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ENVIRONMENTAL CONSERVATION AND RESTORATION: AN ASSESSEMENT OF THE IMPACT OF BIO-INTENSIVE AGRICULTURE IN ENHANCING CAPACITY OF SMALL HOLDERS FARMERS IN MERU, KENYA TO IMPROVE FOOD SECURITY.

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Master in International Environmental Studies

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Declaration

I hereby declare that this thesis is a result of the findings I obtained from the research that I carried out. All other secondary information obtained from other sources that is not my own is fully acknowledged and referenced. Moreover I declare that this research has not been submitted for academic reasons in any other institution for award.

Signature.....

Date.....

Kiaira Ann Mukiri

Dedication

I dedicate this work to the Bio Intensive Training Centre and the small holder farmers in Meru, Kenya.

Acknowledgement

I acknowledge the Holy Spirit for super extraordinary enablement sauced with the conviction that promotion does not come from East, West or South. All along I was inwardly convinced, "it is not by might or by power but my spirit." says the Lord.

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Abstract

Bio- Intensive Agriculture (BIA) is a type of organic agriculture which aims at obtaining highest yields from small pieces of land and ensures increased biodiversity. For BIA to achieve its objectives, that is maintaining soil fertility, through a closed loop system type of agriculture. This study was conducted among small holder farmers in Meru, Kenya and examines how the introduction of Bio-Intensive Agriculture improves food security and capacity of small holder farmers in Meru, Kenya; while conserving and restoring the environment.

I used qualitative research approach for the study because I wanted to get detailed and concentrated verbal explanations from individual small holder farmers. I obtained this through well-structured questionnaires requiring their opinions, ideas, and views as well as experiences regarding Bio-Intensive Agriculture.

I have used capacity enhancement and her determinants as the theory for this research. The determinants are an enabling environment at the organizational and the individual level. I have synchronized these determinants of capacity enhancement with the activities and practice those small holder farmers in Meru, are doing to improve food security while conserving and restoring the environment to form the discussion chapter.

The small holder farmers in this study are involved in: Deep soil preparation, composting, intensive planting, companion planting, open pollination breeding and are doing intensive mixed farming. Moreover, they are involved in conservation and restoration of the environment. This study has found out that BIA has enhanced the capacity of small holder farmers by helping them improve food security, increase income, obtain skills and knowledge as they conserve and restore the environment.

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Chapter one

1.1 Introduction

Bio- Intensive Agriculture (B I A)¹, is a type of organic farming. The method of agriculture aims at obtaining the highest yields from small pieces of land as it ensures increased biodiversity. The BIA objectives are achieved by maintaining soil fertility. It is a closed loop system type of agriculture².

BIA is a system of farming which aims at generating no waste. No waste in the sense that the waste from the farm is used as feed to the farm animals. For example vegetable waste is feed for rabbits, poultry, pig, fish and it acts as a supplement for animals in the farm. In BIA waste is gathered, some stored to decompose whereas the others fed to the soil, vegetables, and to flowers to livestock as well as poultry and fish. Meaning every activity in the farm is controlled by the farmer from the start to the end. Hence ensures long term sustainability³.

This method of agriculture is best suited for small holder farmers who are the central focus in this Thesis. BIA is subsistence in nature. It fosters healthy soils and ensures conserved space. It usually reduces inputs but makes certainly increased yields. This results in sustainability and an all-inclusive health of the small holder farmers⁴. Hence in this investigation, I seek to know: How has the introduction of Bio-Intensive Agriculture Enhanced Capacity of Small Holder Farmers in Meru; while conserving and restoring the Environment?

Meru in Kenya is the case study in this research. The small holder farmers in Meru and their BIA practices and activities are my major focus for this research .On the other hand, unique reference is made to Bio- Intensive Agricultural Training Centre (BIATC)⁵. BIATC and the workers therein are an important point of reference in this research. BIATC trainers form a part my respondents in this thesis.

¹ BIA- This is a short form of Bio- Intensive Agriculture.

² <http://www.resilience.org/stories/2016-04-26/what-is-closed-loop-agriculture> cited on 10/24/16.

³ <http://www.organicauthority.com/mistrustful-of-meat-closed-loop-farming-may-be-the-solution/> cited on 10/24/16.

⁴ <http://www.agroecology.org/Case%20Studies/biointensive.html> cited on 10/24/16.

⁵ BIATC- This is an abbreviation referring to Bio- Intensive Agricultural Training Centre.

This study focuses on BIA because agriculture contributes to almost 75% of Kenya's economy. Moreover, most of the Kenyan population relies on agriculture for a living. Furthermore, almost 75% of working Kenyans generate their income from working on the land⁶. However, food security is a big problem, particularly for poor small holder farmers. BIA is supposed to be a solution for these small holder farmers to conserve and restore the environment, increase food production, income and hence food security.

1.2 Motivation

One of the many motives is my enrolment to study at Norwegian University of Life Sciences (NMBU)⁷. When I got an admission to study a master's of science in international environmental studies brought me fulfillment. I perceived deep in me that my dream comes true; since environmental issues were and are a concern to me.

Moreover, when I heard, read and observed situations such as adverse drought, excess flooding and the like, I asked myself: What can I do to significantly contribute to helping the situation of small holder farmers in Meru -Kenya? Hence my admission to do the course I mentioned meant an opportunity to be informed and know what the environment is its importance; how is destroyed; how is sustained, and how I could help as individual and when in the midst of others wherever I am.

Also, I have a desire to examine agriculture in as many different viewpoints as possible. Agriculture as far as I am concerned is life. It is the backbone of human existence. It is important means of obtaining food for both humans and animals. It is a source of income and a career source. It is an answer to the environmental concerns and thus can no longer be limited to farming⁸. On the other hand, my course in International Environmental Studies consists of units. These units, when, put, together, bring, forth the importance of combining natural and social

⁶ <file:///C:/Users/ann%20kiaira/Downloads/STUDY%20REPORT%20ON%20PRODUCTION%20SYSTEMS%20IN%20KENYA.pdf> cited on 11/9/2016.

⁷ NMBU- This is an abbreviation for Norges Miljø-og biovitenskapelige Universitet(Norwegian University of Life Sciences).

⁸ <http://agriculturegoods.com/the-importance-of-agriculture/> cited on 9/21/16.

sciences to stop environmental challenges. These also help students to be in a position to contribute to sustainable development⁹.

Additional motivation came during my study when I read about climate change; especially that it leads to reduced yields as it affects important crops mainly in developing countries. On top of that, it causes a differing effect on irrigated crop yields. When this happens, it results in a substantial decline in crop and food production. The challenge in that it causes a price increase for the mostly utilized crops such as rice, wheat, maize and soya beans. Hence the effects are anticipated to contribute to increased food prices and high child malnutrition due to reduced calorie consumption (Nelson, G. C. et al 2009).

I reflected on the said effects of global environmental change. Right in me I was convinced that the said are no longer theoretical but experienced in my country on an acute measure. I remembered specifically the effects of increased food insecurity in Kenya at different times¹⁰. I woke up and I realized if something is not done to stop this disaster more weighty unpredicted effects can come up. Besides handling the environment and climate change effectively is not ever a one man's business. It calls upon cooperate articulated networking among the social, economic and the political¹¹.

The factors mentioned above stirred my interest more to find out about the food situation in Kenya and more so in Meru, which is my community. Meru is a name that refers to the county where the Meru people of Kenya are. I thought of analyzing agricultural activities in Meru, Kenya, because agriculture is a great economic activity. The agricultural sector contributes approximately 60-65% of Kenya's export and provides employment of almost 18% to the Kenyan population¹². Meaning development in agriculture results to Kenya's national economic growth¹³.

¹⁰https://www.researchgate.net/publication/238224873_The_Effects_of_Droughts_on_Food_Security_in_Kenya cited on 9/20/16.

¹¹http://www.un.org/en/ecosoc/docs/pdfs/fin_08-45773.pdf cited on 8/11/16.

¹²<http://www.encyclopedia.com/topic/Meru.aspx> cited on 8/12/16.

¹³<http://extensionconference2011.cta.int/node/111> cited 8/12/16.

I concluded that the food security challenge solution is from the grass root level¹⁴. By this, I mean involving farmers of all scales and also encourage other people in Kenya to join farmers in farming. The meaning is creating farmers to join in solving the challenge of food security. My observation of agriculture in this view created a process of observation in my mind. The process was in steps form. The first step I took is to examine various initiatives that are applied by different groups to address food security not in Kenya but also in Meru. In the process, I discovered some programs such as fish farming in South Imenti Constituency in Meru¹⁵, Innovations in achieving sustainable food security in Eastern and Southern Africa¹⁶, Bio-intensive Agricultural Training Centre (BIATC)¹⁷ and many others. I chose to focus on BIATC.

Bio- Intensive Training Centre in a central location. Hence farmers from all corners of Meru and the neighboring districts such as Isiolo, Embu and Laikipia can access the Centre with ease¹⁸. This means the BIATC serve interested farmers not only in Meru but also those in the neighborhood. On the other hand, the BIATC is a church project. Meru has many churches. Almost in every village, there is a church. Traza one of my respondents in my study explained to me how the presence of many churches has been to BIATC as she said,

(...) enables us to reach as many small holder farmers as possible through the church activities. If not we visit churches on Sunday or when they are holding weekly meetings to convey agricultural ideas (...) especially when we want to introduce something new. For example fish farming. We went to churches, chief's meetings and also displayed posters explaining fish farming and its benefits to Meru people.

BIATC is involved in different training categories of farmers, mainly small holder farmers; it is helping small holder farmers increase production of more nutritious food; it is encouraging other populations to join farming and helping the landless to obtain land and create land. The Bio-Intensive Agricultural Centre motivates small holder farmers to utilize small pieces of land for economic gain, create land, by demonstrating how to increase production of nutritious food in their tiny plots, encourages the use of organic techniques which are environmentally friendly. Methods of farming that leads to improved soil structure use. The BIATC sensitize

¹⁴ <http://www.sciencedirect.com/science/article/pii/S0959378013000794> cited on 9/26/16.

¹⁵ <http://erepository.uonbi.ac.ke/handle/11295/44375> cited on 9/26/16.

¹⁶ <https://muse.jhu.edu/book/47790> cited on 9/26/16.

¹⁷ <http://www.methodistchurchkenya.org/index.php/institutions/bio-intensive> cited on 9/26/16.

¹⁸ <http://www.methodistchurchkenya.org/index.php/institutions/bio-intensive> cited on 8/13/16.

diversification of crops and plants¹⁹. These activities all target towards restoration and conservation of the environment because the trainers are not only aiming at food security but also restoration and conservation of the environment.

1.3 Research Questions

This study responds to the question: How has the introduction of Bio- Intensive Agriculture Enhanced Capacity of small holder farmers in Meru, Kenya to improve food security; while conserving and restoring the Environment? To answer this research question I asked the following sub-research questions:

1. How has Introduction of Bio- Intensive Agriculture enhanced the capacity of small holder farmers in Meru-Kenya to improve food security?
2. What agricultural practices are small-holder farmers involved in that improve food security and enhance their capacity as they restore and conserve the environment?
3. What challenges and opportunities do small holder farmers encounter as they carry out Bio- Intensive Agriculture, and how do farmers overcome them?

1.4 Terms and definitions

1.4.1 Bio- Intensive Agriculture

Bio- intensive agriculture is a type of an organic agricultural method of farming. It is a sustainable type of agriculture. BIA aims at interrelating soil, crops and livestock practices. Moreover, it targets at discontinuing or encourages reduced use of chemical or inorganic inputs. Chemical inputs are considered harmful to the farmer, the environment, and the consumers. BIA emphasizes the use of methods that collude and improve the natural environment. BIA ensures economic, environmental and social sustainability (Altieri, M. 2009).

BIA is a method of farming that base on obtaining maximum produce from small pieces of land. On the other hand, it targets attaining increased biodiversity and maintaining of soil fertility.²⁰ Also, the method is specifically meant for small holder farmers. It is a technology that encourages

¹⁹<http://www.umcor.org/Search-for-Projects/Projects/14217A> cited on 8/13/16.

²⁰<http://www.agrivi.com/biointensive-agriculture-a-sustainable-solution-for-growing-food/> cited 9/22/2016.

care for the soil, water, air and even the sun. Hence BIA ensures use of all essential components the soil, water, air and sun to obtain optimum results. There is maximum use of double dug plots, adding compost to the soil, and crops are closely spaced and ensure companion planting and open pollination²¹.

In this thesis, I am going to use all these definitions above at different times in the process of my writing. As I carried out my research respondents of various categories defined BIA differently. Famai one of the small holder farmers said,

BIA is carrying out farming practices while using organic inputs as much as possible. Others said it is “*urimi buti na mithega*²² or *urimi bwa kienyeji*²³”. Means a type of agriculture which involves locally produced inputs and is free of any chemical additives. Additives such as fertilizers, pesticides, herbicides and all other things which are used in the soil to help it increase yields, texture or control pests and diseases.

Another description of BIA according to my respondents it is practices that ensure care for animals and plants as well as the environment. Hence Traza said,

We ensure the safety of plants and animals. We teach farmers that what harm an animal hurts man as well because human being needs unpolluted air, water, and food. When we care for the environment we achieve this. Care for the environment means conserving as well as restoring where damage has taken place

1.4.2 Small holder farmers

A small holder farmer according to the online dictionary is a person owning or renting a smallholding²⁴. In this thesis smallholder farmers are those farmers both male and female who own or have rented smallholdings of land, plots which are up to less than an acre. This land might also be the family farm of up to three acres.

²¹ <http://commongroundgarden.org/?p=384> cited on 9/22/16.

²² Farming where practice farming without applying or using any chemical inputs.

²³ Urimi bwa kienyeji – Referring to a method of agriculture where inputs are as natural or organic as possible.

²⁴ <http://www.thefreedictionary.com/smallholder> cited on 8/14/16.

1.4.3 Capacity Enhancement

Capacity- enhancement is a term whose definition is wide. To appropriately define the term, I will split it into two separate entities as follow: Capacity and enhancement. Then I represent them respectively as follows: Capacity is the total amount of skills, knowledge, and experiences that can be accommodated or produced by a person or a group²⁵. The outcome is inward transformation. Moreover, it is the ability to do a set thing²⁶. On the other hand, enhancement is the act of improving²⁷, to increase, to build, develop, intensify or rise to higher degree²⁸.

Therefore, capacity enhancement is defined as improving the maximum that something or someone can contain and also improving and increasing the amount that something or someone can produce²⁹. Capacity- enhancing involves strengthening of people's ability or capacity to be able to control their own values and their most important considerations. Moreover people are able to order themselves to act on all these are the art of development (Eade, D. 1997, p.23).

As for this study I will examine capacity enhancement as increasing the ability of the small holder farmers such that they are able to determine their own values. Moreover, they are able to make most important considerations and to organize themselves such that they are able; to produce more nutritious food, increase family income by appropriately using the small pieces of land they own. Additionally enhancing their capacity by using appropriate farming methods and their increased knowledge, information, skills, outputs and abilities to improve food security; conserve and restore the environment.

²⁵http://drt.handicap-international.fr/fileadmin/cdroms/Biblio_Renforcement/documents/Chapter-1/Chap1Doc1.pdf cited on 12/10/16.

²⁶<http://dictionary.cambridge.org/dictionary/english/capacity> cited on 7/20/2016.

²⁷<http://www.thefreedictionary.com/enhancement> cited on 7/20/16.

²⁸<http://www.dictionary.com/browse/enhance> cited on 7/20/2016.

²⁹<https://www.google.no/webhp?sourceid=chrome-instant&ion=1&espv=2&ie=UTF-8#q=capacity%20definition>
Cited on 6/21/16.

Chapter 2

2.0 Background

2.1 Introduction

This section contains a background of this research. In the background, I have presented the following sub-headings: Food security in Kenya, malnutrition in Kenya, agriculture in Kenya. Concerning agriculture, in Kenya, I have briefly explained the following types of agriculture: Commercial and organic farming.

2.2 Food Security in Kenya

Food security is;

A situation when all people, at all times, have physical, social and economic access to sufficient, safe and nutritious food which can meet all their dietary needs and food preferences for an active and healthy life³⁰.

