Gollis University

Effect of Animal Manure in Solanum lycopersicum in Arbsio District

A Thesis

By

Omer Ahmed Sh.Adam

&

Umalkheir Abdirahman Ahmed

IN PARTIAL FULFILLMENT OF THE REQUIREMENTS
FOR THE BECHOLAR DEGREE OF AGRICULTURE AND NRM

FACULTY OF AGRICULTURE & NATURAL RESOURCE MANAGEMENT
GOLLIS UNIVERSITY
HARGIESA, SOMALILAND

Date

July, 2015
Accepted by

_______________________
Dean of the Faculty

_______________________
Advisor
**Abbreviations**

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>GDP</td>
<td>Gross Domestic product</td>
</tr>
<tr>
<td>MOA</td>
<td>Ministry of Agriculture</td>
</tr>
<tr>
<td>GU</td>
<td>Gollis University</td>
</tr>
<tr>
<td>NRM</td>
<td>Natural Resource Management</td>
</tr>
<tr>
<td>S/L</td>
<td>Somaliland</td>
</tr>
<tr>
<td>Ha</td>
<td>Hectare</td>
</tr>
<tr>
<td>“Deyr”</td>
<td>Short rainy season in Somali</td>
</tr>
<tr>
<td>“Gu”</td>
<td>Long rainy season in Somali</td>
</tr>
<tr>
<td>SWALIM</td>
<td>Somalia Water and Land Information Management</td>
</tr>
</tbody>
</table>
Dedication

We heartedly dedicate this work of thesis to our parents:

Halimo Omer GoudAdde “Omer’s Mom”

Abdurahman Ahmed Kahin “Umalkeir’s Father”
Acknowledgements

All thankful is to Allah, who allows for completing this thesis book.

We are very thankful to our thesis supervisor Ahmed Ibrahim Adam, for his extensive encouragement and guidance throughout our thesis work and to gratitude the head of the faculty Dr. Hared Abdilahi Nour and Ali Ismail Ibrahim, for having provided us with adequate facilities to complete our thesis and whenever we ever needed help and moral support.

We would like to thank Daha Mohamed Abdi his support for facilitating SPSS, and Muktar Ahmed Arab for his support and Mussa Ahmed Du’aleh for his encouragement.

We would also like to thank our classmates for always being with us during field observations and collection of questions, we also thank our family members who were the backbone behind our deeds and other individuals who have either directly or indirectly contributed to our needs.
Table of Contents

Abbreviations .................................................................................................................. 3
Dedication .......................................................................................................................... 4
Acknowledgements ............................................................................................................ 5
Table of Contents ................................................................................................................ 6

CHAPTER ONE: INTRODUCTION .................................................................................... 9
1.1 Background ..................................................................................................................... 9
1.2 Problem Statement ....................................................................................................... 11
1.3 Research Objectives .................................................................................................... 11
1.4 Scope of the study ......................................................................................................... 11
1.4.1 Soil type .................................................................................................................. 12
1.4.2 Climate ................................................................................................................... 12
1.4.2 Land use ................................................................................................................ 12
1.5 Cropping system of the study area (Arabsiyo).............................................................. 13
1.6 Impact of organic manures to soils of vegetable farm .................................................. 13
1.7 Limitation Of the Study ............................................................................................... 15
1.8 Significance of the Study - .......................................................................................... 15

CHAPTER TWO .................................................................................................................. 16
LITERATURE REVIEW ..................................................................................................... 16
2.1 Classification of manure ............................................................................................... 16
2.2 Organic manures ......................................................................................................... 17
2.2.1 Advantages of organic manures ............................................................................ 17
2.2.2 Major organic sources and transformations ......................................................... 17
2.3 Inorganic or artificial manures ..................................................................................... 20
2.3.1 Green manure ....................................................................................................... 20
2.3.2 Animal manure ..................................................................................................... 21
2.3.2 Fertilizers .............................................................................................................. 21
2.4 Forms of available nitrogen in manures ...................................................................... 21
2.5 COMPOST MANURE ................................................................................................. 23
CHAPTER THREE: MATERIALS AND METHODS ................................................................. 31

3.1. Description of the studied area ........................................................................ 31

3.1.1. Location ........................................................................................................ 31

3.1.2 Map of the studied area ................................................................................ 31

3.1.3 Soil and Climate ............................................................................................ 32

3.1.4 Vegetation ...................................................................................................... 32

3.1.5 Water resource .............................................................................................. 32

3.2 Data collection technique .................................................................................. 32

3.2.1 Sample technique .......................................................................................... 32

3.2.2 Sample size[n] .............................................................................................. 32

3.3 Sampling procedures ......................................................................................... 33

3.4 Research instrument ......................................................................................... 34

CHAPTER FOUR: ANALYSIS ......................................................................................... 35

4.1 Gender .............................................................................................................. 35

4.2 Age ................................................................................................................... 35

4.3 Farm Types ....................................................................................................... 37

4.4 Source of Irrigation .......................................................................................... 38

4.5 Type of the crops .............................................................................................. 39

4.6 Tomato Grower ................................................................................................. 40

(7)
CHAPTER ONE: INTRODUCTION

1.1 Background

Tomato (Lycopericcom esculent) is the edible, often red fruit/berry of the nightshade Solanum, commonly known as a tomato plant. It is used as a food in Mexico, and spread throughout the world following the Spanish.

Tomatoes are characterized by relatively moderate requirements for tropical climate and soil. They can be produced fresh throughout the year and sold fresh (Schaller and Schnitcher, 2000). The following varieties are usually cultivated in Somaliland; globe (dhulubo), cherry tomato (adhiyo) and Roma variety. (Tindall, 1983).

Recognizing the nutritive value of tomato and its high demand, farmers have increased production in the country. This has become feasible by the application of sufficient plant nutrients to depleted soils to improve soil fertility and tomato plant has relatively high demand for soil nutrients especially potassium and nitrogen (William et al., 1991; Bendelet et al., 1992). This necessitates the application of mineral fertilizers for maximum growth and yield. Bumb and Baanite (1996) reports that failure to replenish poor tropical soil can initiate and perpetuate a downward spiral of soil degradation, and ultimately lead to severe crop losses resulting in poverty, hunger and malnutrition. Continuous inorganic fertilizer application may lead to soil acidity or alkalinity. Chemical fertilizers do not sustain soil fertility for long and after their continual use there is deterioration of soil characteristics since they release nutrients at a faster rate.

In Somaliland, organic manure abounds much in the form of animal droppings but they are not usually used due to conveyance problems, bad odour and inadequate extension services. There is therefore the need to exploit this cheaper means of improving soil fertility for high and sustainable carrot production.

