

FACTORS AFFECTING EFFECTIVE USE OF INTERLOCKING  
STABILIZED SOIL BLOCKS (ISSBs) FOR REDUCED COST OF  
SHELTER IMPROVEMENT. A CASE OF TRAINED COMMUNITY  
BASED ORGANIZATIONS AND INDIVIDUALS IN MOMBASA  
COUNTY.

By

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## **DECLARATION**

I declare that, this work is my original work and has not been submitted to any university or institution of higher learning.

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This research project has been submitted for examination with my approval as university supervisor

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## **DEDICATION**

This research project is dedicated to my dear wife Margaret and my two lovely children, Cynthia and Alvin.

## **ACKNOWLEDGEMENT**

I would like to give lots of thanks to the Almighty Lord for showering me with lots of blessings and wisdom throughout this project.

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## **ABBREVIATIONS AND ACRONYMS**

<b>ABT &amp; M</b>	Appropriate Building Technologies & Materials
<b>CBOs</b>	Community Based Organizations
<b>HABRI</b>	Housing and Building Research Institute
<b>ISSBs</b>	Stabilized Interlocking Soil Blocks
<b>UNHCS</b>	United Nations Centre for Human Settlement



## **ABSTRACT**

Meeting the need for adequate housing of the world's population requires sustained investment and continued innovation, particularly in Appropriate Building Materials and Technologies (ABMT) that lower the cost of construction and the cost to the environment. Interlocking Stabilized Soil Block (ISSB) technology is one such technology that is gaining growing recognition in East Africa. Compared with alternatives such as fired brick, it offers lower construction costs at comparable quality, is suitable for a wide range of environments, and dramatically reduces the impact on the environment. (UN-HABITAT 2009)

Appropriate Building Materials and Technologies (ABMT) refers to building processes, materials and tools that are cost-effective, safe, innovative, green/environmentally friendly as well as acceptable to the climate, socio-economic conditions, and natural resources of an area. It uses soil as its major ingredient. This study sought to establish the factors affecting effective use of Interlocking Stabilized Soil Block for reduced cost of shelter improvement in Mombasa County. Four specific objectives guided the survey and these are: To establish how training on ISSBs affects improvement of Shelter, how access to ISSBs Equipments and Cost of transport and construction materials affects improvement of Shelter, and to establish how perception of the quality of the building blocks affects improvement of Shelter.

The literature review has outlined the history of soil technology and recognizes the fact that, earth is the oldest material used by man for the construction purposes. It indicates the efforts man has made in an effort to improve earth as a construction material such as the use of appropriate technologies like Interlocking Stabilized Soil Blocks (ISSBs)

The research was purposively to be carried out in Mombasa County in Kenya. A descriptive case study research design was used to collect primary data in addition to secondary data. Stratified simple random sampling was used to ensure representation. The data collected was analyzed in a descriptive form as well as numerically where possible. A pretested questionnaire was administered to the target population to ensure that the questions were understood equally by all the respondents. The participants were selected through stratification in terms of the groups that have been trained and thereafter simple random sampling was conducted on each group so

as to give each and every individual an equal chance of being represented in the sample. A total of 98 participants were interviewed.

The collected data was analyzed both qualitatively and quantitatively. The responses were coded and keyed in as appropriate while descriptive data is represented in tabular and graphical forms.

# CHAPTER ONE

## INTRODUCTION

### 1.1 Background to the study

Since the early times, man has made relentless efforts to obtain food and shelter. The struggle for these basic needs has increased progressively as the human race advances in numbers and cultural diversity. The Universal Declaration of Human Rights of 1948 recognizes the right to adequate housing as an important component of the right to adequate standard of living. This has been further reaffirmed by subsequent various international instruments including the International Covenant on Economic, Social and Cultural Rights of 1966, the Istanbul Declaration and Habitat Agenda of 1996; and the Declaration on Cities and Other Human Settlements in the New Millennium of 2001. In all these instruments, housing is understood in the broader context of the shelter fabric together with the living environment (National Housing Policy for Kenya, 2004)

Improvement of housing for the Kenyan population is a major concern not only to the Government but to all stakeholders. This concern has been influenced by the fact that the improvement in housing situation is a strategically important social and economic investment. In addition, well-planned housing and infrastructure of acceptable standards and affordable cost when combined with essential services affords dignity, security and privacy to the individual, the family and the community as a whole. Adequate shelter also prevents social unrest occasioned by depravity and frustrations of people living in slums and informal settlements.

Besides this social function, housing is also an investment good contributing both directly and indirectly towards poverty reduction through employment generation, raising of incomes, improved health and increased productivity of the labor force.

Housing is one of the principals sectors that would revitalize the economic growth in Kenya with the shelter being recognized as one of the tools of development. Investment in housing and the related infrastructure and services have effects on the national income that go far beyond the direct investment itself by triggering forward and backward linkages through additional investments in the building materials production, transportation, marketing and Jua kali (fabrication of construction materials). Investment in the sector has a multiplier effect of 7 to 9 times on Kenya's economic development.' (Ministry of Housing 2006)

It is therefore important that each and every individual or family lives in decent affordable housing, whether publicly or privately owned, to meet the necessary requirements of security, health and privacy.

The building materials and construction industry constitutes one of the most important sectors in Kenya's economy. Some of the materials, which are produced in some large-scale industries, end up being costly due to high costs of production arising from high electricity cost. It is also costly to transport the materials to the construction site.

Other factors that contributes to the deficit of housing in Kenya includes low level of investment in the sector by both public agencies and the formal private sector with housing units produced by both sectors representing only an estimated 20 per cent of the total number of new urban households.( Ministry of Lands and Housing 2004) Likewise, rapid urbanization, inaccessibility to land and housing finance, stringent planning regulations, restrictive building standards, high cost of infrastructure, poor economic performance and increased poverty contributes to the national housing shortage.

This study critically examined the effectiveness of Interlocking Stabilized Soil blocks in improving shelter situation in Mombasa County.

## **1.2 Statement of the problem**

The right to adequate housing is a universal right, recognized at the international level and in more than one hundred national constitutions throughout the world. It is a right recognized as valid for every individual person. The Universal Declaration of Human Rights of 1948 recognizes the right to adequate housing as an important component of the right to adequate standard of living (Ouda 2009). This has been further reaffirmed by subsequent various international instruments including the International Covenant on Economic, Social and Cultural Rights of 1966, the Istanbul Declaration and Habitat Agenda of 1996; and the Declaration on Cities and Other Human Settlements in the New Millennium of 2001. As stated before, in all these instruments, housing is understood in the broader context of the shelter fabric together with the living environment (National Housing Policy for Kenya, 2004).

According to the Population and Housing Census of 2009, the number of households in Kenya stood at 8,738,097 households and only 34 % of these households had used stones and bricks as their walling material. This means that, 64 % of houses will require improvement.

Whereas most houses in Kenya are constructed using good quality roofing materials only about 31% of houses uses standard walling materials(stones and brick block) as demonstrated by the following table:-

Table 1.1: Distribution by walling material in rural and urban areas

	Stone	Brick/ Block	Mud/ Wood	Wood only	Corrugated iron sheet	Grass	Tin	Others
Kenya	14.3	16.7	45.4	10.2	3.5	2.9	0.3	1.6
Rural	6.5	14.5	54.0	12.1	2.3	3.7	0.2	2.0
Urban	37.9	23.3	19.4	4.7	7.0	0.4	0.4	0.2

*Source: Kenya Integrated Household Budget Survey (2006)*

In Mombasa County according to the Population and Housing Census of 2009 only 31.83% of the households have used stones to build their houses. However, 78.38 % of the houses have corrugated iron sheets for roofing clearly indicating that, much improvement is required in walling materials for houses in Mombasa County. ISSBs can play an important role in the improvement of walling of houses in Mombasa County and its improved rate of adaption will greatly contribute the improvement of houses in Mombasa County.

In 2006 , the Ministry of Housing introduces Appropriate Building Technologies Programme and more so ISSBs. Several equipments has been procured and ABT Centres constructed.. Training workshops have been conducted throughout the country to transfer skills and empower community groups to construct affordable houses, social facilities and other utilities. Six ISSBs training workshops has been conducted in Mombasa County, five of which involves organized community based organizations like women groups and youth groups and one involves individuals coming together for training. A total of 195 people have been trained on the technology.

Despite the introduction of ISSBS technology, its uptake is very slow and this study seeks to establish the factors that affect the effective implementation of ISSBs programme for reduced cost of shelter improvement in Mombasa County and will target these groups that are trained on ISSBs technology.

### **1.3 Objectives of the study**

The broad objective of this study was to examine the factors affecting the use of interlocking stabilized soil blocks in improving shelter in Mombasa County.

The specific objectives of the study were:-

- 1) To assess the extent to which access to training by the CBOs and individuals influences the implementation of ISSBs.
- 2) To determine the extent to which access to equipments by the CBOs and individuals influences the implementation of ISSBs
- 3) To assess how the cost of transport and construction materials influences the implementation of ISSBs.
- 4) To ascertain whether perceptions on the quality of ISSBs by the CBOs and individuals affects its effective implementation.

