ADDIS ABABA UNIVERSITY

GRADUATE PROGRAMES COLLEGE OF NATURAL AND COMPUTITIONAL SCIENCES

DEPARTMENT ZOOLOGICAL SCIENCES

Local Practices on Compost Preparation and Utilization: the Case of Enarji Enawuga Woreda, East Gojam Zone, Amhara Regional State, Ethiopia.

By:

SEWALE ALEBIE AYEHU

ADVISOR: HABTE JEBESSA DEBELLA (PHD)

A Thesis Submitted to the graduate programs of Addis Ababa University in Partial Fulfillment of the requirement for the degree of Master of Science in Biology.

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SCHOOL OF GRADUATE STUDIES

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Acronyms

IFOAM= International Federation of Organic Agriculture Movement

ISO= International Organization for Standardization

AOR= Adjusted Odd Ratio

ABSTRACT

Organic farming is environmentally friendly and at the same time maintains the soil fertility and its integrity (Kassa Teka et al., 2010). This study was assess awareness and practice of local farmers, in the case of Debre work town surrounding rural Kebeles. *Questionnaires, interviews and field experiment were used to gather necessary information. The researcher took 384 sample respondents from six kebeles; the sampling method applied was simple random and purposive sampling. The data analysis was conducted through statistical techniques such as descriptive statistics and qualitative techniques. In this study all the determinant factors age (AOR=14.492, 3.884-54.075), family size (AOR=13.642, 1.602, 11.297), shortage of input (AOR=2.700, 3.098-6594), type of fertilizer preferred (AOR=2.602, 2.11-7.064), size of pit (AOR=2.456, 2.045-8.980), and knowledge on composting (AOR=1.358, 2.135-5.683) were significantly (P<0.05) associated with organic farm. According to the findings from the total respondents 339(88.28%) utilized inorganic fertilizer, 27 (7.07%) utilized compost and 18(4.69%) of them neither utilized compost nor inorganic fertilizer. From the total respondents 331 (86.19%) are married and 53(13.80%) of them are single. The result of field experiment revealed that, there was a difference in growth rate of crops among compost and inorganic fertilizers (the mean leaf size of cabbage with compost was 13.5cm, with chemical fertilizer was 7.25cm and without any fertilizer was 5.55cm). Therefore, the findings of the study suggest that stakeholders should give more focus on the development of organic farming to improve the quality and quantity of crop products to generate more income from organic farming and maintain the wealth status of people in Enarji Enawuga Woreda.*

Key words*: bio slurry, composting, conventional- composting, Enarji-Enawuga, Organic farming*, and vermin-composting.

1. INTRODUCTION

1.1 BACK GROUND OF THE STUDY

Organic farming helps farmers to maintain healthy feeding system with lower coast. Organic farming is also environmentally friendly and at the same time maintains the soil fertility and its integrity. This farming system also helps farmers to ensure food security and greater independence. Therefore, organic farming is the way towards sustainable development for a developing country like Ethiopia (Kassa Teka *et al*., 2014). The Ethiopian government may also capture international market of organic products and hence earn more foreign exchange by exporting organic products (Sinha *et al*., 2010).

Organic-based agricultural production is a rapidly emerging technology which partly solves waste disposal problems, through conversion of biodegradable waste into organic fertilizer, which can be used for crop production. The fertilizer contributes to rehabilitating and sustaining the fertility of our crop land that have been degraded, or are in danger of degradation, due to intensive crop production and improper soil management practices. Compost improves soil quality and productivity, reduces the need for chemical fertilizers, and can prevent and control erosion (Gajalakshmi and Abbasi, 2008). Weltzien (1989) has revealed that organic farming systems with the aid of various nutrients of biological origin such as compost are thought to be the answer for the 'food safety and security' in the future.

Compost is a decomposed organic material that looks and smells like healthy soil. It is black or dark brown and has high carbon content in the form of humus. It can be made from remains of plants, crop residues, kitchen wastes, weeds, grass and other vegetation. However, high quality compost includes animal manure. Composts contain plenty of beneficial soil microbes which help in soil restoration and fertility improvement and protect them from degradation while also promoting growth in plants (Mugwe *et al*., 2007; Hailu Araya, 2010).

Composting is a process, which converts biomass wastes and animals manure to a stable form of organic matter, such as humus. Composting is a versatile technique for changing biodegradable material to organic matter that can be applied to soil. It can be considered as an important source of organic fertilizer. Organic fertilizers can improve various soil properties related to organic matter. It increases the water holding capacity of soils, and can improve structure and water movement through heavier textured soils that are high in silt and clay content. By increasing the organic content of the soil, biological activity can be enhanced. Compost can suppress fungal diseases and soil borne disease. Compost amendments to soil increase organic matter, nitrogen, phosphorous and potassium content of soil, implying improved biomass production and nutrient uptake. It is a technology which has benefit-cost ratio higher than 1 (Gajalakshmi and Abbasi, 2008).

Agriculture is the major economic activity which produces food supply for the people in the world and to maximize the yield. Many farmers employ organic and inorganic farming system for cultivating different varieties of crops. This is because vast area of Africa in general and Ethiopia in particular is characterized by low soil fertility, high soil degradation, rain fed and fragmented land holding, extremely over cultivation, and the use of traditional farming techniques (Sinha *et al*. 2010). Consequently, the productivity of farm lands is declining. But such problems are not getting attention by stake holders in agricultural activities (Bezabih Emana *et al*., 2010).

In Ethiopia, agriculture contributes 43% to the gross domestic product (GDP), providing 85% of the foreign earnings and employing 85% of the labor force (World Bank, 2010). However, organic farming has not been fully exploited and promoted, to bring sustainable national economic growth and development. And the performance of agriculture depends on natural factors and the intensity of agricultural inputs (Bezabih Emana *et al*., 2010; Sinha *et al*., 2010). The scientific community all over the world is, therefore, seriously looking for an economically viable and environmentally friend agricultural practices (Kassa Teka *et al*., 2014).

In Amhara Regional State the amount of compost for organic farm is not also significant. Amhara region is fertile and suitable farmland and environment, but it has been challenged by the over exploitation of soil nutrients and by over use of chemical fertilizers. Enarji Enawuga Woreda is one of the districts with surplus crop yields in Ethiopia and encompasses a variety of crops that support the food security of people. But crop cultivation is mostly depending on chemical inorganic fertilizers, and the adoption of compost is only practiced for vegetables like, onion, potato and cabbage in minimum rate (Enarji Enawuga Woreda Agriculture and Rural Development Office, 2016).

1.2. Statement of the problem

The efficiency of agriculture in crop farming in Ethiopia are determined by a number of natural factors like; seasonal drought, unseasonal rainfall, soil degradation, leach of soil nutrients and the intensity of agricultural inputs (Bezabih Emana *et al*., 2010). (In EnarjiEnawugaWoreda, application of organic fertilizers is less widely practiced in crop cultivation and became a serious issue and needs urgent intervention in order to expand its application .Generally organic farming residues can solve environmental problems like; soil degradation, water pollution, loss of soil minerals and beneficial soil microorganisms). It can also minimize economic crises of farmers. Since, farmers spend a lot of money to buy enough amount of fertilizer for their farm lands (1360 birr per quintal is required for chemical fertilizer). In addition to this organic fertilizer are long lasting and these are important to maintain the fertility of soil sustainably (Sinha *et al*., 2010).

The use of organic fertilizer contributes to maintain the fertility of croplands that have been leached, or are in risk of degradation, due to intensive crop production and improper soil management practices. By increasing the organic content of the soil, biological activity can be advanced. Water and nutrient holding capacity can be improved in soils. It is also cheap in cost (Gajalakshmi and Abbasi, 2008).

Even though Enarji Enawuga Woreda has high potential for compost production, there are challenges that hinder this sector. Attitude of local farmers on utilization of compost for subsistence application in organic farming may be a major constraint. Preparation of compost in this Woreda per household estimated as very low. There were a number of challenges related to attitude and practice of farmers in organic farming. There are several constraints that hinder compost preparation and utilization such as lack of professional service, and limited access to water for compost preparation, shortage of labor, skill and interest of farmers on composting. Still now, there is no effective research conducted on expanding the use of compost as natural organic fertilizer, in the study area and there is no totally study on compost adoption. But there are some researchers like Hailu Araya (2010) in Tahaty Michew, focused on the chemical and physical composition and on the way of preparation of compost. There is limitation on studying the attitude and practice of farmers on composting. Therefore, this study was conducted to fill the gap of previous researchers by addressing the local farmers by assessing their awareness and practice in compost adoption.

1.2.1. Research Questions

This research tried to answer the following questions:

- Do farmers prefer to compost compared to inorganic fertilizers?
- What are the views of farmers to wards compost?
- To what extent do farmers practice composting?
- What raw materials do farmers use for composting?
- What are the major obstacles for local farmers in compost preparation?

1.3 Objectives

1.3.1 General Objective

The general objective of this study was to investigate local practices on compost preparation and utilization in Enarji Enawuga woreda.

1.3.2 Specific objectives

The specific objectives of this study were:

- ✓ To assess farmer's views and awareness of using compost in organic farming.
- ✓ To identify factors that limits the use of compost by local farmers.
- ✓ To compare the preference of farmers between compost and chemical fertilizer.
- ✓ To assess the practice of using compost by farmers.
- ✓ To investigate the effect of compost and inorganic fertilizer on the growth and yield of cabbage through field experiment.

2. REVIEW LITRATURE

2.1. Conventional Composting and Vermin-Composting

Convectional composting is the process of preparing organic fertilizers with the help of thermophilic decomposer bacteria and vermin-composting is a technique of compost preparation by mesophilic bacteria, fungi and soil worms. Nowadays, the use of earthworms as a composting technique is gaining popularity. This method is commonly known as vermin-composting (Edwards, 1998). The process by which worms are used to convert organic materials into a humus-like material is known as vermin-compost. The vermin-composting process is “bio-oxidation and stabilization of organic material involving the joint actions of earthworms (such as *Eisenia foetida, Eudrilus eugeniae and Perionyx excavates*) and mesophilic microorganisms”. *Eisenia foetida* is the most widely used earthworm due to its efficiency in decomposition process (Aira *et al.,* 2002).

Conventional composting and vermin-composting are quite distinct processes particularly with respect to optimum temperatures for each process and the type of decomposer microbial communities that predominate during active processing; while ‘thermophilic bacteria’ predominate in conventional composting, ‘mesophilic bacteria & fungi’ predominate in vermin-composting. Researchers like Perz-Murcia *et al.*, (2006) and Sinha *et al.*, (2010), have compared the benefits of vermin-composting with the conventional composting. They concluded that vermin-compost provided extra nitrogen (2–3%), potassium (1.85-2.25%), phosphorus (1.55-2.25%) and micronutrients. As high 7.37% nitrogen (N) and 19.58% phosphorus as P_2O_5 in worm’s vermin cast.

Conventional compost is higher in ‘ammonium’ content, while the vermin-compost tended to be higher in ‘nitrates’, which is the more available form of nitrogen. Phosphorus (P), potassium (K), sulfur (S) and magnesium (Mg) can be significantly increased by adding vermin-compost as compared to conventional compost to soil. In Argentina, farmers who use vermin-compost consider it seven times richer than conventional composts in nutrients and growth promoting values (Munroe, 2007). Despite the benefits described above, the use of vermin-compost in Ethiopia is not commonly known.

2.2. Improving Soil Nutrients through Different Composting Techniques

Organic farming systems with the aid of various nutrients of biological origin such as compost are thought to be the answer for the 'food safety and farm security' in the future. Composts contain plenty of 'beneficial soil microbes' which help in 'soil regeneration' and 'fertility improvement' and protect them from degradation which also promoting growth in plants (Hoitink and Fahy, 1986; Scheuerell and Mahaffee, 2002). Compost is becoming widely used by many farmers in the Sub-Saharan Africa, to improve soil fertility and crop production (Mugwe *et al.,* 2007). Compost has been used by about 25% farmers to amend the extremely poor soil fertility in Tigray (Edwards, 2006 and Hailu Araya, 2010).