The tomato is consumed in diverse ways in Somaliland. It is mainly used as an ingredient in sauces, salads or eaten raw. In other parts tomato is even made into drink which is not particularly tasty but people drink it for health reasons. While it is botanically a fruit, it is considered a vegetable for
culinary purposes. Many agronomist and horticultural may be confused by this because they have always known it as vegetable, but technically it's a fruit because it has got seeds.

According to recent research tomato has got many health benefits. The tomato fruit, the part of the plant we normally eat, is rich in lycopene (anti-oxidant), which may have beneficial health effects (reduces the risks of cancer, diabetes and heart diseases).

The production of healthy Food is one among the most important basic necessities of life and therefore increased tomato production is very important per-requisite for achieving food security and encouraging healthy diets in Somaliland. For Somaliland to reach its five year food security plan and development goal in food production, locally produced food including tomato must go up so that they become readily available for our people. Low soil fertility could threaten the security of food production and supply. Soil fertility is a major overriding constraint that affects all aspects of crop production (Mbah, 2006).

In the past years even in former Somalia, inorganic fertilizer was advocated for crop production to ameliorate low inherent fertility of soils in the tropics. In addition to being expensive and scarce, the use of inorganic fertilizer has not been helpful in intensive agriculture because it is often associated with reduced crop yield, soil acidity and nutrient imbalance (Ojeniyi, 2000; Ano and Agwu, 2005; Agbede et al., 2008).

The need to use animal manures could enable for vegetable farmers especially tomato producers to drastically increase their overall production (Ayoola and Adeniyan, 2006). Large quantities of organic wastes such as cow, sheep/goats and poultry manure are available especially in rural and as well as in urban areas and these manure are effective source of nutrients for vegetables such as tomato (Adediran et al., 2003). These manures are very much needed as the fertility of soils in the area of study is considered to be very low. In fact, even in the same of areas of irrigated horticultural farms in Somaliland same nutrient deficiency problems exist. The crop yield response to organic waste is highly variable and depends on the types of wastes, crop type and species, soil type and climate conditions (Adediran et al., 2003).

For horticultural farmers in the Arabsio to obtain a sufficient yield of vegetable crops, especially tomato since tomato is a major income generation for most of the farmers of Arabsio district, fertilization with Nitrogen, Phosphorus and Potassium is a valuable source of these nutrients.
1.2 Problem Statement
There are some major problems not allowing commercial horticultural farmers to use artificial fertilizers. First and foremost artificial fertilizer is not readily available and is not encouraged by agricultural development institutions since it's very expensive for most of these farmers. Secondly, commercial fertilizers have their problems when it comes to their use in dry environments. Therefore animal manure can be used to supply plant nutrients and to optimize soil structure. Manure are often the only means farmers are able to improve the nutrients of their soils.
This research was to intend the poor performance of the sector is partly due to effect of manure.

1.3 Research Objectives

**General:** The main objective of this study was to correlate the effect of manure of tomatoes production in Arabsio Somaliland.

**Specific:** To be sought further in this study is to be as follows:

1. To determine the effect manure in tomatoes yield in Arabsio farming area.
2. To analyze the use of manure and how it effect tomatoes growth and production
3. To explore the importance of manure in tomatoes productivity.

1.4 Scope of the study
The area which is the focus of this study, Arabsio, is located in-between Hargeisa and Gabiley, 9° 41’ 0” North, 43° 46’ 0” East. Arabsio has got one of the biggest dry river beds in Somaliland, which flows and fills with water during the rainy seasons of the year. The land by the banks of this dry river bed (doox in Somali) is fertile and the soil is alluvial soil deposited by the running stream water. Hence, all along this water course one often finds small sized horticultural and irrigated farms.

Arabsio dry river bed is wide and follows to the red sea. The satellite image shown below shows this intermittent river during the rainy season. It is following with with fresh rain water even if only temporarily. Cars and lorries find very difficult to cross when its flowing heavily.
1.4.1 Soil type

Soils in the study area have been classified as predominantly deep and heavy textured alluvial soil (Sorgheia, 1988). Caltisol soils are also found in this area and its very suitable for Crop production.

1.4.2 Climate

Somaliland lies at the extremity of the sub-Saharan semi-arid zone commonly referred to as the Sahel, which traverses the continent from Senegal to Somalia.

The climate of the study area which is Arabsio is hot dry and semi-arid. Mean annual Rainfall ranges from 300 - 500mm (Swalim, 2007). Rainfall in the area is thus bimodal (Dry&rainy season). The northeast monsoon brings the primary Gu rains from March to June, followed by a hot dry period called Xagaa in June and July. Short rains locally known as Deyr also occur between August and October followed by cool long dry Jilaal period between November-February. Temperatures vary considerably with the seasons, with a mean annual temperature of 20-24°. Relative humidity of the highlands is mostly around 40%, except during rainy periods when it may go up to 80%. The major winds in the study area occur between June to July during the Xagaa dry season, during the southwest monsoon and in Jilaal between December and February. Hot, calm weather occurs between the monsoons during April and September). Generally, in the north-west winds are strongest during the southwest monsoon. Average wind speed varies between 8 - 10 m/s, but during a large part of the year strong winds of up to 17 m/s occur, causing frequent ”dust-devils”.

1.4.2 Land use

The main land use in the study area is rain-fed agriculture, irrigated orchards along alluvial plains, extensive livestock rearing and wood collection. Rain-fed agriculture is found in what is considered as the sorghum belt of Somaliland, practiced in combination with pastoralism and wood collection. This class of land use is the economic basis of households in the study area. Study Area.
Cultivation of irrigated orchards is a cash-oriented activity in the area, involving the growing of fruit trees such as citrus, guava, papaya and mango. Supplementary water for irrigating the crops is obtained from wells, dams and other water bodies.

Wood collection for charcoal production is very frequent, occurring in all well-treed areas. Preferred tree species are Acacia bussei, A. nilotica and A. etbaica. Interventions to help introduce sustainable sources of cooking energy are important and urgent. Sedentary pastoralism around homesteads is a common practice in Arabsio and surrounding areas. Hay harvesting from enclosures supports this land use, as harvested hay can be used in the dry season.

Urban centers such as Hargeisa and Gabiley offer a good market for farm produce, especially vegetables, and that is partly due to good asphalt road that links them to both Hargeisa and Gabiley. The urban centers particularly Hargeisa is a point of high demand for both vegetables and fruits produced by Arabsio orchards.

1.5- Cropping system of the study area (Arbsiyo)

In many farms of the study area i have already noticed that almost all of the farmers farming along the Dhamuug dry- riverbed grow either fruit-trees or vegetables including lettuce. The target of their produce is the popular Hargeisa vegetable and fruit market. I can these farmers as business oriented as their main goal is to produce agricultural products in a marketable quantity and quality to satisfy the market demand which already exist in Hargeisa.