### **1.4 Study Hypothesis.**

The Null hypothesis of the study was that, access to training, access to equipments, the cost of transport and construction materials and the perceptions on the quality of ISSBs does not affect the effective implementation of ISSBs in Mombasa County. The alternative hypothesis is that access to training ,access to equipments , the cost of transport and construction materials and the perceptions on the quality of ISSBs affect the effective implementation of ISSBs in Mombasa County.

### **1.5 Research Questions.**

The study was guided by the following questions:-

1. How does access to ISSBs training by the CBOs and individuals influence its effective implementation?
2. How does access to ISSBs equipments by the CBOs and individuals influences the implementation of ISSBs?
3. How does the cost of transport and construction materials influences the implementation of ISSBs?
4. How does the perception on the quality of ISSBs by the CBOs and individuals affects its effective implementation.

### **1.6 Significance of the study.**

For the different stakeholders in the housing sector, the study on the factors that affect the effective implementation of interlocking stabilized soil for improved shelter situation are very important because it will be a means of disseminating this technology thus making the stakeholders aware of the availability of this technology.

For the Government of Kenya, the study will help in identifying the factors that influence the effective implementation of ISSBs. It will help the Government in reviewing the effectiveness of the ISSBs programme and give guidance in decision making as well as policy formulation. It can also be used as a basis for packaging the ISSBs to benefit entrepreneurs interested in setting up small, medium and large scale plants for making building materials and equipments.

The study likewise provides concrete information about the effectiveness of ISSBs and especially to potential users of the ISSBs in order for them to make informed decisions about ISSBs technology.

The study contributes to the body of knowledge in the subject of ISSBs in improving shelter situation and other students/scholars can use it as a reference.

### **1.7 Scope of the study.**

The study took place in Mombasa County where training on ISSBs using Hydraform machine has been operating since 2008. It covered five community based organizations and one sets of individuals who have been trained on ISSBs. This research would have covered all the contractors in Mombasa County but the researcher narrowed on these ISSBs trained groups and individuals partly because of the time it would take to conduct a research on all the contractors and partly because these are trained individuals and organizations who knows the merit and demerits of constructing using both the conventional and ISSBs materials and therefore they gave a comparative opinion of both materials.

### **1.8 Definition of significant terms.**

#### **Interlocking Stabilized Soil Blocks (ISSBs).**

Interlocking Stabilized Soil Blocks refers to construction blocks made of a mixture of soil and a stabilizing agent that is compressed by different types of manual or mechanized press machines. For the purposes of this study, the machine of use was the Hydraform machine of South Africa.



A hydraform Interlocking Stabilized Soil block.

Source; Hydraform South Africa(25-06-2013)

#### **Stabilizing Agent.**



This refers to the supplements or forces to the soil in order to make the soil more water proof and stronger. The quality of the block depends on the properties and mix of soil types, the amount of force applied for compaction, and the addition of chemical or natural products to further stabilize and strengthen the blocks. For the purposes of this study, cement was our stabilizing agent.

## CHAPTER TWO

### LITERATURE REVIEW

#### 2.1 Introduction.

This chapter briefly outlines the motivation for this work and explains why research in ISSB is of great importance to Kenya, Mombasa County and human beings. It focuses on the characteristics, advantages and the disadvantages of the ISSBs. It also focuses on the need to understand the factors affecting effective implementation of ISSBs so as to strengthen and harness this programme which is important for sustainable and cost effective construction and improvement of houses.

In undertaking the literature review, the researcher relied greatly on written books, brochures, journals and various articles on the internet.

#### 2.2 Background to ISSBs

Earth or soil is the oldest material used by man for construction purposes. People have used their native ingenuity to develop forms utilizing soil ranging from the extremely simple to highly complex. They have used the material in response to varying resources, social needs and site conditions (Al- Sakkaf, 2009)

Soil has always been the most widely used material for building in Kenya and is a part of its culture. Traditionally, mud construction varies enormously with topography, traditions and needs of different regions. The most commonly used earth construction however is mud and wattle and in some places burnt bricks (HABRI, 2003)

Generally, soil is mostly considered as a poor man's material and its has some disadvantages such as:-

1. Low durability.
2. Water penetration.
3. Erosion of walls at level by splashing of water from ground surfaces
4. Attack by termites and pests
5. High maintenance requirement

According to the Housing and Building Research Institute (HABRI) of the University of Nairobi, (2003) the compressed earth block overcomes these limitations by increasing block density through compaction using a mechanic press. The water content in the soil is low for compaction as compared to the puddle clay required for mud bricks and ensures much greater dimensional stability. Ouda K, (2009) concurs and adds more advantages of soil blocks such as

1. Soil is easily available in virtually every community.
2. Easy to use and construct with.
3. Green and sustainable.
4. Highly affordable and especially in poor countries and cheap to transport.
5. Proven durability.
6. There is little waste generated. And the material is easy to re-use.
7. Energy efficient and fire resistant.
8. Non-stabilized wall could be used instantly, no transport or curing time required.
9. Fire and mold resistant

According to HABRI 2003, ISSB block has the following characteristics;-

1. Has high density which gives it more load bearing capacity and improved water resistance.
2. Is low cost.
3. Is easy to manufacture and can be done by a small group of people.
4. It has low energy consumption because it doesn't require burning.
5. It's also environmentally friendly unlike burnt bricks.
6. One can use soil available at the site and
7. It has smooth surfaces.

Ouda 2003 adds that, stabilized soil blocks have higher density than concrete blocks, they must be protected from moisture, they are uniform and they have no curing time.

Likewise, Sing L.D and Sing S.S 2011, notes that, stabilized soil blocks have the advantages of low energy and emission, have good thermal insulation, versatile and they are cost effective.

As stated before, Interlocking Stabilized Soil Blocks (ISSBs) technology is one technology that is gaining growing recognition, notably in East Africa. Compared with alternatives such as fired brick, it offers lower construction costs at comparable quality, is suitable for a wide range of

environments, and dramatically reduces the impact on the environment- (United Nations Centre for Human Settlement (UNHCR) -2009

It is worth to note that most of the buildings constructed using conventional building materials are unaffordable by a majority of our population. This has led to the development of alternative relatively cheap, decent and durable on site produced materials. These materials include interlocking Stabilized Soil Blocks (ISSBs), (Ministry of Housing 2011)

According to the Building Materials & Technology Promotion Council (BMTPC) of India, building materials account for approximately 60% of the total building costs. ISSBs can reduce the costs by up to 50% of the materials cost thereby reducing the overall building cost.

The cost effectiveness of stabilized soil blocks has been proved by comparing the bill of quantities of construction involving soil blocks with that of fired brick. Compared to fired bricks, ISSBS are 30% cheaper and even 60% cheaper than concrete blocks and they are faster to build with - (UN-HABITAT 2009)

To be effective, ISSBs have to be complemented with efficiency in layout design, unit designs, appropriate construction specifications, optimization in infrastructure design and minimum project administrative overheads. ISSB addresses poverty through enhanced living/housing conditions and promotion of related income generating activities.

The Ministry of Housing in Kenya established the Appropriate Building Materials and Technology (ABM & T) Programme in 2006 to address the high building costs by facilitating the provision of improved and affordable housing in both urban and rural areas. This was done by facilitating provision of equipments and training on ISSBs to citizens and especially organized Community Based Organizations and individuals through out the country.

To facilitate effective training and implementation of this technology, The then Ministry of Roads, Public Works and Housing in conjunction with Housing and Building Research Institute ( HABRI) of the University of Nairobi organized a training workshop for the staff of the ministry in March 1997.

Apart from ISSBs there are more Appropriate Building technologies and materials available in Kenya such as:

**Table.2.1 Materials and Technologies currently under use in Kenya**

<b>Available from</b>	<b>Technology</b>	<b>Material/Solution</b>
South Africa (SA)	Hydraform machine	Interlocking stabilized soil blocks for walling
Kenya	Manual block press	Interlocking stabilized soil blocks for walling
Kenya	Rammed earth	Walling
Ecuador	Tevi roofing tile vibrator	Micro-concrete roofing tiles
Kenya	Battery roofing tile vibrator	Micro-concrete roofing tiles
Kenya	Machine-cut quarrying	Smooth stones for walling
Kenya	Zinc/aluminum /silicon (ZAS)	Rust-resistant sheets
Kenya	Aluminum	Rust-free sheets
Kenya/SA	Light gauge steel	Walling frames & roofing trusses
Kenya/India	Structural Insulated Panels (SIP)	Cement fibre/polyurethane walling panels
Kenya	Prefabricated concrete panels	Walling
Kenya	Recycled plastics	Posts
Kenya	Powermax cement	Soil stabilization

Source: [www.housing.go.ke-14/9/2012](http://www.housing.go.ke-14/9/2012)

Therefore, ISSBs can be combined with other ABTs to reduce the cost of construction. Likewise, ISSBs have greater advantage than using raw soil just as they are environmentally friendly, as they are not burnt like in the case of burnt bricks.

### **2.3 Trainings on ISSBs.**

Training on ISSBs forms an integral part of ensuring improved houses and imparting important skills, which the trained can use in income generating activities. It is aimed at disseminating the ISSBs technology to the public and to those who need better housing at reasonable costs. It also aims at increasing the production and utilization of these technologies and materials with a view to improve houses and provide a means of earning a living. (Ministry of Housing 2011)

This training programme is greatly boosted by the Government of Kenya through the Ministry of Housing which provides equipment, fuel and facilitates its officers to conduct ISSBs training, demonstration and technical assistance to community groups for free. On the other hand, the beneficiaries are expected to meet the cost of training materials such as soil, cement and water as well as provide labour.