The most important points to ensure maximum use of compost nutrients are well compost making through improved methods like; protect compost from sun, wind and rain by providing cover or shade, If the field compost is far from the home or cattle shed, make the compost right in the field, when the compost is ready, store it in a cool, dry place. Piling the compost in a heap and cover with straw or dry soil reduce volatilization losses of plant nutrients so, transport the compost when needed. If the compost must remain in the field for a while, it is better to make only one or two larger heaps in the field rather than many small ones. If possible, cover the heaps with soil. When it is time to prepare for crop planting, spread the compost evenly on the land, plough it under and mix thoroughly with the soil (Faridullah *et al*., 2014).

If only limited compost is available and crops are planted with wide spacing, use compost only in small pits where the seed is planted along the rows/furrows. The farmers' practice of directly sowing potatoes in compost (reducing the amount of compost used by as much as 2/3) is one good example. For grain crops, the compost can be directly spread into the ploughed furrow immediately after ploughing. For garden crops, make trenches, place the compost in the trench and cover with soil. For tree crops, dig a shallow trench around the tree away from the trunk, just below the drip line. Place the compost in the trench and cover with soil. The same applies for well-established trees as well (Faridullah *et al*., 2014).

2.3. Feedstock

Large quantities of various organic wastes are generated continuously from both point and non-point sources. Food waste, which includes unused consumable food items and rejected products from food manufacturing and processing industries, create significant organic waste in urban areas and food processing locations. Food wastes are produced in high volume and tend to increase with human population improper disposal. Increasing food waste due to increasing population causes ever-increasing problems in environmental pollution and disease occurrence to both human beings and animals. These improperly managed wastes can have negative impacts on human and environmental health during the decomposition process. Therefore, composting of food waste has recognized benefits for reducing volume of household waste for landfills and significantly improves soil properties and land productivity. On other hand landfill by itself requires space and the compounds released by this process pollute air, soil, water and ground water can be contaminated, negatively influencing soil quality and aquatic ecosystems. Playgrounds become unsafe for children due to disease-causing contaminants (Benjawan *et al*., 2015).

According to Giannakis *et al*. (2014), a huge amount of organic waste is either burned or buried in landfills; with both treatments causing environmental pollutants. There are a number of micro and macro organisms that have the ability to naturally convert organic waste into valuable plant nutrients and organic matter (compost) which is otherwise discarded, can be composted and converted into productive uses such as soil amendments. At the same time this potential soil amendment is being thrown away, farmland soils are degrading, showing a progressive productivity decline. Intensive soil cultivation causes a reduction in soil organic matter and influences soil properties. Due to poor soil management and related problems, Ethiopia faces major plant nutrient depletion (Tulema *et al*., 2007).

Organic-based agricultural production is a rapidly emerging technology which partly solves waste disposal problems, through conversion of biodegradable wastes into organic fertilizer, which can be used for crop production. The fertilizer contributes to rehabilitating and sustaining the fertility of our crop lands that have been degraded, or in danger of degradation, due to intensive crop production and improper soil management practices. Compost improves soil quality and productivity, reduces the need for chemical fertilizers, and can prevent and control erosion The Composting process can convert wastes to a stable form of organic matter. It is a profitable technique to amend fertility of soil. It can be considered as an important source of organic matter. Organic fertilizers from waste products can improve various soil properties related to organic matter (Tulema *et al.,* 2007). It can increase the water holding capacity of soils, and can improve structure and water movement through heavier textured soils that are high in silt and clay content. By increasing the organic content of the soil, biological activity can be enhanced. Water and nutrient holding capacity can be improved in soils. Some compost has the ability to suppress fungal diseases and soil borne diseases. Compost amendments to soil increased organic matter, and nitrogen, phosphorus and potassium content of soil, implying improved biomass production and nutrient uptake (Tulema *et al.,* 2007).

The quality of compost itself vary from type of raw materials used, management of composting processes, stage of decomposition processes, type of nutrients applied to enrich the compost and/or to enhance decomposition. Compost prepared by mixing cow dung with paddy straw showed higher total organic matter, C/N ratio, but higher phosphorus, nitrogen, zinc and manganese for composts enriched with nitrogen or phosphorus. On other hand, the compost enrichment with urea, phosphate, zinc, iron, copper and manganese at various stages of composting in chaffed cotton stalks and farm wastes reduced C/N ratio and lignin but increased other nutrients. The compost produced from poultry litter showed higher phosphorus, potassium, calcium and magnesium compared to fresh manure. Some food waste compost may contain significant quantity of heavy elements such as lead, nickel, zinc, manganese, copper and chromium. After complete decomposition, the household waste compost also contains significant proportion of plant nutrients and soil properties amending constituents (Faridullah *et al*., 2014).

Agriculturalists and environmentalists have an increasing interest in converting municipal solid waste to compost that contributes to soil fertility and crop productivity. In addition to soil amendment, composting food scraps reduces greenhouse gas emissions such as carbon dioxide (CO_2), methane (CH_4) and nitrous oxide (N_2O). The Intergovernmental Panel on Climate Change (IPCC) has identified organic waste as a key contributor to climate change, releasing 7 % of total gas emissions in developing countries. This amount is predicted to increase with population growth. Utilizing compost in agriculture supports climate change mitigation in two ways: directly through carbon sequestration and enhanced plant growth; and indirectly from reduced production and use of chemical fertilizers and pesticides that generates greenhouse gases and cause a variety of other environmental issues (Giannakis *et al*., 2014).

2.4. Compost with Bio slurry of Biogas

Composting is the deliberate mixing of organic waste and old compost or soil so that biological and chemical decomposition takes place for the purpose of producing humus. It is the final product obtained from the decomposition of the organic matter, wastes from preparing food and gardening, sweeping up leaves, collecting manure, straw and grass clipping, etc. Compost is an organic fertilizer that can be made on the farm at low cost. The most important impute is the farmer's labor (Roberta, 1999).

The major challenges for farmers to make a good quantity of compost is the labor needed to make and use it correctly, as well as getting sufficient quantities of dry and green organic materials, animal manure and water. Adoption of biogas technology by farmers provides them with bio slurry, the effluent from the biogas digester. Bio slurry makes it possible for farmers to make a higher quantity of higher quality compost throughout the year. Because it is made from broken down animal manure and has high water content (Inckel *et al., 2005).*

Slurry is the remaining organic matter after methane gas is generated by bio digesters. It is used as organic fertilizers in agricultural practices. The groups of bacteria which help to digest the hard component of plants like cellulose in ruminant animals are disposing with their waste and it can facilitate the digestion of detritus and animal dung. Therefore, production of compost from byproduct of biogas has a dual function. At the course of digestion 20-30% of the total raw materials convert in to methane gas and the remain 70-75% organic matter is converted in to slurry which contains water, inorganic matter and organic matter that accumulate in collecting container (Amhara Regional Energy Promotion Program (NBPE), 2010)).

According to National Biogas Promotion of Ethiopia (NBPE) (2010), Bio slurry used as a natural organic fertilizer that improves soil structure and fertility resulting in increased crop yields. It can help to solve soil problems for example, coarse textured or sandy soil is generally poor in nutrients and humus that covers the mineral particles making them stick together and hold more water. In heavy textured soils that high clay content, mixing bio slurry compost into the top soil helps break up the lamps of clay. Therefore, the soil develops a good crump structure with pores air and water. Plant roots have access to oxygen and can then grow more easily and the nutrients in the soil water are more easily available to the roots it is when adding bio slurry. Bio slurry can be used in conjunction with chemical fertilizers. Such practice helps farmers to get better economic returns from the use of these fertilizers, maintain the living nature of the soil and minimizes the loss of nutrients and provides balanced nutrition to crops (NBPE, 2010).

Bio slurry can be applied directly to growing crops either by collecting it in a bucket or watering cane and pouring in a furrow between the plants, or the farmer can make a channel to take the bio slurry direct to the plants he/ she wants to receive fertilizer. Bio slurry can also be mixed with irrigation water and fed to the plants through irrigation channels as in Genesis Farm in Debre Zeit (Hailu Araya, 2010).

2.5. Major Organisms Involved in composting of organic matter

Many organisms work to break down organic matter. Most are not seen by the human eye. Others that are large enough to see are usually associated with the later break down stages. A succession of microbes and insects combine efforts to turn feed stocks, such as leaves, grass clippings, yard pruning and food waste, in to the fully decomposed finished product known as compost. Macro organisms such as mites, centipedes, sow bugs, snails, beetles, ants and earth worms, are physical decomposers; they grind, tear and chew materials in to smaller pieces. However microorganisms such as bacteria, fungi, and actinomycetes are responsible for most of the organic material break down (http://www.calrecycle.ca.gov/organics/.

Billions of aerobic bacteria working to decompose the organic matter in a compost pile cause the pile to warm up. As the temperature rises, different organisms thrive. Psychrophilic bacteria are most active at around 55°F. Mesophilic bacteria take over around 70°F up to 100°F, the heat loving thermophilic bacteria take over. Thermophilic bacteria prefer a temperature between 113°F, and 160°F, if the pile heats to more than 160°F, bacteria begin to die off and decomposition slows down. As thermophilic bacteria run out of food, the pile will cool and the makeup of microbial community will shift back towards cooler temperature bacteria. This is when fungi become more active in the compost pile. Fungi prefer a temperature range between

70°F and 75°F and do a great job breaking down cellulose and lignin, the woody materials in the pile. Actinomycetes are fungi-like bacteria that are light greyish in color and credited with creating the Earthy aroma of good compost. Along with fungi, Actinomycetes play a critical role in degrading the more complex woody materials in the compost pile, such as lignin, chitin, cellulose and proteins. These bacteria prefer a high PH and generally work in moderate temperatures (http://www.calrecycle.ca.gov/organics/.

2.6. Stages of compost preparation

According to Inckel *et al.* (2005), in choosing a place for composting wastes on-farm or off-farm, the first thing to consider is a place where no flooding occurs during the rainy season and there is no chance of polluted surface water and ground water getting into the compost pit. A shelter is necessary in an area with high rainfall and a shade when there is strong sunshine. A windbreak of trees can provide shade and prevent compost being dried out by strong winds. A concrete floor or hardened soil surface is needed to retain moisture in the compost pit or pile, and to prevent wastewater from leaching into groundwater.

During the first stage of composting, the compost starts to heat up considerably. This effect is known as fermentation and is the result of the breaking down of the complex and tough fibrous material of the organic matter by macro-organisms (such as earth worms and termites) and micro-organisms (particularly fungi and bacteria), to get the fermentation going quickly and effectively, a number of factors are important. In the first place the compost heap should be made of organic materials. Secondly, the right microorganisms have to be presented. Thirdly it is very important that there is an adequate balance of air and water. If these three conditions are met, heat is generated quickly (Inckel *et al.,* 2005).

During fermentation, the microorganisms multiply and change at a rapid rate, which adds to the heating up processes started. In this way, a self-accelerated process is started. The formation stage usually begins after 4-5 days and may take 1-2 weeks. Maximum fermentation takes place at a temperature of 60-70^{o}C. If temperature is too high, the necessary microorganisms may die and decomposition becomes halt. In the fermentation process, many pathogenic organisms that are a threat to people, their domestic animals and crop plants, are destroyed. It is often suggested that fermentation also kills many weed seeds. The hot fermentation stage can also be encouraged by covering the compost pit or heap with soil and/or leaves, or black plashing sheeting (Inckel *et al.*, 2005).

The fermentation phase gradually changes into a cooling down phase when decomposition continues without much generation of heat so that the temperature drops slowly. During this period new types of microorganisms convert the organic components into humus. The heap remains moist and warm inside while the temperature drops from 50^{o}C to 30^{o}C. The process can be accelerated or slow down by adjusting the temperature, air and water supply. The time for cooling down depends on the type of heap or pit, the materials in it, the attention given to the process, the climate, etc. (Inckel *et al.*, 2005).

2.7. Factors affecting composting of organic matter

Due to composting is a complicated biochemical reaction process that can be influenced by many factors, such as carbon nitrogen ratio, moisture, oxygen and aeration interaction, temperature, PH value and raw material size of composting. To make sure microorganism nutrient of organics decomposition balanced, composting carbon nitrogen ratio should satisfy the best ratio (25-35:1) required by microorganism (http://compost-turner.net>facors).