Kenya has encountered acute food insecurity since 2008. This time Kenyan government asked for food aid from the international world³¹. Many people in the country could not obtain food either in the right quantity or quality. Many survived on relief food whereas others incurred high food bills³², due to increased food prices. Kenya's staple food is maize³³. Hence it is usually in limited

³⁰<http://www.fao.org/docrep/005/y4671e/y4671e06.htm> cited on 14/8/2016.

³¹https://www.researchgate.net/publication/238224873_The_Effects_of_Droughts_on_Food_Security_in_Kenya cited on 9/29/16.

³²<http://elibrary.acbfpact.org/acbf/collect/acbf/index/assoc/HASH01b5.dir/Food%20crisis%20and%20food%20insecurity%20in%20Kenya.pdf> cited on 9/29/16.

³³<http://pubs.sciepub.com/ajfn/2/2/3/> cited on 9/29/2016.

supply. Maize price was high such that the poor does not access it. Some households cannot afford this food and do not have other food preferences³⁴.

The food security challenge in Kenya associates with several causes. One of these causes is regular drought occurring in several parts of the country.³⁵ Kenyan agriculture is mainly rain –fed. When rains fail, or the rain patterns vary considerably, farmers are not able to organize their agricultural activities properly. The land that is useful for agriculture reduces.³⁶

On the other hand, few extension workers are a factor that affects Kenyan agriculture. Extension workers are necessary for any agricultural growth. For that cause, some farmers do not benefit from agricultural extension services. Such farmers lack the benefits obtained from interacting with experts. Possible benefits from agricultural extension services include agricultural knowledge, skills, technologies which are offered by extension experts. Moreover, the extension experts are usually a bridge between farmers and other actors of the economy (Evenson, R. E. 2001).

Other challenges affecting agricultural productivity include the use of old farming methods as well as invasion by pests and diseases. These lead to high crop and livestock destruction. These reduce yields, and consequently farmers run at a loss. The same cause food shortages. Pests such as weevils attack produce after harvesting, for example, cereals such as maize, beans, and peas. Aflatoxins are also a challenge resulting from poor storage³⁷.

Poor use of farm inputs also affects agriculture in Kenya. Farm inputs are expensive which affects the economically marginalized farmers³⁸. This results in decreased farm yields³⁹. Also, soil degradation and poor infrastructure contribute to poor agriculture⁴⁰. Roads in rural places where most small holder farmers live are poor. They are dusty during the dry season and impassable

³⁴<http://www.foodsecurityportal.org/kenya/food-security-report-prepared-kenya-agricultural-research-institute> cited on 9/29/16.

³⁵<http://extensionconference2011.cta.int/node/111> cited on 10/6/16

³⁶http://www.tabj.co.za/features/april11_features/droughts_in_kenya_detrimetal_to_agriculture_and_economy.html cited on 10/6/16.

³⁷<http://www.fao.org/emergencies/emergency-types/plant-pests-and-diseases/en/> cited on 10/6/16.

³⁸<http://extensionconference2011.cta.int/node/111> cited on 10/24/16.

³⁹http://www.academicjournals.org/article/article1380633470_Chianu%20et%20al.pdf cited on 10/7/16.

⁴⁰https://editorialexpress.com/cgi-bin/conference/download.cgi?db_name=CSAE2014&paper_id=293 cited on 10/7/16.

during the rainy season. Due to this the cost of production increases, spoilage of perishable produce in the process of transportation also increase. Farmers experienced higher losses and others despair cease venturing into agriculture.⁴¹

The stated challenges facing agriculture in Kenya all result in poor agricultural production and lead to food insecurity. A problem such as an increase in food prices is a great contributor to food insecurity. In Kenya food prices have been rising since 2006. Prices of food stuff such as maize, wheat, milk, and meat. The increase in food prices limits the accessibility of food to the poor. The results are food insecurity in poor households. The increase in food prices not only makes food inaccessible but may also lead to malnutrition⁴².

2.3 Malnutrition in Kenya

Malnutrition is a condition that results from not obtaining the right type of food. It refers to undernutrition⁴³. The reason is the food they eat does not contain proper nutrients capable of meeting their daily dietary requirements. These are foods as balanced meals rich in vitamins, nutrients as well as water⁴⁴. In Kenya malnutrition commonly refers to stunted growth among children, wasting as well as the lack of enough micronutrients⁴⁵.

Malnutrition among children is common. Almost 35% of children who are five years old have been noted to have stunted growth. Approximately 16% are underweight, and 7% wasted. At the same time, stunting among children in urban slums is nearly 40%.The increased malnutrition challenge described here is the aftermath of food insecurity. Due to regular drought occurrences, limited access to water and sanitation, diseases such as diarrhea, HIV as well as malaria, poor maternal health, and poor children nurturing habits are results of food insecurity. Malnutrition is a result of wrong prioritization and commitment to nutrition at all levels.⁴⁶

⁴¹<http://www.zakenya.com/agriculture/problems-facing-agriculture-in-kenya.html> cited on 10/24/16.

⁴²<http://borgenproject.org/drought-increases-malnutrition-in-kenya/> cited on 9/30/16.

⁴³<http://www.unicef.org/progressforchildren/2006n4/malnutritiondefinition.html> cited on 10/8/16.

⁴⁴<https://www.wfp.org/hunger/malnutrition> cited on 10/4/16.

⁴⁵<http://globalnutritionreport.org/2014/07/18/the-nutrition-paradox-in-kenya/> cited on 11/10/16.

⁴⁶<http://globalnutritionreport.org/2014/07/18/the-nutrition-paradox-in-kenya/> cited on 11/10/16.

Malnutrition in children usually features right before birth or even after a child are born. For example, when they are still unborn the expectant mother cannot access food both in appropriate quality and quantity⁴⁷. All this a consequence of reduced agricultural productivity, the high cost of input, poor infrastructure, environmental degradation, inaccessibility to markets by small holder farmers, food insecurity and increased poverty⁴⁸.

To combat malnutrition in Kenya requires improving the nutrition of women who are in the reproductive age. To achieve this, education on nutritional health while pregnant is important. What to eat and also strengthen iron and folate supplements. Improve children's nutrition by increased breastfeeding, the proper introduction of supplementary feeding as well as adding micronutrients to their food⁴⁹. Food and supplements, improving knowledge, attitudes, and practices to achieve maximum nutrition as well as cooperation and appropriate networking may reduce micronutrient deficiency.⁵⁰

2.4 Agriculture in Kenya

In this part of my thesis, I am going to write briefly on the following: The general position of agriculture to Kenya and her economy and on the two common types of agricultural practices. These are commercial and organic agriculture⁵¹.

2.4.1 Commercial Agriculture in Kenya

Commercial agriculture refers to cash crop farming. It involves farming with the aim of profit making. The main cash crops in Kenya are tea, flowers, wheat, cotton, maize, Miraa (Khat)⁵², bananas, coffee, and pyrethrum.⁵³ Commercial agriculture benefits Kenyan communities in

⁴⁷ http://www.unicef.org/progressforchildren/2006n4/index_undernutrition.html cited on 10/8/16.

⁴⁸ <http://softkenya.com/information/malnutrition-in-kenya/> cited on 10/8/16.

⁴⁹ <http://jn.nutrition.org/content/133/11/3972S.short> cited on 11/11/16.

⁵⁰ <http://globalnutritionreport.org/2014/07/18/the-nutrition-paradox-in-kenya/> cited on 11/10/16.

⁵¹ <https://www.feedthefuture.gov/country/kenya> cited on 11/10/16.

⁵² Khat is a herb with stimulating effects to the consumer. It grows in Meru , Kenya.

⁵³ <http://www.zakenya.com/agriculture/the-main-cash-crops-in-kenya.html> cited on 11/11/16.

diverse ways, providing employment to people and taxes to the government through taxes. Income from agriculture also contributes towards improved infrastructure such as roads⁵⁴.

On the other hand, commercial agriculture destroys the ecosystem. The ecosystem, in this case, refers to a group of living things. These include plants, animals as well as microorganisms and their relationship with the environment. Moreover, water, air, soil and the atmosphere as well as heat, the sun and the light; all these are constituents of an ecosystem. They all play different roles, but they work together hence creating room for energy flow and recycling of essential components for example carbon and nitrogen (O'riordan, T. 2014).

On top of that, it leads to increased farm produce. The method encourages a high level of different chemical fertilizer application. It involves spraying to control pests and diseases. Commercial agriculture leads to increased food supply. When a particular produce is in the season, the prices are low. The local people can access the cheap food. Nevertheless, this is a disadvantage to commercial farmers. This is because many farmers go at a loss due to low prices. Farmers spend so much to produce yet the income is so little to cover their incurred expenses. Hence farmers go seeking loans and credits to sustain the farm activities.⁵⁵

Most farmers aim at increased produce which they obtain by clearing forests for cultivation, application of different chemical fertilizers, herbicides, and pesticides. These threaten the ecosystem. Destroyed ecosystem leads to increased temperatures which cause several challenges. These include death and extinction of some living organisms. As a result, there is a decrease in biodiversity when different species of both plants and animals reduce. The food chain is distracted. When forests deteriorate, the land is exposed to soil erosion. Hence land loses its ability to support plant life. This situation affects human life as a result of pollutions⁵⁶.

2.4.2 Organic Agriculture in Kenya

Organic farming is a way of cultivation that considers the biological interactions found in nature. It ensures conserved natural resources and environment. On the other hand, organically produced food stuff is free of chemical fertilizers, pesticides, additives, preservatives as well as any genetic

⁵⁴<http://www.cropsreview.com/cash-crop-farming.html> CITED ON 11/11/16.

⁵⁵<http://archive.jsonline.com/business/farmers-struggling-even-as-markets-overflow-with-milk-grain-livestock-b99698326z1-374389581.html> cited on 11/11/16.

⁵⁶<http://www.vegsource.com/articles/chemical.farming.htm> cited on 11/11/16.

influence on the living organisms. It is a method of farming that ensures reduced cost of production⁵⁷. It encourages the use of compost and natural pest control methods. Organic farming aims at increased recycling of organic matter, greater use of farm yard manure and mulching. It also refers to conserving resources such as soil, water, and trees.⁵⁸

In Kenya, organic agriculture is an initiative by Non-Governmental Organizations as well as private organizations. These organizations are Kenya Institute of Organic Farming (KIOF), Manor House Agriculture Centre (MHAC), Kenya Organic Farmers Association (KOFA) Sustainable Agriculture Community Development Programme (SACDEP), Association of Better Land Husbandry, Baraka Agriculture College and Sustainable Agriculture Centre for Research and Development in Africa (SACRED). These organizations formed from 1936, 1984, 1986 1992 and 1994 respectively⁵⁹.

Organic agriculture concentrates among small holder farmers; to improve food security hence is not growing as fast as expected. The government did not show much regard to it until 1990. After seeing how organic agriculture was managing organic matter and contributing towards a sustained environment, the government became interested in it. Hence, from 1990 many players have been involved in organic farming. The result is a shift in the view of organic agriculture. The result is household food security to securing market and also from an individual based involvement to group involvement.

Kenya Organic Agriculture Network (KOAN) is a product of this type of grouping. The organization represents all organic agriculture organization in Kenya. The agricultural sector organized through these initiatives. It is helping grow organic agriculture sector through advocacy, lobbying as well as standards development. The government considered the role of organic agriculture in Kenya though no policy framework is yet established. Despite this, Kenyan universities have started taking interest in organic agriculture offering curriculum on the same. Students in the department of agriculture and environmental resources are researching on organic agriculture⁶⁰.

⁵⁷ <http://rsbl.royalsocietypublishing.org/content/1/4/431.short> cited on 12/10/16.

⁵⁸ https://www.villagevolunteers.org/wp-content/uploads/2011/05/Report-of-IBD_OA-Jan06.pdf cited on 11/11/16.

⁵⁹ <http://orgprints.org/17933/1/kledal-et-al-2009-world-organic-agriculture.pdf> cited on 11/11/16.

⁶⁰ https://www.villagevolunteers.org/wp-content/uploads/2011/05/Report-of-IBD_OA-Jan06.pdf cited on 11/11/16.

Chapter 3

3.1 Methodology

In this study, I adopted the use of a qualitative research approach because the method is well suitable for addressing the research questions for the study. The method also systematically applies a well-defined set of procedures to answer stated questions. Moreover, it leads to obtaining useful evidence for findings that are achieved through qualitative methods only. Also, the results from this study may be relevant to a global audience since information is about a set people about, their values, opinions, behaviors, as well as social background

The method uncovers trends portrayed in thoughts and provides a detailed overview of a problem⁶¹. The qualitative approach data collection strategies include the use of open-ended questions. The advantage is a respondent quickly answer questions in their words. The questions have no fixed type of responses hence the respondents answers the answers the asked question according to their best level of understanding and knowledge (Bryman A, 2015).

The qualitative research approach was of use to me in this study because I used its essential parts in collecting my data. These are direct observation, in-depth interviews, use of focus groups as well as written documents⁶². My study approach is interactive and flexible in nature in data collection and also the research questions are moderated by what I found out in the field⁶³

3.1.1 Case Study and the sampling process

In this study, I involved a case study approach. The case study is Meru County small holder farmers. I conducted the research among small farmers who represent the entire old Meru

⁶¹<http://www.snapsurveys.com/blog/what-is-the-difference-between-qualitative-research-and-quantitative-research/> cited on 8/2/16.

⁶²<http://www.socialresearchmethods.net/kb/qualdata.php> cited on 11/29/16.

⁶³<https://www.fhi360.org/sites/default/files/media/documents/Qualitative%20Research%20Methods%20-%20A%20Data%20Collector's%20Field%20Guide.pdf> cited on 12/9/16.

district⁶⁴. Meru County resulted from the establishment of a county government in Kenya as I mentioned in the background part of this study. The small holder farmers in this study have direct contact with BIA and also BIATC and her practices, skill, and ethics. I conducted this research by interviewing whereby I interviewed **twenty- four small holder farmers**.

The rest we individual farmers though connected to each other through the BIA activities and practices. The others were four BIATC trainers. I sample these farmers on a random basis. Though later in the process of carrying out the research the sampled small holder farmers lead me to each other. Every small holder farmer who practices BIA practices and values qualified to be sampled⁶⁵.

My contacts with my first respondent lead me to the next as I have stated earlier in this study. I employed snowballing sampling approach. It is a method of obtaining respondents. This style of research requires that the sampled group of interviewee connects the researcher to others with similar information as the one the researcher needs⁶⁶. Hence the sampled group of small holder farmers in this study with BIA experiences led me to other who also was carrying out BIA practices and activities. They helped me to identify them within the Meru County. This way to reach small holder farmers of different socioeconomic status, gender and other variation amongst them helped me (Bryman 2012 p.424).

The trainers' names in this research start with Tra and the small holder farmers' names start with Fa. Hence the trainers are Traza, Traphra, Trano and Trasello. The small holder farmers are Fara, Fari, Fama, Famu, Fagi, Fafe, Fafa, Fata, Fale, Fangu and Fachi. Fabro are small holder farmers who are brothers and carry out BIA activities together. Famai is a women group who farm says they cultivate God's way by mulching. Faboys are a group of rehabilitees, former street boys who have started BIA. I chose this sample depending on my research questions and the activities each small holder farmer or small holder farmers practiced. I was particular also in the time I had as well as all the support available (McKay, M. D. et al, 2000).

⁶⁴http://www.geographic.org/geographic_names/name.php?uni=-3113954&fid=3308&c=kenya cited on 10/11/16.

⁶⁵<http://www.animatedsoftware.com/statglos/sgrandsa.htm> cited on 8/3/16.

⁶⁶http://epublications.marquette.edu/cgi/viewcontent.cgi?article=1121&context=edu_fac cited on 12/5/16.

3.1.2 Observations

For this study, I observed different activities as well as practices. All these were mainly about small holder farmers and all that pertained to BIA. I sought to obtain sufficient data for this thesis. I directly observed what small holder farmers were doing and ascertained the content of their plots and farm yards. Moreover, I keenly listened to these respondents as they responded to different research questions. I aimed at examining their actual farm settings and how BIA skills, principles, and values manifested in their activities⁶⁷.

I keenly took note of animals kept and crop suited for BIA. I observed how plants grew, the type of inputs used to enhance plants growth and improve the soil. Also, I inquired about pests and diseases control. I noted different types of pesticides used, the animals kept as well as the sources of their feed. I developed an interest in fish breeding, feeding, harvesting, and marketing. I observed different ways of value addition to both fish and vegetables. I saw trainers demonstrate how fish frying; fish balls and samosa making. I also observed Traza explained drying, grinding and storing of *Kunde*⁶⁸ pigweed (*terere*)⁶⁹ and beans leaves.

