to aid in alleviating food poverty within the society. The study sought to highlight the role of school infrastructure in the implementation of school feeding programmes and also develop a criteria to assess the status of the built environment of public primary and pre-primary schools in relation to food poverty alleviation. Similarly, the research aimed to investigate the effectiveness of the built environment of public primary and pre-primary schools in accommodating school feeding programmes and food poverty alleviation. Moreover, the research sought to formulate morphological and integrated spatial design strategies that can be adopted by public primary and pre-primary schools to enable self-sufficiency in food poverty alleviation.

Research findings from the collected data were analyzed in MS Excel. The analysis presented results in bar charts, pie charts and tables.

4.1 Study Response Rate

The researcher administered 41 interviews and also issued 41 questionnaires. The interview and questionnaires were issued simultaneously during the research. By doing, so, the researcher achieved 100% response rate

4.2 Distribution of Respondents

The respondents were stratified based on the constituency they are located in as shown in the pie chart below:

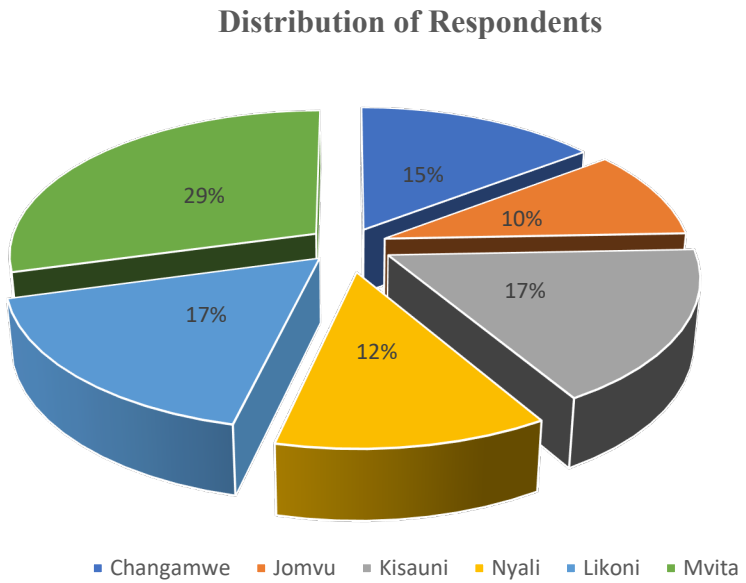


Figure 38 Distribution of Respondents. Source: Field Survey 2023

Mvita constituency had the largest number of respondents with 12 schools in total. Likoni and Kisauni both had 7 respondents followed by Nyali with 5 and Jomvu which had the least number of schools with only 4 respondents.

4.3 The Role of Infrastructure in the implementation of School Feeding Programmes

Infrastructure plays a crucial role in facilitating the implementation of school feeding programmes. This can be achieved through:

i. Providing buildings that will aid in provision of meals such as kitchens, kitchen stores and dining spaces.
ii. Providing adequate clean water to service the kitchens and the pupils so as to provide hygienic meals.
iii. Providing electricity to power kitchens and other spaces such as offices and dining spaces that process relevant documents to feeding programmes and amiable spaces to partake in school meals respectively.
iv. Providing playing fields which allow children to exercise especially those afflicted with health issues such as obesity.
v. Providing health rooms which aid in addressing malnutrition issues brought about by food poverty.
vi. Providing farming gardens and structures that will increase food production through crop farming and animal husbandry

4.4 Criteria to assess the status of the built environment in public primary and pre-primary schools in relation to food poverty alleviation.

As underpinned in the theory of Ecological Urbanism, one of the key principles of this theory is establishment of a high performance building that integrates well with the environment. It is therefore, vital that the built environment of public primary and pre-primary schools in Mombasa County adopt self-sufficiency attributes. To achieve this, a criterion was developed from the spatial requirements to the aspects that make these spaces efficient in achieving self-sufficiency. The table in the next page shows a sample of one of the main spaces.

SPACE		DESCRIPTION	AVAILABILITY YES/NO	NUMBER	SIZE	REMARK
KITCHEN						
		Size				
		Sufficiency in size				
		Quality of lighting and ventilation				
		Location of kitchen within the built environment				
		State of hygiene				
		Source of fuel				
	SUSTAINABILITY FEATURES					
		Presence of water harvesting features				
		Presence of Solar panels				
		Presence of Other alternative sources of energy (wind turbines, biogas)				
		Waste reuse and recycling techniques				
UTILITIES						
		Availability of electricity and water				
		Presence of boreholes				
		Alternative sources of water (Rivers, wells, rain etc.)				
WASTE MANAGEMENT						

	Waste disposal techniques				
	Distance from disposal area				

The structure in the table above is then used to develop a study questionnaire as shown in the appendix 2.

4.5 Status of the Built Environment of School Feeding Programmes

To determine the effectiveness of the built environment of public primary and pre-primary schools in accommodating school feeding programmes and food poverty alleviation, it is crucial that the status is determined and measured as shown in the table below.

Table 4 Source: Field Survey 2023

SPACE		DESCRIPTION	Number of Schools Identified	Total Number of Schools	REMARK
Use		**CLASSROOM**			
	a	Are classrooms used to store food?	41	41	supplies from government like milk, red finger millet flour etc. when in excess are stored in vacant classrooms
	b	If YES, how many classrooms are used to store food?			one or two classes

	c	If YES, why are the classrooms used to store food?			Lack of adequate food stores
	d	Are classrooms used as dining spaces?	31	41	
	e	If YES, how many classrooms are used as dining spaces?			all at different occasions
	f	If YES, why are the classrooms used as dining spaces?			lack of adequate dining spaces
	g	Are classrooms used as offices to facilitate procurement and processing of feeding programme documents?	0	41	
	h	If YES, how many classrooms are used as offices to facilitate procurement and processing of feeding programme documents?			none
	i	If YES, why are the classrooms as offices to facilitate procurement and processing of feeding programme documents?			none
	j	Are there other uses of classroom that pertain to school feeding other than those previously asked? If YES what are these uses?			store firewood, keep livestock

Sustainable Features					
	a	Are classrooms fitted with water harvesting fixtures?	20	41	
	b	If YES, what are the existing fixtures?			gutters, downpipes
	c	Are they fitted with gutters?	20	41	
	d	Are they fitted with downpipes?	12	41	
	e	Do they have overhead water storage tanks?	20	41	
	f	Do they have underground water storage tanks?	16	41	
	g	Is the surface water runoff around classrooms collected?	4	41	
	h	Are they fitted with photovoltaic cells/solar panels?	0	41	
Use		**KITCHEN**			
	a	Is the kitchen size sufficient?	4	41	

	b	Is the kitchen well ventilated?	4	41	
	c	Is the kitchen located away from the waste disposal area?	4	41	
	d	Is the kitchen positioned at a safe distance from the learning areas?	4	41	
	f	Does the kitchen have sufficient supply of clean water?	7	41	
	g	Does the kitchen have surfaces that are cleanable and maintainable?	8	41	
	h	Are the utensils stored in a hygienic space?	4	41	
	i	Is the kitchen close to the food store?	8	41	
	j	Does the kitchen have a sufficient servery?	7	41	
	m	What type of fuel is used to cook food in the kitchen?			firewood, charcoal
	n	Is the fuel stored in the kitchen?	4	41	

	o	If YES, Is the fuel storage sufficient?			Not sufficient
Sustainable Features					
	a	Where does the kitchen get its water supply from?			boreholes, portable water supply
	b	Is the kitchen fitted with water harvesting fixtures?	7	41	
	c	If YES, what are the existing fixtures?			gutters, downpipes
	d	Is the kitchen fitted with gutters?	7	41	
	e	Is the kitchen fitted with downpipes?	4	41	
	f	Does it have overhead water storage tanks?	4	41	
	g	Does it have underground water storage tanks?	4	41	
	h	Is the surface water runoff around Kitchen collected?	4	41	
	i	Is the kitchen fitted with photovoltaic cells/solar panels?	0	41	
	j	Does the kitchen use sustainable energy for lighting? If YES, explain	0	41	

	k	Does the kitchen use sustainable energy for cooking? If YES, explain	0	41	
Use		**FOOD STORE**			
	c	Does the food store have spread area for the perishable foodstuffs?	0	41	
	d	Is there a cold store?	0	41	
	e	Is the food store size sufficient?	0	41	
Sustainable Features					
	a	Is the Food store fitted with water harvesting fixtures?	4	41	
	b	If YES, what are the existing fixtures?	0	41	gutters, downpipes
	c	Is the Food store fitted with gutters?	4	41	
	d	Is the Food store fitted with downpipes?	4	41	
	e	Does it have overhead water storage tanks?	0	41	
	f	Does it have underground water storage tanks?	0	41	
	g	Is the surface water runoff around Food store collected?	4	41	