The best water content of composting raw materials is usually around 50%-60%.Too low (less than 30%) would affect microorganisms activity and make organics hard to decompose while too high would bring down the composting speed and lead to anaerobe decomposition, stench generation and bleeding of nutrient substance. As one of the key parameters of successful composting, the quantity of oxygen supply and aeration is related to organic content in composting materials, namely, the more organic carbon in the material, the larger oxygen consumption rate. The ideal oxygen concentration is 18% one less than 18 percent the microorganism life activity in composting process will be limited, easily causing stench (http://compost-turner.net>facors).

Temperature affecting microorganism growth is an important factor for composting to go with a swing. Too low temperature would greatly extend currying time while too high (over 70 Celsius) may cause adverse impact of composting microorganism. The most appropriate PH value for microorganism is neutral or weak alkali, and too high or too low PH value both can make composting disposal difficult. Lowering size of pellet materials will increase the surface area and promote microorganism activity and accelerate the composting speed. But on the other hand, too thin materials also prevent the flow of air and reduce oxygen content in composting, then bringing down microorganisms activity speed (http://compost-turner.net>facors).

2.8. Merits and Demerits of compost application

2.8.1. Merits of Compost Application

Cultivating organic vegetable is a rapidly growing industry and the concerns over the pesticides residues in food and the environment has resulted to increase in demand for organic food. Organically grown foods are perceived as better quality, healthier and more nutritious than conventional counterparts (Warman and Havard, 1997). On the other hand, the relatively slow mineralization of the composts and other organic fertilizers limits the effective nitrogen utilization. The low availability of nitrogen in organic fertilizers is the main underlying factor contributing to the low yield inorganic farming (Badgley *et al.,* 2007).

The principal objections to the proposition that organic agriculture can contribute significantly to the global food supply are low yields and insufficient quantities of organically acceptable fertilizers. However, liquid organic fertilizers like poultry manure tea and compost tea have been found to contain nitrogen mainly in inorganic form like ammonia (Price and Duddles, 1984; Gross *et al*., 2007) and can provide nutrients instantly to the plants much like the chemical fertilizers. Not much information is available on fustigation of crops by manure teas.

Organic fertilizer commonly used in the cultivation of Broccoli (*Brassica oleracea*) belongs to family Brassicaceae. It is a fast-growing crop and requires high nitrogen input. It is one of the most important crops as it is highly nutritious vegetable with abundant vitamins and minerals such as vitamin A and C, carotenoids, fiber, calcium, and folic acid (Paradis *et al.,* 1995; Michaud *et al.,* 2002). Broccoli and other brassica vegetables have high content of glycosylates which has cancer-fighting properties. Broccoli buds are rich source of minerals especially potassium, sulfur, phosphorus, magnesium and micro-elements.

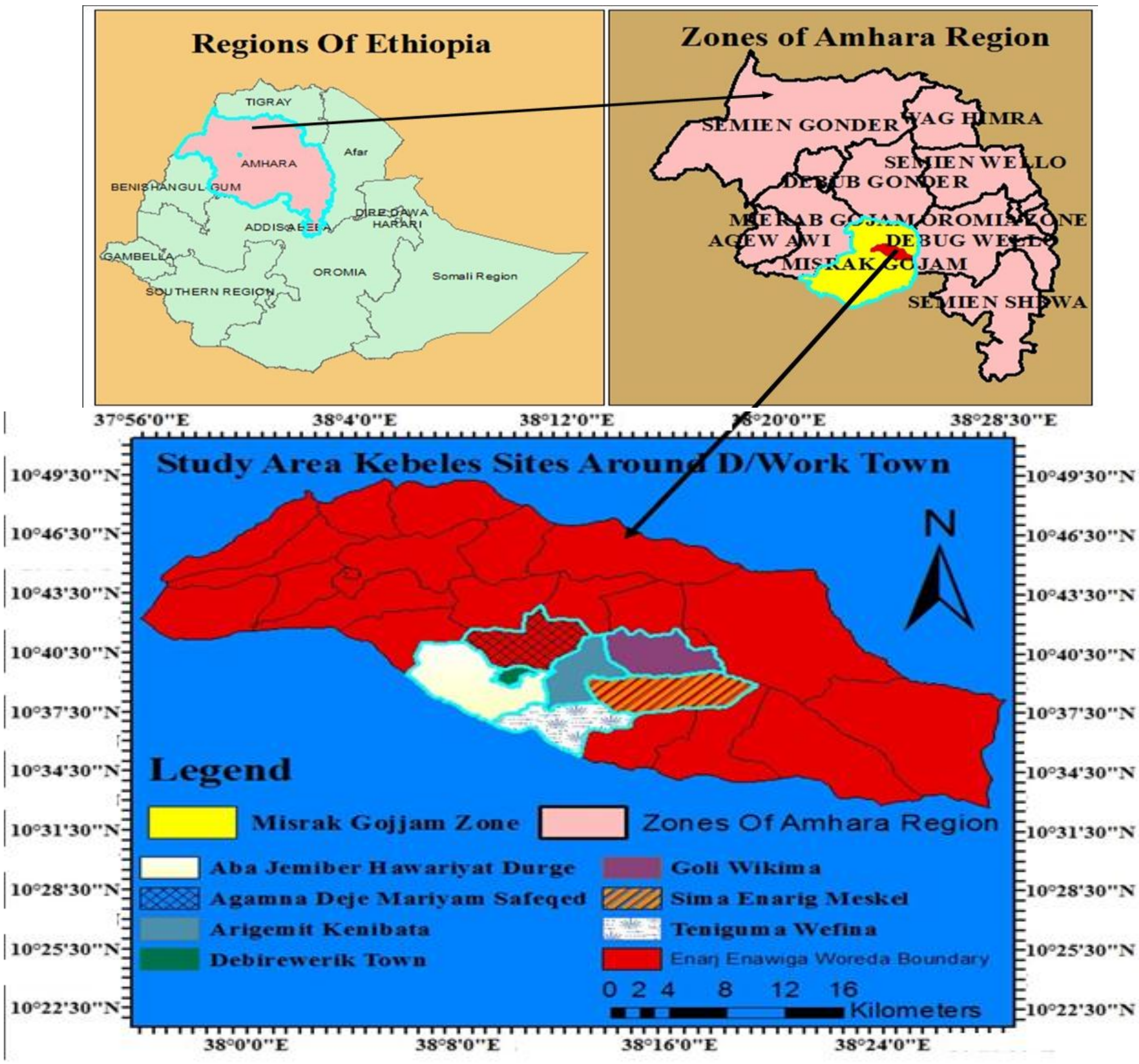
2.8.2. Demerits of Compost Application

Not all products are created equally and many organic products produce inconsistent result. The level of nutrients present in organic fertilizer is often low. In addition, the nutrients are usually complex in organic chemical structure; this means using organic fertilizer may not produce the pop of color seen with a chemical fertilizer. Using an organic fertilizer is a process, not an event (http://www.holganix.com <blog>).

3. MATERIALS AND METHODS

3.1. Description of the Study Area

This study was conducted in East Gojam zone specifically in Enarji-Enawuga Woreda which is one of the districts in East Gojam zone, Amhara Regional State of Ethiopia. Enarji-Enawuga Woreda is situated at 291 km from Addis Ababa in the northwest direction, 198 km from Bahir Dar and 115 km from Debre Markose. Enarji Enawuga Woreda is bordered in the south by Enemay Woreda, in the west by Hulet Eju Enesse, in the north by Goncha Siso Enesse, in the east by the Abay River. The total area of the woreda is 932.87 Km^2 (CSA, 2008). It consists of 28 *Kebeles.* Of these three are urban. People in this Woreda are with orthodox religion. It has Plateaus, plains, valley and terrain topography. EnarjiEnawugaWoreda lies in altitude ranging from 1,100 to 3200 m a.s.l. astronomically, it is located between 10° 33'and 10°49' N and 38°11' and 38°28' E (Figure 1). It has three agro climatic zones. These are Dega (alpine) with cold climate, Woina-Dega (temperate) with moderate temperature and Kolla (tropic) with hot and less adequate rainfall. EnarjiEnawugaWoreda has mean annual rainfall ranges from 750 mm- 1000 mm. There are four major types of soils in the study area. These are Vertisols (black soils), Nitsols (red soils), Cambisols (brown soil) and Regosols (sandy soils). Land in this Woreda mainly used for crop farming purpose (68%) and in some used for grazing for livestock (23%), 3.5% for urbanization and 5.5% for forestation. Agriculture is the main economic activity and livelihood source of the population. It is characterized by mixed farming that includes both crop production and Livestock. Teff, wheat and barley are the main crop types cultivated in the study area (Enarji- Enawuga Woreda Agriculture Rural Development office, 2016).



Source: Enarji-Enawuga Woreda Agricultural and Rural Development office, (2016)

Figure 1: The map of study area

3.1.1. Flora and Fauna

In Enarji Enawuga Woreda, different indigenous tree species are found. But Eucalyptus was the most dominant exotic tree in the study area. Farmers use it for multiple purposes like construction, fuel wood, and furniture and to make farm implements.

Table 1.common floras in the study area

No.	Local name	Scientific name
1	Kulkual	*Opuntia ficus*
2	Abesha Girar	*Acacia abyssinica*
3	Wanza	*Cordia Africana*
4	Endod	*Phytolacca dodecandra*
5	Gesho	*Rhamnus prinoides*
6	Nech Bahirzaf	*Eucalyptus globulus*
7	Yeferenji Tid	*Caroton macrostachyus*
8	Kosso	*Hagenia abyssinica*
9	Koshem	*Dovyalis abyssinica*
10	Abesha Tid	*Juniperus procera*
11	Bisana	*Croton macrostachyus*
12	Sessa	*Albizia gummifera*
13	Sasbania	*Sasbania sesban*
14	Shiferaw	*Moringa stenopetala*
15	Shinet	*Myricia salcifolica*
16	Woyira	*Olea europaea*

Farmers in the study area have different type of animals, cattle *(Bos taurus*), sheep (Ovis aries), donkeys *(Ecuss asinus*), horses (*Ecuss caballus*), poultry (*Galus domesticus*) and goat (*Capra hircus*) and mule. Among livestock groups, poultry is the dominant activity by the farmers of the study area. From wild fauna Spotted hyena (*Crocuta crocuta*), bush buck (*Tragelaphus sylvaticus*), and fox (*Vulpes vulpes*) are common. The economic contribution of livestock to households is milk and milk products, meat and hides. Sheep and goats also used as a source of cash income in time of need. Donkeys, horse and mules used for means of transportation of human beings' agricultural products to home and market. Some of the domestic animals reared are cattle, sheep, goat donkey, mule and poultry (Enarji-Enawuga Woreda Agricultural and Rural Development office, (2016)).

3.2. Study method

3.2.1 Sources of Data and Target Population

To conduct this study primary data was used. For this purpose, the major data sources were people in Enarji Enawuga Woreda especially local farmers from sampled *Kebeles*. Enarji-Enawuga Woreda Agriculture Rural Development Office, agricultural professionals, the environment of study area, and field experiment were a major data source. In general, the population of Enarji Enawuga Woreda was the source of target population with six *Kebeles*. Sample population was selected from those *Kebeles* of target population.

3.2.2 Sample Size and Sampling Techniques

Sampling was applied that focus only on Debre Work town surrounding rural *Kebeles* because these rural Kebeles share border with the town of Debre Work could reduce the problem of man power and time limitation. In the second step, simple to collect primary data both probability and non-probability sampling technique were used. At the beginning, the research focused on mainly Debre Work town surrounding rural *Kebeles*, which found in Enarji EnawugaWoreda. This Woreda have 25 rural and 3 urban *Kebeles.* To make the research manageable in terms of finance and time, and avoid bias six rural *Kebeles* were selected. In this case, the target groups were only farmers in rural *Kebeles* having at least half hectare farm land. By using random sampling techniques sample size was decided by using the following Cochran (1997) formula by taking the value of P as 50% since there is no previous study done in the study area.

$$n= \frac{(z)^2(p.q)}{d^2}$$

$$n= \frac{3.84(0.25)}{0.0025}$$

n=384

Where:

n=sample size

z= standardized normal variable and valued that corresponds to 95% confidence interval equal to 1.96

p=housing unit variable (residential house which is 50% (0.5)

q=1-p

d= Allowable error (0.05)

Proportional sample size will be decided by using the following Cochran (1963) formula

$nj=Nj/N\times n$

Where nj=Number of items be taken from the j stratum

Nj=Total number of items in the j stratum

N=the size of total population

n=sample size

Then, the sample size in each kebele is indicated in table 2:

Table 2.sample size of the study from each selected kebele

No.	Name of kebeles	Types of Settlement	Total households that have farm land	Total sample size selected from each kebele
1.	Tenguma	Rural	734	59
2.	Aregamit	Rural	709	57
3.	Abajember	Rural	883	71
4.	Deji Agamna	Rural	821	66
5.	Tebamit	Rural	796	64
6.	Agamna dejmariam	Rural	833	67
Total			4776	384

3.3. Data Collection Instruments

To collect primary data, the following three primary data collecting instruments were used. These are questionnaire, interview and field experiment.