I saw the recommended types of tins and polythene bags used as storage containers for these products for use not only when out of season but also for other purposes. For example, the trainers told me dried amaranth leaves could make tea. Moreover, I observed how small holder farmers performed BIA in their little holdings. I watched how they made compost, plant and transplant vegetables and tree seedlings, shade, water, attracted beneficial insects to encourage open breeding, conserved and restored the environment. I keenly examined these and other different activities, practices both at the BIATC and also at the small holder farmers various social, economic situations.

As I collected my data for this research, I joined small holder farmers in seed bed preparation, transplanting their vegetable seedlings, feeding their poultry, and fish too. I also interacted with visitors and the customers who bought and inquired about different products and services at the BIATC. I visited some small holder farmers such as Fabro(s), in the company of the BIATC trainers. At this time I watched how the trainer and small holder farmers related while at the small

⁶⁷ <http://www.qualres.org/HomeObse-3594.html> cited on 10/13/16.

⁶⁸ Kunde- vegetable from cow peas plant

⁶⁹ Terere- this is Kimeru name for amaranths

holders' area of operation. I heard and saw her guide the small holder farmers about shading the newly planted fruit seedling. I noted all these experiences and observations (Kothari, C. R. 2004).

3.1.3 Recording

I recorded different findings for this study. These included answers from different respondents and also my observations. I took photos some which I have used as illustrations in this thesis. Some of these are; tomatoes growing bio- intensively, vegetables in a sack and also in plots and also underground fish ponds, poultry, and zero grazing practices. Moreover, I extracted photos from my data album which I used as an illustration of plants growing intensively and also in companionship. I took videos trainers explaining about the establishment of a vegetable sack garden .I took photos of willing small holder farmers while doing different BIA activities. These were either at the BIATC or their farms. Photos have been a perfect way for me to store my data such that I can access them when needed (Bryman, A. 2015).

I noted mainly what different small holder farmers said about BIA. I recorded the benefits of BIA, challenges, and solutions to these challenges too. I recorded what small holder farmers referred to as opportunities associated with BIA. They expressed themselves in Kimeru, Kiswahili or English. The stated in mother tongue, and I translated where necessary in this thesis. They used terms such as *dawa cia miti*⁷⁰, *mithega*⁷¹, *kienyeji*⁷² and terns like *muharubaini*⁷³, I understood clearly the meaning (Polkinghorne, D. E. 2005).

3.1.4 Coding

After and during the interviewing sections I coded my data. I used different symbols to represent various areas addressed. I marked responses depending on their diverse systems. I keenly noted what the thing was who I was dealing with a topic in question and answer. On the other hand, I noted what was happening and the activities in progress at a different time in different places. I

⁷⁰ *Dawa cia miti*- *Dawa cia miti* refers to herbal medicine.

⁷¹ *Mithega*- *Mithega* refers to all types of medicine in general as well as commercial fertilizers.

⁷² *Kienyeji*- *Kienyeji* is a term used to refer to anything that is organic or indigenous

⁷³ *Muharubaini*- It is a Kiswahili name that refers to neem tree. It is believed to relieve forty human health disorders.

was keen on the time of events and what lead to what and why? I analyzed both primary and secondary data. I carried leaflets, reports from BIATC and record⁷⁴.

I also considered what is available in BIATC website. These show the different days, attendants, participants, activities, practices and where they took place. I also carried with me documents showing how various projects started and reports on small holder farmers' training. All this is my secondary data for this study. My primary data is what I observed and obtained from small holder farmers as well as trainers as responses, views, opinions, expressions and also statements. I interpreted and analyzed my data according to the research question of my thesis (Punch, K. F. 2013).

I coded the small holder farmers with a name starting with Fa and the trainers at the BIATC with a name starting with Tra. Small holder farmers are all bearing a name with Fa, for Fafe, Fagi, Fari, Fafe, and Fachi among others. The trainers are Trano, Trasello, Traphra and Traza.

3.1.5 Ethical considerations

Ethics in this study refers to the rules and regulations I observed as I carried my research. As far as I am concerned, this is a means of helping me to obtain trust from my respondents. I have ensured the following: One, I started by clearly explaining to my respondents the purpose of research, I explicitly told them about the use of my research and purposes of my visits. Some small holder farmers willingly gave informed consent. I experienced this with small holder farmers who were practicing fish farming. Two, I chose a coding style that made respondents' names anonymous⁷⁵.

The involvements described above are all about protecting my respondents from any harm. Three, I assured my participants' confidentiality in both data presentation and analysis. On the other hand, I sought help from the BIATC to identify different small holder farmers. Different small holder farmers also introduced me to the others of their kind. The small holders trusted me more when they saw me in the company of their colleagues as I carried my research. Despite the informed consent I have chosen not to reveal any respondents identity (Ritchie, J. et al. 2013).

⁷⁴http://programeval.ucdavis.edu/documents/Tips_Tools_18_2012.pdf cited on 11/30/16.

⁷⁵http://eprints.ncrm.ac.uk/459/1/0808_managing%2520anonymity%2520and%2520confidentiality.pdf cited on 11/30/16.

Chapter 4

4.0 Theoretical Approach

4.1 Capacity Enhancement

Capacity- enhancement is a term defined in different ways. It is a word that can be used to refer to how a person or organization boosts their ability to achieve their set goals effectively and efficiently. It involves establishing internal capacity. Internal capacity, in this case, includes; skills, knowledge, and values of individuals, systems, or of an organization.⁷⁶The UNDP sees capacity enhancement as a way of teaching one how to perform a new task or improving the existing skills to do the same. It is a way of improving how task performance. It is also creating something new, innovating or enabling that which was already there. Capacity enhancement aims at strengthening, educating, increasing rights as well as freedom⁷⁷.

The content in the paragraph above reminds me what Bio- Intensive Training Centre is doing in this study. BIATC objective is to train small holder farmers how to; produce more food, increase income, conserve and restore the environment through demonstrations, seminars, and workshops.⁷⁸I will come back to this in the discussion chapter. Another essential ingredient in the UNDP capacity enhancement is it aims at the end.⁷⁹ Capacity enhancement leads to change that is generated and established or sustained from inside. This type of development is totally mind transforming and hence changed attitudes⁸⁰.Capacity enhancement incorporates participation of all concerned stake holders. These include ministries, local authorities, non-governmental organizations (NGO), professional associations as well as academics and many other groups such as water user groups⁸¹.

⁷⁶https://cgspace.cgiar.org/bitstream/handle/10568/33276/ccafs_capacity_enhancement_strategy.pdf cited on 10/28/16.

⁷⁷http://www.undp.org/content/dam/aplaws/publication/en/publications/capacity-development/capacity-development-a-undp-primer/CDG_PrimerReport_final_web.pdf cited on 12/10/16.

⁷⁸<http://methodistchurchkenya.org/index.php/institutions/bio-intensive> CITED ON 12/10/16.

⁷⁹http://www.undp.org/content/dam/aplaws/publication/en/publications/capacity-development/capacity-development-a-undp-primer/CDG_PrimerReport_final_web.pdf cited on 10/28/16.

⁸⁰http://www.undp.org/content/dam/aplaws/publication/en/publications/capacity-development/capacity-development-a-undp-primer/CDG_PrimerReport_final_web.pdf cited on 10/21/16.

⁸¹<http://www.gdrc.org/uem/capacity-define.html> CITED ON 6/21/16.

Enhanced capacity can overcome or reduce the challenges resulting from environmental degradation as well as food insecurity. To obtain such better livelihood security as well as conserved and restored environments are important considerations.⁸² For that matter capacity enhancement in this study revolves around; One, increasing the ability of the small holder farmers to be able to determine their own values; Two, enabling them to make most important considerations, Three, to be able to organize themselves such that they can obtain food security by producing more nutritious food, increase family income by appropriately using the small pieces of land they own⁸³.

Moreover portraying enhanced capacity by using appropriate BIA farming methods and their increased knowledge, information, skills, output and abilities to conserve and restore the environment. Capacity enhancement made up of the following key arms which are its determinants: An enabling environment; at the organizational level as well as at the individual level⁸⁴.

4.1.1 Enabling Environment

Enabling environment refers to social set up where people and organizations operate. The enabling environment always considers all the rules, policies, and laws that govern the said people, groups and institutions. Besides, it refers to examining the power relations as well as the social norms that regulate civic, local, and public involvements. The enabling environment controls the entire extent of capacity enhancing⁸⁵.

4.1.2 The Organizational Level

The organizational level involves considering the internal structure, rules, policies and processes that determine an organization's success. At this point, I discussed the advantages of the enabling environment. They are put to work and also individuals congregate. Therefore, the more related the resources and components are the stronger the enhanced capacity.⁸⁶

⁸²https://cgspace.cgiar.org/bitstream/handle/10568/33276/ccafs_capacity_enhancement_strategy.pdf cited on 10/28/16.

⁸³<http://www.umcor.org/Search-for-Projects/Projects/14217A> cited on 12/10/16.

⁸⁴<http://www.usace.army.mil/Portals/2/docs/MILCON/CD%20Framework%20Summary.pdf> cited on 11/12/16.

⁸⁵http://www.undp.org/content/dam/aplaws/publication/en/publications/capacity-development/capacity-development-a-undp-primer/CDG_PrimerReport_final_web.pdf cited on 10/21/16.

http://www.undp.org/content/dam/aplaws/publication/en/publications/capacity-development/capacity-development-a-undp-primer/CDG_PrimerReport_final_web.pdf cited on 10/21/16.⁸⁶

4.1.3 Individual Level

The capacity enhancement third determinant manifests at the individual level. Since it at this point where the following crucial elements feature. These are skills, experiences, and knowledge. To obtain skills, experiences, and also knowledge one requires to apply formally or informally strategies. Formally, these are achieved through the process of education or training whereas informally they are acquired through doing and observations. Other times through being exposed to and access to resources and experiences that enhances individual capacity⁸⁷

At the individual level, capacity enhancement looks at accessibility to required materials and required skills that lead to a personal capacity increase. Moreover, these are substantially designed by organizational and environmental conditions. All these are determined by capacity increase level in persons hence capacity enhancement is an integrated approach⁸⁸.

⁸⁷http://drt.handicap-international.fr/fileadmin/cdroms/Biblio_Renforcement/documents/Chapter-1/Chap1Doc1.pdf cited on 12/10/16

⁸⁸http://www.undp.org/content/dam/aplaws/publication/en/publications/capacity-development/capacity-development-a-undp-primer/CDG_PrimerReport_final_web.pdf cited on 10/21/16.

Chapter 5

5.1 Geographical Location of Meru – Kenya

I conducted this study in Meru County in Kenya. Meru County is among the forty- seven counties which the 2010 Kenya’s new constitution created⁸⁹. Meru is in the eastern part of Kenya, in the northeast around two hundred and twenty- five kilometers away from Nairobi. It has a fresh and warm climate with temperatures ranging from sixteen degrees to twenty- three degrees. Meru receives average rainfall which is 500mm and 2600mm per annum.⁹⁰

Meru consist of constituencies. These constituencies are Central Imenti where BIATC is, South Imenti, Tigania West which is my home constituency, Tigania East, Tigania west, Buuri, Igembe South, Igembe Central and Igembe North⁹¹. My respondents in this study represent the area covered by these constituencies. Though the constituencies bears different name they are more or less one and the same. The naming serves administrative purposes⁹².

The same case applies to Imenti, Tigania and Buuri. Buuri is partly Imenti, Tigania and Isiolo⁹³. Meru’s primary economic activity is agriculture. The large part of Meru population relies on subsistence farming. The small holder farmers in this study grow maize, beans, sorghum, millet vegetables and fruits⁹⁴.

Other grows coffee, tea, cotton, Khat, and potatoes. Few farmers are engaging in commercial farming. They grow mangoes, passion fruits for business purposes. The products are made

⁸⁹ <http://www.ustawi.info.ke/index.php/devolution/47-counties-of-2010> cited on 9/29/16.

⁹⁰ <http://www.kenya-information-guide.com/meru-county.html> cited on 11/9/2016.

⁹² <http://www.ustawi.info.ke/index.php/devolution/47-counties-of-2010> cited on 11/30/16.

⁹³ <http://www.kenya-information-guide.com/meru-tribe.html> cited on 10/6/16.

⁹⁴ <http://www.fao.org/docrep/ARTICLE/WFC/XII/0099-B1.HTM> cited on 11/30/16.

available in local markets in Meru.⁹⁵ In the Igembe part of the county, the principal crop is Khat (Miraa). Miraa is also grown in Tigania as well as in Maua. It is a product that fetches a substantial amount of money. This product is not only consumed in Kenya but it is also exported to neighboring countries as well as abroad⁹⁶.

The Meru agriculture has been recognized as the backbone of meru county economy. This has stirred various stakeholders to turn the attention on agriculture. This is by applying all possible techniques to ensure agricultural growth. These include addressing challenges farmers encounter as they interact with different agricultural activities. These are activities such as crop and livestock production .Efforts are also being made to control decline in agricultural and land productivity, soil degradation as well as market challenges.⁹⁷

The county's glory in indigenous food crops .These are declining as a result of increased rush of many farmers to commercial agriculture. Native food is likely to extinct in the county. This is not only as a result of farmers shifting to industrial agriculture but also because of climate changes as well as an increase in pests and disease.⁹⁸ Moreover, Meru is well known for endemic crop types as well as diversity. The county has forests such as Kuuru⁹⁹ and Mieru¹⁰⁰ forest. The Kenyan government has put emphasis in planting more trees¹⁰¹ . There are programs that encourage planting trees of multiple uses. Trees used as food, medicine, wood, cash, and animal requirements services, for soil erosion, rituals and other various uses¹⁰²

⁹⁵ <http://www.zakenya.com/business/gakoromone-soko-mjinga-and-makutano-markets-in-meru-town-in-kenya.html> cited on 10/10/16.

⁹⁶ <http://www.kenya-information-guide.com/meru-county.html> cited on 10/8/16.

⁹⁷ http://meru.go.ke/file/meru_rising_conference_report.pdf cited on 10/10/16.

⁹⁸ <http://www.nation.co.ke/lifestyle/DN2/Indigenous-food-crops-can-alleviate-hunger/957860-2088610-g71kna/index.html> cited on 10/10/16.

⁹⁹ Kuuru- This is a name of one of the forest found in the border of Tigania and Imenti.

¹⁰⁰ Mieru-This is a name used to refer to one of the forests in Meru county.

¹⁰¹ <http://download.portalgaruda.org/article.php?article=354871&val=8143&title=Study%20on%20Species%20Diversity%20and%20Stand%20Structure%20in%20Meru%20Betiri%20National%20Park> cited on 10/10/16.

¹⁰² <http://edepot.wur.nl/121484> cited on 11/9/16.

5.2 BIO- INTENSIVE AGRICULTUAL TRAINING CENTRE

Bio-Intensive Agricultural Training Center is in Meru Kenya. It is an agricultural firm that offers private services to interested people and groups. Small holder farmers pay for training and other services available though at an affordable rate. These services include training small holder farmer in BIA practices. These activities include innovation, implementing of low- cost agro-technologies such as low -cost zero grazing stalls, cheap wooden greenhouses, raised wooden fish ponds and wood liner tanks. At BIATC, conservation activities practiced as well as improved crop management activities. The training is not only theoretical but accompanied with actual doing. Practical demonstrations take place in the demonstration section of the BIATC¹⁰³.

BIATC carry out other services that involve small holder farmers. These services are compost making, establishment of sack vegetable gardens and double dug plot vegetable gardens. In addition, small holder farmers are trained to improvise green houses, feeds, herbicides and pesticides. Some small holder farmers have established underground fish ponds whereas others have raised fish ponds.¹⁰⁴ Other activities are running an accommodation facility, selling of milk, fish and also vegetables. BIATC is an outlet for small holder farmers farm produce, fish, kids, chicks and piglets¹⁰⁵.

