KNOWLEDGE, PERCEPTION AND WILLINGNESS TO PAY FOR FAECAL WASTE REUSE IN AGRICULTURE BY FARMERS IN THE NINGO-PRAMPRAM AND SHAI-OSUDOKU DISTRICTS OF GHANA

By

ENOCH OTI AGYEKUM

(BSc. AGRICULTURE)

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DECLARATION

I, Enoch Oti Agyekum, do hereby declare that this submission is my own work towards the MPhil (Agricultural Economics) and that, to the best of my knowledge, it contains no material previously published by another person nor material which has been accepted for the award of any other degree of the University, except where due acknowledgement has been made in the text.

Enoch Oti Agyekum	……..……..……..	….....……....
(PG4233710)	(Signature)	(Date)
(Student's Name & ID)		

Certified by:

DR. K OHENE-YANKYERA	……..……..……..	….....……....
(Major Supervisor)	(Signature)	(Date)

Dr. SIMON C. FIALOR	……..……..……..	….....……....
(Co- Supervisor)	(Signature)	(Date)

Dr. DADSON AWUNYO-VITOR	……..……..……..	….....……....
(Head of Department)	(Signature)	(Date)

DEDICATION

This work is dedicated to the Ry-Kottoh Family

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ABSTRACT

Food production in Africa suffers from numerous constraints, including diminishing arable land, poor land tenure system, and declining soil fertility. Other constraints include limited irrigation facilities, dwindling water resources, climate variability, unimproved yields and, above all, high cost of agricultural inputs, particularly fertilizer. High rate of soil fertility decline and consistent lower crop yields necessitate increased use of fertilizer for food production. However, high cost of inorganic fertilizer prevents resource-poor farmers from using required fertilizer levels for production. The need for alternative soil amelioration to chemical fertilizer therefore becomes very necessary. Faecal compost (FC) is one of the organic compost that contains enough nutrients for plant growth in addition to its soil conditioning properties. This study which was conducted in the Ningo-Prampram and Shai-Osudoku Districts, utilized choice experiment to elicit famers' willingness to pay for faecal compost. Farmers Knowledge and perception about faecal waste reuse in agriculture was also assessed. Results obtained shows that farmers have relatively low level of experience on faecal compost use as compared to cow dung. Also, farmers perceive FC as having good nutrient value compared to other organic fertilizer, however, they do not know for sure, whether food consumers will reject/accept food commodities produced through the use of faecal waste. Conditional Logit and hybrid conditional logit model estimates of the choice experiment data shows that farmers are interested in using FC and are willing to pay. Willingness to pay was influenced by some respondent's socio-economic factors such as age, educational level, household size Income among others and choice invariant factors such as experience with FC and cow dung.

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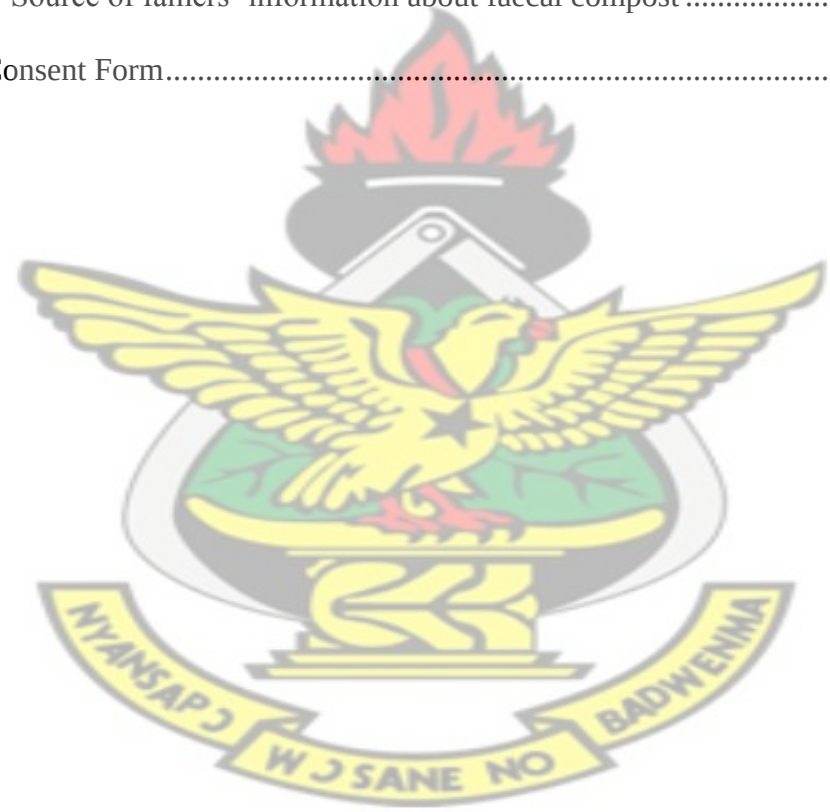

CHAPTER ONE

INTRODUCTION

1.1 Background

In sub-Saharan Africa, the majority of population would be living in and around urban area (and peri-urban areas) by 2020. According to (Drechsel and Kunze, 2001), rapid urbanization has posed not only major challenges to rural–urban planning and food security but also to waste management and environmental protection.