It is therefore important to train as many people as possible in order to provide the critical mass that would in turn help in the dissemination of this technology with a view to increase its adoption and uptake.

### **2.4 Access to ISSBs Equipments.**

Access to ISSBs equipments is critical to the improvement of houses in the Mombasa County as well as creating a means of earning a livelihood. Access to Hydraform machine is limited to the ones provided by the Ministry of Housing. These machines have the capacity to produce up to One Thousand, Five Hundred (1500) blocks per day and they can be used for mass production of ISSBs (Hydraform 2005).

However, they are costly to purchase and maintain and they are far out of reach of the poor. The Ministry of Housing has come in handy as they are purchasing them. In Mombasa County, the Ministry has five Hydraform machines but they may not be enough to satisfy the growing demand. The Ministry is letting people use them for a period for free which is a step forward though this may not be tenable in the long run if the Ministry plans to buy more and ensure this programme is sustainable. The Ministry may need to come up with a business plan for each of the finished ABT & M Centres and funds realized used to purchase more of these machines as well as the maintenance of the existing ones. These machines are bought from South Africa.

On the other hand, Action Pack block Press is locally made by local companies such as Makiga Engineering. On purchase, a free training in operation and maintenance of the block press is provided as well as how to test the soil and produce Stabilized Soil Blocks.

Action Pack block press costs about Kshs 85,000 and can be accessed by organized groups such women groups and youth groups.( Makiga Engineering 2011 )

Access or lack of access to the ISSBs equipment therefore would be the greatest factor in ensuring greater uptake off this technology. As stated above, the Ministry of Housing equipments are too few while the cost of these equipments is prohibitive to most people in Mombasa County. There is need to increase the number of these equipments to meet the demand.

## **2.5 Cost of transport and construction materials.**

The housing construction industry in Mombasa County requires affordable building materials and the use of ISSBs techniques will generate more housing. The Mombasa County government may requires an industrial policy that would promote production and availability of conventional and locally available building materials like cement, steel, stones, ISSBs and Micro Concrete Roofing Tiles.

Most of the materials produced at the large scale industries are usually expensive due to high electricity cost. Moreover, makers of cement, corrugated sheets, paints and steel products have seen prices of raw materials rise because of a surge in commodity prices due to the global economic crisis. The global recession that started in mid 2008 ended a five-year global commodity price boom of metals, fuels and food which kept the cost of building materials stable and low.

Any upheaval in the Arab World likewise affects negatively the cost of construction materials due to rise in fuels which in turn have a spiral effect on electricity and other commodities. The rising prices slow down the construction of houses.

It's important that the Kenyan Government acts accordingly in order to bring down the cost of construction materials with the aim of increasing the production of housing units. Some of the measures the Government can undertake includes:-

1. Reviewing from time to time the taxation levels on building materials so as to reduce the cost construction for housing arising from the building materials.

2. All research actors should harness and document existing locally available building materials and technologies as well as disseminating this information to the users as appropriate.
3. Promote and encourage small-scale enterprises to engage in production and application of the researched materials
4. Promote trainings in requisite skills and construction technologies through youth polytechnics, women groups, youth groups, community based organizations and appropriate building technologies and materials Centres.

On the other hand, transport cost constitutes a major construction cost of materials in Mombasa County. This can be attributed to the long distance of procuring the conventional building materials as well as the bulkiness of the construction materials. Most of the conventional walling materials such as coral blocks are sourced from Kilifi County.

ISSBs are usually produced at the point of use greatly reducing the transport cost of the building materials. It also avoids breakages while transporting the materials thus reducing wastages. (HABRI 2003)

## **2.6 Perception on the quality of ISSBs.**

ISSBs has some basic merits and attractions associated with it such as;-

1. The basic raw material is soil, its source will remain abundant. This facilitates direct site-to-service application, thereby, lowering costs normally associated with acquisition, transportation and production. Home ownership can then be delivered at comparatively low costs.
2. Secondly, the initial performance characteristics of the material such as the wet compressive strength (WCS) dimensional stability, total water absorption (TWA), block dry density (BDD) and durability are technically acceptable.
3. Houses constructed of ISSBs also offer better internal climatic conditions than other modern materials.
4. Thirdly, promoting the use of ISSBs generates more direct and indirect employment opportunities within the local populace than would be in the case with other materials.



Despite these advantages, there is the danger of the wrong perception that ISSBs are not permanent building materials. ISSBs may be strongly associated with the traditional non-stabilized soil construction in the minds of many such as the mud and wattle construction.

The table below illustrates the Properties of compressed stabilized earth blocks versus other walling materials (Adam, 2001)

**Table 2.2. Properties of compressed stabilized earth blocks versus other walling materials).**

<b>Property</b>	<b>Compressed stabilized earth blocks</b>	<b>Fired clay bricks</b>	<b>Calcium silicate bricks</b>	<b>Dense concrete blocks</b>	<b>Aerated concrete blocks</b>	<b>Lightweight concrete blocks</b>
Wet compressive strength (MN/m <sup>2</sup> )	1-40	5-60	10-55	7-50	2-6	2-20
Moisture Movement (%)	0.02 - 0.2	0.00 - 0.02	0.0 - 0.035	0.02- 0.05	0.05- 0.10	0.04 - 0.08
Density(kg/m <sup>3</sup> )	1700 - 2200	1400-2400	1600-2100	1700-2200	400 - 950	600 - 1600
Thermal Conductivity W/m°C	0.81 - 1.04	0.70 - 1.30	1.10- 1.60	1.00- 1.70	0.10- 0.20	0.15 - 0.70
Durability Against rain	Good to Very poor	Excellent to Very poor	Good to Moderate	Good to Poor	Good to Moderate	Good to Poor

**Source: (Adam, 2001)**

## **2.7 Problems in the use of ISSBs.**

In contrast to the various positive impacts associated with ISSBs, other studies have found some challenges associated with the use of ISSBs. Availability of suitable soil for block making is one such challenge. The quality of blocks depends much on the quality of the materials put into the moulds more than the machines. Moreover, more supervision of newly trained individuals in making the block and laying them is necessary to ensure good workmanship.

Full impact of the use of this technology in Mombasa County however has not been documented and enough study has not been done to document the full impact of the use of the technology.

However methods derived from the traditional techniques are being developed to improve the quality of earth construction and broaden the potentials for its application. Earth construction is very cost effective, energy efficient (excellent thermal properties and low energy input required for production), environmentally friendly, and safe, qualities which are particularly relevant and important with the ever growing need for increased awareness to reduce energy consumption worldwide (Adams & Agib 2010)

## 2.8 Empirical Literature

Studies suggest that, more and more people are using earth for construction. Generally, people are re-discovering the benefits of having earth walls in developing houses as better properties can be obtained by using additives to the earth material. In addition, earth construction is possible with a wide variety of building methods. Housing design should not be based solely on imported forms, but rather on traditional forms of architecture as well for example, in 1998, 88% of the Yemeni families lived in the rural areas in their own made houses (Al-Sakkaf Y.K.A-2009)

Similar studies on ISSBs have been studied though as mentioned earlier, none has been conducted in Mombasa County. In Uganda, a study by UN HABITAT (2009) looked at the major challenges in the use of ISSBs such as mobilizing communities to participate in the projects, sensitizing the community on appropriate technologies and ensuring quality control of blocks that are produced. The study documented various lessons learnt in implementation of this technology as:-

1. Intense supervision is needed at the start of the project to ensure block quality.
2. Use of better quality murram taken from more remote locations instead of using local soil increases final cost.
3. Incorporating indigenous construction knowledge leads to innovations and sustainability.

In order to promote this technology in Uganda, it was found that, it is important to work with private sector (local contractors and masons), develop a system of lending the ISSB machines and providing training to interested local community and private developers based on an agreement guaranteeing the use of the machine as well as the construction of ISSB demonstration buildings as resource Centres.

Ouda (2009) gives an overview of compressed earth blocks giving their advantages and disadvantages but he doesn't look at how its implementations are done.

Similarly, Al-Sakkaf Y.K.A in his study 'Durability properties of stabilized earth blocks' does not look at the implementation of the stabilized soil blocks but looks at advantages and disadvantages of using the stabilized soil blocks giving examples where they have been used, their strength testing and quality control and how to improve on their durability.