	h	Is the Food store fitted with photovoltaic cells/solar panels?	0	41	
Use		**DINING AREA**			
	b	Is the dining area size sufficient?	0	41	
	c	Is there a designated serving area?	4	41	
	d	Does the dining area have furniture appropriate for children?	4	41	
	f	Does the dining area link efficiently with the kitchen?	8	41	
	g	Does the dining area provide a safe space for eating?	8	41	
	h	Other than the main dining area, what other spaces are used for eating?			classrooms, outdoor sitting area, corridors,
Sustainable Features					
	a	Is the dining area fitted with water harvesting fixtures?	4	41	
	b	If YES, what are the existing fixtures?			down pipes, gutters
	c	Is the dining area fitted with gutters?	4	41	
	d	Is the dining area fitted with downpipes?	4	41	
	e	Does it have overhead water storage tanks?	0	41	
	f	Does it have underground water storage tanks?	0	41	
	g	Is the surface water runoff around dining area collected?	4	41	

	h	Is the dining area fitted with photovoltaic cells/solar panels?	0	41	
Use		**OFFICE**			
	a	Is the office used to process documents used in feeding programmes?	41	41	
	b	Is the office used to store food?	0	41	
	c	In what ways is the office used to support the feeding programmes?			Processing of documents pertaining to feeding programmes
Sustainable Features					
	a	Is the office fitted with water harvesting fixtures?	20	41	
	b	If YES, what are the existing fixtures?			gutters, downpipes
	c	Is the office fitted with gutters?	20	41	
	d	Is the office fitted with downpipes?	13	41	
	e	Does it have overhead water storage tanks?	0	41	
	f	Does it have underground water storage tanks?	0	41	
	g	Is the surface water runoff around office collected?	4	41	
	h	Is the office fitted with photovoltaic cells/solar panels?	0	41	
Use		**HEALTH ROOM**			
	a	Does the school have a health room?	0	41	
	b	Does the school provide nutritional supplement?	32	41	Occasional supply by government institutions

	c	Are children checked for malnutrition? If YES, where does this take place?	0	41	
Sustainable Features					
	a	Is the health room fitted with water harvesting fixtures?	0	41	
	b	If YES, what are the existing fixtures?	0	41	
	c	Is the health room fitted with gutters?	0	41	
	d	Is the health room fitted with downpipes?	0	41	
	e	Does it have overhead water storage tanks?	0	41	
	f	Does it have underground water storage tanks?	0	41	
	g	Is the surface water runoff around office collected?	0	41	
	h	Is the health room fitted with photovoltaic cells/solar panels?	0	41	
Use		**KITCHEN GARDENS**			
	a	Does the school have kitchen gardens? If NO, why?	41	41	CBC Requirements for planting projects
	b	What is planted in the gardens?			Vegetables, Fruits
	c	Does the school utilise what it plants as part of the school meals?	7	41	
	d	Where does the school obtain water used in the kitchen gardens?			Boreholes, harvested rain water, portable water
	e	Who manages the kitchen gardens?			School casual workers, children

	f	Does the school process harvested food before delivery to the kitchen / food stores?	0	41	
Use		**OTHER FARMING TECHNIQUES**			
	a	Does the school practise fish farming?	0	41	
	b	If YES, does the school feeding programme benefit from this?	0	41	
	c	Does the school keep livestock? If YES, what livestock does it keep?	9	41	Poultry Farming
	d	How secure are the structures housing the livestock?	7	41	
	e	How far are the structures housing livestock from the tuition block?			Close proximity
	f	What techniques have been adopted in supplying water to the farms?			rain water supply, borehole water

The research determined that all schools assessed had overhead water tanks. About 50% of the schools assessed had rain water harvesting features mainly gutters but only about 30% had down pipes. Approximately 40% of the schools had underground water tanks. Nearly 10% of the assessed schools had a system of collecting surface water runoff. No school assessed had a solar system placed above classrooms

4.5.1 Status of Classrooms

All schools assessed during the research acknowledged the use of classrooms to store excess supplies of food. Some of the food often supplied by the authorities included milk and red finger millet flour. Almost 80% of the respondents admitted to sometimes using class rooms as dining spaces. None of the schools assessed stored and processed documents used to facilitate feeding programmes in classrooms.

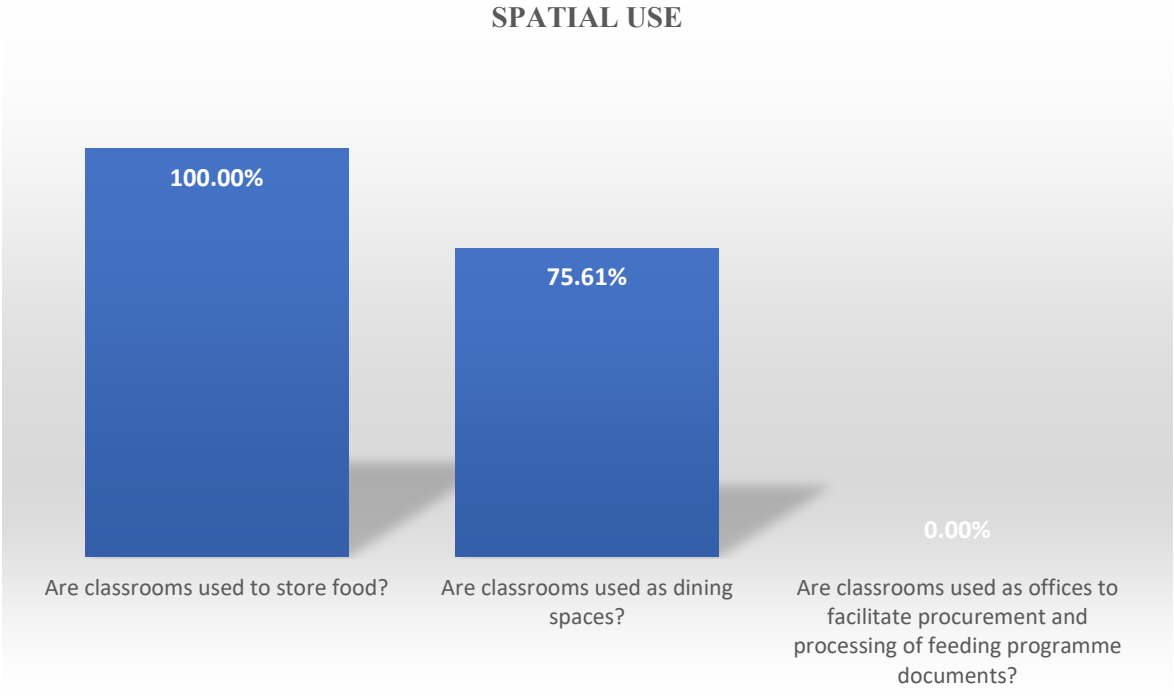


Figure 39 Spatial use of class rooms. Source: Field Survey 2023

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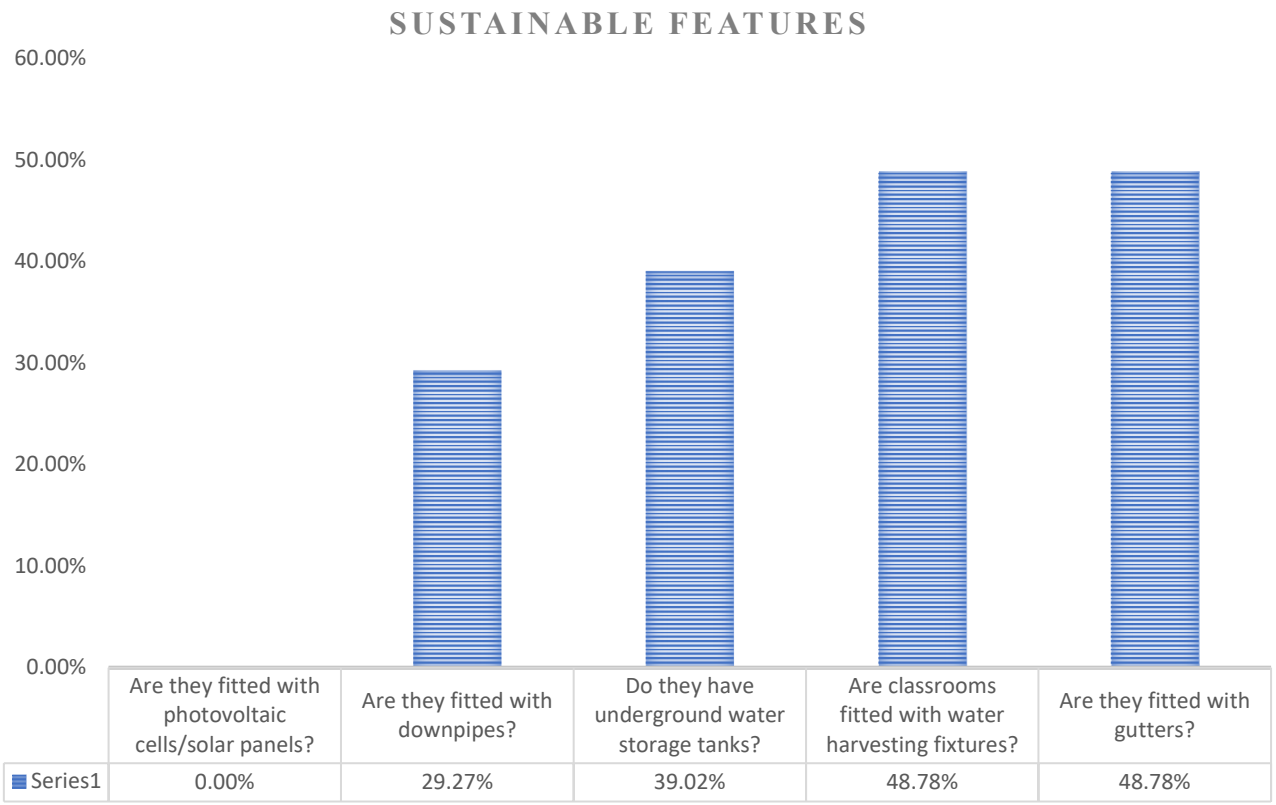