3.3.1. Questionnaires

The objective of using this instrument was to get sufficient information from the respondents about the determinations of households in composting, therefore, information was collected from 384 participants. Questionnaires were intended to answer the extent of farmers using compost, views and practice of using compost, the extent of preferring compost to inorganic fertilizer and major obstacles for composting. Participants include local farmers in six *Kebeles*. These participants were local farmers in sample population. Open ended (10) and close ended (27) items were included in (37) questionnaires.

3.3.2. Interviews

In this study interview-guided questions for model farmers (7) and agricultural professionals (7) who are familiar on composting were selected by purposive sampling method implemented (Appendex IV). That was important to support, enrich, cross check, and supplementary to the responses that collected from participants through the questionnaires. The interview focused on the inputs and out puts of crop products, factors, prospects, farmers out looks on organic farming and their approaches to wards organic farming. All information was recorded and photographs were taken.

3.3.3. Field experiment

In addition to the above tools to collect data on the practice of farmers in using compost field experiment was conducted. Farmer's agricultural land, composting areas, water source and instruments used for preparation of compost and their management skills on their organic farm were observed. For field experiment land and compost have obtained from a volunteer model farmer with permission; and inorganic fertilizer and cabbage seed have obtained from Enarji Enawuga Woreda Agricultural and Rural Development Office. To realize the impact of using organic and inorganic fertilizer on agriculture, field experiment was conducted. Three independent plots of land with equal size ($4m^2$) were covered by cabbage. On the first plot of land 0.25kg chemical fertilizer (a mixture of urea and DAP) was added, on the second plot of land 0.25 quintal compost was added. According to Federal Fruit and Vegetable Production System and Technology; (2017), the amount of chemical fertilizer add per hectare is 400kg with equal proportion of DAP and urea in average depending on level of soil fertility. And the third plot of land was left without any fertilizer. Those plots of land were watered with 3 days interval in average equally 60 L water for each. Weeds were avoided and ventilated the soil by digging at the same time every two weeks. It was protected from animals by constructing fence from wood. Protection and care were lasted up to 3 months.

3.4. Methods of Data Analysis

The study was employed both qualitative and quantitative research techniques to analyze the data. Quantitative analysis was carried out using both descriptive statistical tools (average, frequency tables, percentage, charts) and inferential statistical tools (binary logistic regression, correlation and x^2 - test) used for total inputs of organic farm analysis and multi variety logistic regression was applied to identify the most determinant factors for organic farming. Generally, version 20% of statistical package for social science (SPSS) software was used to analyze the data.

4. RESULTS

4.1 Personal background of respondents

About 88.4% of the respondents were male headed, and 11.6%, were female headed (Table 5).The maximum age was 82, whereas, the minimum age was 18 years (Table 5). The majority of the respondents were age grouped above 40 years account (60.15%). The marital statuses of the respondents in the study area were 13.8% single and 86.2%was married .Couple respondents accounted the higher proportion (Table 5).

4.2 Extent of compost production and utilization

As shown below data in Table 3, only 7.03% of the sampled households used compost alone for agricultural activities. However, most of the households (88.28%) applied inorganic fertilizers alone. The remaining respondents (4.69%) were not applied any type of fertilizers.

Table 3. The number of respondents who prefer compost and inorganic fertilizers

Type of fertilizer	No. of Male HHs (%)	No. of Female HHs (%)	Total HHs (%)
compost	21(5.46)	6(1.56)	27(7.03)
None	16(4.16)	2(0.52)	18(4.69)
Inorganic	320(83.33)	19(4.95)	339(88.28)
Total	357(92.97)	27(7.03)	384(100)

However, for those that made compost, the amounts they made were so little that it covered only 5% of their land. The average land holding size for the area was 0.9 ha per household.

Table 4. Results of type of fertilizer preferred with compost adoption

Variable	No. HHs (%)	No. HHs use<10qu.comp (%)	No. HHs use>10qu.comp (%)	COR	95% Cl	P-value
TF						
Compost	27(8.07)	11(3.38)	16(4.68)	2.604	0.012-0.066	0.000
Inorganic	339(91.93)	327(87.24)	12(4.68)			

Key: TF=Type of fertilizer preferred by respondents, No. HHs=number of households, COR=crude odd ratio, Cl=confidence level, qu. comp=amount of compost in quintal

From the total participants 90.10% of them utilized<10 quintal compost for any crop type in a single farming season, but only 9.9% used >10 quintal compost (Table 5). About 90.47% of males used <10 quintal compost, but 8.96% males used >10 quintal, 88.88% of females used <10 quintal, and about 11.11% of females utilized >10 quintal compost (Table 5). From total respondents 97.24% of respondents with age of <40 years used <10 quintal, 2.76% of them used >10 quintal, 86.62% of respondents with age >40 used <10 quintal and 13.38 of them used >10 quintal compost. It was statistically significant with $P<0.05$ (table 5). 89.73% of married respondents utilized <10 quintal compost per farming season and 10.27% were apply >10 quintal. From single participants 96.23% were use <10 quintal and 3.77% used >10 quintal compost. It was statistically significant ($P<0.05$) (Table 5)

Table 5 .Results of sex, age and marital status with compost adoption

Variable	No. HHs (%)	No. HHs Use<10qu.comp (%)	No. HHs use>10qu.comp (%)	COR	95% Cl	p-value
Sex						
Male	357(92.97)	324(90.48)	33(9.52)	0.604	0.278-1.620	0.443
Female	27(7.03)	23(88.88)	3(11.11)			
Age						
< 40years	145(37.76)	141(97.24)	4(2.76)			
>40years	239(62.24)	207(86.62)	32(13.38)	2.226	1.102-4.497	0.026
M. status						
Married	331(86.19)	297(89.73)	34(10.27)	5.918	3.141-11.151	0.000
Single	53(13.80)	51(96.23)	2(3.77)			

Key: M. status=marital status

From the total respondents, illiterate respondents account 54.95%, respondents who can read and write were 32.29%, 8.6% were with education level of elementary (grade1-8) and only 4.2% were secondary (grade 9-12)(Table 6). About 63% and 14% of respondents had family size of 4-6 and 1-3, respectively (Table 6). The average family size per household in the study area was 4.31±0.075 individuals and the maximum and minimum family size was 2 and 11 individuals respectively (Table 6).

Table 6. χ^2-test analysis result of education level and family size with compost adoption

Variable	Option	No. HHs use <10qu.comp	No. HHs use >10qu.comp
EL	Illiterate	200(52.08)	9(2.34)
	W&R	120(31.25)	6(1.56)
	1-8	21(5.46)	7(1.82)
	9-12	8(2.08)	14(3.64)
	Dep & abo	-	-
	Total	348(90.63)	36(9.37)
χ^2-value=93.686[a] , df=4, 95%Cl and p=0.000			
FS			
	1-3	82(21.35)	4(1.04)
	4-6	187(48.70)	7(1.82)
	7-9	64(16.66)	12(3.13)
	>9	15(3.91)	13(3.38)
	Total	348(90.63)	36(9.37)
χ^2-value=58.781[a] , df=3, 95%Cl and p=0.000			

Key: EL=education level, FS=family size, Dep & abo=diploma and above df=degree of freedom, R &W=read and write

4.3. Shortage of inputs for composting

As the result shown from questionnaire survey indicated that most of the participants (84.9%) were challenged by shortage of input materials for preparation of compost in their organic farm. Only about 15.10% respondents reflected that there was no shortage of inputs (Table 7).

Table 7. Result of shortage of inputs with compost adoption

Variable	No. HHs (%)	No. HHs use<10qu.comp (%)	No. HHs use>10qu.cop (%)	COR	95% Cl	p-value
S. input						
Yes	326(84.89)	305(93.56)	21(6.44)			
No	58(14.11)	35(60.34)	23(39.65)	3.700	2.076-6.594	0.000

Key: S. input=shortage of inputs for composting, COR=crude odd ratio

4.3.1. Measures taken to solve shortage of inputs

From total male respondents, 49.22% never found solution for the existing shortage of raw materials for composting, only 50.78% of respondents tried to find a solution for the shortage of animal dung in compost preparation in different ways (Figure 2).Some farmers (28.6%) tried to mitigate limitation of inputs by using dung from field (Figure 2). From total respondents, 6.8% replied that reduce the wastage of dung and plant residue, 18% of participants shift animal's shed and 44.8% of respondents did not take any measure to solve the shortage of raw materials on composting practice (Figure 2).

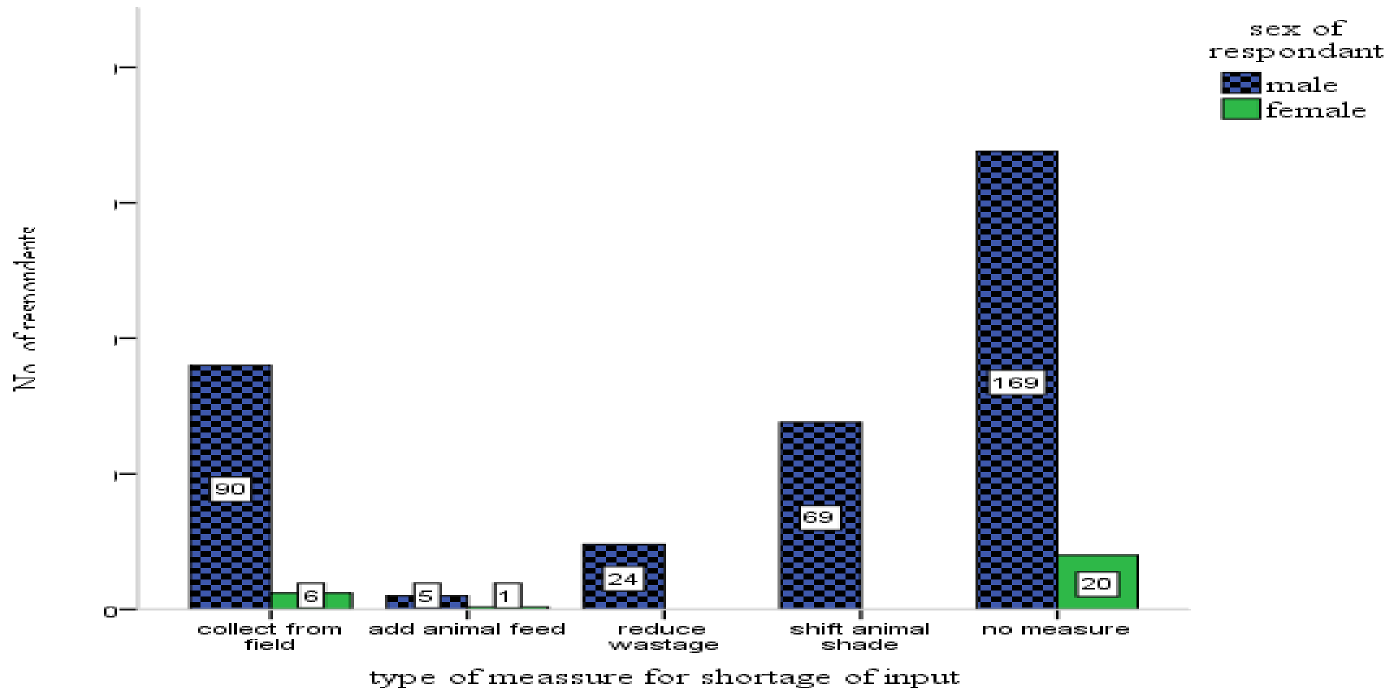


Figure 2. Type of solution used for shortage of resource

As shown below in Figure 3, about 42% of respondents replied that the obstacle for their composting practice was shortage of input, 32.81% were suffer from distance of source of input, 8.33% lack of knowledge(Figure 3).