At BIATC small holder farmers obtain fingerlings, fish feed, seedlings at an affordable fee. On the other hand, the experts at the BIATC help small holder farmers in the construction of concrete water tanks, fish ponds as well as the improvised green houses¹⁰⁶.BIATC is an establishment of the Methodist Church in Kenya(MCK). The reason is to demonstrate to small holder farmers that they can enhance their capacities by using BIA. BIA helps in improving food insecurity through producing sufficient nutritious food from small pieces of land. Moreover, the practice helps fighting malnutrition mainly among children and expectant mothers¹⁰⁷.

¹⁰³ <http://methodistchurchkenya.org/index.php/institutions/bio-intensive> CITED ON 11/30/16.

¹⁰⁴ <http://www.umcor.org/Search-for-Projects/Projects/14217A> cited on 11/9/16.

¹⁰⁵ <http://www.umcor.org/Search-for-Projects/Projects/14217A> cited on 11/11/16.

¹⁰⁶ <http://methodistchurchkenya.org/index.php/institutions/bio-intensive> cited 11/9/16.

¹⁰⁷ <http://methodistchurchkenya.org/index.php/institutions/bio-intensive> cited on 11/11/16.

On the other hand provide nutrient rich food for their families, obtain income by using simple farming techniques. BIATC is a means to decreasing poverty by offering facilities to farmers and students as well as any interested group or individuals. The facilities give a forum to share experiences, knowledge, and skills. All which lead to a holistic human growth¹⁰⁸.



Figure 1: A map of Kenya showing the location of Meru county; a map copied from the overview of Meru-county¹⁰⁹.

¹⁰⁸ <http://methodistchurchkenya.org/index.php/institutions/bio-intensive> cited on 11/9/16.

¹⁰⁹ <http://www.kenya-information-guide.com/meru-county.html> cited on 9/27/16.

Chapter Six

6.0 Findings

6.1 Introduction

In this section of my thesis, I will write what respondents said concerning: The introduction of Bio- intensive agriculture as a way to enhance the capacity of small holder farmers in Meru-Kenya to improve food security; while conserving and restoring the environment. Moreover, I will write what I observed at BIATC as well as at the respondents' farms and at different places where I met them during my research.¹¹⁰

During my data collection period, I asked the study research questions as follows: How has Introduction of Bio -Intensive Agriculture enhanced the capacity of small holder farmers in Meru-Kenya to improve food security; while conserving and restoring the environment? How has Introduction of Bio- Intensive Agriculture enhanced the capacity of small holder farmers in Meru-Kenya to improve food security? What agricultural practices are small-holder farmers involved in that improve food security and enhance their capacity as they restore and conserve the environment? What challenges and opportunities do small holder farmers encounter as they carry out Bio-Intensive Agriculture, and how do farmers overcome them. I have used these research questions to structure this chapter.

First of all, I am going to talk about enhancing the capacity of small holder farmers in Meru Kenya to improve food security and conserve the environment.

6.2Introducing Bio- Intensive Agriculture, Enhancing Capacity of Small holder Farmers; to Improve Food Security

¹¹⁰<http://www.ncbi.nlm.nih.gov/pubmed/21138082> cited on 9/14/2016.

The respondents in this study said that Bio-Intensive Agriculture (BIA) enhanced their capacity to improve food security as they conserve the environment by helping them to: grow healthy nutritious food for their families, add value to farm produce, increase income and acquire training and education on Bio- Intensive Agriculture. I will do this by using the examples and illustrations the respondents in this study used.

6.2.1 Growing healthy nutritious food

Bio- Intensive Agriculture according to respondents in this study assures growing of healthy and nutritious food. Since small holder farmers no longer plant, crops using chemical fertilizers. Instead, they use compost manure and also crop rotation. Small holder farmers said that their vegetables grow organically. BIA technology assures them proper nutrient and vitamin intake whenever they consume organically produced vegetables. Fagi said,

The foods we consume reduce chances of suffering from diseases such as *Kisukari*¹¹¹ high blood pressure, heart disease as well as cancers. Our children drink whole milk from goats rich in omega and vitamins since we feed our goats and dairy cows from pastured grass. Hence our children develop strong bones and muscles.

Fafe said that consumers come to buy vegetables, milk, eggs, chickens as well as fish from the farms. Many are confident that the vegetables and other agricultural produce grow organically. According to these respondents, other buyers go direct Bio- Intensive Training Centre since it is an outlet for small holders' agricultural products. BIATC seeks markets for products such as fish, goat kids, local indigenous chicks, eggs, broilers, and layers.

Fafe explained how they ascertain healthy nutritious food production as she said,

We prepare the soil; add compost which is free from insects, weeds, and other destructive animals. We manage by adding neem oil to the ground. We also use predators. These are animals and insects that eat harmful animals and insects. Organic fertilizers are also a good solution. Therefore BIATC encourages small holder farmers to use containers such as sacks, polythene bags and pots to grow own vegetables for home use. Also, BIA ensures sufficient food supply all year round and hence food security.

¹¹¹ Kisukari is a Kiswahili name for diabetes

6.2.2 Adding value to farm produce

Respondents in this study talked about the importance of value addition whenever they produce farm products. Fafa explained how and why they add value as he said,

We do this by mainly preserving our produce. We ensure we maintain the original color of fruits and vegetables, taste, and also their texture as possible. We ascertain preservation of nutrients such as vitamins, carbohydrates, proteins, and minerals. We do this by avoiding decay as a result of attacks by molds, yeasts and also bacteria.

According to Trano value addition is something they consider and train small holder farmers to observe right from the start. Hence he said, “We ensure that pests and diseases do not attack our vegetable and other farm produce. We also make sure our food is clean while picking and transporting. We do this mainly for vegetables, fruits, milk and also fish.” Fachi, on the other hand also explained how she adds value to her red pepper by canning as well as making chili sauce which comes from pepper paste. Moreover, she uses the same pepper as a pesticide after making pepper solutions to spray against aphids and nematodes.

Trano, explain why preservation to add value is important by saying,

We supply when out of season and add variety to our diets. We save time and energy because we ensure our produce availability for use. In addition, this stabilizes the prices of the products in the market and ensures improved health of our consumers.

According to Traza, a small holder farmer who add value to her produce fetch more income hence increased profits. She further told, “We train small holder farmers in fish, vegetable and fruit value addition, through samosa making, fish mincing, fish butter making and also fruit butter. We ponder ripe banana and paw paws to make fruit butter.

Concerning vegetables she said, “We mainly encourage drying, grinding and storing of vegetables such as *Kunde*¹¹² and amaranths. Their powder is added to food to color and add nutrients. Amaranths are used to make tea as well.”

¹¹² Kunde- These vegetables obtained from cowpeas plants. They are dark green fibre rich vegetables.

6.2.3 Increasing income

Bio- Intensive Agriculture has helped small holder famers increase family income through maximum usage their small pieces of land to produce food. Moreover, BIA ensures improved agronomic and economic functioning, making produce stable, for example, in areas that receive little rainfall.

According to Trasello, the introduction of reduced cost zero grazing stalls as well as wood-made raised fish ponds and liner tanks have helped small holder farmers to reduce production cost. The result is increased income. Fangu, a small holder farmer, told me how she produces spinach in sacks in a nearby town. She has obtained extra income through the selling of her vegetables. Fale, on the other hand, praised BIA because of the high income from her poultry as she said,

To know what type of chicken to rear, I underwent training at BIATC. I saw many kinds of breeds when I attended seminars. The thing is we no longer run to hybrids, we have our kienyeji¹¹³ chicken. With BIATC help I make a profit. Moreover traditional chicken breeds here are diverse. No particular characteristic or standards as is with hybrids. They are chicken with maguulu or Rasta¹¹⁴ Frizzled feathers, mikune¹¹⁵, nkanga¹¹⁶, bearded, dwarfed feathered and shanks. Indigenous chicken eats less feed than hybrids, resist diseases more and sells quicker (...) However, at BIATC we are warned against thinking they are miracle birds. Hence we care for them by feeding them well and take care by vaccinating. The thing is we increase income as we rear indigenous chicken.

On the other according to Fachi red pepper production is a source of income for her. She described this as she said,

(...) Before, I used to grow maize. It failed severally due to insufficient rainfall. When I discovered BIA and red pepper farming, I decided to try red pepper. I wanted to use my piece of land specifically for income generation. Today my red pepper is consumed all over Meru, Nairobi and is exported too.

¹¹³ Kienyeji- refers to anything indigenous.

¹¹⁴ Maguulu or rasta- The name is used to refer to chicken with frizzled feathers.

¹¹⁵ Mikune- A name used to refer to naked neck chicken.

¹¹⁶ Nkanga – A name referring to chicken with barred feathers

6.2.4 Acquire training and education on Bio- Intensive Agriculture

Traza told me that small holder farmers in Meru train in BIA. The result in increased skills and knowledge acquired in: crop pests and diseases control, feed production, healthy diets, land creation, companion planting, crop rotation, mulching as well as many ways of conserving and restoring the environment. These increases food production and increase income and also led to a better environment.

According to my respondents' small holder farmers in this study are trained in the following: Composting, use of bio- slurry, drip irrigation, fish and fish feed production, construction of wooden greenhouses, vegetable and fruit growing as well as BIA livestock production. Small holder farmers are hence doing fish farming, feed production for livestock, poultry and also keep cattle on zero grazing bases in their farms. They add value to fish, fruits, poultry, and vegetables. Vegetables drying and grinding as well as making samosa, butter and fish ball from fish, and selling slaughtered chicken to hotels are quick means of increasing profit in this study.

On the other hand, they establish basket or sack gardens, kitchen gardens and use bio- slurry. These are activities different respondents performed. Traza explained to me how small holder farmers in Meru make pesticides and herbicides using BIA knowledge. They also ensure animal health, observing milking hygiene, nutrition, animal welfare. She explained that animals must be free from hunger, thirst, malnutrition, pain, injury, diseases and also ensure they are free from fear. She added that they care for the environment by not overgrazing as well as overstocking.

In the next part of this thesis, I am going to write about the Practices and activities that small holder farmers in Meru, Kenya are involved in. I will also write about the benefits, and challenges they encounter as they interact with capacity enhancing activities to improve food security.

6.3 Small holder farmers' agricultural practices and activities in Meru to improve food security

Small holder farmers in Meru are involved in various agricultural practices and activities designed to improve food security as they conserve and restore the environment. These include deep soil preparation, compost making, intensive planting, companion planting, use and growing of open pollinated seeds, mixed farming, and whole system agriculture. I will briefly explain the practices

and activities as per; the observations I made. At the same time, I will take into consideration my respondents' explanations, views, and opinions about the activities they do.

6.3.1 Deep Soil Preparation

Deep soil preparation is an activity small holder farmers in Meru, Kenya are involved in. Some of the small holder farmers in this study referred to it as deep tilling and others called it double digging as well as deep soil preparation. I will use these descriptions of this activity interchangeably. My respondents candidly said the first thing they learn in BIA is deep soil preparation. Fagi one of my respondents explained,

We dig deep to aerate the soil. One way of aerating the soil is double digging our plots. We dig manually loose the soil. The roots of our plants reach more nutrients; retain more water hence more room to grow as a result. This means the more the roots the more the plant. This results to unusually high yields in a small piece of land.

Deep tilling is an activity that was repeatedly mentioned by Traza too. I also observed it is a method used at BIATC to make seed beds as well as vegetable demonstration plots.

6.3.2 Composting

Another technique small holder farmers carry out as an essential requirement of BIA is composting. Small holder farmers learn how to make compost manure. After training, they compulsorily establish their composts using raw material from their farms. Hence Fare said,

Making enough treated compost manure is our main concern in BIA. We do this is on a yearly basis. We replenish our plots without seeking chemical fertilizers. We make this possible by ensuring almost 60% of our growing is covered with compost crops. These are crops such as maize, beans, *terere*¹¹⁷, organic kitchen and livestock waste. Composting add nutrients as well as organic matter to the soil. We sustain both the crops and the microorganisms. The soil becomes more fertile. Hence, the water holding capacity and nutrients content increase in a big manner. In addition, the soil structure is improved.

¹¹⁷ Terere- These are plants of amaranth family.

6.3.3 Intensive planting

Small holder farmers as I collected my data for this study explained how they do the intensive planting. They said it is a skill taught at BIATC. They emphasized how the practice is repeatedly taught at every seminar, workshops as well as during field trips and conferences. They said that the technic of intensive planting involves planting crops in a pattern that looks like a six- sided figure. Their crops are not in rows but appear in a pattern which forms a canopy as the plants grow in size.

According to these respondents, the method of planting allows the crops enough room to grow and use all the soil in the space. Also, this type of farming ensures when plants grow their leaves touches the leaves of the next plant. The canopy shape is meant to covers the soil. They referred to this as another way of mulching. The shade created by plants reduces water loss through evaporation and hence resulting in reduced watering. Moreover, the soil is protected from erosion and weeds are discouraged from growing. The method of planting increases the number of vegetables grown on a small plot .Fama one of the small holder farmers said, “ We are intensive planting in towns.”

6.3.4 Companion planting

Trano said,

Small holder farmers learn how to do companion planting. This is inter-planting flowers with vegetables. The bright coloured scented flower attracts useful insects. On the other hand, small holder farmers plant beans together with maize. The beans help in nitrogen fixing and cover the soil from splash erosion.

Trano further said, “The corn is trills for beans. This is where they climb”. On the same she said,

We grow tomatoes and basil, pumpkins and cucumber with taller crops. The aim is to create as vast biodiversity as possible and ensure the good of every crop is used for the good of the soil and other crops. This is material for composts.

6.3.4 Open pollinated seeds

Small holder farmers in Meru, Kenya practicing growing of open pollinated seeds These seeds according to my respondents are pollinated naturally by birds, insects or by wind. The farmers always grow seeds for the next planting season. The small holder farmers said that they select

seed from the fast growing plants which help them end up with crops that are suited for their immediate surrounding.

6.3.5 Mixed Farming

Small holder farmers in this study are practicing mixed farming. I saw the practice in the field. Few of the small holder farmers that I visited were not carrying out mixed agricultural activity. Fangu, a respondent who is an urban farmer ventured into BIA. She established sack gardens and grew spinach as an alternative source of income. The other is Fachi who was a commercial small holder farmer. According to Fachi, she grew maize many times but always was frustrated as rain declined repeatedly. Instead, she is growing red pepper using BIA methods, which have turned out to be profitable. She said, “My one acre can now produce an average of three hundred kilograms of red pepper two times in a week. The prices are good I earn up to twenty thousand Kenyan shillings per harvest.”

All the rest of my respondents practiced crop growing together with livestock or poultry or fish farming. In the respondents’ yards there were poultry, pig, dairy goat, dairy cow, and fish together with bag or plot vegetable gardens. Most of the small holder farmer had established sack or basket vegetable gardens. I illustrated this in a photo which I extracted from my research photo album. BIA is convenient for small holder farmers in this study wherever they reside. Moreover, my respondents portrayed an increased application of waste recycling methods. These included using waste as feed for fish, poultry as well as rabbits and other livestock. Emphasis was made of nutrients both for the soil as well as for the human body. I observed the acute use of organic pesticide as well as disease control mechanisms. Generally, the small order farmers who participated in this research referred to BIA as a whole system method. Hence Traza said,

Small holder farmers in Meru have learned how to manage fish ponds. This is because they train in how to increase fish production and fish pond management skills. These include how to stock fish and feed. They have learned different pests, diseases, and predators that attack fish. They can harvest their fish correctly and can keep records. They have acquired skills in animal husbandry as well crop production. BIATC train them skills in Livestock and crop production, and also we have integrated fish farming to increase food diversity among our trainees and hence to Meru community.

I also observed that Small holder farmers made feed for their livestock, fish as well as for poultry. They applied different ways of waste recycling which include re-using poultry dropping and bio- slurry as feed for fish. Conclusively Traphra said as we talked,

Our small holder farmers can establish the following; plot and sack vegetable gardens, poultry nests, fish ponds, Zero grazing stalls, can raise dairy goats as well as rabbits. These have enabled them to create land, produce more nutritious food, obtain income and care for the environment.

Below are photos extracted from my data album which I have used as an illustration of the activities small holder farmers are carrying out in Meru.



A photo from my data album showing vegetables grown in a sack on the sides and on top are onions whereas in a plot are Kale. Besides is grass meant to control run off. Flowers and onions are pest repelling crops.



A tomato growing on a plot which is covered with a polythene paper and on top of the paper is soil. The polythene paper helps the soil to retain water.