Figure 40 Sustainable features in classrooms. Source: Field Survey 2023

Classrooms make up a large percentage of the school built infrastructure. The large surface area becomes advantages if there is optimum utility of space and form. The assessed classrooms did not have an effective water harvesting system where all the necessary components such as gutters, downpipes, tanks, filtration system etc. were fully functioning. To

optimize space, introducing photovoltaic cells will increase electric power supply. The 4 schools that had surface water runoff rain harvesting systems benefited from increased and consistent water supply.

Flexibility of spaces is also important. It saves on resource and maximizes utility of spaces. Classrooms performing other duties such as dining areas, storage spaces allows for service provision. It is however, important to customize the design of these spaces so as not to jeopardize the main activities.

4.5.2 Status of Kitchens

Approximately 10% of the schools assessed had kitchens of a sufficient size, were well ventilated and located at an acceptable distance from waste dumping area and tuition blocks. About 20% of the schools assessed had kitchens with sufficient supply of clean water for use in the kitchens. Nearly 20% of the schools evaluated had kitchens with surfaces that were easy to maintain and clean, had adequate serving area and a food store close to the kitchen. Over 50% of the fuel received was stored in the kitchen.

The kitchens in a large number of the schools assessed are substandard. A majority of them are makeshift structures with no proper design. There is no proper plan that incorporates kitchens into the master plans of the existing schools with a proper servery, food preparation area, cooking area and service yard.

To mitigate the cost of fuel, green energy systems such as photovoltaic cells can power solar cookers and provide electricity to light the kitchens. Biogas can provide alternative fuel for cooking. Harvested rain should be utilized to clean utensils and kitchens.

A sufficient and functioning kitchen will facilitate meal preparation conveniently, improve meal production and may attract food donations for meals prepared in schools. Food 4 education currently supplies lunch to pre-primary schools in Mombasa County with all meals prepared outside the schools. The feedback from most school administrators is that they fear that if the funding for the programme by the county government was to cease, most children will suffer.

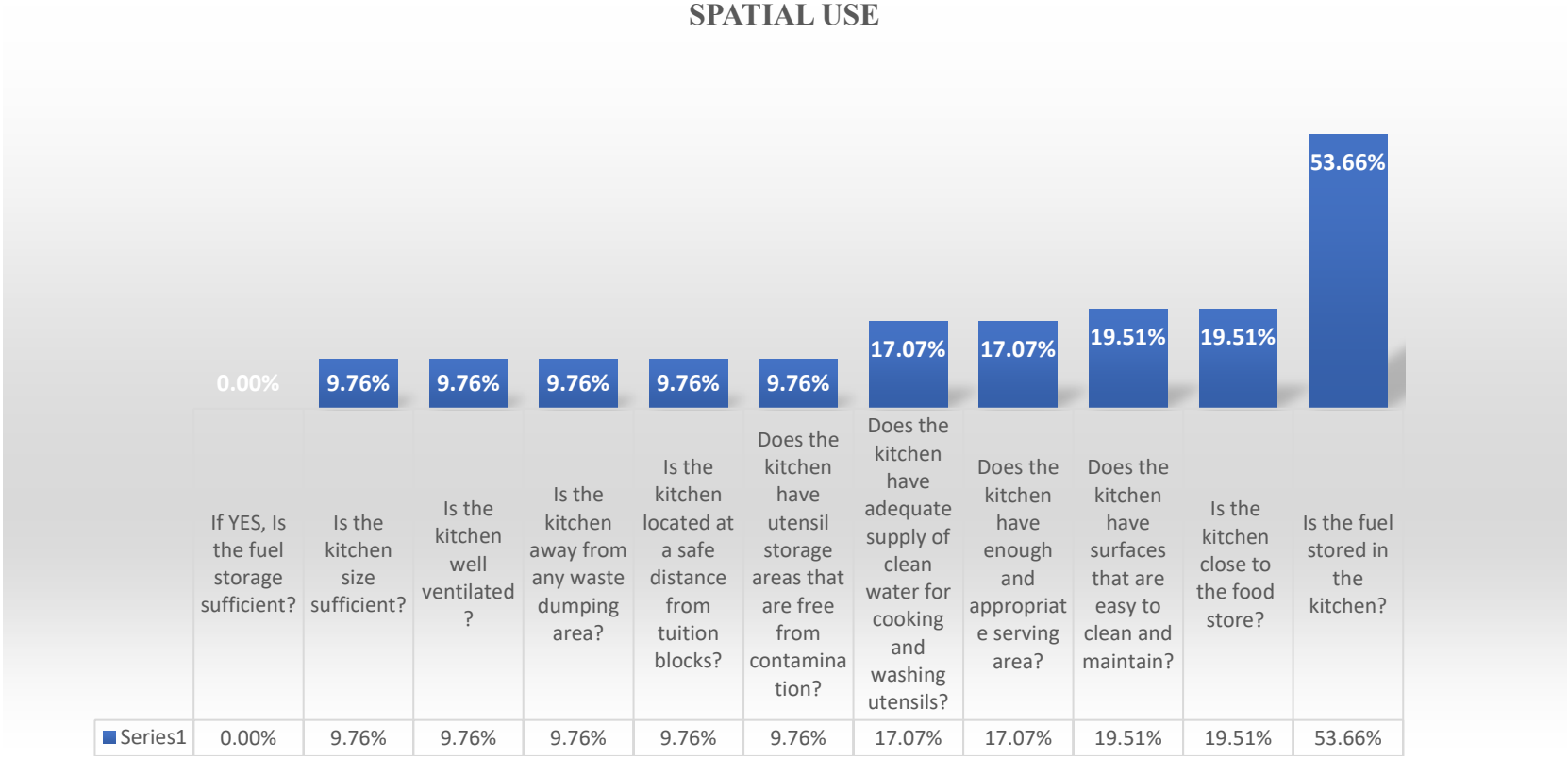

Figure 41 Spatial use of Kitchens. Source: Field Survey 2023

Approximately 20% of the schools had kitchens fitted with gutters while nearly 10% were fitted with downpipes, had overhead storage tanks, underground water tanks and a system for collecting surface water runoff. None of the kitchens assessed had a solar system installed, or any form of sustainable energy system for lighting and cooking.