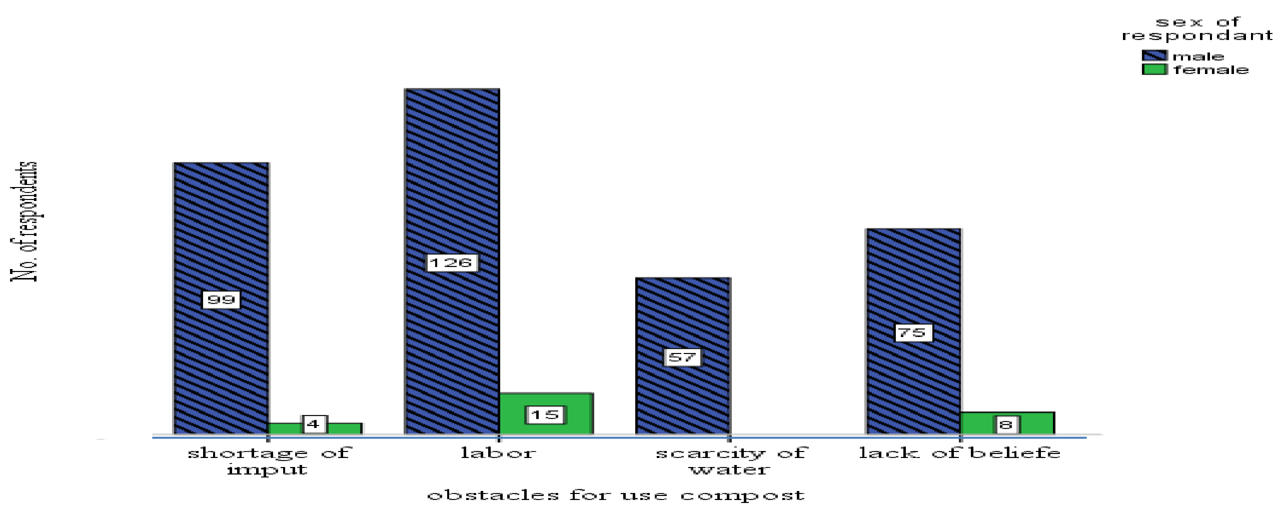


Figure 3. Major constraints on practice of composting

4.4. Water related problems in the study area

From total respondents of this study about 42.71% were depend on rain fed only for composting, 4.1% of them were faced very far distance of water, 57.29% with moderately far source, 12.5% were with nearby and 8.85% of households reflected that they are very close to water source(Table 8). Access of water for composting in the study area was 42.97% and 57.03% of the respondents responded no access of water in their *Kebeles* (Table 8).

Table 8. Access of water in the study area

Variable	Response	No. HHs use <10qu.comp (%)	No. HHs use <10qu.comp (%)
Access of water	Yes	145(37.76)	20(5.21)
	No	203(52.86)	16(4.16)
	Total	348(90.62)	36(9.38)
	COR=1.706, 0.002-0.123 at 95% Cl, P=0.000		
Water source	Rain fed only	207(43.97)	14(59.26)
	Another source	141(56.02)	22(74.07)
	Total	348(90.62)	36(9.38)
Distance of water source	>2km	78(20.31)	5(1.30)-
	1-2km	183(47.66)	6(1.56)
	0.5km	36(9.37)	11(2.86)
	<0.5km	51(13.28)	15(3.91)
	Total	348(100)	36(100)

4.5. Professional support in compost preparation for local farmers

As shown below in Figure 4, from total partcipants, 4.17% were supported by experinced farmers who directed by government, 62.50% respondents replied that they were supported by government agricultural professionals and the rest of rspondents (31.77%) did not get any support from government. (Figure 4).

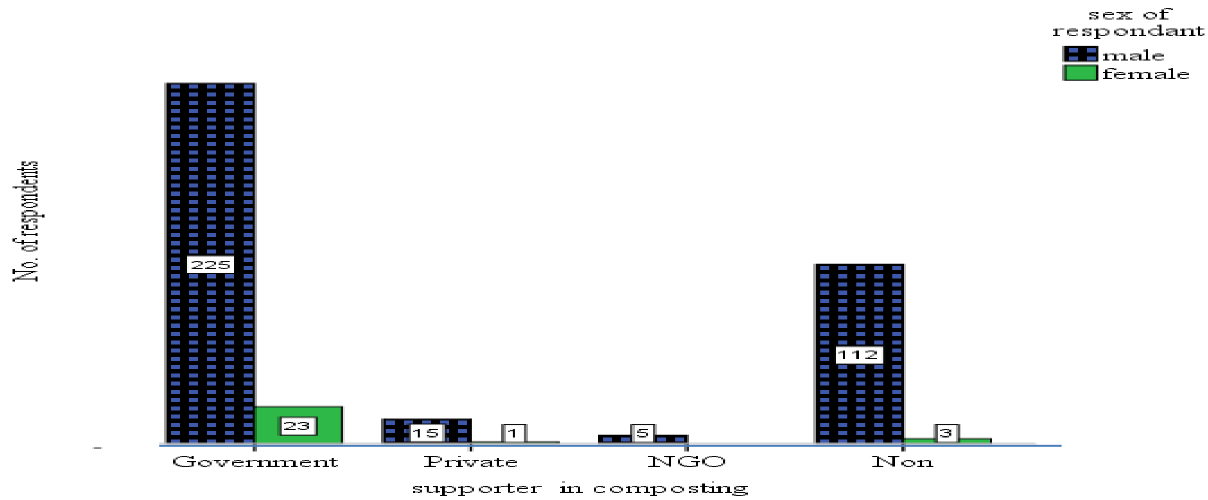


Figure 4. Support for local farmers in composting activity

4.6. Supervision by concerned bodies for respondents in composting activities

Out of total respondents 51.56% were supervised sometimes (rarely), 20.05% supervised frequently and about 28.39% were never supervised by anybody on their composting activity (Figure 5).

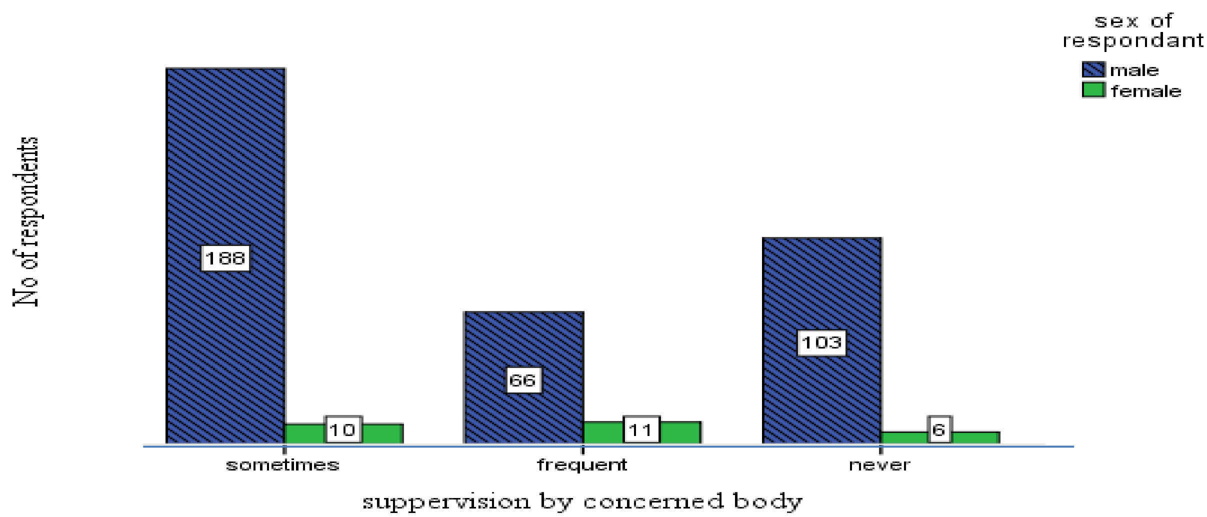


Figure 5. Supervision by concerned bodies for respondents in composting activity

4.7. Sharing of experience

From total participants only 53 (13.80%) shared experience with their neighboring farmers on composting, but about 331 (86.18%) of respondents didn't share any experience (Table 9).

Table 9. Result analysis of sharing experience with compost adoption

Variable	No. HHs (%)	No. HHs use<10qu.comp(%)	No. HHs use>10qu.comp(%)	COR	95% CI	P-value
She. ex						
Yes	53(13.80)	25(6.51)	28(7.29)	2.206	0.011-0.064	0.000
No	331(86.18)	323(84.11)	8(2.08)			

Key: She.ex=sharing of experience

4.8. The major raw materials for composting

4.8.1 The use of plant materials for compost preparation

From total participants, 13.8% used different varieties of weeds for composting activity, 35.9 % of them were used crop residue, 9.6% used any type of plants and about 40% of respondents reflected that they didn't use any type of plant for composting (Table 10).

Table 10. Types of plant used and methods for composting

Variable	Option	No. HHs use<10qu. Comp (%)	No. HHs>10qu. Comp (%)	r-value	p-value
Types of plant				0.238**	0.000
	Weeds	73(19.01)	10(2.604)		
	Crop residue	102(26.56)	19(4.95)		
	Any plant	39(10.15)	7(1.82)		
	Nothing	156(40.62)	--		
	Total	348(90.63)	36(9.37)		

key: **= correlation at 95% Cl, No. HHs use<10qu.comp=number of respondents who use <10 quintal, No. HHs use>10qu.comp=number of respondents use >10 quintal compost,

4.8.2. Livestock Types used for dung source by respondents

Type of livestock used by farming in the study area as shown in Figure 6 for animal dung source in the preparation of compost varied in different households. A 15.96% of respondents used only cattle, 3.64% used only sheep and goat, 7.56% used only horse and donkey, and 38.93% used all type of livestock (figure 6).

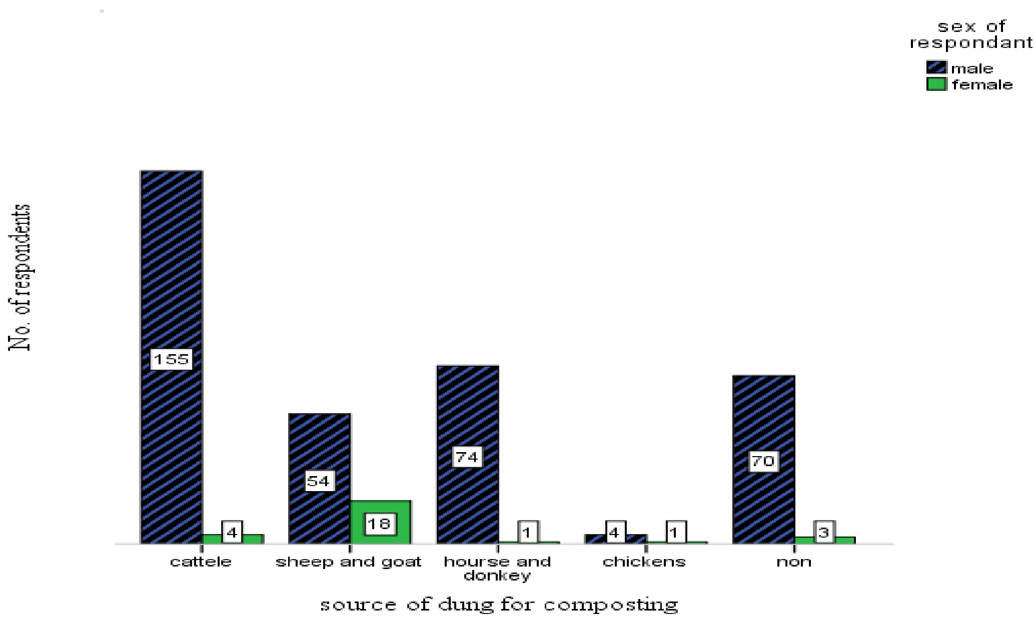


Figure 6. Livestock type used as a source of dung

4.9. Assessment of farmer's awareness on advantage and preparation of compost

About 30% knew the use of compost to enhance soil fertility for long run and they also had awareness of the process of composting, 70% of respondents didn’t know (Table 11).