A photo from my data photos what small holder farmers referred to as intensive as well as companion planting.

Figure 2: An illustration showing Various Bio-Intensive Agriculture crop production practices carried out by small-holders farmers in Meru, to improve food security, conserve, and restore environment



A photo from my photo album illustrating fish rearing practice:
 Besides are pawpaw fruit trees, vegetables and grass to control run off.



A photo from my data album illustrating different types of indigenous chicken the barred and others.



A photo from my data album illustrating a zero grazing stall as behind is a slurry drain.
 This drains the waste from the cow shed to a waste tank. The waste is used as bio slurry and also connects to produce bio gas.

Figure 3: illustrations showing, diverse BIA animal production practices used to improve food security, conserve and restore the environment.

Small holder farmers in Meru, Kenya are involved in BIA practices and activities as explained earlier, these activities enhance their capacity to improve food security and conserve and restore the environment. Hence the photos above illustrate the following practices: crop production, pest control, mulching and pollination activities as well as fish, poultry, livestock production and waste recycling means. Hence Photo 1, 2, 3, 4, 5 and 6 illustrates; vegetable grown in a sack as well as in a plot, tomato growing on a plot with soil covered with a polythene paper, companion planting, fish rearing, poultry and dairy production respectively. All these are Bio- Intensively.

6.4 Challenges and opportunities encountered by small holder farmers in Meru, Kenya.

In this section of my thesis, I am going to write about the challenges small holder farmers face while carrying out bio- intensive activities and practices to improve food security in Meru, Kenya while conserving and restoring the environment. In this section, I have included how they overcome these challenges as well as the opportunities they encounter.

6.4.1 Challenges encountered by small holder farmers

As I visited small holder farmers, I discovered they faced challenges as they worked with BIA. Small holder farmers described their problems at an individual level. I have categorized these challenges as extension services, education, infrastructure, weed management and climatic challenges, funding, land, roads, markets, culture, feather pecking and cannibalism in poultry. I will explain these challenges according to how small holder farmers expressed them to me.

Extension services

As I carried out, this research small holder farmers said they experienced the challenge of inadequate extension services. The trainers mentioned this at BIATC, where Traza said, “Small holder farmers receive inadequate extension services. Interested small holder farmers come here to seek information. BIATC does not offer extension services.” Several small holder farmers such as Fari, Fara, and others said as they carry out BIA the greatest challenge concerns extension services. Fari described obtaining extension service to be expensive and unreliable. Fari said, “To

get extension services small holder farmers rely on government officers who are few and hence overworked!”

Education

Education is important in BIA. In this research, I learned most of the small farmers did not have adequately formal education. Some were dropouts, and others had not obtained minimum formal education though they carried the BIA practices well. Fari said, “I have never gone to school. I rely on informally acquired knowledge”. Fangu on the other hand, explained to me that Bio-intensive agricultural practices and activities have a particularly stated way of carrying them. She said,

Some rules and regulations observed while carrying out bio- intensive practices include establishing sack, garden soil, and manure. All these should be mixed well. All these practices require education and training.

Infrastructure

Infrastructure is a challenge encountered by small holder farmers in this study. Infrastructural challenges refer to problems associated with water, roads, and buildings and power supply problems. For example, some small holder farmers depend on piped water, whose infrastructure is unreliable and supply intermittent. The water supply dries mainly in the dry weather period. Fabro one of the small holder farmers, for example, mentioned this while I visited their farm as they said,

We encounter some challenges as we carry out the activities in this farm. Our challenge is the water shortage. Watering our plants and animals is costly. Hence we mulch and shade where applicable to reduce water use. We also use pipes for drip and underground irrigation in some parts of the farm. In addition, we use bottles and drip irrigates young tree plants.

Fari also talked about water challenge as he said,

I experience water shortage sometimes when I am running all the activities in this compound. The reasons, why I take longer time than expected to drain the fish ponds is to conserve water. I have

only two water tanks which collect rain water. Sometimes I buy water when the borehole water level is down.

Fangu also talked about water. She said it is expensive to obtain water in town. She explained the water challenge saying,

Water is a factor that discourages many farmers from carrying out these engaging agricultural activities and practices. These include growing vegetables just as I am doing. Others are such as what the government is encouraging; fish farming. Water cost increases the general cost of production. When I visited one of our slums, I was amazed. *Kibira*¹¹⁸ small holder farmers are outstanding urban farmers.

Fabro explained their encounter with sometimes dust roads. He said this as he was talking about how dust covers their farm produce. Fabros' told me their farm is besides a dusty road. Hence their farm's produce is usually dirty and unclean. They said they clean before selling and also use overhead sprinklers to water mainly along the road. Fabro called their nearness to the road an advantage and a disadvantage. Moreover, Traza explained poor roads as a serious problem as she said,

Most of the small holder farmers live away from the main road. They use carts and other poor means of transport to reach the markets. We are encouraging them to sell their products in the farm. Though they do not get good money for their produce, they save their farm products from wasting. However, our food security target is achieved. They supply nutritious food not only to their families but also to their neighbours. Others are engaging in value addition activities depending on their financial capabilities.

Weed management and harsh climatic conditions

Some farmers described thorns as a challenge affecting their farming activities. Fabro mentioned this when I visited their farm. He said,

¹¹⁸ Kibira – This is one of the biggest slums in Kenya.

(...) Our garden has thorns, a thing we want to clear with time. Thorns hinder us as we carry farming. Sometimes they pierce water pipes. Anyhow, we are trying our best to make the land appropriate for farming activities.

He further explained,

This area is according to me is supposed to listed in the semi- arid parts of this country. The neighboring district is among the ASAL¹¹⁹. Thorny vegetation is very common, and it is a hindrance to our activities. In fact, this is why we grow fast growing tomatoes, mangoes, and cassava.

Funding

To carry out Bio- intensive agricultural practices requires funding. Small holder farmers such as Famai(s) expressed a desire to do better saying, “we are yet to do more.” We require funds to establish some structure necessary for BIA. Others, Faboys for example, said despite what they had done, it took them long to start due to insufficient money. Money is a challenged which common among poultry, livestock, fish and crop producing small holder farmers.

Small holder farmers had this to say. “Fingerlings and fish feed are usually in short supply and sometimes expensive.” Trano stated the same but different as follows:

Our fish project is a demonstration of microfinance. We encourage small holder farmers to establish fish ponds. We advise on what to do where and when. We provide fingerlings, fish feed at an affordable cost. We produce feed for livestock, poultry, and fish. We pack in small quantities that farmers of different financial ability can afford. On the other hand, we connect small holder farmers to we established poultry farms and to fish farmers to fisheries such as Thika aquafarm, Sagana fisheries or other farmers. We encourage farmers networking. Networking is good in exchange of knowledge and skill. The practice worked for several women groups in Meru. On request, we visit farmers. We help them to improvise feeds mainly depending on what other activities they carry. We are giving as much support as we can to fish farmers especially on request.

¹¹⁹ ASAL- Means the Arid and Semi-Arid Lands.

According to my observations, small holder farmers' capital is low. The challenge was mentioned by Fangu as she talked about the money required to start urban farming. She said,

(...) Adequate vegetable production requires a farmer to buy a minimum of ten sacks. However one can buy up to hundred depending on financial capability. One bag costs around two thousand Kenyan shillings. Moreover, farmers need a plot measuring approximately fifty by hundred feet. Part of the plot is to live on, and the other part is for agricultural practices. Besides, a sprayer, manure, and soil. The soil recommended that which comes from the forest or farm soil and later we treat it. We treat the soil by sieving and adding effective microorganisms and then dry under protection from direct sunlight. In this case, I store the soil in sacks on a raised ground to avoid contamination. Another thing a farmer need is a water pipe and a reliable water source.

Land

The land is another issue small holder farmers expressed as a challenge. Some have rented land. Others have co- owned family land as was said by Fabro. Fari was also talking about inadequate space to do things as per the set standard requirement. Consequently, he established poultry nests above the fish ponds. Little did he know that the chicken droppings are feed to his fish! To express this, he said,

(...) I had initially started poultry rearing. My objective was a source of income and food for home use. Late re-use of waste came up. So as I did my tailoring I had my chicken (...). When activities increased here, I thought of the useful waste use of waste from different activities in this compound. I mainly thought of waste from the maize mill and the kitchen. Space became a challenge; I had to modify the fish pond as well as the poultry nests. I carried the nests up. Little did I know my birds dropping is good a feed for fish (...)

Market and culture

Other farmers mentioned market for their produce as inadequate. The challenge mainly faced fish farmers. I observed as a fish buyer visited Fari hoping to buy fish yet Fari could not fish. Fari was unwell, and no one else could harvest fish on his behalf. Fari lament is, he is only who can fish. "I lack appropriate fishing tools." He said.

A fish buyer also confirms the market challenge when I inquired from him how he had known that Fari had fish for selling. He said that a friend told him about Fari's fish. Fari instead answered saying, "information about my fish is passed on by and "word of mouth." .I connected this with the challenges of inadequate advertisement facilities. All this according to me concerns marketing.

Other small holder farmers including Fama mentioned culture as a challenge. Culture affects market and establishment of some BIA activities. For example, Fama ascertained that fish is not a cultural food for the Meru. Fama stated, "Meru peoples' traditional diets are not fish." Fama said, "Furthermore when our government introduced fish to us, Meru people, they retorted saying, "take fish to the *Luo- Nyanza*.¹²⁰" I noticed the same attitude expressed by Fari's friend as he talked about fish saying "The smell of fish is terrible." He added by sharing his experience on fish encounters. He said, "The first time I cooked fish, I threw away the pot after cooking. The smell did not go away even after a week". He further said,

However, I improved a bit. I eat fish because of the healthy benefits attached to it. It is good food when it comes to controlling coughs and flu. My friend Fama always encourages me to eat fish especially when I see how he enjoys fish meals.

Feather pecking and cannibalism

Feather pecking is another challenge that small holder farmers encounter. Faboy raised this as a challenge when he said, "I experience challenges in poultry keeping. These are feather pecking and cannibalism." When I sought to know what they meant, Faboy explained the matter as follows,

In a flock like this one (*Now pointing at her poultry*), there is a social order. This order means the flock is not equally ranked. Hence, pecking occurs to establish the order. In such situations, small pecking is allowed. We see it as normal.

She continued explaining feather pecking and as he said,

¹²⁰ Luo-Nyanza- They are people of Kenya who live in the lake region of Kenya.

Feather pecking is when birds pull out the feathers of other birds. The habit is dangerous because it damages plumage and harms the other bird's skin. The damaged skin is wounded and hence red with blood stains. The presence of blood and wounds provoke cannibalism. The physical appearance and feel of the feather is an important feature in feather pecking and feather eating.

Feather pecking is commonly among egg-laying hens. Fale explained the habit as she said, "When hens start laying eggs, they develop the habit of pecking their short feathers more regularly than long ones." She added by explaining the basis of her views;

I spend a lot of time observing these birds. I have learned so much, and I feel good to let people know some behaviors like these among birds. For example, hens that lay brown shelled eggs feather peck more than those which lay white shelled egg".

Concerning cannibalism, Faboy said,

Cannibalism is a situation where a bird pecks and cut the other birds skin. Then it eats the meat of the other in the flock. The behavior can occur to birds of any age or breed. I saw my friend's ducks and turkeys attacking each other and pecks till the other die. Cannibalism is dangerous because when a bird die each and every bird starts pecking the carcass. We normally say that cannibalism is something that birds learn and can spread speedily in a flock.

He added,

If one bird starts pecking, others can start doing the same. Hence every poultry farmer is encouraged to keep a close look on the flock. Cannibalism can trigger significant losses almost equivalent to diseases outbreaks. The habit can initiate birds' injuries and even death. We have no room for losses.

Hearing different farmers' views concerning the challenges they face I asked my next research question that asked: How do small holder farmers overcome the challenges they encountered as they carry Bio- Intensive Agricultural practices and activities. Hence in the next section of this chapter I am going to write on; how different small holder farmers overcome the challenges they encounter while carrying out Bio- Intensive Agricultural activities and practices. I stated the responses according to the small holder farmers' views, suggestions, and practices.

6.4.2How small holder farmers overcome the challenges they face.

In this section of my thesis I am going to write how small holder famers overcome the challenges they face as they carry out BIA. I will explain the strategies applied to overcome the challenges already explained earlier in this study. The challenges are extension services, education, infrastructure, weed management, and harsh climatic conditions, funding, land, market, and culture as well as Feather pecking, and cannibalism.

Extensive services challenges

To overcome the challenges related to extension services this research has found out that small holder farmers have discovered non-expert ways of carrying out BIA. For example, to breed fish, Fari said,

I breed my fish mechanically. I kill the male fish to obtain sperms from around the head. I then press out eggs from a female fish. I observed since the time I started keeping fish; I know how a fish which is ready to release eggs looks like.

Fari said despite that he sometimes sought for artificial insemination services when he was starting fish farming. According to Fari he not only breeds fish himself but also fed his fish using locally available feed such as poultry droppings, waste from his kitchen and also searched for some water weed from a nearby lake.

Other small holder farmers such as Fara said that they seek expert knowledge from the government extension workers. According to Fara government extension workers are not efficient because they are few. Moreover, small holder farmers wait for long before they obtain extension help. Some of the small holder farmers said they always consult trainers at BIATC though they kept emphasizing that BIATC trainers do not carry out extension work.

My respondents for example Fafe embraced the aspect of a farmer to farmer knowledge exchange. Hence Fafe said,

We help one another do our BIA activities. Some of us know how to, vaccinate as well as treat sick animals. We help a cow- calf and also trim the beaks of our poultry. We also do artificial insemination for one another. On the other hand, we help each other in establishing sacks or plots for vegetable growing. We have finally become trainers. Doing these things by ourselves is fun.

This respondent's views concurred with what Trasello told me as we traveled to Fabros farm. She said that; "Small holder farmers are trained to obtain skills and knowledge, and we expect them to use these skills and knowledge for both themselves and other farmers." She explained, "We train small holder farmers to use organic techniques which are suitable for healthy soil formation and structuring and those does not harm nature." To clarify the same, she added,

Nature in our context refers to all things including human beings, plants and animals, air, water, soil and the atmosphere. The things we emphasize on during our training sessions are: composting, making the slurry, utilizing manure and slurry. We train on building wooden greenhouses. I am happy you will see such greenhouses at Fabros. Other simple and cheap practices are drip irrigations, producing feed for fish and all livestock, crop production, rabbit, chicken rearing and zeros grazing.

Trasello assured saying,

Most of these are well set at the farm we are visiting. Farmers can assist a calving cow; they rear goat for milk. Fabro has a goat for milk. In fact, we ask farmers who want to start goat rearing to buy young goats from the Fabros, whenever they are available. We help in the marketing of farmers' products. We try our level best to be an outlet for their produce. Farmers learned skills required in beekeeping and also value additions on vegetables. Vegetables are available for their families when they are in short supply.

Educational challenges

To overcome the challenge of inadequate and low education different ways to train and educate apply. Training through seminars, workshops, field trips and networking among small holder farmers. Hence Traza a respondent in this research said,

To ensure that small holder farmers in Meru can carry BIA, we train them to increase fish production by training in fish pond management and practices such as stocking, feeding, soil and water quality, fish diseases, and their control, harvesting, and also record keeping.

Infrastructural and funding challenges

Small holder farmers are overcoming infrastructure problems by carrying several BIA activities. These include mulching, growing drought resistant plants, and harvesting rainwater. Fangu, one of the respondents in study, said,

When I am preparing my seedling after planting, I cover the top of every sack with grass. The grass must be dry to help the soil to maintain moisture and protects the growing seedlings from direct sunlight.

I saw the practice at Fabros' farm. They spread dried weeds of the grass family at the base of tree seedlings and also under banana trees. The mulching is common in their nurseries. Mulching is a practice that Traza talked about extensively during the interviewing session with her. She explained why they had mulched some of the demonstration plots at the BIATC and said;

We mulch and we also train farmers' to mulch. Mulching is one of the many ways of soil and water conservation. We always let our small holder farmers to know the benefits of mulching. Mulching has multiple advantages in BIA. It helps moderates the soil temperatures. When it is very hot mulching helps the soil to hold water because the soil is protected from direct sunlight..