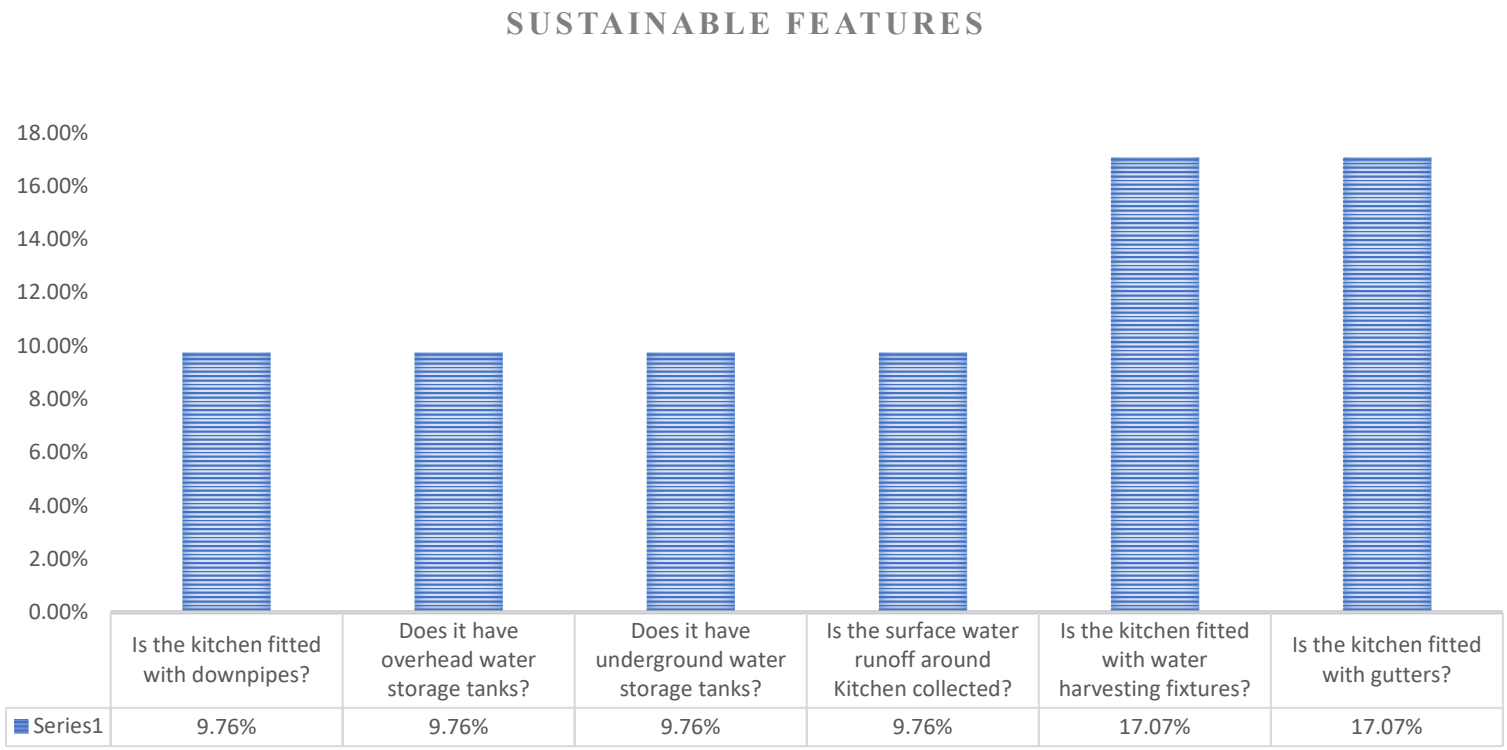

Figure 42 Sustainable features in Kitchens. Source: Field Survey 2023

4.5.3 Status of Food Stores

None of the food stores assessed had spread area for the perishable foodstuffs, a cold store and were sufficient in size for food storage. Less than 10% of the schools assessed had food stores with water harvesting features such as gutters, down pipes and surface water runoff collecting system. No food store had an overhead tank above it, underground water storage tank below it and any solar system installed.

Figure 43 Sustainable features in Food Store. Source: Field Survey 2023

Most schools assessed lacked sufficient food stores to service the kitchen. The kitchen require specialized stores such as cold stores, dry stores, general stores etc. to accommodate more supplies of food from donors, governments and even internal purchases. Installing sustainable features in these stores will increase the capacity of water and electric supply from rain and solar. Sufficient food stores will free classrooms for other crucial activities other than storing food.

4.5.4 Status of Dining Areas

All Dining areas in the schools assessed were insufficient in size. Less than 10% of the schools assessed had dining areas with a servery and appropriate furniture for children. Approximately 50% of the schools assessed had dining areas sufficiently linked with the kitchen and a safe space for eating.

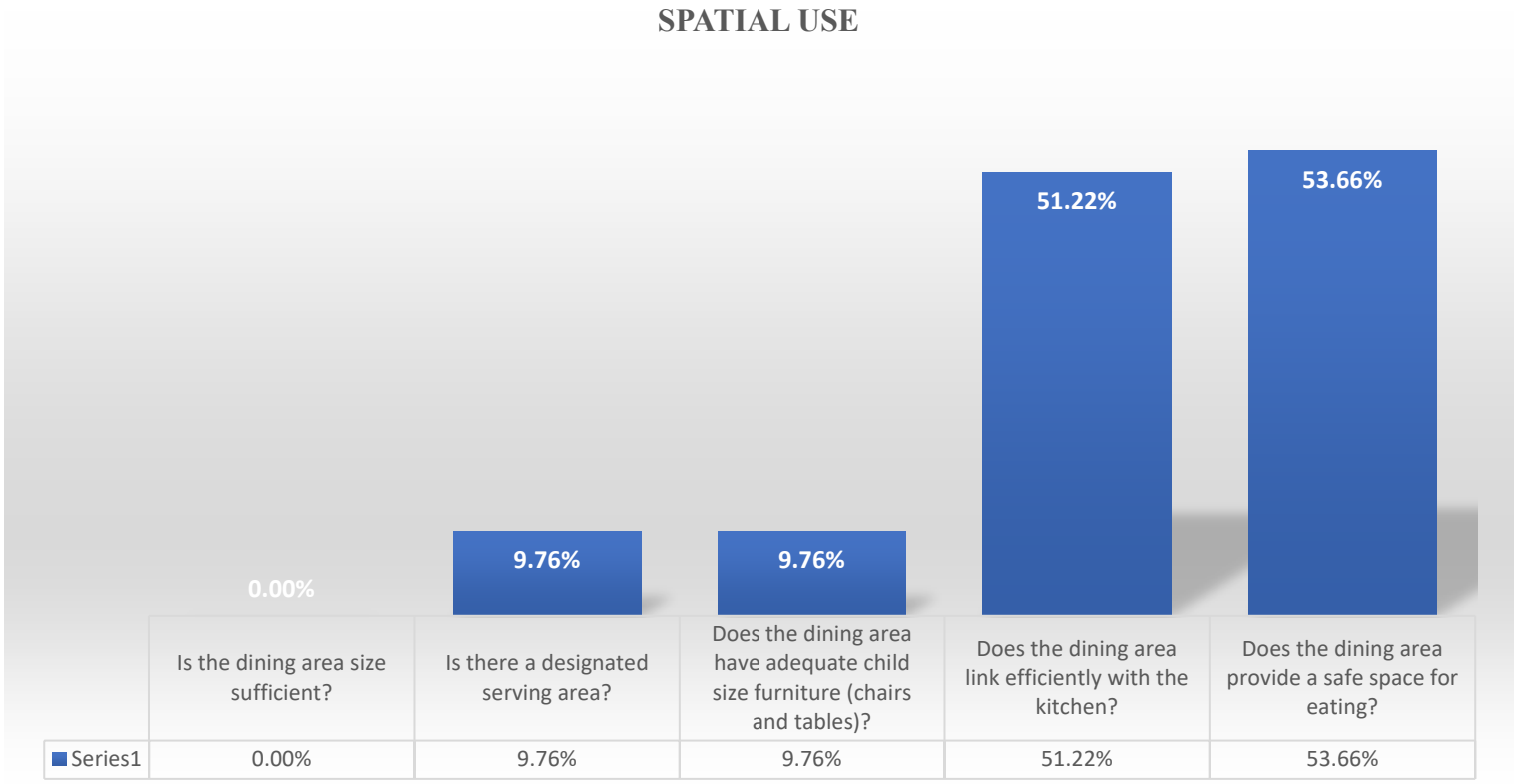

Figure 44 Spatial use of Dining Areas. Source: Field Survey 2023

The schools assessed did not have overhead and underground water tanks placed above and below the dining areas. None of the dining areas was fitted with solar panels. Less than 10% of the schools assessed had dining areas fitted with gutters, down pipes and a surface water runoff collecting system.

Dining halls provide amiable spaces for meal taking. Most schools lacked sufficient dining areas with students having meals in makeshift shades, in classrooms, in open spaces etc. Dining areas should be built to improve the quality of space when partaking in school meals. To maximize on utility, some dining halls can have multiple uses such as accommodation of meetings or public engagements while at the same time acting as dining spaces.