1.6 Impact of organic manures to soils of vegetable farm

According to agronomical aspect and soil science knowledge, that when crops, including tomato, is harvested and sold, nutrients are lost from the farm. While many soils can supply nutrients for crop growth without fertilizer additions for many years, eventually the productivity of the farm will decrease unless the nutrients are replaced. No doubt the soils in the study area was being used for a very long time to produce crop without the nutrients lost being put back.
A major challenge of managing soil fertility for organic food production is to integrate the input of nutrients from acceptable sources with the use of proper crop rotation. For animal farming operations, this task is fairly straightforward. Farmers will grow and feed their livestock for producing manure, provide this feed to their animals, collect the manure from the animals, and then apply the manure to appropriate crops.

If livestock are not raised on a farm, nutrients from manure or other organic amendments/fertilizers need to be obtained externally. These organic fertilizers such as manure are usually bulkier than synthetic fertilizer sources.

**Nutrient forms taken up by tomato plants**

Before discussing how to grow healthy tomato crop through addition of well fermented animal manure and before write about managing soil fertility using different sorts of manuring techniques, a simple review of the forms of nutrients that plant roots absorb may be useful. The majority of nutrients must be dissolved in the soil solution before plant roots can take them up. If animal manure fertilizer is applied to the soil, it must first be broken down by microbes to its simplest inorganic forms to be efficiently used by plants. Plant roots can absorb some larger organic molecules, but their rate of absorption is slow. From a plant root perspective, it makes little difference if the nutrient originally came from an organic or inorganic fertilizer.

**Animal as a fertilizer and as a soil fertilizer**

For a manure to be considered acceptable for organic crop production, certain requirements must be met. From a strict chemical sense, animal manure is a substance containing carbon, nitrogen, fiber and wide range of micro-nutrients necessary for plant growth. Organic farming, however, does not rigidly adhere to this definition. Some carbon containing fertilizers such as synthetic urea are not acceptable for organic production. Similarly, some materials that are considered to be inorganic (no carbon) such as rock phosphate are acceptable. In general, fertilizers or amendments for organic production must come from natural carbon containing, non-synthetic materials (erg manure) or non-synthetic inorganic materials that have not been chemically processed (erg limestone, rock phosphate).

Fertilizers coming from animal manure are usually acceptable for organic production of tomato, even though they usually have a low nutrient (NPK) and are made up of larger, insoluble molecules that take time to be broken down into forms usable by the plant and into organic matter. The composition of
manures that can be acceptable for producing organically grown tomato crops varies considerably with moisture content, preservation of nutrients and production practices. A chemical analysis of the organic fertilizer or amendment is necessary to determine precise application rates. Any fertilizer to be used in horticultural farms must have the N-P-O-K (nitrogen-phosphate-potash) in a form available to growing plants. It is always good any fertilizer material or soil amendment unless the nutrient content is known. Table 1 provides the approximate nutrient composition of some commonly used organic fertilizers and soil amendments.

1.7 Limitation Of The Study
This research is limited to different factors such as:

1. Lack of cost
2. Insufficient time for doing the research because it needs proper time to complete.
3. Lack of previous studies about this field in Somaliland.

1.8 Significance of the Study -
This research is significance to many areas and directly useful such as

1. Students: who are interesting and involved in this field study.
2. Academies; who want to search and study more about this research
3. Local and international Ngo: who are worked in these areas.
CHAPTER TWO

LITERATURE REVIEW

Plant needs a well-balanced diet, for better growth and yield. Some of these can come from manures, which are the substances that provide nutrients for proper growth of plants. For the sake of clarity, it will need to explain what does mean by manure. Manure may have different meanings.

Manure is defined as anything that is added to the soil to increase its fertility and to enhance plant growth (Boller and Hani, 2004).

Generally speaking, the word manure came from Middle English "manuren" meaning "to cultivate land," and initially from French "main-oeuvre" = "handwork" alluding to the work which involved maturing land.

Manure is not just the urine and faeces from livestock, but also the bedding, runoff, spilled feed, parlorwash, and anything else mixed with it (Brandjes, 1996).

Manure contributes to soil fertility and tilth. In addition to nutrients, manure provides carbon and other constituents that affect soil humus content, biological activity, and soil physical structure (Wagner and George, 2004).

Manure contributes to the fertility of the soil due to addition of organic matter and nutrients, such as nitrogen, trapped by bacteria in the soil (Haynes, 2003).

2.1- Classification of manure

Manures can be divided into two classes, Organic or Inorganic. Organic manures are derived from decaying material of plant or animal origin. Inorganic manures, also known as fertilizer, are derived from chemical processes, which are most often made. Organic manures often provide more than one of the many substances needed by plants for their growth. Inorganic manures usually provide only one of the many substances needed by plants for their growth (Boller and Hani, 2004).
2.2 Organic manures

Almost any kind of organic matter may be used as manure, but some kinds are better than others. Organic manures vary widely in the amount of plant nutrients that they contain. Some are more concentrated than others. Compost is one of the less concentrated organic manures, but it is extremely valuable in adding extra body to soils. Organic manures which breakdown or decay quickly are available to the plant faster than those which decay slowly (Boller and Hani, 2004).¹

2.2.1 ADVANTAGES OF ORGANIC MANURES

1. Organic manure provides all the nutrients that are required by plants but in limited quantities.
2. It helps in maintaining C:N ratio in the soil and also increases the fertility and productivity of the soil.
3. It improves the physical, chemical and biological properties of the soil.
4. It improves both the structure and texture of the soils.
5. It increases the water holding capacity of the soil.
6. Due to an increase in the biological activity, the nutrients that are in the lower depths are made available to the plants.
7. It acts as much, thereby minimizing the evaporation losses of moisture from the soil.

2.2.2-MAJOR ORGANIC SOURCES AND TRANSFORMATIONS

Carbon present in soils in the form of organic matter. The organic materials most commonly used to improve soil conditions and fertility include farmyard manure (FYM), animal wastes, crop residues, urban organic wastes (either as such or composted), green manures, biogas plants, slurry, microbial

(17)
preparations, vermicompost and biodynamic preparations. Sewage sludge and some of the industrial wastes also find application in agriculture (Teasdale, Abdul-Baki, 1997).

For all organic matter, atmospheric carbon dioxide serves as the main source of carbon. Carbon dioxide is converted to organic carbon largely by the action of photoautotrophic organisms; the higher green plants on land and algae in aquatic habitats. Carbon is being contentiously fixed into organic form through the process of photosynthesis and once bound, the carbon becomes unavailable for use in the generation of new plant life. Carbon fixation involves a reduction of carbon dioxide by hydrogen donor (reduced form of the co-enzyme nicotinamide adenine dinucleotide phosphate) and the synthesis of carbohydrate from reduced carbon through complex cyclic mechanism called the Calvin cycle. Carbon dioxide constitutes only 0.03 percent by volume of the earth's atmosphere. It has been estimated that the vegetation of the earth's surface consumes some 90 billion kg of carbon dioxide per annum, about one twenty-fifth of the total supply of the atmosphere and that the total supply of carbon dioxide would be completely exhausted in twenty years at the present rate of photosynthesis, if not replenished by decomposition of organic materials (Toyota, K., Kuninaga, S., 2006).