Table 11. . Result analysis of farmer's awareness on advantage and preparation of compost

Variable	No.HHs (%)	No.HHs use <10qu.comp (%)	No.HHs use>10qun.comp (%)	COR	95%Cl	p-value
KC						
Yes	115(29.97)	93(24.22)	22(5.75)	1.358	2.135-5.683	0.025
No	269(70,04)	255(66.40)	14(3.64)			

Key: **= correlation at 95% Cl, No. HHs use<10qu.comp=number of respondents who use <10 quintal, No. HHs use>10qu.comp=number of respondents use >10 quintal compost,

4.10. Techniques of composting in study area

From the respondents 17.44% used a direct decomposing method of plants, 9.63% used decomposing method of dung, 33.07% used direct decomposing method of plant and dung, only 2.60% used bio slurry and about 37.24% didn’t apply any method (Figure 7).

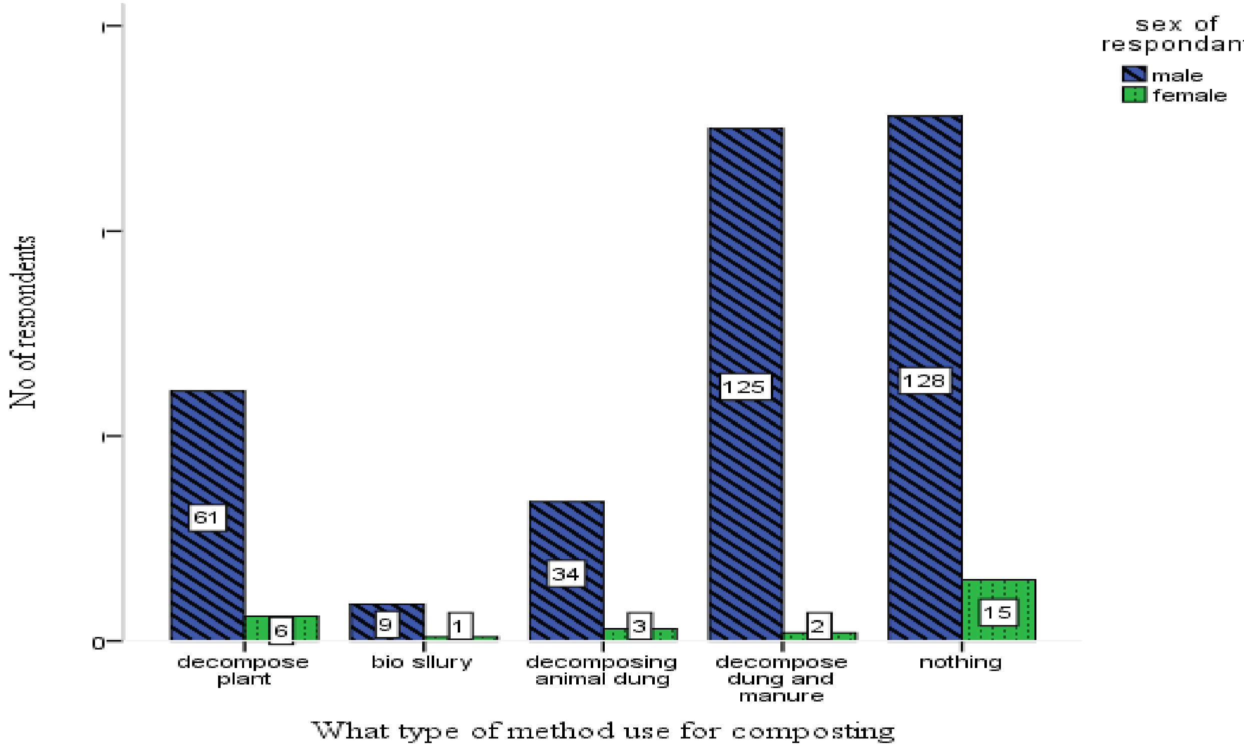


Figure 7. Techniques of composting by respondents

4.11. Field experiments

Figure 8a shows cabbage with compost, figure 8b shows cabbage with inorganic fertilizer (chemical) and figure 8c shows cabbage grown under no fertilizers. At 10 weeks old the leaf width of cabbage grown with compost was 13.25cm in average, cabbage with artificial fertilizer was 7.55cm but cabbage that received no fertilizers gave width of 5.25cm in average (Figure 8).

8A 8B 8C

Figure: 8A: Cabbage with compost; Figure: 8B.cabbage with chemical Fertilizer: Figure: 8c cabbage with no fertilizer

Figure 8. Cabbages with different fertilizers

Table 12. Results of experiment on growth rate of cabbage with different fertilizers

Type of fertilizer used for experiment	Initial number of cabbages per plot of land (%)	Number of cabbages at 10weeks old (%)	Width of leaf at 10 weeks old
Compost	60(100)	54(90)	13.5cm
Artificial	60(100)	34(56.66)	7.55cm
Non	60(100)	41(68.33)	5.25cm

5. DISCUSSION

Majority of the study participants were male-headed households. Due to thus result, male farmers households have taken the lion‗s share of crop farming in the study area. The chance for males having knowledge about advantage of compost in maximizing soil fertility in the long run was 1.421 times higher than those of female households. The association was not statistically significant ($p>0.05$) because maleness and femaleness is not mandatory in attitude and practice of farmers for compost application in the study area. In China agriculture is also dominated by male headed households. Because of heads of households play a major role in agricultural production decisions, over 90% of the respondent farmers were male in current survey (Solomon Asifaw, 2012).

Majority of the respondents were above the age of 40 (60.15%). Therefore, there was difference between different age groups in terms of total compost adoption for current study. According to Somda *et al.,* (2002), there was negative association between age and compost adoption. But the current study realized that age is one of the most determinant household variables that affect composting technology adoption. Elderly farmers are supposed to have rich farming experiences and may rely more on traditional or indigenous knowledge and it might take time to compromise their practices. Younger farmers may also tend to be more risk-averse than elderly farmers or might wait until the new technology is taken up among fellow farmers.

Married households have got an opportunity to perform organic farming compared to single ones. Because, through discussion they will develop a better knowledge and skill on composting and they make a better decision on preferring the most appropriate and ecologically friendly type of fertilizer on their farming activity. It might also result in to increase labor access for preparing and transporting compost.

The labor requirement is one of the constraints mainly for digging compost pits which serves for many years after once constructed. For many farmers labor limitation in current study is a big problem, because labor is not required for only composting process but also for transporting the prepared compost from a place of settlement to the distant farmlands and to collect inputs. Family size plays a major role to determine the access of labor and indirectly it was determinant factor for compost adoption. In Senegal the problem related to labor minimized by the practice of female farmers through group work. As reflected by Hailu Araya (2010), group work in organic farming activities is also a common practice in Tahaty Michew.

A positive impact of education on technology acquisition is generally expected as it enhances farmer's ability to acquire and analyze new ideas, and provides specific or general skills that contribute to farm productivity. But Solomon Asfaw *et al.*, (2012) and Asrat Ayza *et al.*, (2013), in Ethiopia and Tanzania, reported that no impact of education on technology adoption. These results were more or less different from the current study. According to the finding of the above researchers, illiterates were 35.8% and the remaining participants were literates and it was insignificant in compost adoption. It might be due to the difference of study area with different socio demographic composition. Generally, education is a key to mitigate the determinant factor that negatively affect organic farm and increase the acceleration development of organic farming in the study area by increasing farmer’s ability to capture and apply new and indigenous knowledge and skills related to organic farming.

There was a shortage of input for preparation of compost in their organic farm. Only about 54.2% tried to solve limitation of animal dung and plant residue. This result can realize that shortage of input was one of the most determinant factors in the composting practice of local farmers and it can also indicate that there was no effective solution taken to mitigate the problem. It might be due to lack of interest and belief to use compost as a main fertilizer for their farming activity.

Directly or indirectly, composting problem linked to the inputs that used in organic farm. Some respondents mentioned quality of compost mainly influenced by limitation and fluctuation of water accessibility in dry season especially in winter season of the study area. The other point is that composting of plant residues require longer period; the owner of land cannot believe in productive of using compost on the yield of crops; there was shortage of animal dung and shortage of green plants, which used as an input for composting. This problem was critical in most respondents. Among the problems they listed out like: collecting inputs (by products of biogas, crop residues and animal dung), watering compost, transporting compost to the farm lands, and mixing to prepare compost. were the most significant. Due to this, farmers forced to use only donkeys and manpower in the study area for transporting the prepared compost. This was also triangulated by documental report of EnarjiEnawugaWoreda Agricultural Office, 2009 EC (from July 1/11/2008-April 30/7/2009 EC). Similarly, Hailu Araya (2010) stated that, farmers faced to shortage of raw materials for composting in Tahaty Michew. About 40% of straw are wasted during feeding. The rest of straw can be eaten by cattle. To mitigate such problems farmers were collected different plants from their homesteads, farms and surroundings like fresh weeds tree branches leaves, and some farmers planted multipurpose plants on their farmlands to reduce also the effect of erosion.

It showed the size of composting pit, shortage of input, knowledge on the advantage of compost in maximizing the fertility of soil for long run, family size, type of fertilizer and age of participants found as significant factors that affect organic farming of the households. This is because, if the size of the compost pit increase the amount of compost also maximized, family size was also important to increase the amount of compost prepared, it means if family size increase the labor access can be increased for composting activity.

According to the result of this study, type of plant used in composting was significantly and positively related to the amount of fertilizer used. Intensified production systems (e.g. ornamental and vegetable production systems) and farmers with better access to livelihood assets utilize agricultural waste mainly for soil amendment. For example, shortage of labor and in secure landownership impeded many field crop farmers from using agricultural waste for soil amendment because land acquisition is the main challenge, which prevents farmers from investing in their farmlands. Field crop farmers had large farm size and the farms are located far away. As a result, farmers allocated manure and crop residues mainly to household consumption because large energy investment is needed to transport agricultural waste. Many cattles density in field crop production systems could be another reason to retain only a small fraction of crop residues on farmlands. This result was consistent with the findings of Menale Kassie *et al*., (2008).

About 38.93% of total respondents were used livestock's dung for organic farming. The number of cattle owned by the households was positively associated with the probability of compost adoption as it provides manure for compost preparation. Because most farmers in the study area rare cattles and mixed farming cattels play un estimated role in dairy farming and crop farming. Next to cattle sheep and goats were used as a source of dung. The adopter farmers all indicated that farm yard manure was used as a plant nutrient source and they applied significantly less DAP he^{-1} compared with non-adopter farmers (Edwards, 2006).

Extension services, supervision and sharing experience also influence utilization of agricultural waste and adoption of compost for soil amendment, probably due to increasing farmers' awareness about the benefits of organic amendments. Similarly, Jaleta *et al*., (2014) described the significant influence of extension services on the retention of crop residues on farmland in Ethiopia. The current use of agricultural waste observed in this study is consistent with the study of Helena Kahiluoto (2014), who reported retention of <10% of crop residues on croplands in rural parts of Ethiopia. Over 80% of crop residues were utilized for feed and less than 20% of crop residues retained on farmlands in sub-Saharan and South Asian countries. In Ethiopia cattle density is higher compared to farmers in sub-Saharan and South Asia (Abdulkadir *et al.,* 2012). However, current study respondents applied lower amounts of manure on their farmlands (<1 t/ha/yr). For this low manure production, lack of experience and less efficient collection of manure are the causes for the minimum allocation of manure on farmlands.

The role of experianced farmers and NGOs in the study area for helping other farmers was extremly low. The results also suggest to improve extension on compost preparation in order to improve awareness and knowledge in the farming community. Perceived health risk concerns in connection to compost preparation raised by farmers should be recognized and information on these aspects should be included in agricultural extension information and services.