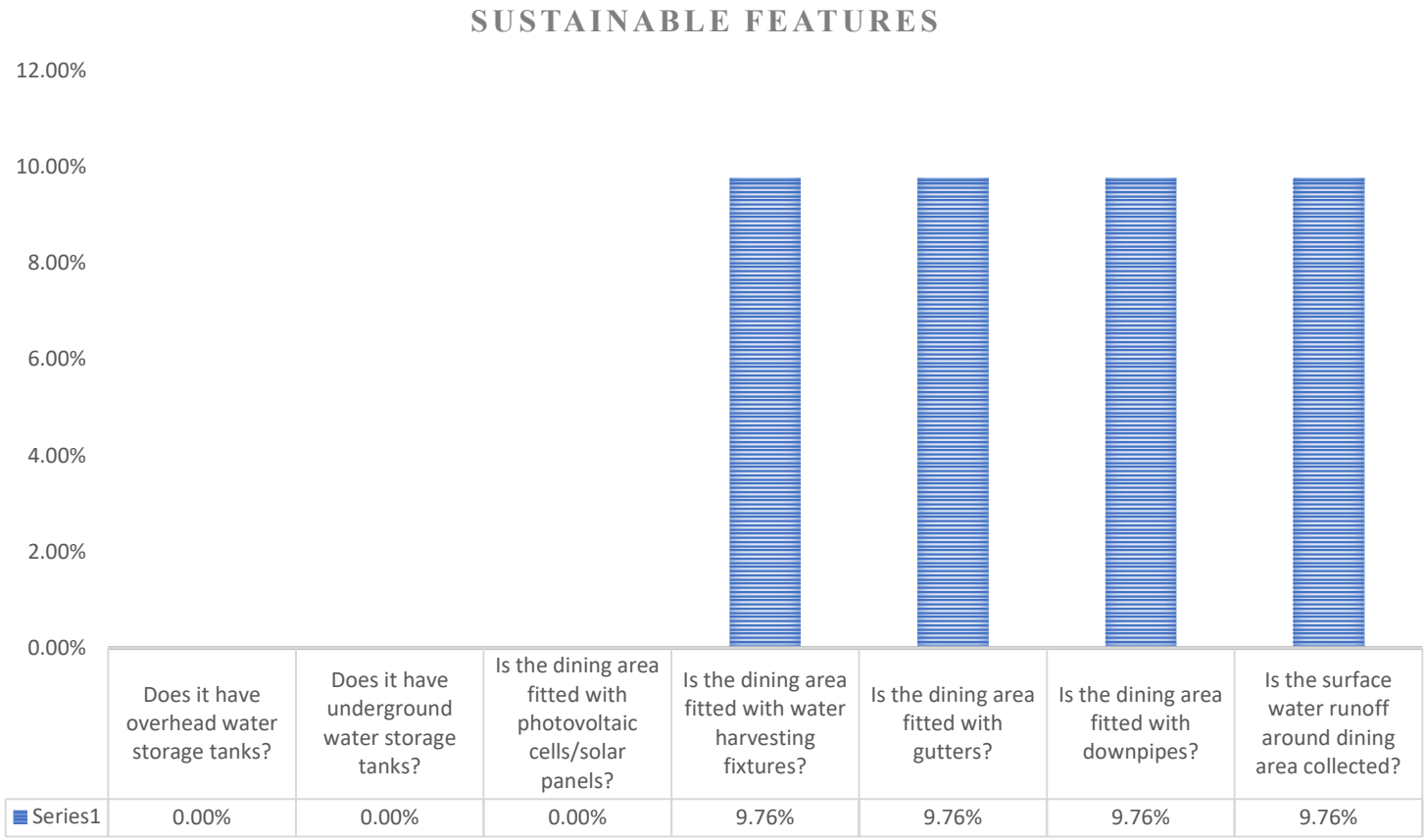

Figure 45 Sustainable features in Dining Areas. Source: Field Survey 2023

4.5.5 Status of Offices

All schools assessed used offices to process documents used in feeding programmes and none was used to store food. Less than 35% of the schools assessed had offices fitted with gutters and downpipes. None of the offices assessed had overhead water tanks placed on the roof and underground water tanks placed below office. Approximately 10% of the schools assessed had offices that collected surface water runoff around them. Finally, no office was fitted with photovoltaic cells.

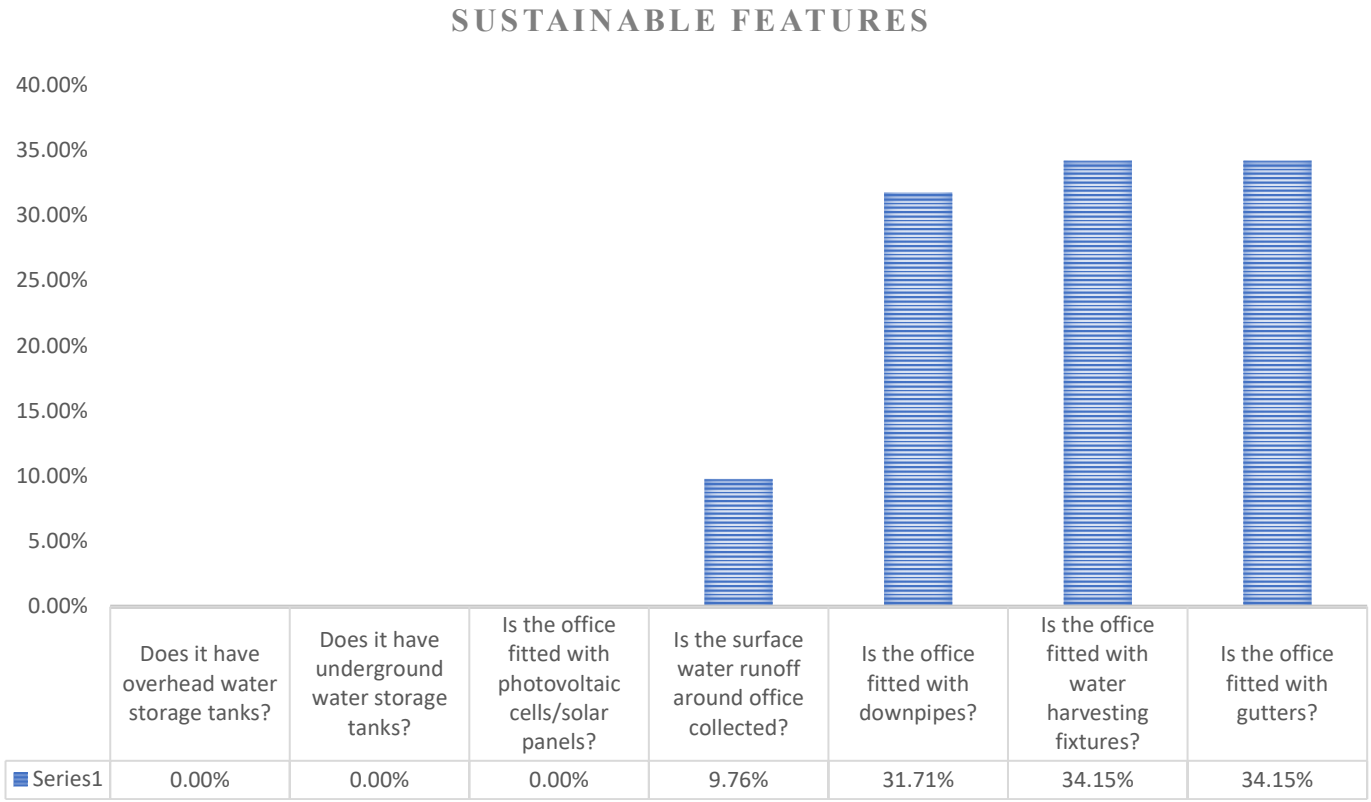

Figure 46 Sustainable features in Offices. Source: Field Survey 2023

Installing sustainable features in offices will increase the surface area of photovoltaic cells installation and rain water harvesting thus increasing the supply of water and electricity to the schools.

N.B.

In compliance with the new CBC system of education; all schools had small gardens to plant vegetables and fruits but less than 20% of the schools used the produce to facilitate the school feeding programmes. None of the schools evaluated practiced fish farming. Approximately 25% of the schools assessed practiced poultry keeping.

- All pre-primary schools assessed received lunch meals from a private organization known as Food 4 Education financed by the County Government of Mombasa.
  All primary schools assessed had internal systems established to provide lunch meals at a fee to primary school students. None of the assessed schools were beneficiaries of the HGSM and NMK school feeding programmes.
- 4 out of the 41 assessed schools built shops fronting the school that generated revenue that was partially used to finance meals for needy students.
  23 out of the 41 assessed schools had boreholes drilled for water supply that serviced the toilets and for cleaning in the kitchens.
  All schools with functioning kitchens purchased portable water for cooking in the kitchens.
- None of the assessed schools had integrated programmes with local farmers.
- None of the assessed schools had food processing and packaging plants.
- None of the schools allowed children to go home for lunch and food was either supplied to the school by local food vendors or guardians as per the school policies.
- All schools receiving food from local vendors required the suppliers to have a food hygiene license or food handler certificate.
- 4 out of the 41 assessed schools had solar panels to pump water to overhead tanks.
  None of the schools used alternative energy supply to power the main infrastructure of the school.
- All schools were fenced.
  Only 7 out of the 41 assessed schools had fenced kitchen gardens.

4.6 Spatial and Morphological strategies

To reduce the cost of feeding programmes in public primary and pre-primary schools, several strategies can be adopted. These strategies include:

i. Provision of adequate spaces to facilitate school feeding programmes. These spaces include: dining halls, kitchens and food stores, kitchen gardens, livestock farms, fish farms, health rooms, food processing and packaging plants and flexible spaces such as classrooms, halls etc. that can be used for multiple purposes other than the main purpose including facilitation of school meals.
ii. Installation of a solar system including solar panels. These panels can be installed on top of roofs, infused on glazed surfaces with photovoltaic cells or placed on elevated platforms.
iii. Installation of wind turbines. These turbines can be installed on roof tops, in open spaces and even on facades.
iv. Construction of a biogas system with pipes that supply cooking gas to kitchens.
v. Installation of a rainwater harvesting system that involves installation of gutters, downpipes, water storage tanks, water pipes, water treatment plant and a pumping system.
vi. Drilling of wells and boreholes, piping water from nearby rivers, lakes and streams.
vii. Establishing kitchen gardens, livestock farms, poultry farms and fish farms.