As the availability of carbon dioxide on the earth's surface is very limited, it must be recycled. Upon the death of the plants and animals, microbiological metabolism assumes the dominant role in cyclic sequence. The dead tissues added to soil undergo decay and are transformed into microbial cells and vast heterogeneous body of carbonaceous compounds. According to the different stages of decomposition, the soil organic matter becomes available in distinct fractions. Farad manure is made from cattle dung, excreta of other animals, animal tissues and excreta of products, and compost from rural and urban wastes, crop residues and green manure are collectively designated as bulky organic manures because of their low content of major nutrients, while materials like oil cakes, fish meal, animal meal, poultry manures, slaughterhouse wastes containing comparatively higher content of plant nutrients are grouped under concentrated organic manures (Wathe, M., Shejval et al, 2000).
In general organic manures containing up to two percent nitrogen are included in bulk category and those with more than two percent nitrogen are treated as concentrated. Irrespective of source and composition, organic matter when added into the soil undergoes microbial decay and becomes the food form of microflora and fauna. Even the microbial cells serve as a source of carbon for succeeding generations of microscopic populations. A great variety of microorganisms live in soil which include bacteria, actinocetes, fungi, algae and protozoa (Wright et al., 1998). In general the number per gram of soil is bacteria > actinocetes > fungi > algae > protozoa. The average nutrient content of bulky manures given in Table 3

**Table 2: Average nutrient content of bulky manure**

<table>
<thead>
<tr>
<th>Manure</th>
<th>Percentage content</th>
<th>P2O5</th>
<th>K2O</th>
</tr>
</thead>
<tbody>
<tr>
<td>Animal refuse</td>
<td>0.3-0.4</td>
<td>0.1-0.2</td>
<td>0.1-0.3</td>
</tr>
<tr>
<td>Cattle dung, fresh</td>
<td>0.4-0.5</td>
<td>0.3-0.4</td>
<td>0.3-0.4</td>
</tr>
<tr>
<td>Poultry manure, fresh</td>
<td>1.0-1.8</td>
<td>1.4-1.8</td>
<td>0.8-0.9</td>
</tr>
<tr>
<td>Cattle urine</td>
<td>0.9-1.2</td>
<td>Trace</td>
<td>0.5-1.0</td>
</tr>
<tr>
<td>Human urine</td>
<td>0.6-1.0</td>
<td>0.1-0.2</td>
<td>0.2-0.3</td>
</tr>
<tr>
<td>Sheep urine</td>
<td>1.5-1.7</td>
<td>trace</td>
<td>1.8-2.0</td>
</tr>
<tr>
<td>Ash, coal</td>
<td>0.73</td>
<td>0.45</td>
<td>0.53</td>
</tr>
<tr>
<td>Ash, household</td>
<td>0.5-1.9</td>
<td>1.6-4.2</td>
<td>2.3-12.0</td>
</tr>
<tr>
<td>Compost, dry</td>
<td>0.5-1.0</td>
<td>0.4-0.8</td>
<td>0.8-1.2</td>
</tr>
</tbody>
</table>
2.3-Inorganic or Artificial manures

These manures, or fertilizers, are either of mineral origin or man-made through chemical processes. Because these fertilizers are relatively simple in structure, they break down and are available to plants rather quickly. Fertilizers are available as 'Complete Fertilizers' with varying degrees of chemical compositions or as individual chemicals such as Nitrogen, Phosphorous or Potash. In neither case are fertilizers also available as timed release or quick acting (Wright et al, 1998).

2.3.1 - Green manure

Even though this thesis tries to confine itself on animal manures, including a short account of other types of manure is deemed relevant. In addition to that soil productivity is an important concern for farmers and green manuring is gaining popularity as a method that successfully improves soil productivity (Haynes, 2004). The addition of peat moss material improves soil tilth. At the same time, the nutrients used in plant growth are conserved and returned to the soil to enhance its fertility (Boller and Hani, 2004). Leguminous crops, such as clover, when used as green manure also fix nitrogen through rhizobium harboured in their root nodules (Whitmore, 2000). Green manure approaches to crop production may improve economic viability, while reducing the environmental impact of agriculture (Cherry et al, 2006).
2.3.2 Animal manure

Most animal manure is faeces—excrement (variously called "droppings" or "crap" etc) of herbivores and poultry—or plant material (often straw) which has been used as bedding for animals and thus is heavily contaminated with their faeces and urine (Whitmore, 2000). The vermicompost manures may be used by mixing earthworm with soil or by adding them to compost. Cow dung is a good source of nitrogen and phosphorus. Seaweed with amino acids is an excellent source of calcium and potash (Boller and Hani, 2004).

2.3.2 Fertilizers

Fertilizers quickly break down to provide specific nutritional needs to plants. Urea is another good source of nitrogen, but once again, must be used carefully as it will promote an excess of green growth and make plants weak, spindly and susceptible to disease. Potassium is an essential element deficient in sandy soils. Calcium is another essential element for most plants. Also known as lime, it helps to neutralize the acidity of acidic soils and allows the release of plant nutrients that would otherwise be bound in the soil and unavailable to plants. Lime should be applied carefully as it may cause a deficiency of other elements in plants if used in large quantities. Superphosphate, Nitrochalk, Rock phosphate, Calcium cyanamide, Ammonium sulfate, Ammonium nitrate and Magnesium phosphate are the different examples of fertilizers (Boller and Hani, 2004).

2.4 Forms of available nitrogen in manures
half of the nitrogen in manure is in the form of ammonium and about half is in the form of organic material. Microbes that consume the organic compound excrete ammonium. One of the fourth things will happen to the ammonium—regardless of whether it comes directly from the manure or from microbes consuming the organic compounds. The ammonium may be used by plants immediately, converted to ammonia and lost to the air or converted to nitrate which will be used by plants or microbes. The "immobilized" nutrients become available to plants when the microbes are consumed by other organisms that release ammonium as a waste product.

In the warmth of summer, plants and microbes used by plants or microbes. The "immobilized" nutrients become available to plants when the microbes are consumed by other organisms that release ammonium as a waste product. In the warmth of summer, plants and microbes grow more vigorously and use ammonium and nitrate quickly. Losses of nitrate to leaching are great in spring and autumn when fewer plants and microbes can turn nitrite into organic matter (Wagner and George 2004).