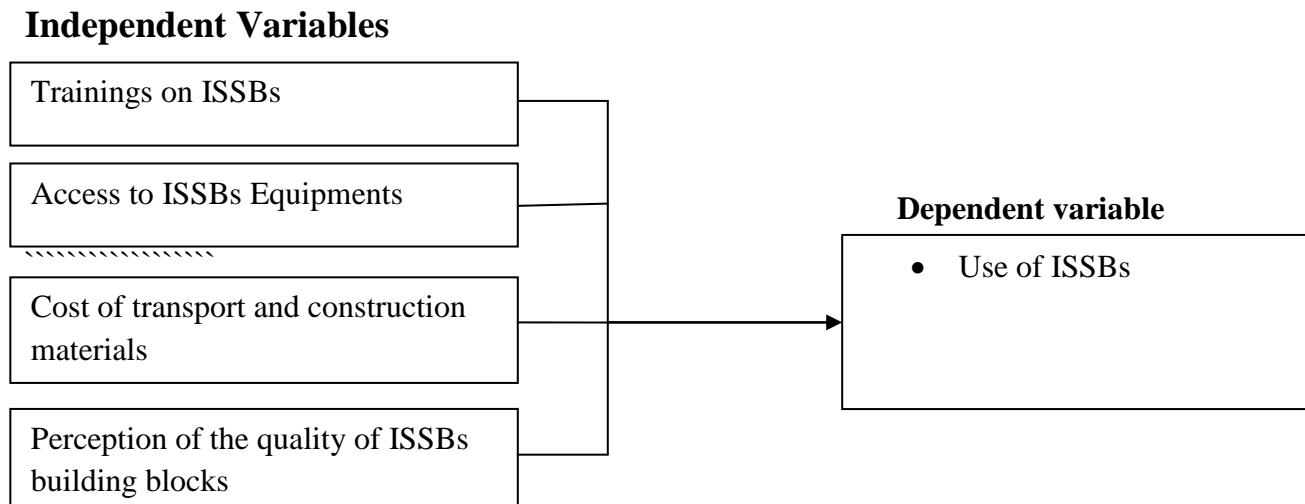
This study concentrated on looking at the factors that influence the effective iuse of ISSBs and not their properties.

From the literature review, it is apparent that, this technology is relatively new and especially in Mombasa county and therefore, a lot of training is required as well as provision of ISSBs equipments. Since the production takes place on site, transport cost is greatly reduced and there is need to deal with the perceptions of the people towards this technology.

### 2.9 Conceptual Framework.

The conceptual framework outlines the independent variables and the dependent variables. The independent variables are: - trainings on ISSBs, access to ISSBs equipments, cost of transport and construction materials and the perception of the quality of the building blocks while the dependent variable is the ISSBs.

**Figure 2.1. Conceptual framework.**



### 2.10 Independent Variables

The most critical independent variables are training on the use of ISSBs, access to ISSBs equipments, cost of transport and construction materials and the perception of the quality of ISSBs building blocks

Training goes hand in hand with dissemination of the technologies thus raising awareness on the availability of these technologies.

### **2.11 Dependent Variables.**

Based on the research objective, the dependent variable ISSB for improved housing situation was tested against the independent variables i.e. trainings on ISSBs, access to ISSBs equipments, cost of construction materials. Perception of the quality of ISSBs and the transport cost.

Training on ISSBs ensures knowledge of this technology as well as helps in the dissemination of this technology. Likewise, access to the equipments will affect the implementation of ISSBs as will the cost of construction materials and especially the stabilizing agent, the perception of the quality of the building blocks and transport cost which could be positive as the materials are produced on site thus no transport cost on the finished ISSBs.

### **2.12 Summary of Literature.**

The literature review has covered the background to ISSBs, trainings on ISSBs, access to ISSBs equipments, cost of construction materials, the perception on the quality of the building blocks (ISSBs) and the transport cost. There are constraints and success stories to the effective implementation of ISSBs that informed the question of this paper on factors affecting effective use of interlocking stabilized soil blocks (ISSBs) for reduced cost of shelter improvement.

## CHAPTER THREE

### RESEARCH METHODOLOGY

#### **3.1 Introduction.**

The chapter focuses on applied research technique and methods that was used to validate the study objectives. It includes research design, the target sample, sampling procedures and methods of data collection. It also looks at the validity and reliability of the data collected the collection tools, how data was to be presented and the data analysis techniques.

#### **3.2 Background to the study area.**

Mombasa County lies on the shores of the Indian Ocean along Kenya's coastline. It is located on the South Eastern part of the Kenya Coast. It borders the Indian Ocean to the East and South East, Kilifi County to the North and Kwale County to the West and South West.

The county lies between latitudes 3° 80' and 4° 10' S and longitudes 39° 60' and 39° 80' E, with a total land mass of 229.6 km<sup>2</sup> and inshore waters covering 65 km<sup>2</sup>.

Mombasa is a major trade centre and home to Kenya's only large seaport, the Kilindini Harbour. Mombasa is the centre of coastal tourism in Kenya and has a population of 939, 370. A land use classification study (UNEP/FAO/PAP/CDA, 1999) indicated that only 31.2% of the total land area in Mombasa County was under residential settlements. The direction of growth in human settlements is northwards, concentrated in Kisauni District. This has entailed the crowding of many people in small areas with serious social implications. These unplanned crowded human settlements have the poorest sanitation and generally poor infrastructure facilities, resulting in a myriad of environmental problems (Gatabaki-Kamau et al., 2000). The land area for residential purposes has increased by almost two and half times. Whereas, land area claimed for tourism activities has increased threefold, land for commercial purposes has doubled in the period (UNEP/FAO/PAP/CDA, 1999).

#### **3.3 The nature of the Research.**

The study is a descriptive research survey design that was meant to describe the factors that affect the effective implementation of ISSBs for improved shelter situation in Mombasa County. The researcher gathered information and attempted to explain the problem as it were in the field. The study focused on what the respondents were saying and done in order to improve their

housing situation from the use of ISSBs. Therefore, observation played an important role in documenting any improved houses constructed using ISSBs.

### **3.4 Sampling procedures and Sample size**

#### **3.4.1 Target population.**

The target population was the groups that have been trained on ISSBs in Mombasa County since 2009. The subject of the study was the individuals in these trained groups. This is because by being trained the individuals know the existence of alternative building technologies (ISSBs) and it was imperative to know how they are using the newly acquired knowledge. The total number of people trained on this technology is 195 which constituted the researcher's target population.

#### **3.4.2 Sample size.**

The researcher selected a sample size of 98 people from a total of 195 people who are trained on this technology in Mombasa County. This was arrived at by establishing a sampling frame for each group that is trained and then conducted simple random sampling at each group so as to give each member of each group an equal opportunity to be included in the sample. The sample size was determined by adopting the recommendations of Nkapa (1997) that for a population which runs in to thousands, the sample size should be in the range of 5% to 20%, but for a population that runs in hundreds the sample size should be 50% The size of the target population is 195, 50% of this population will be about 98 people as tabulated below.

**Table 3.1 Description of the Population and the Sample size.**

<b>Name of Group</b>	<b>No of Members</b>	<b>No. of sample</b>	<b>Percentage</b>
Illishe Trust	77	39	20
Modern Technology Young Contractors	28	14	7.2
Individuals organized by Ministry of Water.	10	5	2.6
Ukombozi Group association	40	20	10.3
Tuamkeni Kasokoni Welfare Group.	10	5	2.6
Sofia Youth Group	30	15	7.7
<b>Total</b>	<b>198</b>	<b>98</b>	<b>50.4</b>

**Source: County Housing Office.**

### **3.4.3 Sampling procedures**

To ensure representation stratified random sampling was used to select the sample. This involved stratification of groups that are trained and thereafter an independent simple random sampling was drawn from each group. A total of five groups and one set of individuals have been trained.

### **3.5 Methods of data collection.**

Data collection tools of questionnaires and observation was used. The main tool of data collection was however the questionnaire. The questions were closed ended multiple choice questions as well as short answer questions for ease of analysis and interpretation. The researcher visited the groups and explained to the chairman/secretary of the groups the details of the study and what it entails and involves before administering the questionnaires.

### **3.6 Methods of data analysis and presentation.**

The collected data was analyzed both qualitatively and quantitatively. The responses were coded and keyed in as appropriate while descriptive data is represented in tabular forms.



## CHAPTER FOUR

### PRESENTATION / ANALYSIS OF DATA

#### 4.1. Introduction

This section concerns itself with a description and analysis of basic data obtained from the various groups comprising of Sofia Youth Group, Ilishe Trust, Ukombozi Group Association, Individuals organized by ministry of Water, Tuamkeni Kasokoni Welfare Group and Modern Technology Youth Group.

Data is analyzed according to research questions formulated for this study.

#### 4.2 Responses.

Questionnaires were distributed to the respondents through their officials. There was a response rate of 81.6% as follows.

Sample size.	98
Number of respondents who responded	. 80

**Table 4.1 Responses by groups**

Name of Group	Sample Size	No. of Respondents	Percentage
Ilishe Trust	39	26	66.7
Modern Technology Young Contractors	14	14	100
Individuals organized by Ministry of Water.	5	5	100
Ukombozi Group Association	20	15	75
Tuamkeni Kasokoni Welfare Group	5	5	100
Sofia Youth Group	15	15	100

This response rate is considered adequate according to Mugenda and Mugenda (2003) who considers a response rate of 50% as adequate for analysis and reporting, 60% as good and 70% and above as very good.

### 4.3. DATA ANALYSIS

The basis of the study was described in the initial discussion of chapter three. The intent of this section is to present findings of data analysis.