4.7 Research Proposition

The research proposition stated that effective design of the built environment of public primary and pre-primary schools can engender food security in the society. The proposal argued that lowered cost of meals provided in schools will offset household expenditure on school meals thus improving the spending power of various households. To reduce the cost of meal delivery in schools, the proposition suggested that efficient provision of utilities at lower costs through improved infrastructure and school produced food from in-house farms can aid in lowering the cost of meals in schools. The study targeted 41 schools issuing 41 questionnaires and administering 41 interviews.

Notably, 4 of the assessed schools had recently been renovated by donors from Germany. The new designs had incorporated some of the design strategies proposed in this research. It was noted that these schools exponentially increased their water supply. The new kitchens efficiently supported Food 4 Education meal facilitation for pre-primary

pupils. Primary school children also benefited from this by being supplied meals, not free like their pre-primary counterparts but at a fee of around Ksh 30 per meal.

The initiative by the German donors also built shops along the façade facing the main access. By doing so, the school was able to raise funds which could be used to purchase fuel in kitchens and even pay for meals for needy students. These schools, however, lacked an effective solar energy system with a few available solar panels servicing the water pumps only.

The newly German renovated schools did not capitalize on the productivity of the kitchen gardens. Increased farming in these gardens would improve food production for meal facilitation in these schools.

4.8 Challenges encountered during the field investigation

The researcher encountered various challenges during the field investigation. The main challenge was obtaining approval to carry out research in government schools. The public primary schools are mainly managed by the national government through the MOE. The public pre-primary schools, on the other hand, are managed by the county government of Mombasa. The process of obtaining authorization to carry out the research was however, dogged with a lot of red tape which was not only frustrating but also time consuming. The researcher was however heavily assisted by the County of Mombasa ECDE Director who through his personnel and influence enabled the whole process to be expedited in the latter stages.

The technicality of the research forced the researcher to administer the questionnaires in tandem with the face to face interviews, so as to aid the respondents in quick delivery of feedback. This was a rather laborious process. To mitigate the tedious nature of this process, the engagement with the stakeholders through interviews created a rapport that made the respondents amiable.

CHAPTER 5

Summary of Findings, Conclusion and Recommendation

5.0 Introduction

In this chapter, the research comes into a conclusion. The findings discussed in chapter 4 are summarised in this chapter and conclusions drawn in response to the research proposition and project objectives. Moreover, this chapter also provides recommendations pertaining to the research objectives and further makes recommendations on potential areas for further research.

5.1 Revisiting Research Objectives

The key objectives of this research were:

i. To explain the role of school infrastructure in implementation of school feeding programmes.
ii. To develop criteria to assess the status of the built environment in public primary and pre-primary schools in relation to food poverty alleviation.
iii. To investigate the effectiveness of the built environment of public primary and pre-primary schools in accommodating school feeding programmes and food poverty alleviation.
iv. To formulate morphological and integrated spatial design strategies that can be adopted by public primary and pre-primary schools to enable self-sufficiency in food poverty alleviation.

5.2 Summary of Study Findings

The theoretical underpinning of this research were found to suffice. The theory of change addressed the study's main objective of analyzing how the built environment of public primary and pre-primary schools can employ appropriate design strategies that can augment performance in facilitation of school meals and food production. The research highlighted these strategies and the anticipated performance in meeting this objective. The other theory was the theory of ecological urbanism. The theory engages the built environment with the goal of ensuring that urban projects are designed from the potential and limitations of existing resources. The research engaged the built environment of public primary and

pre-primary schools in Mombasa County and adopted sustainable design strategies that optimized the resources available ensuring the propagation of a more self-sufficient school infrastructural system.

5.2.1 The role of School Infrastructure in Implementation of School Feeding Programmes

The role of school infrastructure as stipulated in Chapter 2 is to provide buildings, utilities and spaces for facilitation of services within schools. This research delved into the core buildings and spaces that facilitate meals preparation and food production. Some of these buildings included kitchens, food stores, dining areas, chicken coups, goat pens, cow pens and offices. The role of infrastructure is also to provide utilities such as water and electricity. Water is crucial for meal preparation, cooking and cleaning. Infrastructure for water provision included boreholes, wells, rain water harvesting systems, piping system from lakes and rivers and a water treatment plant. Electricity is important for lighting and providing energy for cooking. The research focused on sustainable electric supply from sources such as solar, wind energy and biogas. Infrastructure also provides ideal spaces for meal facilitation. Some of these spaces may include kitchen yards, kitchen gardens, food delivery areas etc.

5.2.2 Criteria to assess the status of the built environment in relation to food poverty alleviation

The researcher analysed the status of the the built environment in public primary and pre-primary schools in relation to food poverty alleviation by focusing on the spatial sufficiency of the existing spaces in meeting their roles in facilitating the provision of school meals. The researcher also delved into the morphological features of these spaces that engender self-sufficiency in provision of utilities that are crucial for meal facilitation. By doing so, the researcher was able to create a checklist with key elements that was used as a guide in developing questionnaires as shown in table 5.

5.2.3 Status of the Built Environment of Schools

Classrooms make up the largest percentage of buildings in public primary and pre-primary schools in Mombasa County. None of the schools assessed had solar panels installed for supply of electricity. Rain water harvesting features were minimal and there is need for installation of an elaborate functioning system that optimizes rain water tapping with a properly linked system of storage. Creation of flexible classrooms that can be used for storage and other activities may be ideal but there is need for proper management to ensure that main learning activities are not jeopardized.

Kitchens are the epicentres for meal preparation. Most schools in Mombasa County lack elaborate functioning kitchens. There is need to provide kitchens that are not only ample in size but up to standard to ensure efficiency in meal preparation. The existing kitchens are makeshift structures acting as appendages to the existing buildings with no flowing connections to the existing spaces due to the absence of a proper master plan. Installation of sustainable features such as photovoltaic cells and rain water harvesting systems will augment utility provision and curtail the cost of services such as water and electricity in meal facilitation.

Food stores allow for storage of food supplies. Sufficient food stores will ensure food last longer and is secure thus ensuring optimum use of food supplies with minimal wastage. A majority of the schools in Mombasa County lacked sufficient food stores. There is need for construction of appropriate food stores that are linked to the core spaces such as kitchens and provide all necessary spaces such as cold stores, dry stores and general stores. Installing sustainable features in the food stores will increase the capacity of water and electric supply from rain and solar power. Sufficient food stores will free classrooms from being used as food stores.

Dining areas mainly provide a hospitable space for taking meals. A majority of schools in Mombasa lack proper functioning dining halls. Dining halls take up a lot of space but if effectively designed, can provide a multitude of functions other than dining; for example host meetings and public engagements. Dining areas should be properly linked to kitchens and have a sufficient serveries. Installation of sustainable features in dining areas will increase the capacity of water and electric supply from rain and solar power supply.

Offices provide a safe and convenient space for processing of documents fundamental in the facilitation of meal programmes in schools. Offices ensure that documents are stored safely. Offices also facilitate meetings between various stakeholders on matters pertaining to the provision of meals in public primary and pre-primary schools. All schools in

Mombasa County processed their documents in offices. Installation of sustainable features in offices will increase the capacity of water and electric supply from rain and solar power.

Food production in most of the public primary and pre-primary schools gardens in Mombasa was low. The existing gardens were mainly projects of the CBC programme. The gardens were not productive due to the lack of adequate water to service the soil. Livestock keeping was also very low with few schools having some chicken coops. Some classrooms had been converted to chicken coops due to security concern over theft of free range chickens. In other situations, chickens had succumbed to diseases and all left were empty chicken houses. None of the schools practiced fish farming mainly due to lack of adequate water for such activities. The schools did not have an integrated programme with local farmers. Collaboration between local farmers and schools can create a symbiotic relationship where both parties benefit. Local farmers can benefit from supplying their produce to school for a reasonable fee while the schools can benefit from fresh produce. Local arrangements between farmers and the schools can enable local farmers to till within school grounds and share the produce with the school at an agreed rate. Through such engagements, local farmers and the schools can also exchange ideas on best farming practices. None of the schools had a food processing and packaging plant due to the lack of an elaborate farming system in the schools. These structures may later be a viable option if the farming in these schools was to intensify.

One of the main issues raised by some of the school head teachers in the assessed schools was the lack of adequate funds to effectively run school feeding programmes. The existing food programmes were not sustainable since they relied heavily on external funding. It is therefore paramount that initiatives are adopted to raise revenue for school feeding programmes. The creation of shop fronts for letting was one of the successful initiatives that emerged during the research. The shops were let to outsiders who paid a monthly rent fee. Some of the schools with proper infrastructure would also rent out their meeting halls to outsiders for weddings and the revenue raised would partly be used to buy fuel for the kitchens.