Figure: Forms of available nitrogen in manure
2.5 COMPOST MANURE

Large quantities of fresh crop residues on application directly to soil, causes extremely severe nitrogen immobilization and development of excessive reduced conditions in the soil. To overcome such problems, organic residues are piled up, moistened, turned occasionally, aerated and allowed adequate time to decompose partially and bring down the carbon/nitrogen ratio to about 30. This process is called composting. Compost is utilized for improving or maintaining soil fertility. The collected organic refuse may be from rural and urban origin and may include straw, leaves, paddy husk, ground nut husk, sugar cane trash, bagasse, cattle dung, urine, crop residues, city garbage, night soil, sewage, kitchen and vegetable wastes, hedge clippings, water hyacinth and all other residues. Counting organic matter, during composting under thermophilic and mesophilic conditions in windrows, heaps or pits, adequate moisture and aeration are essential. The final product is brown to black colored, humified material which on addition to soil replenishes plant nutrients, maintains soil organic matter content and helps in improving the physical, chemical and biological conditions of the soil.

2.6 REQUIREMENTS OF COMPOSTING

In general, composting is carried out in open pits or above ground, by filing alternate layers of organic wastes and other materials including topsoil, cattle dung, half-decomposed farmland manure, rock phosphate and other amendments. If the organic wastes are largely high-carbohydrate materials, some fertilizer nitrogen is needed. The addition of poultry waste and farmland manure while layering the compost pit, tends to speed up decomposition and
helpstoimprovethetextureoftheproduct. The optimum C:N ratio of the composting materials is below 40. Good aeration in the compost pile is essential. It is good to mix succulents and organic materials with the materials that decompose slowly. This prevents packing into soggy anaerobic mixtures. Since composting is a biological process, sufficient moisture for the proper development of microorganisms is essential. The material should not be too dry or soggy. The requirement of moisture for microorganisms is almost similar to that of higher plants.

2.7 FACTORS INFLUENCING THE BIO COMPOSTING PROCESS

a) **Particle Size:** If particle is small, the space for the growth of microorganisms will be more, which ultimately increases the microbial activity and fastened the composting process.

b) **Nutrients:** Any waste materials which do not contain heavy metals/toxic wastes should be used. The list of nutrient values is a table - 5 should be taken into account to increase the nutrition value of the waste. Preferably, the local waste with some available agrowaste is always ideal.

c) **Moisture:** The total net weight moisture should be maintained at 50-60%. Which is optimum for microbial growth? Hence, this percentage of moisture should be maintained throughout the process which will increase the process of decomposition. If the moisture is below 50%, the microbial activity is less, which results in slow down the composting process. If the moisture is above 60%, anaerobic condition (clogging) will take place which also slows down the activity of microorganisms.

Aeration and Agitation:

For the growth and activity of microorganisms, oxygen supply is most essential part. Any process to be adopted only to ensure the oxygen supply. The agitation, turning by any tools or by means of aerotilling, may be used.

2.8 COMPOSTING PROCESS DESCRIPTION:
Biocomposting is a process for rapid conversion of organic waste into thoroughly decomposed, stable and humus-rich compost for use as a fertilizer and soil conditioner. The process is aerobic and the technology highlights the following activities for large and commercial scale Biocomposting.

**Windrowing**: The waste material should be chopped in small size and formed in windows of 3 meters width and 1.2 meters height, the length according to the availability of the land.

**Inoculation**: Mixed population of microorganisms is sprinkled over the windrows at a rate of 4 kg/tone of waste materials. In case of liquid 2 litres/tone is enough as the population of fungus and bacteria is 100 times more than solid base inoculum.

**Aerotilling**: The windrow is aerotilled/dressed in alternative days by using a special type of machine called “Aerotiller” or manual method. It helps for uniform mixing and provides oxygen to the microorganisms.

**Application of spent wash**: To maintain the optimum moisture of 60% and to maintain temperature between 65-70°C for high rate composting, then nutrient-rich spent wash is sprayed on the windrows, if it is available. Otherwise, any wash like cow dung wash, vermiwash, kitchen wash, any animal wash, etc., can be sprayed.

2.8.1 COMPOSTING PROCESS DESCRIPTION:
Biocomposting is a process for rapid conversion of organic waste into thoroughly decomposed, stable and humus-rich compost for use as a fertilizer and soil conditioner. The process is aerobic and the technology highlights the following activities for large and commercial scale Biocomposting.
2.8.2 COMPOSTINGPROCEDURE
A composting cycle takes 1 week to complete and involves the following activities.

2.8.3 1st Week:
2. Formation of windrows and trimming.
3. Aerotilling for uniform mixing of material and to bring down the moisture at optimum level.
4. Inoculation of microorganisms in windrows only high temperature tolerant fungus/bacteria should be used.

2.8.4 2nd to 8th Week:
Application of wash & Aerotilling. Monitoring moisture content and temperature of windrows (by any thermometer).

2.8.5 9th to 11th Week:
After 11th week, the ready biocompost is enriched with biofertilizers.

Enrichment of compost with Bio fertilizers:
N-fixing bacteria—Azotobacter, Azospirillum each 2 kg/ton if solid, 1 litre/tonne if liquid.
P-solubilizing bacteria—Bacillus polymixa etc—4 kg/ton if solid, 2 litres/ton, 1 litre/tonne if liquid.
K-Mobilizing bacteria—Fraturia aurantia 4 kg/ton if solid, 2 ltrs/ton if liquid.

Enrichment of compost with Bio Agents:
Bio-control agents like Trichoderma viride, Pseudomonas Fluorescence at the rate of 2 kg/ton of each if solid, 500 ml/ton if liquid form.

2.9 OLD METHODS OF COMPOST PRODUCTION—CHIMNEY AND WALL METHOD
Forwallaerationtechniquetwobrick walls, 30cm apart, 1m high, 23 thick and having 40 holes of size 22 cm x 10 cm each are constructed in the centre of a 2 x 3 m pit. Chimney aeration is provided by constructing two 1 meter high chimneys, one metre apart on a rectangular base of 23 cm. Each chimney has 40 holes of similar size as provided in wall aeration. Substrates are filled in layers with each layer consisting of three sublayers. In a trial carried out at Jabalpur, the sublayers were consisted of (1) overnight water soaked paddy straw 50 kg (air dry basis), (2) dung slurry (20 kg dung in 40 litres water), (3) mixture of 20 kg well pulverised soil, half kg urea, and 1.5 kg urea and 1.5 kg rock phosphates (1.5 percent available phosphorus), 150 mesh passed. Total quantity of substrate in tensuch layers is each pit was 2 tonne. After one month, the towers and chimney were sealed with dung and mud mixture. Chimney aeration yielded 60 percent recovery with nitrogen ranging from 1.10 to 1.70 percent. Further trials have shown that the biomass of the noxious weed, *Parthenium histophorus* yields better quality compost than rice straw. However, before using the *parthenium* compost, it is to be ensured that the weed are not viable.