#### 4.3.1 Research data and analysis of training on ISSBs.

**Table 4.2. Time taken for the training to take place from the time it is requested.**

Category	Frequency	Percentage
1 weeks	18	22.5%
2 weeks	42	52.5%
3 weeks	3	3.75%
1 month	5	6%
5 months	5	6%
1 year	1	1%
No answer	6	8%
<b>Total</b>	<b>80</b>	<b>100%</b>

As illustrated in table 4.2, 52.5 % of the respondents indicated that, it took 2 weeks for the training to take place while 22.5% indicated one week. Those who indicated one to five months were 6% each and those who indicated it took about a year were 3%. The rest of the respondents never attempted the question. This indicates that, most of the trainings take place within two weeks from the time of their request.

This is important in that, more and more people are trained quickly thus increasing the critical mass of people with the knowledge on this technology who would in turn disseminate this technology which may lead to its greater adoption.

**Table 4.3. Relevance of the training content to improving the respondents' housing situation.**

Category	Frequency	Percentage
To a Very large extent	20	25%
To a large extent	50	62.5%
To a sufficient extent	10	12.5%
To a small extent		
To a every small extent		
Total	80	100%

The majority of the respondents indicated that the training was relevant to a very large and large extent (87.5%%). This may be an indication that this technology has the potential to contribute immensely to the improvement of houses in Mombasa County. It may also be a pointer to the fact that, the trainees may embrace the technology and especially if they feel the knowledge acquired in the trainings is relevant as opposed to the feeling that they have wasted their time.▸

**Table 4.4. Opinion on the level of the ISSBs training programme.**

Category	Frequency	Percentage
Too high	8	10
Adequate	72	90
Too low	0	0
Total	80	100%

Majority of the respondents were of the opinion that the training level was adequate (90%) while none of the respondents felt the training level was poor.

**Table 4.5 Respondents consideration of the daily training schedule during training**

<b>Category</b>	<b>Frequency</b>	<b>Category</b>
Too heavy	4	5%
Just right	76	95%
Too light	-0	0
<b>Total</b>	<b>80</b>	<b>100%</b>

Training schedule during the trainings was just right. This is according to 95% of the responses that the schedule was just right.

This may imply that the trainers' mode and methods of facilitation, explanations and time for assignments and practical were right or went according to their plans and may have encouraged trainees' participation and concentration.

**Table 4.6 Respondents opinion on any areas of construction they felt was not covered during the training.**

<b>Category</b>	<b>Frequency</b>	<b>Percentage</b>
No	70	87.5%
Yes	10	12.5 %
<b>Total</b>	<b>80</b>	<b>100%</b>

Majority of respondents felt that the training covered most of the areas of interest. This may mean that, the trainers managed to comprehensively tackle important area pertaining to ISSBs construction which was in their programme.

**Table 4.7. Respondents’ opinion on whether they would get opportunity to apply newly acquired knowledge**

Category	Frequency	Percentage
Yes	80	100%
No	-	0%
<b>Total</b>	<b>80</b>	<b>100%</b>

All the respondents will have an opportunity to apply the knowledge they have acquired by improving their own houses or /and constructing houses for others and other social amenities such as schools.

**Table 4.8 Suggestions on how training workshop can be improve.**

Category	Frequency	Percentage
More time for training	31	38
Workshops to be decentralized	30	37
More practical work	20	25%
<b>Total</b>		<b>100%</b>

The findings above show that 38% of respondents would like more training time to be allocated during the training workshops, while 37% would like to see the decentralization of the training workshops. Still 25% indicated that more practical work during the training is necessary.

All the above responses could effectively help in improvements of future workshops.

**Table 4.9: Respondents opinion on cost of construction using conventional building materials**

Category	Frequency	Percentage
Very Expensive	30	38%
Expensive	40	50%
Affordable	5	6%
Too cheap	5	6%

<b>Total</b>	<b>80</b>	<b>100%</b>
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Majority of the respondents' opinion (50%) is that using conventional building materials is expensive in Mombasa County. Those who feel that it is very expensive were 38% of the respondents. A few respondents claimed the use of such material is affordable (6%) while another 6% of the respondents indicated that conventional materials are too cheap.

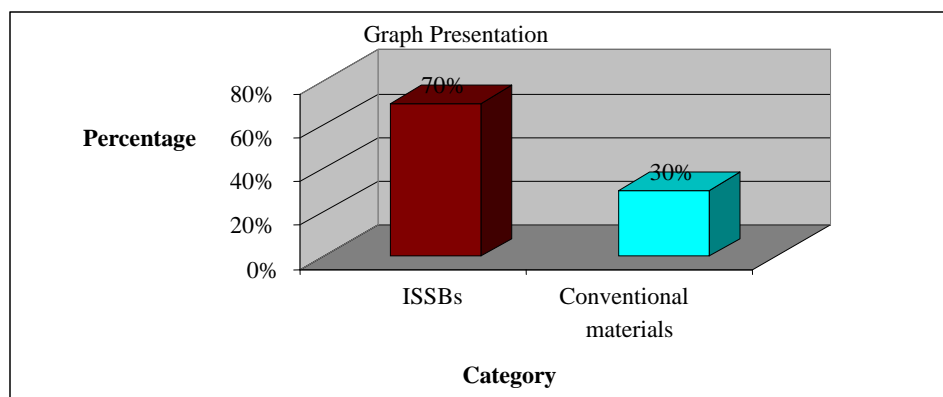
**Table 4.10 Respondent's opinion on cost of construction using ISSBs materials**

Category	Frequency	Percentage
Affordable	45	56%
Too cheap	30	38%
Too expensive	5	6%
Expensive	-	-
<b>Total</b>	<b>80</b>	<b>100%</b>

Using ISSBs is affordable, according to 56% of respondents, while the respondents who consider the use of ISSBs is too cheap were 38%. 6% claimed it was too expensive.

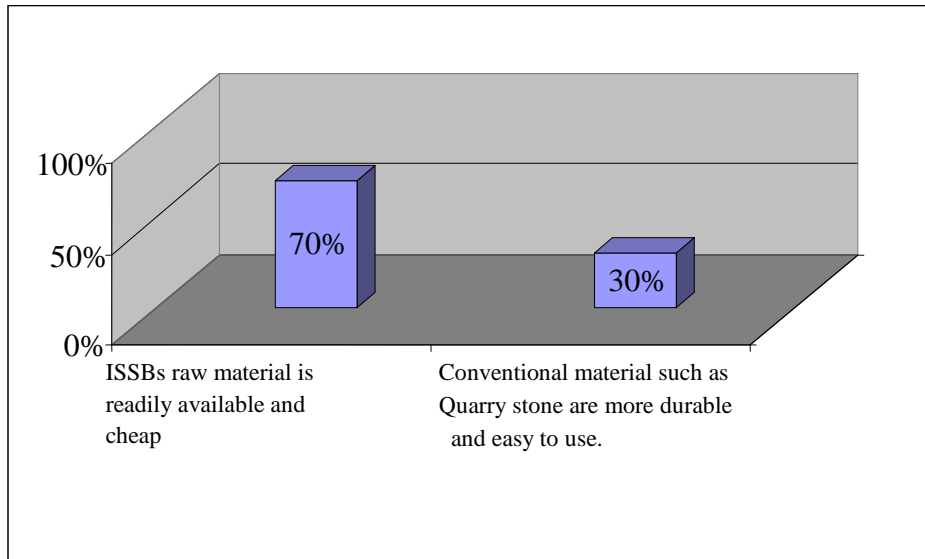
These may be an indication that, ISSBs is more affordable than the conventional materials.

**Figure 4.1. Most affordable construction material**



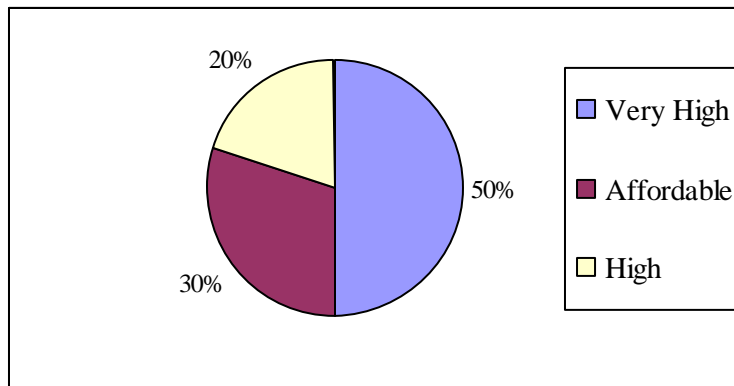
The findings show that 70% of the respondents indicated ISSBs is the most affordable and 30% chose the conventional materials. This may be a plus in the use of ISSBs for the improvement of houses in Mombasa County.

**Figure 4.2. Reasons for the choice of the material.**



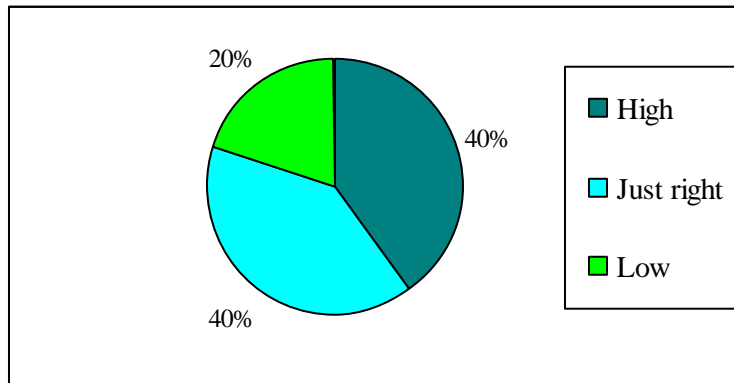
The reason why the majority of the respondents (70%) prefer ISSBs is due to the fact that, the main component of the ISSBs is soil which is readily available. The rest of the respondents 30 % indicated that the conventional materials are more durable and easy to use.