5.2.4 Spatial and Morphological strategies

The infrastructure of most public primary and pre-primary schools in Mombasa is old. Most of the pre-primary and primary schools share a common compound and in some cases the same building. The initial master plan for these schools did not provide some of the key spaces such as kitchens, food stores, dining areas that are crucial for facilitating feeding initiatives. The introduction of school feeding programmes such as NMK and HGSM meant that most schools had to improvise to facilitate these initiatives. The CBC system of education is also redefining the roles of some of the existing structures and spaces in most primary and pre-primary schools nationally.

To effectively execute the school feeding programmes in public primary and pre-primary schools, it is vital that newer structures are built to provide proper infrastructure for the implementation of these feeding programmes. All public primary and pre-primary schools should have standardized kitchens, adequate dining spaces, proper food storage facilities and kitchen yards.

Autonomy of schools in facilitating school feeding programmes is crucial for the longevity of these programmes. The morphological strategies proposed in this research aim to engender self-sufficiency of public primary and pre-primary schools in providing meals to students. These strategies strive to produce the necessary resources for meal provision at the lowest possible cost.

Installation of water harvesting systems in buildings will increase the supply of water to schools. The installation of renewable energy systems such as photovoltaic cells, wind turbines, biogas etc. will generate fuel and electricity for use not only in school kitchens but in the entire school.

Establishing kitchen gardens, livestock farms, poultry farms and fish farms will increase food production in public primary and pre-primary schools. Excess food produced by the schools may be sold to raise revenue fs or donated to needy members of the society.

5.3 Revisiting the Research Proposition

The research proposition stated that effective design of the built environment of public primary and pre-primary schools can engender food security in the society. The research findings support this proposition.

5.4 Recommendations

Objective1 - To explain the role of school infrastructure in implementation of school feeding programmes.

School infrastructure plays a significant role in the facilitation of feeding programmes. The status of most of the infrastructure in public primary and pre-primary schools in Kenya is poor. It is therefore recommended that; the GOK, through the MOE and Ministry of Finance, allocate more finances and resources in the development and improvement of public primary school infrastructure in Mombasa County to ensure construction of spaces vital for efficient implementation of school feeding programmes. The county government of Mombasa should also divert more finances and resources in the development and improvement of public pre-primary school infrastructure in Mombasa County to ensure construction of spaces vital for efficient implementation of school feeding programmes.

Objective 2 - To develop criteria to assess the status of the built environment in public primary and pre-primary schools in relation to food poverty alleviation.

The evaluation of public primary and pre-primary schools infrastructure is based on sets of standard guidelines. The guidelines are however not geared towards self-sufficiency. It is therefore recommended that the existing guidelines are amended and improved with the introduction of newer guidelines geared towards sustainability and green architecture to promote self-sufficiency of public primary and pre-primary schools in the facilitation of school feeding programmes.

Objective 3 - To investigate the effectiveness of the built environment of public primary and pre-primary schools in accommodating school feeding programmes and food poverty alleviation.

The built environment of most of the public primary and pre-primary schools in Mombasa County has not been optimized for the facilitation of school feeding programmes. The dilapidated state of infrastructure compounded with the lack of adequate funding has rendered the implementation of school feeding programmes not only costly but inefficient. To remedy this, all public primary and pre-primary schools in Mombasa County should adopt autonomous practices to promote self-sufficiency and reduce dependency on external funding for effective implementation of school feeding programmes. Moreover, all public primary and pre-primary schools in Mombasa County should explore alternative income generating ventures through development of income generating infrastructure that can aid in financing school feeding programmes.

Objective 4 – To formulate morphological and integrated spatial design strategies that can be adopted by public primary and pre-primary schools to enable self-sufficiency in food poverty alleviation.

Various strategies can be adopted by public primary and pre-primary schools in Mombasa County to improve efficiency of implementation of school feeding programmes. This can be achieved through provision of sufficient spaces necessary to facilitate school feeding programmes and augmentation of the school infrastructure by capitalizing on green design techniques. These techniques will reduce cost of utilities such as water and electricity thus engendering self-sufficiency. Furthermore, all public primary and pre-primary schools should adopt integrated programmes with local farmers to ensure improvement of food security in the facilitation of school feeding programmes. Moreover, public primary and pre-primary should adopt farming practices integrated into the CBC system of education at a large scale to increase food production thus supporting their respective school feeding programmes.

5.5 Areas for Further Research

The research identified several areas for further research as listed below:

i. The evolution of the infrastructure of public primary schools in Kenya in facilitation of school feeding programmes since independence.
ii. The integration of CBC system of education in food generation in public primary schools.
iii. The integration of sustainable energy in facilitating school feeding programmes in public schools in Kenya.

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Appendix 1: [Research Authorization Letter]

UNIVERSITY OF NAIROBI
Faculty of Built Environment and Design
DEPARTMENT OF ARCHITECTURE
E- mail: architecture@uonbi.ac.ke

P.O. BOX 30197,
Nairobi, Kenya
Telephone: 020-4913519
Telegrams: Varsity.

Our Ref: UON/FBED/Arch/37963/2020 ***Date:*** 25th January, 2023

TO WHOM IT MAY CONCERN

Dear Sir/Madam,

RE: ALEX SYDNEY MANINGA – REG. NO. W50/37963/2020

This is to confirm that the above named is a registered Masters student in Urban Management in the Department of Architecture, University of Nairobi.

He is carrying out a project titled **"THE USE OF BUILT FORM TO ADDRESS FOOD POVERTY IN PUBLIC PRIMARY AND PRE-PRIMARY SCHOOLS: CASE OF MOMBASA, KENYA".**

We are thus requesting you to give him some of your valuable time and respond positively to his enquiries, provision of drawings, maps, etc as may be required. This is for academic purposes only.

Any assistance accorded to him will be highly appreciated.

Yours sincerely,

CHAIRMAN
DEPARTMENT OF ARCHITECTURE
UNIVERSITY OF NAIROBI

Arch. Musau Kimeu
CHAIRMAN,
DEPT. OF ARCHITECTURE

REPUBLIC OF KENYA

NATIONAL COMMISSION FOR SCIENCE,TECHNOLOGY & INNOVATION

Ref No: **561017**

Date of Issue: **09/March/2023**

RESEARCH LICENSE

This is to Certify that Mr.. Alex Sydney Maninga of University of Nairobi, has been licensed to conduct research as per the provision of the Science, Technology and Innovation Act, 2013 (Rev.2014) in Mombasa on the topic: THE USE OF BUILT FORM TO ADDRESS FOOD POVERTY IN PUBLIC PRIMARY for the period ending : 09/March/2024.

License No: **NACOSTI/P/23/23555**

561017

Applicant Identification Number

Director General
NATIONAL COMMISSION FOR SCIENCE,TECHNOLOGY & INNOVATION

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THE SCIENCE, TECHNOLOGY AND INNOVATION ACT, 2013 (Rev. 2014)
Legal Notice No. 108: The Science, Technology and Innovation (Research Licensing) Regulations, 2014

The National Commission for Science, Technology and Innovation, hereafter referred to as the Commission, was the established under the Science, Technology and Innovation Act 2013 (Revised 2014) herein after referred to as the Act. The objective of the Commission shall be to regulate and assure quality in the science, technology and innovation sector and advise the Government in matters related thereto.

CONDITIONS OF THE RESEARCH LICENSE

1. The License is granted subject to provisions of the Constitution of Kenya, the Science, Technology and Innovation Act, and other relevant laws, policies and regulations. Accordingly, the licensee shall adhere to such procedures, standards, code of ethics and guidelines as may be prescribed by regulations made under the Act, or prescribed by provisions of International treaties of which Kenya is a signatory to
2. The research and its related activities as well as outcomes shall be beneficial to the country and shall not in any way;
   i. Endanger national security
   ii. Adversely affect the lives of Kenyans
   iii. Be in contravention of Kenya's international obligations including Biological Weapons Convention (BWC), Comprehensive Nuclear-Test-Ban Treaty Organization (CTBTO), Chemical, Biological, Radiological and Nuclear (CBRN).
   iv. Result in exploitation of intellectual property rights of communities in Kenya
   v. Adversely affect the environment
   vi. Adversely affect the rights of communities
   vii. Endanger public safety and national cohesion
   viii. Plagiarize someone else's work
3. The License is valid for the proposed research, location and specified period.
4. The license any rights thereunder are non-transferable
5. The Commission reserves the right to cancel the research at any time during the research period if in the opinion of the Commission the research is not implemented in conformity with the provisions of the Act or any other written law.
6. The Licensee shall inform the relevant County Director of Education, County Commissioner and County Governor before commencement of the research.
7. Excavation, filming, movement, and collection of specimens are subject to further necessary clearance from relevant Government Agencies.
8. The License does not give authority to transfer research materials.
9. The Commission may monitor and evaluate the licensed research project for the purpose of assessing and evaluating compliance with the conditions of the License.
10. The Licensee shall submit one hard copy, and upload a soft copy of their final report (thesis) onto a platform designated by the Commission within one year of completion of the research.
11. The Commission reserves the right to modify the conditions of the License including cancellation without prior notice.
12. Research, findings and information regarding research systems shall be stored or disseminated, utilized or applied in such a manner as may be prescribed by the Commission from time to time.
13. The Licensee shall disclose to the Commission, the relevant Institutional Scientific and Ethical Review Committee, and the relevant national agencies any inventions and discoveries that are of National strategic importance.
14. The Commission shall have powers to acquire from any person the right in, or to, any scientific innovation, invention or patent of strategic importance to the country.
15. Relevant Institutional Scientific and Ethical Review Committee shall monitor and evaluate the research periodically, and make a report of its findings to the Commission for necessary action.