Enrichment of compost with nitrogen, phosphorus, and potassium can be achieved by *Azobacter*, *Azospirillum*, and phosphates solubilizing and potassium mobilizer biofertilizers after the thermophilic phase is subsided at the rate of 2-4 kg each per tonne of substrate. The biofertilizers may be dissolved in 50 litres water and poured in holes previously made in compost piles. If biofertilizers are not available while composting is in progress, enrichment can be done by mixing biofertilizers with the harvested compost and heaping the treated compost in the shed for at least two weeks. By doing so, increase in the population of *Azobacter*, *Azospirillum* PSM, KMB has been noted. Inoculation of the substrates with cellulolytic and lignolytic microorganisms like *Trichoderma harzianum*, *Aspergillus niger*, *Aterreus* etc. has been found to accelerate the decomposition during composting. Likewise, *Trichoderma harzianum* is the most effective organism for making compost from rice straw.
2.9.1 NADEPmethod

NADEPmethodofcompostmakinghasbeendevelopedbyafarmer, NarayanRaoPandhariPande,inMaharastra,India. This methodis basedonthe principleofaerobic decompositionwithnaturalflow ofoptimumair. Thesubstrate isconvertedatatthetopbyplasteringwithdungandoitominizethe lossof moisture.Toobtain2-2.5tonnesofcompostwith0.6-1.0,0.5-0.8and1.2-1.5 percent nitrogen, phosphorus andpotash respectively, the required raw materials are1.4to1.5tonnesorganicrefuse,90-1000kgofcattledung,1.7to1.8 tonnesofpulveriseddrysoiland1500-2000litresofwater. Thesematerialsare filledlayerbylayerinanatankof3mx2mx1msizeandmadeupbrickswith holes (15-20cmrectangular)onallfourwallsforeasy entryandcirculationofair. Thetank isconstructedabovegroundathighlyingareatoavoidsentryof rainwaterfromsurroundingplace. Internalsurfaceoftankispaintedwithdeth slurry.


Themoisturelevelofthemassismaintainedat15-20 percentbysprinklingwithwaterandaddingslurrythroughholes. Normally the substratetakes3-4monthstoaattainmaturitywithoutturning. Frometank about4.5-5.0cubicmetrecompost1.5-2.0cubicmetre undercomposesdrawrefuse, weighingabouttheretonnesareobtained. Accordingtoanestimate, fromtheannualcollectionofdungfromonecow, 80
tonnes of compost can be prepared which contain 800 kg nitrogen, 560 kg phosphorus and 1000 kg potash (Bonbatkar, 1989).

There are some limitations in using this method of composting like unavailability of dry soil during rainy seasons and water during summer. The ratio of organic refuse and soil is about 1:1. Soil is added to provide microorganisms for carrying out decomposition and nitrogen fixation. The compost harvested does not give dark brown colour, has a higher density and lower nutrient composition as compared to the product obtained from the chimney and tower aeration method.

### 2.9.2 Padegaon Method

This method is recommended for composting resistant substrates like sugarcane trash and cotton stubbles. These materials are shredded into 30 cm size particles and trampled to make a 30 cm thick above ground layer. This layer is drenched with a slurry consisting of wood ash, cow dung and soil. Four or five such layers are added to the pile. The completed heap is about 1.5 m high, 2 m wide and as long as necessary. Since the material is very resistant to decay, the heap is turned each month, re-trampled and sufficient water is added to keep it moist. The material is ready for use in about five months. The compost compares very well in composition with farad manure (Arakari et al., 1962).

### 2.9.3 Indore Method

Sir Albert Howard (1924-26) at Indore, Madhya Pradesh, developed this method in which the conservation of cattle urine is effected by getting it absorbed in rice straw, straw dust and other organic wastes used as bedding in cattle shed. The urine soaked material along with fresh cow dung serves as a major source of nitrogen for the microorganisms involved in composting. The material collected from cattle shed is spread evenly in a pit to form a formal layer of 10-15 cm thick. To this layer is added dung slurried made of 4.5 kg dung + 3.5 kg guineearth + 4.5 kg inoculum from 15 day old compost pit. Water is then sprinkled to achieve 100
percentsaturation. The layering is repeated to fill the pit within seven days. The material is turned three times, first two turnings in 15 days interval after filling the pit and third turning after one month of the first turning (Cherry et al., 2006).

To provide succulent biomass, seeds of sunhemp and cowpea grown on compost heaps and at the first turning, the green plants are turned in. During rainy season the piling of 20 cm carbonaceous material (leaves, hay, straw, sawdust, woodchips, cornstalks etc.) and 10 cm nitrogenous materials (fresh grass, weeds, digested sewage, sludge, poultry litter) in alternate layers is repeated until the pile is one metre high. The recommended size of the heap is 2.4 m square at the base and 2.1 m square at the top. The method is highly labour intensive and less suitable to those farmers who do not have enough cattle and irrigation facilities. The method being aerobic in nature, it hastens the maturity period and results in substantial loss of organic matter and nitrogen. Table 8 and 9 show some bacteria, fungi and actinocetes capable of utilizing various components of organic matter (Cherry et al., 2006).

Despite the fact that huge of knowledge about different types and different ways of improving soil fertility and soil condition is widely available our farmers in Somaliland rarely use them in any meaningful way. Absolute knowledge of what they can do to collect, preserve and use them at the right time to boast the fertility of the soils of their farms is often lacking and there is no extension service helping to improve on this matter. Therefore this thesis is the first of its kind and is intended to give a detailed written document about current use of animal manures, the effect manure application is having on tomato production and what kind can be done to get increased utilization of this important source of plant nutrients. The area this thesis is addressing Arabsio area and this is only for tomato growers. That is partly why this graduation thesis important.
CHAPTER THREE: MATERIALS AND METHODS

3.1. Description of the studied area

Arabsio is suitable for agriculture and rearing livestock most of the people cultivate horticulture crops, is the leading area in terms of agriculture, on the major products were fruits and vegetables also small amount of Cereals, most farms are irrigated farms.

3.1.1. Location

Arabsio Located in North West of Somaliland. It is about 35km and 20 Km in Somaliland Capital Hargeisa and Gabiley region respectively.

3.1.2 Map of the studied area

Fig 1. Somaliland Map. Fig 2. Arabio Map include Gabiley and Hargeisa.


3.1.3 Soil and Climate

Arabsio area has a bimodal pattern of rain fall as all other parts of the country, there are two cropping seasons GU and DEYR the relatively long season GU, {March and April} and short rainy seasons DEYR {October to November}.

And the soils: ARIDIC and soil classification: CALCIC VERTISOL and land form: Pediment and also effective soil depth: 50-100cm and also moisture condition: dry and drainage: moderately well and the rock out crops. (Swalim 2007).

3.1.4 Vegetation

The vegetation is characterized mostly by herbs and shrub also number of acacia species are found but is limited according to other parts of the country.