**Figure 4.3. Transport cost of conventional materials.**



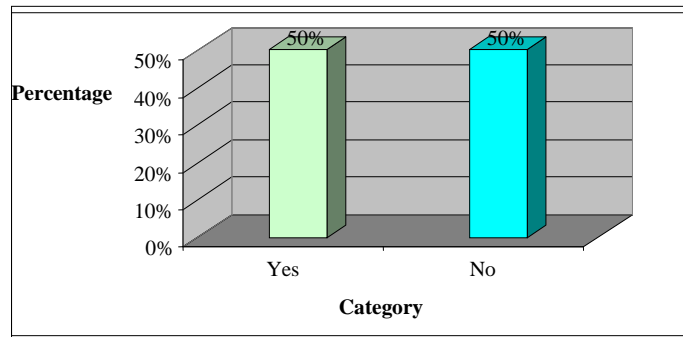
The findings indicate that, most respondents (50 %) consider the transport cost of conventional material as very high, while 30% of the responses consider it as affordable.

**Figure 4.4. Transport cost of ISSBs**



Only 40% of the respondents consider transport costs of ISSBs as high 60% of them feels the cost of transport for ISSBs affordable. Considering that, Mombasa County is a township county like Nairobi, this may explain the high number (40%) of the respondents considering transport cost of ISSBs as high as they have to buy and transport soil and quarry dust outside of the county. However, the majority still considers this cost as manageable.

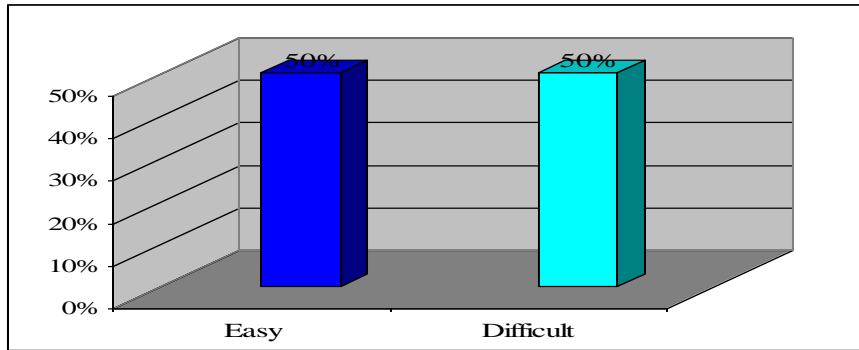
**Figure 4.5 Chances of accessing ISSBs equipment in the County**



Half the number of the respondents indicated that it is not easy to access ISSBs equipment in the County, while the other half was of the opinion that it is easy.



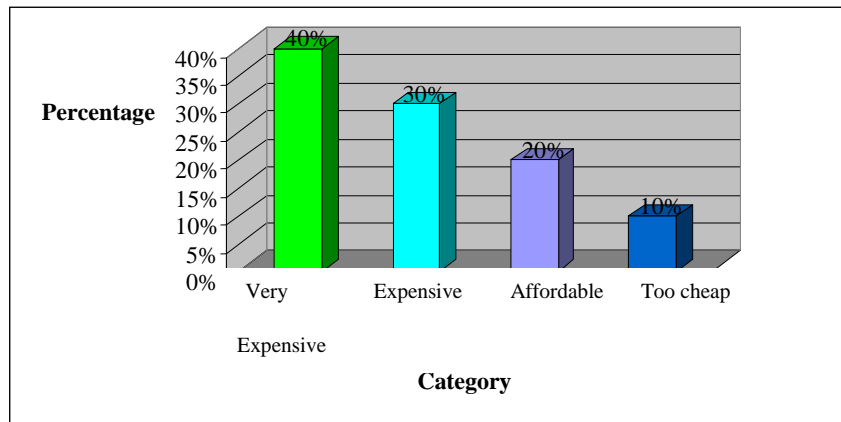
**Figure 4.6. The reasons why ISSBs equipment in the County are easy or difficult to access**



Those who said it is not easy to get the equipments said it took a long time to get the machines as there was a long queue for the machines. While those who indicated it is easy were first on the queue.

Easy access to the equipments may lead to more uptake of the technology. On the other hand, lack of access to these equipments means slow uptake of the technology. This is a problem that can be solved by procuring more equipments.

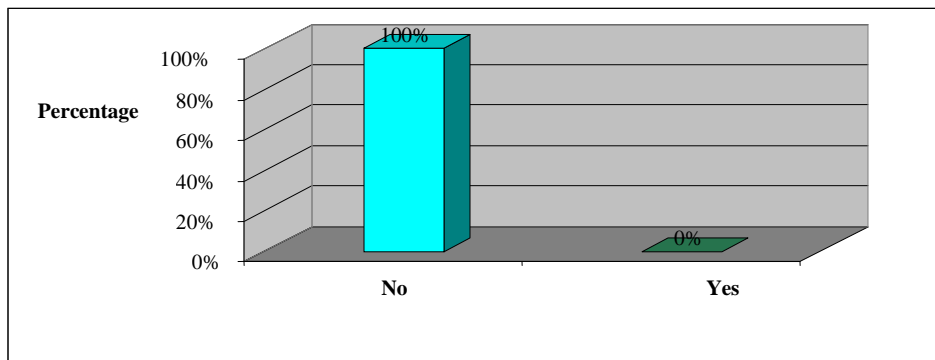
**Figure 4.7. Opinion on the cost of acquiring ISSBs equipment**



Majority (20%) indicated that the cost is affordable while (40%) of respondents claimed the cost of equipment is very expensive. Still (30%) of respondents thought cost of the same is expensive. 10% of respondents indicated that the cost of equipment is too cheap

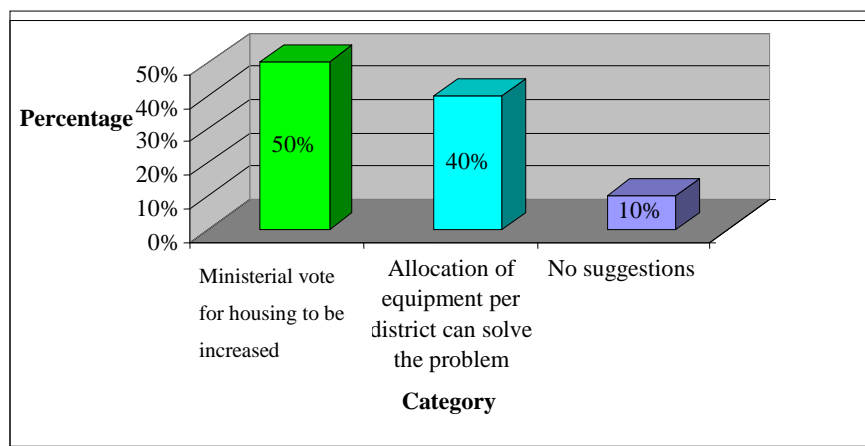
This may indicate access to the equipments is inaccessible to the majority and that ownership of the equipments is prohibitive and the majority of people in Mombasa County may continue to rely on equipments provided by the Ministry of Lands, Housing and Urban Development. Inaccessibility would also mean slow uptake of the technology.

**Figure 4.8. Whether ISSBs equipments from the ministry are enough to serve Mombasa County.**



All the respondents indicated that ISSBs equipments supplied by the ministry are not adequate to serve Mombasa County. This means whereas there may be demand for the technology, its effective use is slowed down by lack of adequate equipments.

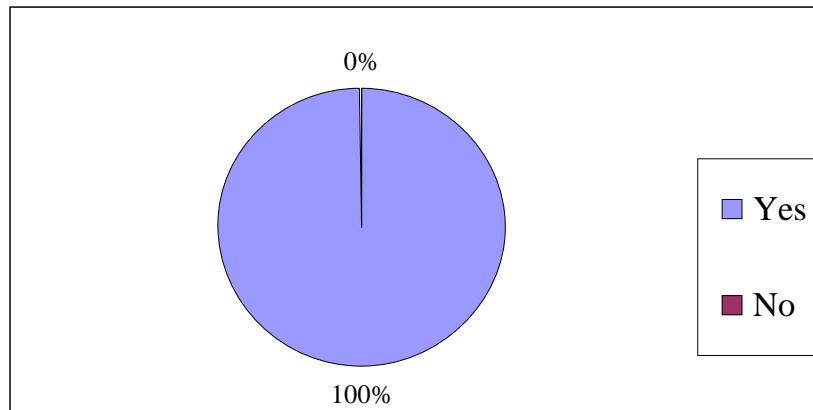
**Figure 4.9. Suggestion on how access to equipment can be improved**



Most respondents (50%) suggested that access of equipment can be improved, if the government expanded ministerial vote for housing, while 40% of respondents suggested allocation of ISSBs equipment per district.