Traza continued,

Mulching helps in nitrogen fixing. It helps reduce weeds because mulches cover the soil and hinder sunlight. Moreover, mulching is important, it add manure and important nutrients to the soil. Sometimes we encourage farmers to mulch using material from *Mang'au*¹²¹. Mulching protects the soil from splash erosion.

Traza categorized mulches as dry and live mulches,

Hay, straw, leaves, waste paper, saw dust are mulches. We put these in the category of dry mulches. We too have live mulches. All fast growing cover crops like spreading beans, pumpkins, and sweet potatoes are in this category. Hence we do companion planting as well as intensive planting. Mulching suppress weeds and help to fix nitrogen in the soil and control soil erosion.

Mulching according to these respondents reduces soil disturbance but allow growth of useful micro-organisms. According to Traphra, small holder farmers always mix manure with the planting soil. By doing this they address to the problem of water challenge. Besides, this respondent said,

Some of our small holder farmers live in slightly hotter and dry area of Meru for example Buuri¹²². That is Rwanda¹²³. Hence we train them to adhere to set rules of effective mulching- These are

¹²¹ Mang'au- This a kimeru name that refers to waste material from beans plants

¹²² Buuri- This is one of the areas in Meru.

things such as mulching height. Mulching height is important mainly in areas encountering water shortage like Rwanda. So farmers must ensure the mulch height is from two to four inches. The soil retains water better for a longer time.

In addition to mulching, small holder farmers water their crops at a correct watering time. Observing the time set for watering by *wataalamu*¹²⁴. Using specified amount of water, using appropriate methods of watering, re-using used water in the entire farm. Trano explained,

We train small holder farms on watering of plants. Watering has several purposes. One is to save water and control evaporation. The reason is the more reduced evaporation the more atmospheric heating (warming) reduces. Hence we encourage small holder farmers every time to ensure they water their vegetable at the right time. They water their crops at the appropriate time of the day. The recommended periods, is early in the morning and preferably in the evening.

He added,

Farmers should be aware of their soil type. Not to over water because over watering consumes more time, leads to overwork and it is wasteful. We train farmer to use the spade to check the wetness or dryness of the soil. When damp we encourage farmers not to water but if dry that is a sign that the soil needs watering. Alternatively, we want farmers to learn to look at their crops. These shows when they need watering by the way the leaves look as well as their position. These are called the signs of water stressed plants.

During my research period, I noticed Small holder farmers apply several techniques to conserve water other than mulching. These are sprinkling, watering using watering cans, hose pipes and seep hoses. Another technique I noticed is collecting rainwater for storage. Small holder farmers have established water storage tanks. These are both plastic as well as cemented tanks. Many farmers said that the tanks are expensive to buy or construct. For example, Famai said,

We have formed self-help groups. My self-help group is called *Wirigiro*¹²⁵. When we meet we collect a set amount of money from every member monthly and this money put together. When it reaches a specified amount, we buy two members a tank. These tanks help us to obtain water for agriculture and domestic use.

¹²³ Rwanda- This is a name used to describe an area with weather hot, dry conditions.

¹²⁴ Wataalamu- This is a Kiswahili that is used to refer to a specialist.

¹²⁵ Wirigiro- It is a Kimeru name that means hope.

The description above is not only solving water challenge but also funding issues. In addition to forming self-help groups, small holder farmers receive donor aid from non-governmental organizations and private individuals. I will briefly elaborate about aid according to Traza and Faboy in this study.

Traza said that USAID,¹²⁶ and other aid- giving bodies have sponsored initiating fish farming as well as establishment of low- cost greenhouses. Small holder farmers contributed a third of the cost whereas the rest is donation from these bodies. The government too has played a role by sensitizing on diversification of food. Moreover, it is providing extension services in animal, fish and fish farming in Meru. Private individuals such as Faboy sponsored a group of street boys to establish urban poultry.

Land

The land is a challenge to urban residing small holder farmers. These farmers have addressed this problem by maximum use of the available land. Some small holder farms were a beehive of activities. For example, Fabros who owned a land of about three and half acre and Fachi who shifted from maize growing to hot pepper. These farmers maximally utilized their land.

The same case applied to those who owned small pieces of land as Fari, small holder farmers who lived in town or in the outskirts of the town in rented or hired plot. Others graduated from hiring to owning. Bio-Intensive activities according to this research respondent enabled them to obtain money enough to buy plots measuring hundred metres by hundred metres. Fangu, one spinach small holder farmer explained,

When a small holder farmer buys such land, she will just require a fifty by hundred plot which half to grow spinach. The remaining part is to live. I always advise people with their plots to try BIA since it will always earn them extra income and minimize the cost of life in town.

Small holder farmers said concerning handling the land challenge, “We create land (...) by buying soil from farmers who own land. We also collect soil when people want to construct in town. Then put the soil in sacks and lean the sacks by our house wall.

¹²⁶ USAID- USAID stands for United States Agency for International Development.

According to Fata, she has been given a housing portion by his brother. She expressed this as follows,

I lean these sacks on my house walls since my brother has given me only a housing portion (...). From these sacks of vegetable I get daily vegetables for my use, I sell though (...). I always appreciate the BIATC trainers. Their methods have brought hope to me. Might be next time you will find me in a different place. I carry knowledge. All I lack is land to make it work.

Concerning markets, the small holder farmers are supplying their produce to their neighbours. On the other hand, BIATC is helping small holder farmers to access markets. For instance, BIATC buys small holder farmers' produce and then sells it on their behalf. In addition to buying and selling small holder produce, BIATC is training small holder farmers on value addition which leads to selling fish in different forms. After harvesting vegetables, they dried and preserved. Therefore they can be sold when they are in short supply.

Feather pecking, cannibalism and disease control measures

Small holder farmers who specialized in BIA poultry farming explained how they overcome feather pecking, cannibalism and poultry diseases as follows, "We encourage caging our birds as compared to free range. Moreover we stock in small number. This makes the pecking order established hence reduced pecking challenges," Fale.

According to Faboy the most severe behavior among birds is the aspect of cannibalism. We discouraged the habit as follows,

The first this we observe is overcrowding. We ensure there are enough rooms for bird to perch and enough room on the floor of their nests. Another thing we avoid is we control overheating. We ensure poultry house heat is balanced accordingly. Finally, we control lighting. Since too much light encourages cannibalism.

In addition, Fale said,

We balance the heat in the poultry house, control lighting and ensure enriched nutrition. Moreover, we involve birds in pecking activities. In addition, we protect the birds from injuries (...) and remove the injured and dead birds if any.

As far as diseases are concerned, small holder farmers who kept poultry said that they overcame diseases through involving government extension workers. They helped immunizing their chickens. Moreover, they trained in how to care for their chickens. According to Fale, chicks are immunized when two weeks old. Traza says to control diseases the BIATC helps farmers to obtain chicks, which are local but cross bred from KARI¹²⁷. The local chickens according to her are cheap and easy to keep. They feed less and are disease resistant. Moreover, they are bred easily by just introducing a cock of the desired breed to the local chickens.

6.4.3 Opportunities small holder farmer encounter as they carry BIA practices.

As I interviewed respondents in this study most of them appreciated BIA as a means of obtaining food security, increased income, waste recycling, conserving the environment by conserving resources, management of ecological relations, acquisition of skills and knowledge, growing and keeping adapted breeds as well as health promotion. I will explain these opportunities briefly according to how my respondents' expressed them as I interacted with them and the BIA practices.

Food security

BIA is a method of farming that targets high yields due to activities small holder farmers are required to perform. According to Fale, practices such as deep soil preparation lead to well aerated soils. On the other hand, the roots of the crops access more nutrients from the soil. Additionally the soil holds increased water and also has more space to grow. Traza said, more roots in a plant results in unusually high yields.

Moreover, BIA leads to increased food security because it encourages biodiversity. The respondents in this study said biodiversity one of the targets of BIA. Small holder farmers carry out activities such as intensive planting. Hand in hand with intensive planting is encouragement of mixed agricultural practices. These according to Trano include livestock keeping together with crop production. On the contrary BIA encourages diversifying fish as well. Trano said,

¹²⁷ KARI –Kenya Agricultural Research Institute

These activities put together have made small holder farmers in Meru achieve the following. One, produce more nutritious food for their families by efficiently using their small pieces of land. Two, by applying appropriate BIA methods.

Hence attained food security which is having sufficient, safe, nutritious food at all times physically, socially and economically to meet their dietary needs as well as food preferences for a healthy and active life¹²⁸

Increased Income

The respondents in this study said that through the use BIA practices, they have increased their income. Fangu explained how establishing of vegetable gardens has helped her income. Other small holders such as Fachi earn more from their small pieces of land. After shifting from commercial maize planting practices to chili growing. Other small holder farmers too said they are getting extra income from milk, poultry and also fish farming.

Recycling of waste

BIA also enables small holder farmers to recycle nutrient by growing cover crop, establishing compost, and mulching. The later is practiced by Famais. Women who mulched between the maize rows. The practice enabled their maize to resist the harsh drought that struck the area. Fale grew tomatoes in a plot which is prepared using BIA method. Then she uses a holed black sheet of polythene bag spread under the soil to conserve moisture. Small holder farmer explained how they applied by bio- slurry and other waste from livestock to their crops. All this is about recycling.

Conserve the environment

The respondents in this study apply BIA technologies to conserve the environment. This research found out that conserving environment included conserving resources and reducing toxics from the environment. They described this as an opportunity for them. Traza said that the entire process is concerned with care for the environment. Then she said in conclusion,

¹²⁸ <http://www.fao.org/docrep/005/y4671e/y4671e06.htm> cited on 11/16/16.

We aim at not harming animals, man or our surrounding through pollution. Hence most of our inputs are organic. We boldly say we are conserving and restoring the environment.

The small holder farmers embraced the use of natural pest repellants such as American marigold, rosemary, coriander, onions and pepper. Moreover, they praised the use of medicinal trees such as neem whose solution is a pesticide for both plants and livestock. Small holder farmers such as Fachi use Pepper concoction to clear aphids and nematodes.

Conserving Resources

Use of BIA technologies has enabled small holder farmers to conserve resources. They have conserved the soil by use of minimum digging or no digging. Famai in this study does not dig, they mulch instead after planting. Moreover, they clear weed by hand picking. According to these respondents they apply God given grace in their farm practices. Famai said,

This grace enables us to carry out all farm activities. Before we tilled, weeded and yet our crops dried due to drought. This time we just mulch, hand pick weed, no chemical spraying, yet we will harvest to the full.

Small holder farmers are conserving water. This is through hand watering and double tilling strategy. According to Famai, hand tilling does not harden the soil nor does it disrupt the natural soil arrangement. Hence she said, “We ensure the soil is the way God wanted it be so that it can produce food for us. This makes water to penetrate well. Moreover the water conserving capacity of double tilled soil is high”. On the other hand, Water from kitchen, bathrooms and fish ponds is reused. They use this water to water their crops such as arrowroots, vegetable and other crops as Fabro said. To conserve water the respondents said they did dry farming. Trano explained this as follows,

Dry farming is a method of farming which involve growing of drought resistant crops. On the other hand we advise our farmers to plant the seed deep in the soil and mulch. This is all dry farming. It is a practice found in Rwanda, Buuri Chuka and Tharaka. All these areas receive very little rain. They also have water shortages.

Another opportunity is BIA practices helps in conserving energy. Respondent in this study said as they interact with bio intensive technologies they conserve energy. The practice involves activities such as handpicking weeds from sacks after work in the evening. Hence Traza said, “BIA activities do not require use of machines and high intensive physical labor.” According to her what is required is use of body strength which is a health routine to the small holder farmers.

Moreover Traza said that bio intensive practices lead to genetics conservation by saying,

In this situation farmers avoid hybrids. Alternatively farmers ensure open pollination takes place. The seeds produced are almost similar to the mother plants. We refer to these as heirloom. Bio-intensive practices encourage heirloom varieties.

Meaning the seeds produced have same qualities as the mother plant as much as possible. Fabro, a respondent in this study told me that he and his brother allowed some weeds to grow around their green houses. Small holder farmers are conserving forests by tree planting and growing trees together with their crops. The respondents said that they plant trees along roads as well as growing both fruit and tree seedlings in their nurseries. Moreover, they are using bio gas as the source of energy in their houses for cooking instead of wood fuel. All those are conservation practices.

Management of ecological relations

Another opportunity the respondents in this study talked about is bio intensive activities have enabled them to manage ecological relationships. Fabro explained this as we stood by their greenhouses saying,

See, these weeds growing on the sides of these greenhouses attract not only insects such as bees and butterflies but also frogs. The frogs feed on insects such as mosquitoes. You know mosquitoes like dark places. They are food for frogs. Bees help in pollination. These bees are coming from our beehives you know? We were taught all this at the seminar. The extension workers said that our activities manage ecological relationships. Because organisms are related to each other as well as to the environment around.

This also was mentioned by Famu when she said,

We control pests by use of pest repelling plants. We also control weeds by just picking using our hands. We care for our environment. It is our priority in all our activities. We like when we grow many plants together. See maize, vegetable such as kale, spinach, cucumber and cabbage and our Kunde¹²⁹.

Fachi said as conducted my research that she discovered pepper concoction controls soil diseases and controls aphids. As I visited several Smallholder farmers' farms, plots and their varied activities I observed they were diversifying species as much as possible. They managed diversification through inter cropping. In addition, they were enhancing useful insects through planting different flowers. They were recycling nutrients using residue from, beans to cover the soil and other waste such animal manure , kitchen waste were all used as raw material for compost manure.

Acquisition of skills and knowledge

Some small holder farmers train others on bio intensive activities such as establishing a vegetable plot or sack. Other such as Fari charges whoever goes to learn at his project. Fangu and Famu also said they not only practice the bio intensive activities but also they have become trainers. They can make balanced meals which includes fruit and vegetable salads. Moreover they have learnt more about different diseases and how to control using healthy diets. Fari told me that fish is good for children as well as adults. According to him consuming fish increases lifespan of people with terminal diseases such as HIV/aids.

In addition small holder farmers increase their knowledge as they share knowledge, expertise, experiences as well as skills. This is also enhanced in their networking and also connections with research centres such as the ones mentioned in this study.

Growing and keeping adapted breeds of animals and plants

According to the respondents in this study, they grow crops and keep animals that are suitable for the Meru environment. This included the fish. The green houses are not compulsorily used. They are used when they are needed. This is for example when they are growing cucumber, pepper and chilies. In other occasions is when they are growing tomatoes. Traza said, "We use greenhouses

¹²⁹ Kunde – This refers to local vegetables from cow peas which are consumed so much in Meru.

only when it is a little hot ,for example in the month of June, July, august, September and part of October.

Healthy Promotion

Bio intensive practices promoted health in Meru. This is a statement that was stated by Fagi as she tried to answer the question in relation to the opportunities small holder farmer encounter as they carry out bio intensive activities. She said,

We produce and eat health food. This food is not just for us but also for our neighbours. Traphra talked in a conclusive manner saying, “bio intensive activities value health. This is because we farm organically caring for both human health and other living things. This includes air, soil and even the water. We ensure Meru people obtain healthy food .Hence we introduced fish farming.

Chapter Seven

7.0 Discussion

7.1 Introduction

In this chapter, I will discuss the findings of this research. The findings in this case, are responses to research questions obtained from: The small holder farmers and BIATC trainers', their perspectives, descriptions, activities, and practices. In addition, I have included the observations I made as I carried out my research. I have discussed these findings in view of how these respondents answered this study's research question. The research question states: How has introduction of bio intensive agriculture (BIA) enhanced the capacity of small holder farmers in Meru- Kenya to improve food security; while conserving and restoring the environment?

To answer this research question I used sub research questions. These sub research questions are: How has Introduction of Bio- Intensive Agriculture enhanced the capacity of small holder farmers in Meru-Kenya to improve food security? What agricultural practices is small holder farmers involved in that improve food security and enhance their capacity as they restore and conserve the environment? What challenges and opportunities do small holder farmers encounter as they carry out Bio- Intensive Agriculture, and how do farmers overcome these challenges?

The responses to the above sub-research questions for this study in conjunction with the three determinants of capacity enhancement form the structure of this chapter. The determinants of capacity enhancement are the theoretical approach for this study. Additionally, the responses I obtained from different respondents, their narratives, practices, and my observations are the actuality. The three determinants of capacity enhancement UNDP (2009), are observed in relation to the activities and practices small holder farmers and the BIATC trainers are involved in. These

determinants in question are: The enabling environment; the organizational level and at the individual level¹³⁰.