3.1.5 Water resource

In Arabsio the main resources of water for and livestock and irrigated their crops and human are stream, shallow wells and reservoir ponds and seasonal streams are mostly of used during rainy seasons while wells and dams are used during the dry period, most of the sources are empty at the time of the extended dry periods or during recurrent droughts.

3.2 Data collection technique
3.2.1 Sample technique

\[ N = \frac{N}{1+N(e^2)} \]

Simple random that we select answers 80%

3.2.2 Sample size [n]

Given the target population of 22, a sample size of 19 will be selected. This was arrived at using Slovene’s formula used to determine the minimum sample size which states as follows

\[ n = \frac{N}{1+N(e^2)} \]

Where:

n = the required sample size

N = the known population size
\[ e = \text{the level of significance, fixed at } 0.05. \text{ so } e^2 = 0.05 \times 0.05 = 0.0025 \]

<table>
<thead>
<tr>
<th>AGRICULTURAL AREA</th>
<th>Less Experience</th>
<th>Experience</th>
<th>More Experience</th>
<th>TOTAL</th>
<th>SAMPLE SIZE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Agamsaha</td>
<td>03</td>
<td>08</td>
<td>04</td>
<td>12</td>
<td>10</td>
</tr>
<tr>
<td>Arabsio</td>
<td>05</td>
<td>10</td>
<td>05</td>
<td>10</td>
<td>08</td>
</tr>
<tr>
<td>Total</td>
<td>8</td>
<td>18</td>
<td>09</td>
<td>22</td>
<td>19</td>
</tr>
</tbody>
</table>

Therefore, given the formula, the sample size of 54 was calculated as follows:

\[
n = \frac{22}{1 + 22(0.0025)}
\]

\[
= \frac{22}{1 + 0.1575}
\]

\[
= \frac{22}{1.1575}
\]

\[ n = 19 \]

3.3 Sampling procedures

The purposive sampling will be utilized to select the respondents based on these criteria.

1. Male or female respondents in any SMBs included in the study.
2. All the six industrial area are selected including professional and non-professionals.

From the list of qualified respondents chosen based on the inclusion criteria, the systematic random sampling will be used to finally select the respondents with consideration to the computed minimum sample size.
3.4 Research instrument

The data for this research will be collected through use of Questionnaires as the main tool. Such instruments will be guided by the nature of data to be collected and also for easy collection of the information needed in a short period of time.
CHAPTER FOUR: ANALYSIS

4.1 Gender

<table>
<thead>
<tr>
<th>Gender</th>
<th>Frequency</th>
<th>Percent</th>
<th>Valid Percent</th>
<th>Cumulative Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male</td>
<td>13</td>
<td>68.4</td>
<td>68.4</td>
<td>68.4</td>
</tr>
<tr>
<td>Female</td>
<td>6</td>
<td>31.6</td>
<td>31.6</td>
<td>100.0</td>
</tr>
<tr>
<td>Total</td>
<td>19</td>
<td>100.0</td>
<td>100.0</td>
<td></td>
</tr>
</tbody>
</table>

The above Figure and Table (4.1) 68.42% of respondents were Male while the other 31.58% were Female.

4.2 Age
The above Figure and Table (4.2) 14 of respondents were at the age of 31-45 while 4 of respondents were at the age of 15-30 and 1 was at the age of 46-60.
4.3 Farm Types

The above Figure and Table (4.3) 2 farms of respondents were Rainfed while other 17 farms of respondents were irrigation.
4.4 Source of Irrigation

The above Figure and Table (4.4) 12 farms of respondents there source of irrigation were Borehole while 5 farms of respondents there source of irrigation were Barked and the other 2 were Dam and others.
4.5 Type of the crops

The above Figure and Table (4.5) 5% farms of respondents crops they grow were Cereals while 47% farms of respondents crops they grow were Vegetables and 10% grown Fruits and the other 36% were Intercropping.
4.6 Tomato Grower

The above Figure and Table (4.6) 17 of respondents are saying yes and the others are saying no.

Most of the farmers cultivated tomato but few of them told us that they does not plant tomato due to many reasons

1. Bad market
2. Diseases and pests
3. Lack of storage facilities
4. That they are new in the area (arabsio) and they are waiting to adopt

4.7 Years they grown Tomato
The above Figure and Table (4.7) 8 farms of respondents were growing tomato 1-3 years, 6 farms of respondents were growing tomato 4-6 years and 5 farms were growing tomato 6-8 years while 1 farms was above 8 years.
4.8 Does farmers use Manure

<table>
<thead>
<tr>
<th></th>
<th>Frequency</th>
<th>Percent</th>
<th>Valid Percent</th>
<th>Cumulative Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes</td>
<td>15</td>
<td>78.9</td>
<td>78.9</td>
<td>78.9</td>
</tr>
<tr>
<td>Valid No</td>
<td>4</td>
<td>21.1</td>
<td>21.1</td>
<td>100.0</td>
</tr>
<tr>
<td>Total</td>
<td>19</td>
<td>100.0</td>
<td>100.0</td>
<td></td>
</tr>
</tbody>
</table>

The above Figure and Table (4.9) 78.95% of respondents are saying yes and the other 21% are saying no
4.9 Type of Manure they Use

The above Figure and Table (4.9) 72% farms of respondents the manure they use were cattle manure while 27.7% farms of respondents use goat and sheep manure while 5.5% did not use noting.
4.10 Does they own Livestock

The above Figure and Table (4.10) 5 of respondents are saying yes and the other 14 are saying no.
4.11 Time of Drying

The above Figure and Table (4.11) 4 farms of respondents dry the manure 2-4 weeks while 12 farms of respondents dry the manure 4-6 weeks and the other 2 farms of respondents dry the manure 6-8.
4.12 Number of Loads they use per Season

The above Figure and Table (4.12) 66.6% farms of respondents use 2-3 loads per season while 33.3% farms of respondents use 4-5 loads of manure per season and the others did not use.
4.13 Way they Use Manure

The above Figure and Table (4.13) 14 of respondents use the manure direct and other 4 are saying compost.
### Manure, Place of Storage

<table>
<thead>
<tr>
<th></th>
<th>Frequency</th>
<th>Percent</th>
<th>Valid Percent</th>
<th>Cumulative Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Center of the Farm</td>
<td>4</td>
<td>21.1</td>
<td>21.1</td>
<td>21.1</td>
</tr>
<tr>
<td>Near Farm</td>
<td>13</td>
<td>68.4</td>
<td>68.4</td>
<td>89.5</td>
</tr>
<tr>
<td>Houses</td>
<td>2</td>
<td>10.5</td>
<td>10.5</td>
<td>100.0</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>19</strong></td>
<td><strong>100.0</strong></td>
<td><strong>100.0</strong></td>
<td></td>
</tr>
</tbody>
</table>