Due to their prohibitive cost to individual owners, the respondents indicated that access to these equipments can be improved by the ministry in charge of housing procuring more equipments for their use.

**Figure 4.10. Consideration of whether to construct own houses using ISSBs.**



All the respondents indicated, they would prefer constructing their own houses using ISSBs.

The respondents felt that, ISSBs is cost effective and it can be used for gain and especially by the youth by making blocks for sale. Likewise, some indicated that the blocks are durable just as they are beautiful.

## CHAPTER FIVE

### CONCLUSION AND RECOMMENDATIONS.

#### 5.1. Introductions

This chapter gives the summary of findings as per the objectives of this study. It's followed by a brief discussion of the findings which shows that, most of the findings were in agreement with the literature review. This chapter also gives the recommendations and the conclusions of the study as well as the areas of further research.

#### 5.2. Summary of the study findings

The study was carried out to find out the factors affecting effective use of interlocking stabilized soil blocks for reduced cost of shelter improvement in Mombasa County.

Training on ISSBs was found to be one critical area that positively affects the adoption of ISSBs programme. It's also an avenue for disseminating this technology as well as a means of producing qualified personnel who in turn will be the agents for the dissemination of the technology as well as in improving the housing situation in Mombasa County. Most of the respondents agree that, the trainings were relevant.

The cost of construction materials has been seen to affect the adoption of the programme, in that, the conventional materials are seen to attract high transport cost a factor that may work in favor of ISSBs. On the other hand, access to ISSBs equipments in the county may hinder the effective implementation of ISSBs technology.

The prohibitive cost of these equipments was found to hinder adoption of ISSBs. The study likewise found that, perception on the quality of ISSBs has effect on the adoption of the technology. This is much so due to the fact that, the people view ISSBs as of high quality, cost effective and beautiful with all the respondents indicating they would build their houses using ISSBs.

It is also important to note that, the study found the cost of transport and the cost of the conventional construction materials affects the implementation of ISSBs. Most respondents

found the transport cost in the production of ISSBs lower than when they are transporting the conventional materials like the quarry stones.

Due to the high cost of housing the trainees indicated that they can embrace the new ISSBs technology which they indicated has the ability to reduce the cost of construction in the county.

It is also emerging that; the technology will greatly help the middle class as well as the low earners in improving their housing situation.

The intervention by the Ministry of Lands, Housing and Urban Development has thus offered opportunities for alternative housing technologies that are capable of reducing the cost of construction by providing equipments, free trainings as well as the construction of training centres hopefully in every constituency by the government plan period of the Vision 2030.

The technology will also contribute immensely towards poverty alleviation by proving job opportunities to the members of the community. An improved housing situation comes with improved health and a good sense of well being.

### **5.3. Conclusion**

The researcher is encouraged by the increasing interest and demand for the use of ISSBs and its ability to address the housing situation and creating employment opportunities and especially to the youth. It's even more encouraging to find the technology being used by the private sector to construct high rise buildings.

However, despite the increasing popularity of these technologies, stringent evaluation of the effectiveness of the technologies has to be carried out. Most of the studies conducted use case study approach in looking at the effects of ISSBs of a given program in a given region but few looks at the impact of multiple regions. To be able to say that, ISSBs programs are effective at improving the housing situation and much more in reducing poverty, a large sample from multi regions with data that can be rigorously analyzed with replicable methods and generalizable findings needs to be conducted.

Secondly, there are questions of ISSBs being seen as a poor man's material and whether these materials can be produced on large scale to benefits as many people as possible. It's also

debatable whether the materials will be fully accepted by the private sector for large scale production of houses.

#### **5.4. RECOMMENDATIONS**

The study makes the following recommendations:-

1. Allocation should be increased to research institutions to facilitate research on building materials and technologies, and also consider imposing a research levy on the building construction industry. The Government should establish a National Research Coordination Secretariat within the ministry concerned with housing to coordinate and disseminate research findings.
2. More efforts should be made to promote intensified training in requisite skills and construction technologies through Youth Polytechnics, Women and Youth Groups, Community-Based Organizations and Appropriate Technology Building Centres.
3. The government should consider promoting the local Jua Kali sector so as to modify ABT & M equipments with the view of bringing down the cost of these equipments.
4. The public, private and voluntary sectors should be encouraged to utilize the research materials in their housing and other development programmes while large scale builders and constructors should be sensitized on this technology
5. All research actors should harness and document existing locally available building materials and technologies as well as disseminate this information to the users as appropriate;

#### **5.5 Areas of further research.**

ISSBs is being mostly trained on the youth more so young men and therefore more research needs to be done on gender training of these technologies and the incentives that can be given to encourage gender parity. The effect of sea corrosion on roofing materials is evident in Mombasa County and for a holistic improvement of houses in the county; study on roofing materials that withstands the unique climatic condition needs to be carried out such as Micro Concrete Roofing (MCR) Tiles.

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**APPENDIX 1**  
**PHOTOS OF HOUSES CONSTRUCTED USING ISSBs.**



An ISSBs training in progress.



ABT & M Centre in Mombasa County.



Stacking and curing of interlocking stabilized soil blocks.





Some of the houses constructed using ISSBs in Mombasa County.

## APPENDIX 2

### SAMPLING FRAME BY ORGANISATION

#### A) ILLISHE TRUST

S/NO	Name
1	Juma A Rindano
2	Charo M. Mwanguo
3	Elizabeth Mkongo
4	Kadir H Munga
5	Juma H. Piri
6	Humpry Safar
7	Dickson Masha
8	Salome Atieno
9	Edward Madu
10	Miriam N. Juma
11	Ali Mungwari
12	Amina Kithuka
13	Kiwoi M Kiwoi
14	Steven Charo
15	Said Mwapombe

16	Agness Mbura
17	Francis Mwashamba
18	Rachael Karisa
19	Mwansiti Juma
20	Joseph Muriuki
21	Ezekiel kilonzo Salim
22	Kilian Mwandori
23	Muhambi W. Ziro
24	Charo Fundi Kalama
25	Loicy bendera
26	Crispas Mande
27	Khamisi Karisa Katana
28	Jane M. Ngui
29	Juma Ngao
30	Givan M Katana
31	Leah Poul
32	Riziki A Kombo
33	Mwanatum Mwinyi Hamis
34	Omar M Mohammed
35	Proconsul Mwabonje
36	Chengo Kalume Kazaa
37	Laurence Nyatome
38	Joseph Mumbo
39	Juma M Otiangala
40	Khadija Owiso
41	Cyrus Mumo
42	Samuel Ochieng Odhiambo
43	Elmond Ogutu

44	Kitili Sila
45	Riungu Mungatia Denis
46	Kiti Cheshensa
47	Ibra Mohammed
48	David W. Muhambi
49	Hilda B Yockson
50	Dan Yogo
51	Swaleh Abdalla
52	Philip G. Nyamato
53	Richard Mnyambu
54	Herbert Omwaka
55	Francis M Mwanguo
56	Bernard Ngige
57	Shida W. Charo
58	Salim Suleiman
59	Wardah Vihenda
60	Pastor Ezekiel Kilonzo
61	Mackmillan Kioko
62	Lydia Obara
63	Elizabeth Mwangangi
64	Alex M Muasya
65	Eric Musango
66	Hassan Green Charo
67	Salim C. Mure
68	Franciscah K. Mururi
69	Mangema Ngowa
70	Kandungati Manguti
71	Ramadhani Badi Hamisi

72	Charo M Tangai
73	Enozu O Ondieki
74	Jesse Kigotho Maina
75	James Muinde Nzuki
76	Vigilante M. Mganga
77	David Mwapanga

## **B) MODERN TECHNOLOGY YOUTH CONTRACTORS**

<b>S/NO</b>	<b>Name</b>
1	Rashid Ali Kidzugah
2	Hamadi Mohammed Badi
3	Hamadi Said M.
4	Omar Raisi
5	Kassim S. Kazi
6	Said S. kazi
7	Hassam Ali
8	Ali Athumani Ali
9	Yalya B Chambweka
10	Mwazondo J
11	Omar M. Mgwisho
12	Abdirahim Mwaniki
13	Mohamed Abdala
14	Idd A. Malevi
15	Omar Sopa
16	Sudi Suleiman
17	Hamis M Mgwisho
18	Salim M Mwakileo
19	Bakari M Mgwisho

20	Salim Nyalombo
21	Idi Juma Basho
22	Mohammed M Mwisho
23	Mohammed M Mwalesi
24	Jiti Mohamed
25	Said M Mgwisho
26	Adallah M Rama
27	Mohamed Raisi
28	Hamadi Saidi Mgwisho

**C) INDIVIDUALS ORGANISED BY THE MINISTRY OF WATER.**

<b>S/NO</b>	<b>Name</b>
1	Samwel M. Mwachala
2	Albert M. Mutuko
3	Herick M. Dokota
4	Harrison M. mwakalu
5	Eban K Mwandambo
6	Ali Ngoro simba
7	Stanley C. Mwatando
8	Stephen Nyiro Mwatsuma
9	Alexander K Mwamgombe
10	Alexander K. Mwanza