I am going to intertwine the theoretical approach and actual BIA activities and practices that small holder farmers are involved in. These two forms the structure of my discussion chapter. Therefore, the subheadings in this chapter are: Enabling environment and actuality; the organizational level and actuality and the individual level and actuality.

7.2 Enabling Environment and actuality

Enabling environment according to UNDP (2009) refers to a conducive social set up where people and organizations operate. In enabling environment all the rules, policies and laws that govern the said people and organization are considered. In addition, it refers to examining the power relations as well as the social norms that regulate civil involvements. The enabling environment controls the entire extent of capacity enhancing.¹³¹

An enabling environment determines sustainability and effectiveness of the set ideas and practices aimed at enhancing people's capacities. Therefore, it is important to set an enabling environment for decision makers and stakeholders to see the need for any intended action. Considerations should be made in relation to technical requirements; technical aspects that a system must accomplish. These are matters in relation to performance, reliability and availability. The important thing here is considering the quality of services offered¹³² and also the social, economic and the policy requirements.¹³³

As far as this study is concerned, BIATC is the organ that carries her capacity enhancing activities to small holder farmers. To be able to do these activities Traza said there is an established operational board. The board oversees how BIATC is run to ensure sustainability and effectiveness of the project. Hence she described BIATC to me as follows;

¹³⁰http://www.undp.org/content/dam/aplaws/publication/en/publications/capacity-development/capacity-development-a-undp-primer/CDG_PrimerReport_final_web.pdf cited on 10/28/16.

¹³¹http://www.undp.org/content/dam/aplaws/publication/en/publications/capacity-development/capacity-development-a-undp-primer/CDG_PrimerReport_final_web.pdf cited on 10/31/16.

¹³²
¹³³<ftp://ftp.fao.org/agl/agll/ch10/Enaenv.pdf> cited on 10/31/16.

BIATC is a church project. (...)The MCK presiding bishop appoints the board members. The board consists of the following; a member from the ministry of livestock, a member from the ministry of agriculture, two from the community and members from the church. These represent BIATC wherever they are. Board members elect three out of the entire group. These make the executive of the board (...) signatories when we need to transact funds. The manager is the secretary of the board and oversees the running of BIATC.

Traza's statement shows a created enabling environment in the BIATC board membership establishment. The board membership represents different arms required to establish an enabling environment which are the: technical, social and economic. The board membership represents government whose representative is the civil servants from the ministry of agriculture and livestock. The society's representative is the church and the community is represented by the community members who according to Traza are small holder farmers. Hence she explained,

We cannot do without the government nor the church as well as the community. The two members from the two ministries help in offering technical ideas and skill. We invite them to facilitate seminars and workshops. Our trainers are trained experts in their department. In addition ,we offer service for a fee(...) The rule here is every department is self- sustaining. We never seek aid from the church nor does the project give money to church despite the fact that the project is engineered by the MCK.

The BIATC board composition portrayed presence of key features which make an enabling environment. These are: the technical which is taken care by BIATC experts and the two members from ministry of agriculture and animal production. As far as I am concerned this assures availability of expertise knowledge and reliability in that the BIATC are full time works. Therefore running BIA practices and services to small holder farmers in Meru is easy.

The social, economic as well as policy considerations are also observed in the same BIATC board formation. This is where the society is represented by the church as well as small holders farmers elected in the board. The economic aspects in attended to too. This is because Traza said that departments are self-sustaining. This meant the project generates income to enable its running. As we were discussing BIATC financial sources she stated that NGO such as USAID

and other partners too fund initiation of some projects. This ensures they cater for the economic and social issues for them to achieve their set goal¹³⁴.

This (...) helps small holder farmers to obtain sufficient food and income while conserving the environment as well as maintaining biodiversity through use of BIA technologies. These are composting, manuring and use of bio slurry (Traza).

These are paramount in ensuring an enabling environment¹³⁵. On the other hand according to Traza the board and the personnel all work as a team. Hence according to this research the sustainability and effectiveness of BIATC and her capacity enhancing activities is through networking, connectedness and partnership. This help in reach small holder farmers hence extension services, market, training and sensitization are offered. Moreover BIATC connects small holder farmers to the broad world. This is seen in Traza's explanation when she said,

(...)We partner with the external world too. This is presented by USAID¹³⁶. USAID funded small holder farmers in a project we called snow peas farming. Small holder farmers were assisted to establish low cost green houses. USAID provided three quarters of the total cost whereas the small holder farmers provided the remaining quarter. Besides we partner with U.S.A Missionaries. Some are from Texas mission and Colorado. Whenever they come they help in renovation.

As per some respondents the BIATC network with the church and the community. This was confirmed by Trasello when she told me,

We reach small holder farmers by going to church gatherings, chief's meetings, schools as well as to women groups. This is when we want to pass new information or introduce a new product. We use our trainees too to pass on information by word of mouth and their activities. Furthermore when we visit small holder farmers we ask them to invite friends and neighbours. At times like this we tell the importance of BIA in obtaining food security, environmental conservation and restoration. Also we demonstrate what we do for example simple practices such as establishing a sack kitchen vegetable garden and also compost making.

Other agricultural institutions and projects cooperate with small holder farmers and BIATC. This is to offer services to small holder farmers in Meru. This is mainly in fish farming, dairy and

¹³⁴<http://www.fao.org/docrep/017/i3121e/i3121e00.pdf> cited on 12/9/16.

¹³⁵http://www.rti.org/sites/default/files/resources/Brinkerhoff_pub.pdf cited on 11/7/16.

¹³⁶USAID- This refers to United States Agency for International Development

poultry activities as well as vegetable gardens. Small holder farmers such as Fari obtained his initial fingerlings from Sagana fisheries. Other small holder farmers get extension services from government extension officers. On the other hand information is offered by agricultural research centres that work hand in hand with BIATC as mentioned earlier for example KARI. Fale during my data collection session explained how she attends seminars organized by KARI.¹³⁷

Moreover according to Trano the other agricultural bodies that work with BIATC and small holder farmers in Meru is Thika aquafarm. This was explained by Traza when she said,

We connect small holder farmers to get goats, cows, pigs and chicks. This is the objective is to ensure the small holder farmers benefit. We connect small holder farmers to other small holder farmers too.

The above paragraphs show presence of the key considerations to be met in the presence of an enabling environment. These are the technical considerations, social and economic.¹³⁸ BIA has enhanced capacity of small holder farmers in Meru to improve food security while conserving the environment. This is because many are using their small pieces of land, plots, sack vegetable gardens for subsistence food supplies and economic benefits. This means reduction in poverty. There is now more food, more income as many respondents said. BIA activities on the other hand can be established wherever small holder farmers are including in urban places and also in villages. This includes drip irrigation, raised fish ponds, green houses, rabbits, poultry, fish production and also crop production. On the same note they are making compost, bio slurry whereby the latter is feed for livestock and fish for some small holder farmers.

7.3 The Organizational Level and Actuality

Organizational level in capacity enhancement refers to considering the internal structure, rules, policies and processes that determine an organization's success. At this point the advantages of enabling environment are considered. They are put to work and also individuals congregate. This

¹³⁷KARI- This Kenya Agricultural Research Institute.

¹³⁸<http://ftp.fao.org/agl/agll/ch10/Enaenv.pdf> cited on 11/3/16.

means the more organized the resources and components are the stronger the enhanced capacity¹³⁹.

As per this research the organization is BIATC. Her background, mission, vision, goals and objectives form her internal setting. BIATC is a church project which is established as a way of the church to respond to poverty, joblessness, landlessness, environmental degradation and food insecurity. Hence BIATC majors in demonstrating that small holder farmers can grow nutritious food. They can also increase family income as they apply BIA technologies in the available land¹⁴⁰.

BIATC enhance capacity of small holder farmers by offering training, information, inputs and enhanced marketing. Moreover the project's objective is to help the local community to obtain enough nutritious food for their families. On the other hand obtain additional income by selling their land produce which are produced using BIA methods. Her internal organization is established observing the background, mission, vision, goal and objectives of BIATC¹⁴¹. Hence Traza one of my respondents explained,

The BIATC is managed by a management board. The board serves for a term of three years.. There is a staff of seven members. We have seven departments. These are fish and fish training, Biogas, biogas training and kitchen garden, nurseries and green houses, catering and accommodation, natural resources, flowers and fences departments. Finally we have livestock department and the overall manager. This means every staff member represents a department. Moreover each department has a head. The security is in charge of all securities.

In addition she said,

We have demonstration sites for zero grazing, bio gas, fig farming, fish, dairy goat, organic kitchen garden, nurseries and green house and rabbit section. We make efforts to combat climate change, cancer and HIV. This is why we are working closely with Maua hospital. Also we work with food for the hungry international, Compassion international educate less fortunate children. These bring their seminars here. The people they work with and for learn about animal and crop production. We work hand in hand with schools for agriculture.

¹³⁹ http://www.undp.org/content/dam/aplaws/publication/en/publications/capacity-development/capacity-development-a-undp-primer/CDG_PrimerReport_final_web.pdf cited on 10/21/16.

¹⁴⁰ <http://methodistchurchkenya.org/index.php/institutions/bio-intensive> cited on 11/16/16.

¹⁴¹ <http://methodistchurchkenya.org/index.php/institutions/bio-intensive> cited on 11/3/16.

Conclusively Traza said,

Whenever we say bio we mean we are making use of every portion and integrating. This is goat for manure used in kitchen garden, milk for cash and nutrients, vegetables from gardens , waste water from fish ponds is used for watering crops, used dam liners are used to make tanks, low cost technology to make tanks and ponds. Everywhere we ensure minimum use of artificial fertilizers. It is all integration.

The above paragraphs above suggest that organizational set up and it's important. This allows room to enhance capacity through promoting knowledge and learning. The result is a better world. Moreover changes in the way things are done and the organizational behavior results in improvement. This concerns services offered to the community as well as contribute to the country's income.¹⁴²

BIATC target to increased nutrition leads to introduction of fish farming, fish feed production in addition to the kitchen gardens, nurseries, green houses, zero grazing and bio gas generation. The organization integrates every activity in there. This ensures that waste recycling is well managed to eliminate any waste loss. Waste water from fish pond waters gardens, bio slurry and compost manure all are ensured the get back to the system again¹⁴³

According to this study BIATC composition, values, targets and networking all help address the various challenges small holder farmers faced in this study .On the other hand the system solves them in form of training, networking, connectedness as well as accurate application of BIA methods. These ensure food security and conservation as well as restoration of the environment.

More at the organization level BIATC offers motivations to small holder farmers. This is by offering inputs in quantities that equal the economic level of different small holder farmers. This is stated earlier in this study. Additionally it acts as an out let to market small holders produce, offering information and training; all these encourage the small holder farmers in their interaction with BIA activities.

The BIATC has created connectivity with different categories of small holder farmer in the various parts of Meru. Moreover it has connection with institutions such as schools, hospitals,

¹⁴² <http://siteresources.worldbank.org/INTCDRC/Resources/CDBrief02.pdf> cited on 11/3/16.

¹⁴³ <https://cefs.ncsu.edu/wp-content/uploads/growbiointensive.pdf?522a23> cited on 11/3/16.

universities, the church and the general community. On the other hand I discovered that BIA information is open to every interested person. I ascertained this when a physician visited BIATC. He and his wife had come to seek information on BIA activities. The trainers at BIATC explained as well as demonstrated the process. This was an opportunity for me too to watch Trano demonstrate how to set a sack for growing vegetables. Availability of such expertise guarantees sustainability and effectiveness of BIA practices and activities in Meru. On the other hand shows the function of BIATC as an organization.

7.4 The individual level or human resource development and actuality

At the individual level skills, experiences and knowledge are examined. These are the ones that act as the outcomes of training, teaching and the evidence of transformation that has taken place. These skills, experiences also are as result of informal practices which are obtained through seeing and doing. In this research small holder farmers are carrying out several BIA activities and practices. For example Fari breeds his fish using a type of knowledge which he described saying, “This is knowledge that is not found in books. This is because I have never school”. Fari portrays application of informal practice. This means he has acquired it through see and doing. The small holders’ skills and experiences discussed and explained in this thesis shows that despite the challenges they face, training has taken place.

Materials and necessary experiences have been offered through training, demonstrations as well as practically involving small holder farmer to educate others. Just as UNDP (2009), suggests that at the individual Level capacity enhancement looks at accessibility to required materials and required experiences which leads to individual capacity enhancement. Moreover these are greatly designed by organizational and environmental conditions. All these are determined by capacity enhancement level in an individual person as seen in this study.

I will summarize this section with an illustration as follows:

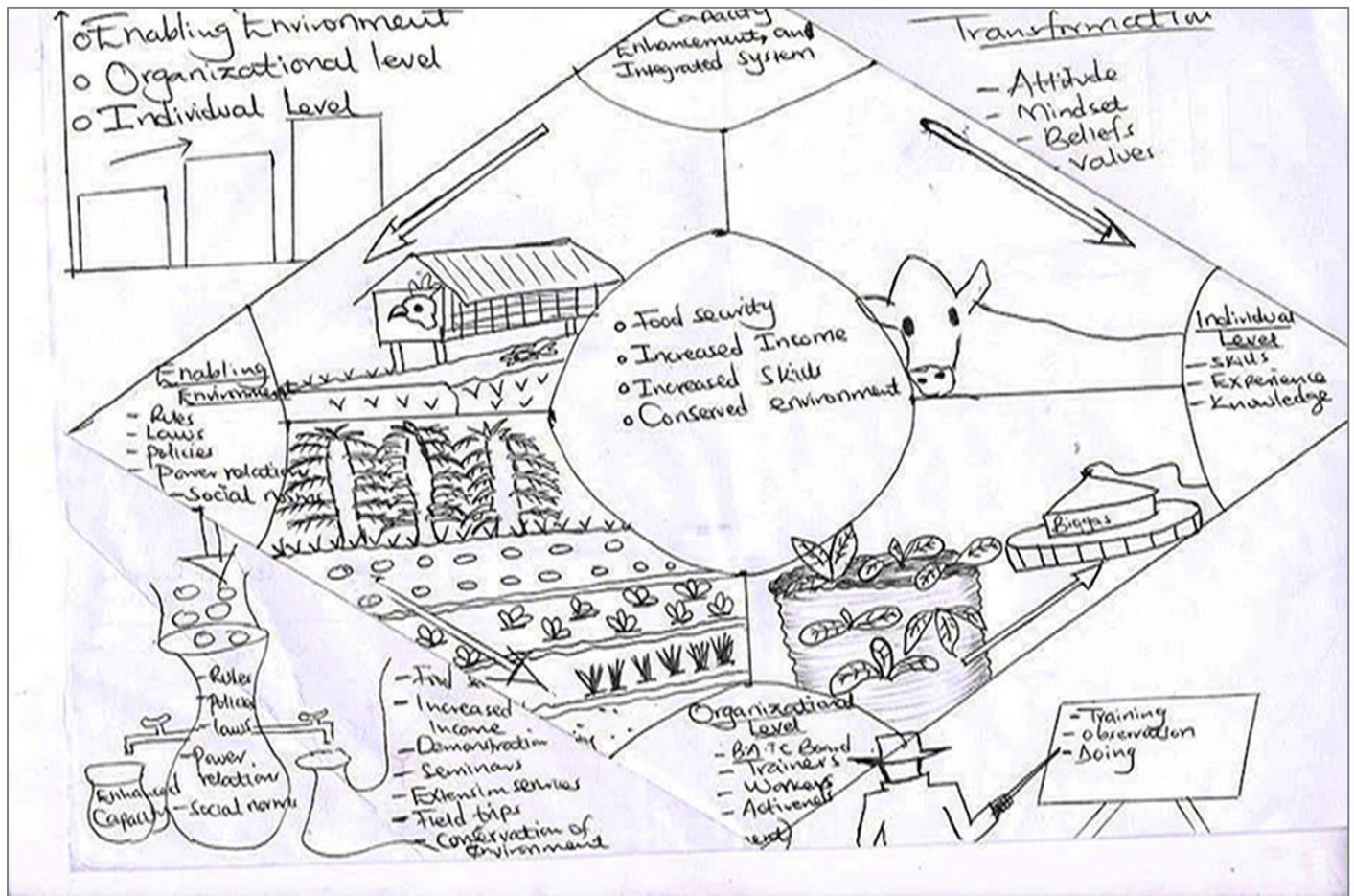


Figure 4: A diagram illustrating capacity enhancement, her determinants and small holder farmers’ activities and practices to improve food security.