Water in the study area is a serious problem in rural *Kebeles*.. From the sampled *Kebeles,* respondents mentioned water was the major problem for composting. In Tenguma *Kebele* Wefina-Abrajet dam was constructed. However, currently farmers below the dam, faced problems because the canal closed by sediments (Picture in Appendix IV). Access of water for composting in the study area was 42.97% and 57.03% of the respondents responded no access of water in their *Kebele*. From this result, water was a serious problem in the study area composting activity. The study of Tesfaye Mengstie (2007) in Metema, was found similar result on water access with current study.

Method of composting was the other significant factor for exercising compost adoption. It can be due to the determinant power of composting method on total amount of compost and quality of adoption. On the other hand, there are four types of composting methods which recommended in Malawi. These were; Chimato (mud insulated), Pit (dug), because of the short time it takes to mature (also commonly known as Chinese or speed) and box (which is box shaped and grass thatched) (Bekunda, 1998). The study revealed that Chimato (mud insulated) and Pit were the most commonly used methods. Just a little over 50% of those who made compost reported that they frequently used chimato method because it was easy to make and was commonly promoted by front line extension staff in the area. But in current study all compost adopters use pit method because once a pit was dug, they used it several times. From all other methods compost from bio slurry has the highest in quality, at the course of digestion 20-30% of the total raw materials convert in to methane gas and the remain 70-75% organic matter is convert in to slurry which contain water, inorganic matter and organic matter that accumulate in collecting container (Amhara Regional Energy promotion program, 2010). But in the study area the application of bio slurry was very low. It is due to the bio digester of biogas in the study area is not widely common. However, most households (86.19%) applied inorganic fertilizers alone. As stated by Tulema *et al*., (2007), soil nutrient status is widely constrained by nutrient loss and the limited use of compost. The focus of this discussion is to see the change of soil fertility and yield by the use of compost and mineral fertilizer. However, sometimes it may be difficult to judge, which type of input out-yielded over another without getting the right information. For example, the assessments by Hailu Araya and Edwards (2006), reported that the yields of the usual farmers' compost application rate (3.2t/ha/y) are higher than the yields from the applications of mineral fertilizer. But it is only right when compared with sufficient application of mineral fertilizer, because many farmers in the study area and somewhere else do not use the recommended rate of the mineral fertilizer (Elias Eshetu, 2002). Generally, crop production in Ethiopia is increasing through time. For example, as Elias Eshetu (2002), the grain production in Tahity Maichew increased from 26,640 ton by 2005 into 28,860 ton by 2007.

As observed by Hailu Araya (2010), compost production varied according to crop type and treatment. But the Cumulative Productivity Index of all the three field crops (teff, barley and faba bean) grown over the three years (2005-2007) clearly showed the highest production of compost from the application of 6.4 t/ha/yr compost continuously. This means using compost at 6.4 t/ha/yr rate is sustaining yield longer than the other applications and the control. And the amounts of cumulative biomass yield of composted fields were significantly higher than non-composted and mineral fertilizer yields. The study in Kabete, Kenya, also showed that treatments with only mineral fertilizer yields initially out-yielded the non-input and farm yard manure treatments, but yields tended to decline rapidly (Bekunda, 1998). This may be because compost accumulates nutrient in the soil, improves soil structure and then moisture holding capacity. But in this research local farmers had no interest to check the productivity of compost and apply it on their farmlands alone. That is because of lack of trust and commitment on the productiveness of compost.

Field experiment was conducted to check the difference in growth rate and product of cabbage on the same farmlands with three plots of land with $4m^2$ area. The field experiment finding in the case of shortage of water especially in dry season crop cultivation with artificial fertilizer resulted in the desiccation of crops. On the other hand using compost is important to maximize water holding and conserving capacity of soil. Cabbage with compost was resist scarcity of water up to five days without desiccation, but cabbage with inorganic fertilizer was start to desiccate from two days. This study was confirmed with Hailu Araya (2010) in Tahaty Michew. According to his finding the farmers who use mineral fertilizer requires reliable rainfall and good soil; otherwise it upsets farmers socially and economically it is used in degraded and moisture stressed areas. It was due to the low efficiency of inorganic fertilizers in crop products on water scarce farmlands resulted in the wastage of fertilizers. At 10 weeks old the leaf width of cabbage grown with compost was 13.25cm in average, cabbage with artificial fertilizer was 7.55cm and cabbage's leaf width was 5.25cm in average from plot of land without any type of fertilizer. It was because of the higher nutrient content of compost than the inorganic one. And also, the cabbage with compost can withstand the limitation of water due to moisture conservation capacity of it.

6. CONCLUSION AND RECOMONDATION

6.1 Conclusion

According to the findings the mean compost prepared by the local farmers was very low. Family size, age, education, and water access and input materials were associated with organic farming of the households. Among factors affecting compost adoption, shortage of input and family size in terms of labor were found the most determinant factors. The other challenges observed in the study area linked to organic farming were lack of trust on productivity of organic fertilizer, labor, time consuming process of composting, and the case of landownership. In addition to this lack of interest of professionals to support local farmers was one of the major constraints for compost adoption. Organic farming in Enarji Enawuga Woreda faced challenges and hindered from time to time but some prospects are available for the development of organic farming in the future.

6.2 Recommendation

From the above findings of the study, the following recommendations are forwarded to improve future development of organic farm by minimizing the challenges and use the available opportunities in Enarji Enawuga woreda, Ethiopia.

- Arrange panel discussions that focus on organic farming by inviting agronomists, and stakeholders to reshape the bad outlooks towards this sector.
- Agricultural office should give attention to organic farming in rural areas by facilitating the farming activities.
- Small and micro office recruits and organizes youth on organic farm project in rural *areas* to generate their own income, continuously inspect, supervise, support organic farmers and connect with vocational college to modernize the traditional composting process, transporting, collecting and also farming systems.
- Stakeholders should solve challenges through Water conservation, tackling bad outlook associated to organic farming, updating the skill, knowledge and attitudes of experts, developmental agents, and organic farmers from lower hierarchy to higher administrative divisions, protection of crop disease and parasites, search market outlet for organic crop products outside Debre Work town with cope strategies.

- Technology specific training, farmer-to-farmer technology exchange and NGO interventions are important for facilitating compost adoption.
- Collaborate with NGO; work in this sector to support organic farm association even individual organic farmers by accessing organic farm requirements like training, materials and other necessary instruments for organic farm.
- Concerned bodies initiate individual organic farmer to form organic farm association even at each area.
- Select best role model organic farmers and then invite organic farmers to visit these role model farmers.
- Establish and expand organic farm association and connect to other associations to modernize organic farm through cooperation.

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Appendix I

Data collecting sheet for water accessibility from woreda agriculture rural development office

Kebele	2007/8 EC	2008/9 E.C	2009/10 E.C	2010/11 E.C	2011/12 E.C

Appendix II

Data collected sheet for experiment result

Code of plot of land_________________________

Month	Initial no. of cabbages	No. of cabbages remain	Size of leaf in average	Remark
Month 1				
Month 2				
Month 3				

APENDEX III

Questioners

This household survey questionnaire is prepared to obtain relevant information from selected households for the study "local practices on compost preparation and utilization in the case of Enarji Enawuga Woreda Debre Work Zurea Kebeles East Gojam, Amhara Regional State, Ethiopia." The purpose of the questionnaire is to gather information about the challenges and prospects of compost, Thank you for your time and cooperation in advance!

It is not necessary to write your name

***General Instruction*.**

- ✓ For objective questions choose from the given alternatives
- ✓ whereas for subjective questions write your answer briefly in the space provided as much as possible.

Part 1: Socio-demographic survey questionnaires

1. Name of *Kebele*………………

2. Sex of Household 1=Male, 2=Female

3. Age 1=below 20 2=20-40 3=40-60 4=above 60

4. Marital status of Household 1=Single, 2= Married

5. Educational level of household head: 1= illiterate 2= read and write, 3=primary (1-8) 4=secondary (9-12) 5= Diploma and above

6. Family size 1=1-3, 2= 4-6, 3= 7-9, 4= >9

7. Occupation 1=crop production 2=livestock husbandry 3=mixed

PART 2: Inputs of organic farming

8. Do you use animal dung for composting? 1=yes 2=no

9. What are the main sources of animal dung for composting? 1=cattle 2=sheep and goat 3=horse and donkey 4=chicks 5=not at all

10. How much animal dung do you use for composting in quintal?

11. Do you use plant residue for composting? 1=yes   2=no

12. If no, what are the reasons for not using plant residue? 1=shortage of plant. 2=distance of availability. 3=lack of knowledge. 4= fearing of cost for plants

13. Do you integrate plant residue conservation and animal dung harvesting on your farmland? 1= yes. 2= no

14. What type of techniques of composting do you use? 1=…………2=……3=……4=……

14. Is there shortage of input? 1=yes 2=no

15. If yes what type of measure do you take?

17. What is the size of the composting pit? 1= narrow 2=medium   3=moderately wide. 4=very wide

18. Is the composting pit exposed to chicks? 1=no. 2=yes.

19. If yes, is there any cover protect from rain. 1=yes   .2=no

20. How much compost do you use per farming season in quintal?

PART 3: composting exercise and professional support

21. Do you get educational services for your compost preparation? 1=yes   2=no

22**.** From whom you get professional support? 1= Government institution   2= Private sector. 3=NGOs extension services   4= from others.

23. If from government who provide service for you? 1= model farmers 2= agricultural professionals 3= researchers 4= not at all

24. Do you prefer organic fertilizer than inorganic fertilizer? 1= yes 2= no

25. List the obstacles that affect your composting practices,

1=…………………………… 3=……………………………

2=……………………………. 4=…………………………….

26. Distance of access of water 1=>2km 2= 1-2km 3= 0.5-1km 4= <0.5km

26. Access of water 1= yes 2= no

27. Which types of plant do you use for composting?

28. Which methods you used for composting? 1=by direct decomposition of manur.2=by using slurry of biogas 3=by decomposing animal dung 4= by decomposing both manure and dung 5=non

29. List the factors affected quality of your compost? 1=…...2=….3=….4=…

PART 4: Outlook of farmers towards organic farming

30. Do you know the main stages of composting? 1= yes 2= no

31. Do you believe that organic farming practice is profitable (economically) in long run? 1=yes. 2=no

32. Did the concerned institutions carry out frequent supervision to reshape your out looks towards organic farming? 1= sometimes, 2= frequently, 3= never

33. Do you visit other organic farm to get experience and good attitudes on this sector? 1=yes .2=no

34. Do you believe that using compost has ecological importance?

1= yes. 2=no

35. Is there farmers training center (OFTC) in your *kebele*? 1= Yes 2= No.

36. in general what do you think about the application of compost in the future for organic farming____
____
____
____
____

37. what type of help do you need to improve your composting practices for the future____
____
____
____
____

THANK YOU!