National Commission for Science, Technology and Innovation(NACOSTI),
Off Waiyaki Way, Upper Kabete,
P. O. Box 30623 - 00100 Nairobi, KENYA
Telephone: 020 4007000, 0713788787, 0735404245
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Website: www.nacosti.go.ke

THE OFFICE OF THE PRESIDENT
MINISTRY OF INTERIOR AND NATIONAL ADMINISTRATION
State Department for Internal Security and National Administration

COUNTY COMMISSIONER'S OFFICE
P.O. BOX 90424-80100
MOMBASA

Tel. 0715 040444/0780 040445
Email: ccmombasa@yahoo.com
When Replying please quote:

Ref. No. **MCC/ADM.25 VOL.IV/93** **15th March, 2023**

All Deputy County Commissioners,
MOMBASA COUNTY

RE: RESEARCH AUTHORIZATION – MR. ALEX SYDNEY MANINGA NACOSTI LICENSE NO. NACOSTI/P/23/23555.

This is to authorize the above named student from University of Nairobi to carry out research on ***"The use of built form to address food poverty in public primary"***, in Mombasa County, Kenya for the period ending 9th March, 2024.

Any assistance accorded to him will be highly appreciated.

Thank you.

COUNTY COMMISSIONER
MOMBASA

IRENE M. MUNYOKI
FOR: COUNTY COMMISSIONER
MOMBASA COUNTY

Cc

County Director of Education
MOMBASA

Appendix 2: [General Questionnaire]

Questionnaire

Please fill in the blanks spaces. Where options are provided, tick in the box alongside the appropriate choice

SPACE		DESCRIPTION	YES/NO	SIZE	NUMBER	REMARK
Use		**CLASSROOM**				
	a	Are classrooms used to store food?				
	b	If YES, how many classrooms are used to store food?				
	c	If YES, why are the classrooms used to store food?				
	d	Are classrooms used as dining spaces?				
	e	If YES, how many classrooms are used as dining spaces?				
	f	If YES, why are the classrooms used as dining spaces?				
	g	Are classrooms used as offices to facilitate procurement and processing of feeding programme documents?				
	h	If YES, how many classrooms are used as offices to facilitate procurement and processing of feeding programme documents?				
	i	If YES, why are the classrooms as offices to facilitate procurement and processing of feeding programme documents?				

	j	Are there other uses of classroom that pertain to school feeding other than those previously asked? If YES what are these uses?				
Sustainable Features						
	a	Are classrooms fitted with water harvesting fixtures?				
	b	If YES, what are the existing fixtures?				
	c	Are they fitted with gutters?				
	d	Are they fitted with downpipes?				
	e	Do they have overhead water storage tanks?				
	f	Do they have underground water storage tanks?				
	g	Is the surface water runoff around classrooms collected?				
	h	Are they fitted with photovoltaic cells/solar panels?				
Use		**KITCHEN**				
	a	Is the kitchen size sufficient?				
	b	Is the kitchen well ventilated?				
	c	Is the kitchen away from any waste dumping area?				
	d	Is the kitchen located at a safe distance from tuition blocks?				
	e	Does the kitchen have hygienic waste handling equipment?				

	f	Does the kitchen have adequate supply of clean water for cooking and washing utensils?				
	g	Does the kitchen have surfaces that are easy to clean and maintain?				
	h	Does the kitchen have utensil storage areas that are free from contamination?				
	i	Is the kitchen close to the food store?				
	j	Does the kitchen have enough and appropriate utensils and a serving area?				
	k	Is the kitchen fitted with a firefighting equipment and a functional First Aid Kit?				
	l	How easy is it to keep the kitchen clean?				
	m	What type of fuel is used to cook food in the kitchen?				
	n	Is the fuel stored in the kitchen?				
	o	If YES, Is the fuel storage sufficient?				
Sustainable Features						
	a	Where does the kitchen get its water supply from?				
	b	Is the kitchen fitted with water harvesting fixtures?				
	c	If YES, what are the existing fixtures?				
	d	Is the kitchen fitted with gutters?				

	e	Is the kitchen fitted with downpipes?				
	f	Does it have overhead water storage tanks?				
	g	Does it have underground water storage tanks?				
	h	Is the surface water runoff around Kitchen collected?				
	i	Is the kitchen fitted with photovoltaic cells/solar panels?				
	j	Does the kitchen use sustainable energy for lighting? If YES, explain				
	k	Does the kitchen use sustainable energy for cooking? If YES, explain				
Use		**FOOD STORE**				
	a	Is the food store well ventilated?				
	b	Is the food store safe and secure?				
	c	Does the food store have spread area for the perishable foodstuffs?				
	d	Is there a cold store?				
	e	Is the food store size sufficient?				
Sustainable Features						
	a	Is the Food store fitted with water harvesting fixtures?				
	b	If YES, what are the existing fixtures?				
	c	Is the Food store fitted with gutters?				

	d	Is the Food store fitted with downpipes?				
	e	Does it have overhead water storage tanks?				
	f	Does it have underground water storage tanks?				
	g	Is the surface water runoff around Food store collected?				
	h	Is the Food store fitted with photovoltaic cells/solar panels?				
Use		**DINING AREA**				
	a	Is the dining area well ventilated?				
	b	Is the dining area size sufficient?				
	c	Is there a designated serving area?				
	d	Does the dining area have adequate child size furniture (chairs and tables)?				
	e	Does the dining area have a well-documented menu and food service plan?				
	f	Does the dining area link efficiently with the kitchen?				
	g	Does the dining area provide a safe space for eating?				
	h	Other than the main dining area, what other spaces are used for eating?				
Sustainable Features						
	a	Is the dining area fitted with water harvesting fixtures?				
	b	If YES, what are the existing fixtures?				

	c	Is the dining area fitted with gutters?				
	d	Is the dining area fitted with downpipes?				
	e	Does it have overhead water storage tanks?				
	f	Does it have underground water storage tanks?				
	g	Is the surface water runoff around dining area collected?				
	h	Is the dining area fitted with photovoltaic cells/solar panels?				
Use		**OFFICE**				
	a	Is the office used to process documents used in feeding programmes?				
	b	Is the office used to store food?				
	c	In what ways is the office used to support the feeding programmes?				
Sustainable Features						
	a	Is the office fitted with water harvesting fixtures?				
	b	If YES, what are the existing fixtures?				
	c	Is the office fitted with gutters?				
	d	Is the office fitted with downpipes?				
	e	Does it have overhead water storage tanks?				
	f	Does it have underground water storage tanks?				
	g	Is the surface water runoff around office collected?				

	h	Is the office fitted with photovoltaic cells/solar panels?				
Use		**HEALTH ROOM**				
	a	Does the school have a health room?				
	b	Does the school provide nutritional supplement? If YES, where does this take place?				
	c	Are children checked for malnutrition? If YES, where does this take place?				
Sustainable Features						
	a	Is the health room fitted with water harvesting fixtures?				
	b	If YES, what are the existing fixtures?				
	c	Is the health room fitted with gutters?				
	d	Is the health room fitted with downpipes?				
	e	Does it have overhead water storage tanks?				
	f	Does it have underground water storage tanks?				
	g	Is the surface water runoff around office collected?				
	h	Is the health room fitted with photovoltaic cells/solar panels?				
Use		**KITCHEN GARDENS**				

	a	Does the school have kitchen gardens? If NO, why?				
	b	What is planted in the gardens?				
	c	Does the school utilise what it plants as part of the school meals?				
	d	Where does the school obtain water used in the kitchen gardens?				
	e	Who manages the kitchen gardens?				
	f	Where does the school process harvested food before delivery to the kitchen / food stores?				
Use		**OTHER FARMING TECHNIQUES**				
	a	Does the school practise fish farming?				
	b	If YES, does the school feeding programme benefit from this?				
	c	Does the school keep livestock? If YES, what livestock does it keep?				
	d	How secure are the structures housing the livestock?				
	e	How far are the structures housing livestock from the tuition block?				
	f	What techniques have been adopted in supplying water to the farms?				

INTERVIEW QUESTIONS

- How are students fed in the school?
- What techniques have been adopted by the school towards its infrastructure to reduce the cost of feeding programmes?
- How is the school integrated with local farming?
- Does the school have a food processing and packaging plant?
- What is the proximity of the school to food vendors and food supply?
- Does the school monitor the quality of food supplied outside the school?
- Other than power supply from KPLC, does the school have alternative supply of energy?
- Is the School fenced?