Figure 4, is a diagram that I drew to illustrate capacity enhancement as an integrated system. This means her three determinants and their characteristics must be evident in a system in order for it to succeed. These are the enabling environment, organizational level and individual levels- These are examined in this research in relation to small holder farmers’ in Meru, Kenya and their BIA activities and practices. An enabling environment in this case is the wide social system in which people and organizations function¹⁴⁴. This consist of rules, laws, social norms and power

¹⁴⁴ http://www.undp.org/content/dam/aplaws/publication/en/publications/capacity-development/capacity-development-a-undp-primer/CDG_PrimerReport_final_web.pdf cited on 12/6/16.

relations all which should be observed and examined for the success of any social related program as with BIA in this study.

When they are successfully handled they result in enhanced capacities. On the other hand there is the organizational level. In this study the internal structure in consideration is that of BIATC. Which is consists of BIATC board, trainers, workers and their BIA practices and activities. The intertwine of enabling environment and the organizational level results to food security, increased income, demonstrations, seminars, extension services, field trips, and conservation and restoration of environment. The other is the individual level which is categorized by skills, knowledge and experiences. These are obtained through training, seminars and actual doing by small holder farmers. At the Centre of the diagram is food security, increased income, increased skills, conserved and restored environment

Chapter 8

8.1 Conclusion

In this part of this study I am going to conclude my thesis whose title is Environmental conservation and restoration: An assessment of the impact of Bio-Intensive Agriculture in enhancing capacity of small holders' farmers in Meru, Kenya to improve food security In this chapter I have written a summary of my study that answered the research and sub-research questions stated earlier in this thesis. Moreover I have suggested some recommendations.

BIA practices and activities have enhanced the capacity of small holder farmers in Meru in enabling them to achieve food security. This is because they can produce increased the amount of healthy nutritious food. Moreover they can earn income from the practices they are involved in. They have acquired BIA knowledge. They have increased knowledge in food and nutrition, value addition to their products, pest and disease control, soil treatment as well as soil fertility. Small holder farmers in this study portrayed knowledge in the way different plants and crops have multiple uses: Those which serve as spices as well as pesticides, other as herbs as well as soil treatment and other as flowers yet are pest repellants. In addition they cared for useful insects both in the environment and in their farms. They are conserving and restoring of the environment as they are involved in intense waste recycling, composting as well as making and use of bio slurry.

They have varied weed management, and plants and crop breeding skills Small holder farmers have increased their BIA networking and connectedness. This connection and networking ranges from small holder farmer to small holder farmer; it also goes further to agricultural bodies such as research institutes, both private and non-governmental bodies. Also they work hand in hand with fish production bodies hence exchanging knowledge skills and information. They can make appropriate utilization of their small pieces of land and can shift to more profitable agricultural practices. They have diversified sources of income. Hence this has resulted in transformation that is evident in their crop and animal production, nutritional, soil and water conservation practices. Famu said,

When I am doing any activity in my plots, I ensure nutritional value of my plot content, care for the environment. This is because environment is my responsibility. I consider also what is my income both financial and in terms of health.

Through BIA small holder farmers in Meru have increased their farm yields. This is due to activities small holder farmers are performing. Fale said practices such as deep soil preparation have led to well aerated soil. Hence the roots of their crops access more nutrients from the soil. Additionally the soil holds increased water and also more room to grow. According to her, more roots results in a plant lead to unusually high yields.

Moreover this has resulted in increased food security because BIA encourages biodiversity. This according to this study is experienced as small holder farmers carry out activities such as intensive planting as this research has recorded. Together with intensive planting is encouragement of mixed agricultural practices. These according to Trano as said earlier include livestock keeping together with crop production. BIA has encouraged diversifying fish farming. Trano said, “We have experienced food security “. Whereby;

Food security is having sufficient, safe, nutritious food at all times physically, socially and economically to meet their dietary needs as well as food preferences for a healthy and active life¹⁴⁵

Small holder farmers in this study as they applied BIA practices, they have increased their income. This is through growing vegetables in plots, sacked gardens as Fangu explained how establishing of vegetable gardens has helped her as a different source of income. This is through selling spinach. Fachi on the other hand earns more from her piece of land after she shifted from commercial maize planting practices to chili growing. Other small holder farmer too said they are getting extra income from milk, poultry and also fish farming.

The method also enables small holder farmers to recycle nutrient by cover crop, composting, and mulching. The later was a practice I saw at Famais’ farm. These women were mulching in between maize rows. This enabled their maize to resist the harsh drought that struck the area. Fale grew tomatoes in a plot which is prepared using BIA method. Then she use a holed black sheet of

¹⁴⁵<http://www.fao.org/docrep/005/y4671e/y4671e06.htm> cited on 11/16/16.

polythene bag spread under the soil to conserve moisture as illustrated in this thesis. Moreover small holder farmer expressed the way they applied by bio slurry and other waste from livestock to their crops. This is all about recycling.

The small holder farmers in this study apply BIA technologies to conserve the environment. This includes conserving resources and reducing toxics to the environment. This according to them is an opportunity. This is how Traza defined the entire process is concerned with care for the environment as she said,

We aim at not harming animals, man or our surrounding through pollution. Hence most of our inputs are organic. This is why we boldly say we are conserving and restoring the environment.

The small holder farmers embraced the use of natural pest repellants such as American marigold, rosemary, coriander, onions and pepper. Moreover use of medicinal trees such as neem whose juice is used as pesticide for both plants and livestock. Small holder farmers such as Fachi use Pepper concoction to clear aphids and nematodes.

Use BIA technologies has enabled small holder farmers in this study to conserve resources. They have conserved the soil by use of minimum digging or no digging as was practice with Famai(s) in this study. The Famai group does not dig. They mulch instead after planting. They clear weed by hand picking.

On the other hand the small holder farmers are conserving water. This is through hand watering and double tilling strategies. According to Famai, hand tilling does not harden the soil nor does it disrupt the natural soil arrangement. Mulching makes water to penetrate well. She added, “Moreover the water conserving capacity of double tilled soil is high”. To conserve water the respondents said they do what they described as dry farming. This was explained by Trano as follows,

Dry farming is a method of farming which involve growing of drought resistant crops. On the other hand we advise our farmers to plant the seed deep in the soil and mulch. This is all dry farming. It is a practice found in Rwanda, Buuri Chuka and Tharaka (...)

The small holder farmers said bio intensive practices helps in conserving energy. This is by being involved activities such as hand picking weeds from sacks after work in the evening. This is why

Traza said that the bio intensive activities do not require use of machines and high intensive physical labor.

Moreover Traza said that bio intensive practices lead to genetics conservation as she said,

In this situation farmers avoid hybrids. Alternatively farmers ensure open pollination takes place. This means the seeds produced are almost similar to the mother plants. This is what we refer to as heirloom. Bio intensive practices encourage heirloom varieties.

This meant that the seeds produced have same qualities as the mother plant as much as possible. Others such as Fabros in this study told me that they allowed some weeds to grow around their green houses. This is because the flowering scented weeds attract insects which instead find their way into the green houses. Small holder farmers are conserving forests. This mainly by tree planting which is growing trees together with their crops. Small holder farmers in this research are planting trees along roads as well as growing both fruit and tree seedlings in their nurseries. Moreover they are using bio gas as the source of energy in their houses for cooking instead of wood fuel.

All these BIA activities and others discussed in this study have resulted in management of ecological relations, growing and keeping adapted breeds of animals and plants suited particularly for their environment and have promoted healthy. These respondents views and generally the findings of this research concur with what capacity enhancement theory says concerning transformation: That is it should be from within hence resulting in transformed livelihood, attitudes, character and mindsets.¹⁴⁶

Recommendations

Small holder farmers in this study have faced several challenges while carrying out BIA. Among them is the challenge of extension services. Extension workers are important in developing sustainable agriculture. This is because extension workers work closely with farmers both on –site

¹⁴⁶http://www.undp.org/content/dam/aplaws/publication/en/publications/capacity-development/capacity-development-a-undp-primer/CDG_PrimerReport_final_web.pdf cited on 12/12/16.

and off-site by; offering seminars, workshops and training. This sometimes is done in the field where farmers are found or by convening them for training¹⁴⁷.

On the other hand extension workers work hand in hand with local crop and plant breeders to improve crop and animal production and finally improve the farmers' standard of living. The test the adaptive capacity of particular breeds by establishing pilot plots. These calls for pilot farmers so that they can obtain feedback and learn from the results. Moreover they are in regular contact with farmers and government which in return results in an enabling environment to review policies, stabilizing appropriate value chain, help in transferring technology, ideas and connect farmers to markets and also aid giving organization.¹⁴⁸ Hence this study recommends an establishment of a public BIATC. This will enable small holder farmers to access free or affordable extension services.

In addition to this this study recommends that peer tutoring should be encouraged as well as increased networking and small holder connectedness to: small holder farmers, government and private BIA bodies such as research centres. In addition increased training should be offered to ensure sustained transformation. Moreover partnering with donor and aid giving bodies and improve market to reduce the funding challenge.

¹⁴⁷ <http://www.fao.org/docrep/W5830E/w5830e0m.htm> cited on 12/12/16.

¹⁴⁸ https://www.ifad.org/topic/resource/tags/rainfed_agriculture/2088038 cited on 12/12/16.

References

- Altieri, M. A. (2009). Agroecology, small farms, and food sovereignty. *Monthly review*, 61(3), 102.
- Bryman, A. (2015). *Social research methods*. Oxford: university press, London.
- Corbin, J., & Strauss, A. (2014). *Basics of qualitative research: Techniques and procedures for developing grounded theory*. Sage publications, London.
- Creswell, J. W., & Clark, V. L. P. (2007). *Designing and conducting mixed methods research*. Sage Publications, London.
- Eade, D., & Oxfam Ireland. (2000). *Capacity-building: An approach to people-centred development*. Oxford: Oxfam, London.
- Evenson, R. E., & Mwabu, G. (2001). The effect of agricultural extension on farm yields in Kenya. *African Development Review*, 13(1), 1-23.
- Evenson, R. E. (2001). Economic impacts of agricultural research and extension. *Handbook of agricultural economics*, 1, 573-628.
- Farrington, J., & Lewis, D. J. (Eds.). (2014). *Non-governmental organizations and the state in Asia: Rethinking roles in sustainable agricultural development*. Routledge, London.
- Giller, K. E., Witter, E., Corbeels, M., & Tiftonell, P. (2009). Conservation agriculture and smallholder farming in Africa: the heretics' view. *Field crops research*, 114(1), 23-34.
- Harwell, M. R. (2011). Research design in qualitative/quantitative/mixed methods. *CONRAD, Clifton F.; SERLIN, Ronald C. The SAGE Handbook for Research in Education: Pursuing ideas as the keystone of exemplary inquiry. 2^a Edition. Thousand Oaks, CA: SAGE Publications*, 147-163.
- Huho, J. M., & Mugalavai, E. M. (2010). The effects of droughts on food security in Kenya. *International Journal of Climate Change: Impacts and Responses*, 2(2), 61-72.
- Jeavons, J. C. (2001). Bio intensive sustainable mini-farming: III. System performance—initial trials. *Journal of Sustainable Agriculture*, 19(2), 77-83.

- Kaplan, A. (1999). The developing of capacity. *Community Development Resource Association*, 1-32.
- Karlen, D. L., Mausbach, M. J., Doran, J. W., Cline, R. G., Harris, R. F., & Schuman, G. E. (1997). Soil quality: a concept, definition, and framework for evaluation (a guest editorial). *Soil Science Society of America Journal*, 61(1), 4-10.
- Kothari, C. R. (2004). Research methodology: Methods and techniques. *New Age International*, Darya Ganj.
- Lang, T., & Heasman, M. (2015). Food wars: The global battle for mouths, minds and markets. Routledge, London.
- McKay, M. D., Beckman, R. J., & Conover, W. J. (2000). A comparison of three methods for selecting values of input variables in the analysis of output from a computer code. *Technometrics*, 42(1), 55-61.
- Mertens, D. M. (2014). *Research and evaluation in education and psychology: Integrating diversity with quantitative, qualitative, and mixed methods*. Sage publications, London.
- Mizrahi, Y. (2004). Capacity enhancement indicators. *Washington, DC Retrieved from <http://info.worldbank.org/etools/docs/library/80314/eg03-72.pdf>*.
- Morton, J. F. (2007). The impact of climate change on smallholder and subsistence agriculture. *Proceedings of the national academy of sciences*, 104(50), 19680-19685.
- Moore, S. R. (2010). Energy efficiency in small-scale biointensive organic onion production in Pennsylvania, USA. *Renewable Agriculture and Food Systems*, 25(03), 181-188.
- Nelson, G. C., Rosegrant, M. W., Koo, J., Robertson, R., Sulser, T., Zhu, T., ...& Magalhaes, M. (2009). *Climate change: Impact on agriculture and costs of adaptation* (Vol. 21). Intl Food Policy Res Inst

Appendices

Appendix 1

Main study Research Question and the three sub- Research Questions.

Research Question

How has introduction of Bio intensive Agriculture Enhanced Capacity of small holder farmers in Meru, Kenya to improve food security; while conserving and restoring the Environment?

Sub-Research Questions:

- I. How has Introduction of Bio Intensive Agriculture enhanced the capacity of small holder farmers in Meru-Kenya to improve food security?
- II. What agricultural practices are small-holder farmers involved in that improve food security and enhance their capacity as they restore and conserve the environment?
- III. What challenges and opportunities do small holder farmers encounter as they carry out bio intensive agriculture, and how do farmers overcome them?

Appendix 2

Questions to Trainers at BIATC concerning BIATC and BIA activities and practices

1. What is contained in BIATC?
2. How was BIATC established?
3. How is BIATC administered and ran?
4. What activities and practices are carried out at BIATC?
5. How is the training conducted?
6. To whom are the training and services offered, Males and females?
7. Are there incentives and motivation offered to encourage the trainees to adopt the BIA technologies?
8. Why the project was named BIATC?

Appendix 3

Questions to small holder farmers carrying out BIA activities and practices

1. What activities are you carrying out in your farm?
2. How long have you been farming the way you are farming?
3. How do you do the activities you are involved now?
4. How were you farming before?
5. How did you come in contact with the new farming technology?
6. What are the benefits you obtain from the new farming technology?
7. Are there challenges you face as you carry out these activities?
8. How do you overcome the challenges?

Appendix 4

Questions to BIATC Trainers in relation to Introduction of Fish farming at BIATC and in also Meru

1. How long have you been practicing fish farming in BIATC?
2. How did the idea of fish farming come up?
3. What type of fish is reared?
4. Where did you get their fingerlings from?
5. How do you obtain the fish feed?
6. Are there other fish types you are aware of?
7. Which is better in terms of production?
8. Which is popular among small holder farmers?
9. Which is consumed more than the rest ?
10. Do you sell the fish you produce?
11. Where do you sell the fish
12. How can you define your fish farming experiences, satisfactory or unsatisfied?
13. What are the uses of the fish you produce?
14. Are there other benefits of rearing fish?
15. What challenges do you experience as you practice fish farming?
16. Has fish farming help reduce food insecurity in meru?
17. Who consumes fish more in meru?
18. Who adopts more fish farming more and why?
19. How the BIATC does help fish farmers and fish farming in general?

Appendix 5

Questions to small holder farmer involved in fish farming activities as they carry out other BIA practices

1. How did you come in contact with fish farming practices?
2. How long have you been practicing fish farming?
3. What type of fish is reared?
4. Where did you get their fingerlings from?
5. How do you obtain the fish feed?
6. Are there other fish types you are aware of?
7. Which is better in terms of production as well as consumers preference?
8. How can you define your fish farming experiences, satisfactory or unsatisfied?
9. What are the uses of the fish you produce?
10. Are there other benefits of rearing fish?
11. What challenges do you experience as you practice fish farming?
12. Has fish farming help reduce food insecurity in Meru?
13. Who consumes fish more in Meru?
14. How does the BIATC helps fish farmers and fish farming in general?



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