መጠይቅ

ይህ መጠይቅ የተዘጋጀው በአዲስ አበባ ዩኒቨርሲቲ በሁለተኛ ዲግሪ መርሃ ግብር የማስተርስ መመረቂያ ጥናትና ምርምር በእና/እና ወረዳ አርሶ አደሮች የኮምፖስት አጠቃቀም እና ግንዛቢያቸውን በተመለከተ ጥናትና ምርምር ለማድረግ ነው ::

የመጠይቁ አላማ

በእናርጅ እናውጋ ወረዳ ውስጥ ያለውን የተፈጥሮ ማዳበሪያ አጠቃቀም በተመለከተ የዳሰሳ ጥናት ለማድረግ ነው::

አጠቃላይ መረጃዎች

- ለጥያቄዎች መልሥ ነው የሚሉትን ከተሠጡት አማራጮች መካከል ያክብቡ
- አማራጭ ለሌላቸው ጥያቄዎች ደግሞ መልስ የሚሉትን በአጭሩ ይግለጹ
- ስለ ትብብርዎ እናመሰግናለን ::

ክፍል አንድ የተሳታፊው አጠቃላይ መረጃ

1. የቀበሌ ስም ---------------------------
2. የአባወራው ፆታ 1 = ወ 2 = ሴ
3. የጋብቻ ሁኔታ 1 = ያላገባ 2 = የአገባ 3 = የፈታ
4. የትምህርት ደረጃ 1= ያልተማረ 2= ማንበብና መጻፍ የሚችል 3 = የመጀመሪያ ደረጃ (1 — 4) 4 = የሁለተኛ ደረጃ (9 — 12) 5 = ዲፕሎማና በላይ
5. የቤተሰብ ብዛት 1 = 1 — 3 2 = 4 — 6 3 = 7 — 9 4 = ከ9 በላይ
6. እድሜ 1 ከ15 በታች 2 = ከ18 — 28 3 = 29 — 39 4 ከ40 በላይ
7. የሥራ ዘርፍ 1 = ሰብል አምራች ;2 = ከብት አርቢ 3 = ነጋዴ 4 = ሌላ

ክፍል 2 የተፈጥሮ ማዳበሪያ ግብዓትን በተመለከተ

8. የእንስሳትን ፍግ ለማዳበሪያነት ትጠቀማለህ /ሽ/? 1= አዎ 2 = አልጠቀምም
9. ዋና ዋና የእንስሳት ፍግ ምንጮች ምንምን ናቸው? 1 = ከብቶች 2 = በጎችና ፍየሎች 3 =ፈረሶችና አህዮች 4 = ዶሮዎች 5 = ሁሉም
10. ምን ያህል የእንስሳት ፍግ ለኮምፖስት ዝግጅት ትጠቀማለህ /ሽ/?
1 = 3ኩንታል በሄክታር 2 = ከ4 — 5 ኩንታል በሄክታር 3 = ከ5 ኩንታል በላይ
11. ኮምፖስት ለማዘጋጀት የእንስሳት ፍግ እጥረት አለ? 1 = አዎ 2 = የለም
12. የእፅዋትን ብስባሽ ለተፈጥሮ ማዳበሪያነት ትጠቀማለህ /ሽ/? 1 = አዎ 2 = አልጠቀምም
13. መልስዎ አይደለም ከሆነ ምክንያቱ ምንድን ነው? 1= የእፅዋት እጥረት 2 = የቦታ ርቀት 3= ባለማወቅ 4 = ያለምንም ምክንያት
14. የእፅዋት ብሥባሽና የእንስሳት ፍግን በመቀላቀል ለኮምፖስት ትጠቀማለህ /ሽ/?1 = አዎ 2 = የለም
15. መልስዎ አዎ ከሆነ የሚጠቀሙበትን ዘዴ ጥቀሱ?

1. --------------------------- 3. -----------------
2. --------------------------- 4. -----------------

16. ለኮምፖስት ዝግጅት የግባት እጥረት አለ? 1 = አዎ 2 = የለም
17. መልስዎ አዎ ከሆነ የወሰዱት እርምጃ ምንድን ነው?
18. የኮምፖስት ማዘጋጃ ጉድጓዱ ምንያህል ነው?

1 = ጠባብ 2 = መካከለኛ 3 = ሰፋ ያለ 4 = በጣም ሰፊ

19.የኮምፖስት ማዘጋጃ ቦታው ለጎርፍ የተጋለጠ ነው? 1 = አዎ 2 = አይደለም

20.መልስዎ አዎ ከሆነ ከዝናብ መከላኪያ አለው? 1 = አለው 2 = የለውም

<u>ክፍል ሦስት የኮምፖስት አዘገጃጀትና የባለሙያ ድጋፍን በተመለከተ</u>

21. የስልጠናና የትምርት ድጋፍ ያገኛሉ? 1 = አዎ 2 = የለም

22.የባለሙያ ድጋፍ የሚያገኙት ከማን ነው?

1 = ከመንግስት ተቋማት 2 = ከግል መስሪያ ቤት 3 = ከግብረ ሰናይ ድርጅት

23.ከመንግስት ድጋፍ የሚያገኙ ከሆነ ድጋፍ የሚያደርጉት እነማን ናቸው?

1 = ሞዴል አርሶ አደሮች 2 = የግብርና ባለሙያዎች 3 = ተመራማሪዎች

24.የተፈጥሮ ማዳበሪያን ከሰው ሰራሽ ይመርጣሉ? 1 = አዎ 2 = አልመርጥም

25. ኮምፖስትን ለማዘጋጀት እንቅፋት ናቸው የሚሉትን ጥቀሱ

26. የውሃ አቅርቦት አለ? 1 = አዎ 2 = የለም

27.ለኮምፖስት ዝግጅት የሚጠቀሙባቸውን ዋናዋና የእፅዋት ዘሮችን ይጥቀሱ?

1. ------------------------- 3. ---

2. -------------------------- 4. ---------------------

1. --------------------- 2. -----------------

3. --------------------

28.ኮምፖስትን ለማዘጋጀት ምን አይነት ዘዴን ይጠቀማሉ?

1 = ቀጥታ እፅዋትና ፍግን በማበስበስ 2=የባዩ ጋዝን ተረፋ ምርት በመጠቀም 3= ሌላ ካለ

29. የኮምፖስትዎን ጥራት የሚያጎድሉ እንቅፋቶች ጥቀሱ

<u>ክፍል አራት በተፈጥሮ ማዳበሪያ ላይ የአርሶ አደሩን ግንዛቤ በተመለከተ</u>

30. የኮምፖስት አዘገጃጀትን ዋናዋና ደረጃዎች ያውቃል? 1 = አዎ 2 = አላውቅም

31.የተፈጥሮ ማዳበሪያን መጠቀም ለረጅም ጊዜ ጠቀሜታ አለው ብለው ያምናሉ?1= አዎ;2 = አላምንም

32.የሚመለከተው አካል ለአርሶ አደሩ የተፈጥሮ ማዳበሪያን በተመለከተ ስልጠና ሰጥቶ ያውቃል? 1 = አዎ 2 = አያውቅም

33.የተፈጥሮ ማዳበሪያን በተመለከተ ልምድ ለመቅሰም ከሌላ አርሶ አደር ጉብኝት አድርገው ያውቃሉ?

1 = አዎ   2 = አላውቅም

34.የተፈጥሮ ማዳበሪያ የአካባቢን ብክለት ከመቀነስ አንፃር ጠቀሜታ እንዳለው ያውቃሉ? 1= አዎ 2 = አላውቅም

35.በቀበሌዎ የገበሬዎች ማሰልጠኛ ማዕከል አለ?   1 = አዎ   2 = የለም

36.ባጠቃላይወደፊትየኮምፖስትአጠቃቀምንበተመለከተምንያስባሉ……………………………………
…………………………………………………………………………………………
…………………………………………………………………………………………
…………………?

37.የኮምፖስትአጠቃቀምዎንለማዳበርምንምንድጋፍይፈልጋሉ………………………………………………
…………………………………………………………………………………………
…………………………………………………………………………………………
………………………?

እናመሰግናለን!

Appendix IV

Checklist for Interviews

1. What kind of support gained or given for organic farmers to improve this sector? Would you like to explain the type of support given or gained and changes brought?
2. Is that organic farmer in your institution get extension service at the right time? Is their major constraint to deliver proper extension service?
3. How do you explain the development of organic farming in your *Kebeles*? What are the manifestations?
4. Do you think that organic farming brought income diversification by the users? What is the manifestation?

5. What are the main challenges of organic farming in your working *Kebeles* and solutions?

6. What are the main future prospects of organic farming in your working *Kebeles*?

7. How do you see the participation and attitude of local communities in organic farming?

Appendix V

Pictures related to composting practice

Picture1. Farm lands occupied by urban area

Picture 2. A nonfunctional water canal in the study

Picture 3. Sample compost used for field experiment

Picture 4. Sample compost taken from study area

APPENDIX VI: Tables

Table 13. Coverage of water in the study area

Kebele	2007 EC	2008 EC	2009 EC	2010 EC	2011 EC
Abajenber	56%	41%	51%	45%	44%
Dej-agamina	43%	60%	52%	57%	53%
Tenguma	57%	54%	53%	47%	47%
Tebamit	36%	50%	45%	43%	39%
Aregamit	45%	36%	43%	35%	44%
Agamina-dejmariam	42%	43%	41%	38%	41%

Source: Enarji-Enawuga Woreda Agriculture Rural Development office, (2016)

Table 14. Results of determinant factors for composting activity

Variable	No. (%)	Use<10qu.comp (%)	use>10qu.comp (%)	COR	95% Cl	p-value
Sex						
Male	357(92.97)	323(84.11)	32(8.33)	0.704	0.288-1.72	0.441
Female	27(7.03)	23(5.99)	4(1.04)			
Age						
< 40years	145(37.76)	122(31.77)	23(5.99)			
>40years	239(62.24)	226(58.85)	13(3.38)	2.226	1.102-4.497	0.026
CI						
Yes	113(29.43)	91(23.69)	22(5.73)	3.43	2.168-5.44	0.001
No	271(70.57)	257(66.93)	14(3.64)			
Use plant						
Yes	228(22.97)	210(54.68)	18(4.68)	0.212	0.108-0.417	0.000
No	156(40.625)	138(35.94)	18(4.68)			
Training						
Yes	134(34.89)	118(30.73)	16(4.166)	0.368	0.086-1.580	0.179
No	250(65.10)	230(59.89)	20(5.21)			
Sinput						
Yes	326(84.89)	305(79.42)	21(5.47)			
No	58(14.11)	35(9.11)	15(3.91)	3.700	2.076-6.594	0.000
M.status						
Married	331(86.19)	303(78.91)	28(7.29)	5.918	3.141-11.151	0.000
Single	53(13.80)	45(11.71)	8(2.08)			
TF						
Organic	31(8.07)	13(3.38)	18(4.68)	2.602		
Inorganic	353(91.93)	335(87.24)	18(4.68)			
Cover pit						
Yes	62(16.14)	31(8.07)	31(8.07)	4.704	8.879-13.583	0.004
No	322(83.85)	317(82.55)	5(1.30)			
Size of pit						
Narrow	297(77.34)	2702(70.31)	27(7.03)			
wide	87(22.65)	78(20.31)	9(2.34)	7.673	2.303-25.502	0.001
SUP						
<3 times	286(74.47)	273(71.09)	13(3.39)			
>3 times	98(25.52)	75(19.53)	23(5.99)	0.289	0.602-1.446	0.201

Key: No. HHs have knowl. on comp=number of households have knowledge on compost utilization, No. HHs lack of knowledge. Comp=number of households' lack knowledge on compost Utilization MS=marital status, EL=education level, FS=family size, Ocup=occupation, CI=compost increase income, S.input=shortage of inputs for composting, M .status=marital status,TF=type of fertilizer preferred by respondents, COR=crude ode ratio, SUP= Supervision rate, PS=professional support, qu.comp=amount of compost in quintal, Cl=confidence level, She.ex=sharing of experience, Wat.ac=access of water for composting

NB: total sample size (N)=384 households

Table 15. Results on determinant factors for compost adoption

Variable	No.usebelow10qu.(%)	No. use above 10qu.(%)	AOR	95%Cl	P-value.
Age					
Below 40	134(32.29)	13(3.39)			
Above 40	214(58.33)	23(5.98)	14.492	3.884-54.075	0.000
FS					
Below4	212(55.21)	11(2.86)			
Above 4	13635.42)	25(6.51)	13.649	1.602-11.297	0.017
Edu					
Litrate	112(29.16)	12(3.13)	0.484	0.150-1.566	0.222
Illiterate	236(61.46)	24(6.25)			
Spit					
Below 3	316(82.29)	9(2.34)			
Above 3	32(8.33)	27(7.03)	2.456	2.045-8.98	0.032
KC					
Yes	93(24.22)	22(5.73)	1.358	2.135-5.683	0.025
No	255(66.40)	14(3.64)			
M.status					
Single	45(11.71)	8(2.08)			
Married	303(78.91)	28(7.29)	0.219	0.511-9.436	0.290
Sinput					
Yes	305(79.42)	21(5.47)			
No	35(9.11)	15(3.91)	2.700	3.078-6.594	0.000
TF					
Organic	13(3.38)	18(4.68)	2.602	2.011-7.064	0.004
Inorganic	335(87.24)	18(4.68)			

DECLARATION

I, the undersigned, declare that this thesis is my original work and has not been presented for any degree in any other university and that all sources of materials sited for the thesis have been fully acknowledged.

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Date: __________________________

This work has been submitted for examination with my approval as advised

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Signature___________________

Date ______________________