The above Figure and Table (4.14) 12 farms of respondents store the manure near the farm while 4 farms of respondents store manure center of the farm while the other store the manure houses.
The above Figure and Table (4.15) 12 farms of respondents store the tomato in the nursery 22-27 days and 3 farms of respondents store the tomato in the nursery 16-21 days while 3 store the tomato in the nursery 10-15 days.
4.16 Cost of Purchasing

The above Figure and Table (4.16) 20% of respondents use cost of purchasing manure in $40 and 50% use cost of purchasing manure in $50 while the other 30% use $60.
4.17 Way of Using Manure
Direct which they mean broadcasting

4.18 Manure effect of crop
Manure increase the quality of the crop
Also rise the quantity that crop will produce
Also increase the nutrient of the soil

4.19 extra dosage of manure
It does not affect the crop

4.20 Marketing of the tomato
Most farmers told us that the marketing of tomato is not good all the time but sometimes can say it is good.
Chapter Five:

Conclusion and Recommendation

5.1 Conclusion

The aim of this study was to explain how manure effect production of tomatoes in Arabsio area in the western part of the Somaliland, now everybody knows the manure have positive impact in horticultural crops in farming system and it is higher density.

The farmers identified the good effect of manure impact, it consequence every side it related the life cycle and also the result of yield production and fruit quality and increase the marketability of tomato and other horticultural crops, on the other hand, effect human and animal health, and also effect the environment aspect and also to rise soil fertility. They don’t have suitable way like composting.

The goal of this research was to observe the impact of manure the crop production and environment and also land use and impact the land cover and vegetation’s, the main purpose was to evaluate out though the ability of manure in horticultural species. Results of the study have shown that agriculture is the major livelihood activity for the communities and how manure partake production of their farms.

Tomato (Lycopericom esculent) is the edible, often red fruit/berry of the nightshade Solanum, commonly known as a tomato plant. it is used as a food in Mexico, and spread throughout the world following the Spanish. Tomatoes are characterized by relatively moderate requirements for tropical climate and soil. They can be produced fresh throughout the year and sold fresh (Schaller and Schnitcher, 2000). The following varieties are usually cultivated in Somaliland; globe (dhulubo), cherry tomato (adhiyo) and Roma variety(Roma VF). (Tindall, 1983). The tomato is consumed in diverse ways in Somaliland. it is mainly used as an ingredient in sauces, salads or eaten raw.

In Somaliland, organic manure abounds much in the form of animal droppings but they are not usually used due to conveyance problems, bad odour and inadequate extension services.
There is therefore the need to exploit this cheaper means of improving soil fertility for high and sustainable carrot production. Somaliland lies at the extremity of the sub-Saharan semi-arid zone commonly referred to as the Sahel, which traverses the continent from Senegal to Somalia. The climate of the study area which is Arabsio is hot dry and semi-arid. Mean annual Rainfall ranges from 300 - 500mm (Swalim, 2007). Rainfall in the area is thus bimodal (Dry & rainy season).

According to agronomical aspect and soil science knowledge, that when crops, including tomato, is harvested and sold, nutrients are lost from the farm. While many soils can supply nutrients for crop growth without fertilizer additions for many years, eventually the productivity of the farm will decrease unless the nutrients are replaced. No doubt the soils in the study area was being used for a very long time to produce crop without the nutrients lost being put back.

If livestock are not raised on a farm, nutrients from manure or other organic amendments/fertilizers need to be obtained externally. These organic fertilizers such as manure are usually bulkier than synthetic fertilizer sources,

5.2 Recommendation

- More studies are needed to determine, over the long term, the impact on yield for field and horticultural crops of “soil quality”, comparing the influence of organic vs inorganic nutrient sources.
- There should be further research to better quantify the conditions under which manure can control plant pathogens.
- Manure should be composted whenever possible
- Farmers should learn composting of manure
- If not (aerobically) composted, storage of manure slurry for 4 months without adding new material is recommended
- Solid manure is preferable to slurry
- After planting and sowing, manure and slurry should be applied and is even prohibited under certain organic regulations
- Manure should be promoted as a resource that has value beyond its nutrient value.
• In vegetable crops with short cropping period which are intended for raw consumption and for raw convenience food fresh manure/slurry should be applied at the latest 4 months before crop establishment.
Reference

1- Heather M. Fraser, 2009: Non-Nutrient Value of Manure - Literature Review.

2- M.A. Awodun 2007: Effect of Animal Manure Amended Spent Grain and Cocoa Husk on Nutrient Status, Growth and Yield of Tomato

3. KARL STAHR 2009: Integration of Organic and Inorganic Fertilizers: Effect on Vegetable Productivity


5. Technical guide (Manure for vegetables) international edition FIBL 2011


8. Ijearu 2013: Effect of Different Sources Of Animal Manure On The Growth And Yield


24. **P.M. Bierman, 2005.** Using manure and compost as nutrient sources for fruit and vegetable crops University of Minnesota Extension Service.


Appendix
Photos

Tomato not used for Manure

Tomato used for Manure

Tomato used for Manure

Tomato Not used for Manure
Questionnaire

1. Name_________________________________________
   Sex (Do not ask)  ☐ Man  ☐ Wowem
   Position  ☐ Owner  ☐ Labour
   Position of the farm (do not ask)
   ☐ Arabsio  ☐ K.Arabsio  ☐ B.Arabsio  ☐ G.Arabsio  ☐ W.Arabsio

2. Size of the Farm __________hectare

3. Farm Type  ☐ Rain fed  ☐ Irrigated
   Source of Irrigation
   ☐ Bore hole, Berkad
   ☐ Dam
   Other______________

4. Crops of the farm

5. 5 main challenges of your farm

6. does your farm use Manure  ☐ Yes  ☐ No

7. Type of manure
   ☐ Cattle Manure
   ☐ Poultry Manure
   ☐ Sheep and Goat

8. From own livestock husbandry
   ☐ Yes  ☐ No (I Purchase)

9. If No, Cost of purchase
10. If Yes, how long it take to dry
   - [ ] 2 weeks
   - [ ] 3 weeks
   - [ ] 4 weeks
   - [ ] 6 weeks

11. Per season, how many loads of manure you use
   - [ ] 20-30 load
   - [ ] 30-40
   - [ ] 40-50
   - [ ] 50-60
   - [ ] >60

12. How you use,
   - [ ] Direct
   - [ ] Compost

13. If Direct, How you use

14. If Compost, How you use and prepare

15. Place of storage
   - [ ] Center of the farm
   - [ ] Near farm
   - [ ] Your Home

16. How the manure effect your crop

17. If you use extra quantity of manure, what is the side effect of the crop

18. In composting, (if he answer composting in question 11)
   a. Size of the Hole
   b. Ratio of Humus and manure
   c. Fermentation days

19. Marketing of the tomato

20. Nursery days

21. Effect of nematodes into the tomatoes