**D) UKOMBOZI GROUP ASSOCIATION**

<b>S/NO</b>	<b>Name</b>
1	Charity K Mganga
2	Joyce Mwandoro
3	Esther T Konde

4	Joyce Salome Kalonyo
5	Abraham Okuto
6	Alfred konde
7	Mohamed Gulani
8	James Mungai
9	Janet Mkoba
10	Adam Lwambi
11	Margaret kanene
12	Martin Chipi
13	Mary Lwambi
14	Stella Lwambi
15	Sydney Sanda
16	Albert Ndune
17	Fatuma Dzu0a
18	Elizabeth Mupa
19	Lizzie Mupe
20	Garero C ali
21	Julius Changa
22	Margaret Mangi
23	Mwambaji pandao
24	Mwarua Garero
25	Mwanamvua Mwalwembe
26	Uchi Katumo
27	Amina Pandao
28	Joyce Mwakonde
29	Florence Mrichwa
30	Joyce Kalongo
31	Irene Nyando



32	Salim K mwambaji
33	Christine Washe
34	Cathrine Kisima
35	Donald Malanga
36	George Kisima
37	Konde Jaka
38	Rau Tinga
39	Walter Galelo
40	Michael Gandani

#### **E) TUAMKENI KOSOKONI WELFARE GROUP**

<b>S/NO</b>	<b>Name</b>
1	Nguruzi Christopher
2	Rose Ndivoi
3	Tabitha Mlonzi
4	Peter Kengia
5	Maria nagira
6	Rachael Fadhili
7	Michael maswumbuko
8	John Matata
9	Emanuel J. Memiri
10	Teresia Makau

#### **F) SOFIA YOUTH GROUP**

<b>S/NO</b>	<b>Name</b>
1	Abubakar Mwake
2	Joseph Mwambingu
3	Joseph R Mlamba

4	Tonny M. Mwangata
5	Eunice Wavua
6	James Mwanjua
7	Bene Sadalai
8	Willmot A. mlamba
9	Lydia Wakesho
10	Regina Mnazi
11	David Mwakweli
12	John M. Mwanganda
13	Ester Mkei
14	Josphat Mwanyasi
15	Mwalenga Mwangore
16	Dan Karoki
17	Agata John
18	James Mbote
19	Dannis Kariuki
20	Antony Kilai
21	Kelvin K. Mwangi
22	Yusuf Nyange
23	Sheila W. Mwangi
24	David Mwakireti
25	Neville Ndeleko
26	Scaver Mwanake
27	Kelvin K. Mwangi
28	AbubaKal Maghanga
29	Pascak M Mwachshindo
30	Irene Saghe

### APPENDIX 3

#### RESPONDENT QUESTIONNAIRE

I am currently a student at the University of Nairobi where I am pursuing a course leading to Post Graduate Diploma in Housing Administration. In order to successfully complete this course, I have to conduct and submit for examination a research project on “Factors affecting effective use of interlocking stabilized soil blocks (ISSBs) for reduced cost of shelter improvement. A case of trained community based organizations and individuals in Mombasa County’. Having been trained on ISSBs, you have been randomly selected to participate in this study that will take place in Mombasa County. Your participation will be highly appreciated and i would like to assure you that the information you will provide will be used solely for academic purposes.

May you please fill this form. Your complete and honest answer will be highly appreciated.

#### **Section A: Identification**

Respondent’s full names (Optional).....

Name of the Organization .....

#### **Section B: Training on ISSBS**

1. How long did it take for you to be trained from the time you requested for training?

.....  
.....  
.....

2. Did you find the content of the training relevant to improving your housing situation?

- To a very large extent
- To a large extent
- To a sufficient extent
- To a small extent
- To a very small extent

3 What is your opinion on the overall level of the ISSBs Training Programme

Too High

Adequate

Too low

4. How would you consider the daily schedule during the training?

Too heavy

Just right

Too light

5 Were there in your opinion any areas of the construction that were not adequately covered in the training programme

Yes

No

6. If yes, what areas would you like to suggest?

.....  
.....  
.....

7. Do you think you will have an opportunity to apply the newly acquired knowledge?

Yes

No

8. Give you suggestion on the ways you think the training workshop can be improved.

.....  
.....  
.....  
.....

**Section C: Cost of Construction material**

9. What is your opinion on the cost of construction using the conventional building materials like quarry stones?

- Very expensive
- Expensive
- Affordable
- Too cheap

10. What is your opinion on the cost of construction using ISSBs materials?

- Very expensive
- Expensive
- Affordable
- Too cheap

11. In your experience, which construction material is the most affordable?

- Conventional materials e.g quarry stones)
- ISSBs Materials

12. Give reasons.

.....

.....

.....

.....

.....

13. What is your opinion on the transport cost of the conventional materials (eg quarry stones) in your area?

- Very high
- High
- Just right
- Low
- Very low

14 . What is your opinion on the transport cost of the ISSBs Materials in your area?

- Very high
- High
- Just right
- Low
- Very low

**Section D: Access to ISSBs Equipments**

15. Are the ISSBs Equipments available in the County easy to access?

- Yes
- No

16. Give reasons to the above question

.....

.....

.....

.....

.....

17. What is your opinion on the cost of acquiring the ISSBs Equipments?

- Very expensive
- Expensive
- Affordable
- Too cheap

18. In your opinion, do you consider the ISSBs equipments provided by the Ministry of Housing enough to serve Mombasa County?

- Yes
- No

19. What are your suggestions on how access to the ISSBs equipment can be improved?

.....  
.....  
.....  
.....

**Section E: Perception on the quality of ISSBs**

20. Would you consider constructing your own house using ISSBs?

Yes

No

21. Give reasons to the above question.

.....  
.....  
.....  
.....

22. What are the qualities of ISSBs that you consider attractive to build with?

.....  
.....  
.....  
.....

High

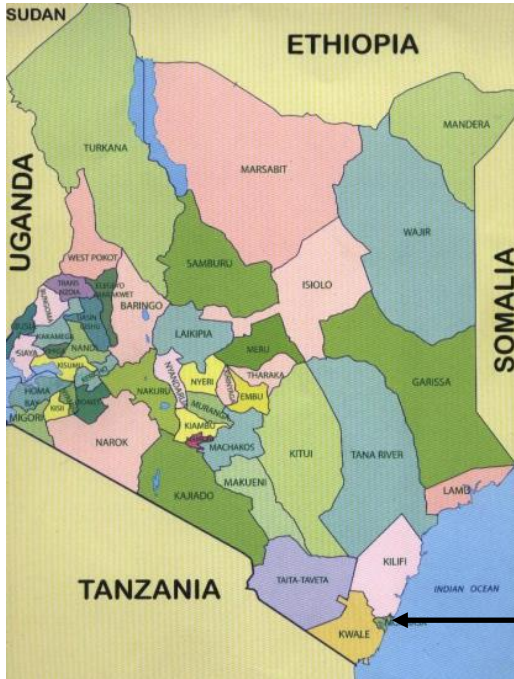
Just right

Low

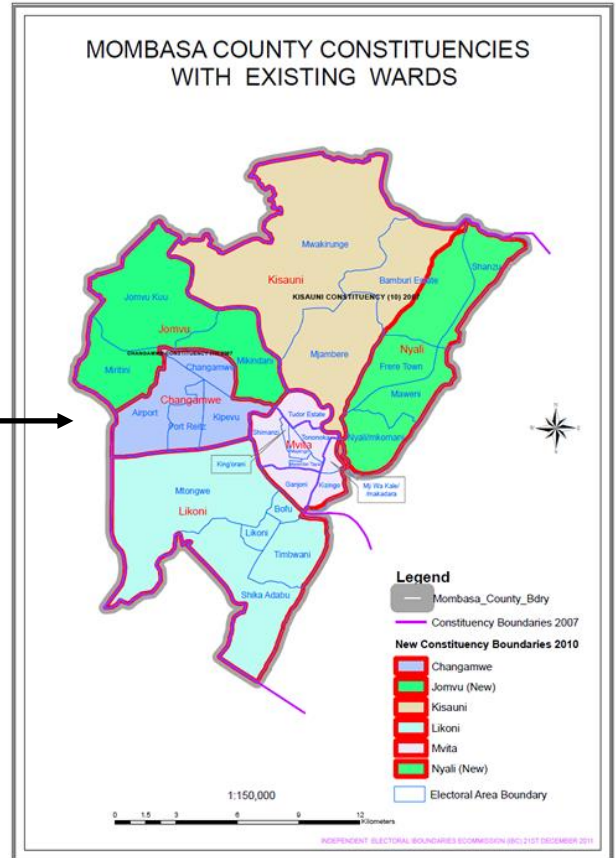
Very low

# APPENDIX 4

## COUNTIES MAP OF KENYA



Source: Wikipedia.org.(03-06-2013)





## APPENDIX 5

### TIME TABLE

<b>Months</b>	<b>December 2012/ January 2013</b>	<b>February 2012</b>	<b>March 2013</b>	<b>April 2013</b>	<b>May 2013</b>	<b>June 2013</b>
<b>Activities</b>						
Proposal development						
Proposal defense						
Pretesting of tools						
Tools finalization						
Production of tools						
Data Collection						
Data entry and cleaning and analysis						
Report writing						
Viva presentation						