Agriculture, which includes all economic activities from the provision of farm inputs to food production and value-addition, (Duncker et al., 2007) remains an important sector in the Ghanaian economy. Meanwhile food production in Africa is affected by numerous constraints, including diminishing arable land (due to urbanization and land degradation), poor land tenure system, declining soil fertility, limited irrigation facilities and dwindling water resources, climate variability, low access to credit, poor marketing and distribution system, and, above all, high cost of agricultural inputs, particularly fertilizer (Alfsen, 1997; Croppenstedt, 2003) . Higher rate of soil fertility decline and consistent lower crop yields therefore necessitate increased use of inorganic fertilizer in agricultural production in Africa (Alfsen et al., 1997; Xu et al., 2009; Larson, 1993).

However, according to Yawson et al., (2010) the high cost of inorganic fertilizer prevents particularly small-holder farmers, who are resource-poor (and predominantly within low income bracket), from using the required levels of fertilizer to boost crop production. There is therefore the need for cost effective alternative soil ameliorant which in addition to

increasing farmer productivity through the use of cheaper plant nutrient sources would also provide protection and restoration to the ecosystem.

Ecological sanitation is a sanitation concept that turns human excreta into useful and valuable resource with minimum risk of environmental pollution and no threat to human health. It is a sustainable closed-loop system that treats human excreta as a resource, not as a waste product. Through this process, excreta are processed until it is free of disease organisms (Duncker et al., 2007). The nutrients contained in the excreta may be recycled and used for agricultural purposes.

Also in promoting uptake of sanitation, it is important that whichever technology is being promoted offers value and also meets other household needs in addition to the health benefits of improved hygiene. For instance, according to Jensen et al., (2005), in areas where use of human excreta in agriculture is common, farming households would probably accept sanitation technology and hygiene promotional activities if they could be accommodated within the agricultural production system and be seen as offering economic advantages.

In the current climate where food security and poverty reduction strategies are key developmental agenda of most developing nations, some potential benefits of improved environmental sanitation such as increased agricultural productivity and increase household income resulting from waste reuse could be an important argument to support further resource allocations to sanitation research and development (Hutton and Haller, 2004). For

agricultural folks and entrepreneurs living in peri-urban and rural towns, treatment and reuse of latrine waste can offer a great source of income.

Several types and forms of organic fertilizers are used by farmers. These includes, poultry manure, cow dung, plant compost among others. Faecal compost is also one of the organic compost that contains adequate nutrients for plant growth in addition to its soil conditioning properties (Ketchumm, 1988). According to Mäkelä-Kurtto, (1994), increases in organic matter in the soil improves the structure and water economy of the soil and enhance microbial activity whiles effectively binding various harmful substances, such as heavy metals to prevent their action on the soil.

Each year, an average of 520kg of toilet waste containing 7.5kg of nitrogen phosphorus and potassium and some micronutrients in a form usable by plants is produced by one person which if converted into fertilizer can organically produce 250kg of grain/cereals (Wolgast 1993). However evidence of use of this important resource has not been adequately documented in Ghanaian literature. From the demand point of view, this study investigated the acceptability and willingness to pay for faecal compost for agricultural production.

The willingness to pay theory has been proven to be an acceptable concept for evaluating stated preferences/choices of individuals Louviere, (1988a); (1988b); Batsell and Louviere, (1991); Hanemann, (1999); Hensher, (1994). The Contingent Valuation CV and the Choice Experiment CE have been the two key methods that dominate the literature as methods of

eliciting willingness to pay or in other words, measuring the value people attach to a product/service or some aspects of the products as in the latter (Whitehead, 2000).

1.2 Problem Statement

For an emerging business to be sustainable it is very imperative that the demand and willingness to pay for its goods by target consumers be solicited for. Whether or not the product will be accepted by the market is a crucial problem that needs to be evaluated before investment is made (Anderson et al., 1993). More so, the form in which consumers want the product to appear is of great significance.

According to Wolgast (1993) faecal matter contains very valuable nutrients for plant growth and development. When processed into organic fertilizer, it can act as a source of soil nutrient and also improves the entire soil structure (Malkki, S. 1999). It is however unclear whether farmers are fully aware of these benefits/value that faecal matter offer.

In Ghana, faecal matter might not be considered as a valuable resource but rather, as a harmful waste product associated with foul smell. This fact may reduce the value that people will put on faecal compost as an important source of plant nutrient. It is therefore assumed that farmers may reject the reuse of faecal waste due to public ridicule or some perceptions they have about the product.

Agriculture in Ghana is dominated with small scale farmers known to be associated with poor income levels (Yawson et al; 2010). Meanwhile it requires some financial investment to turn raw faecal matter into a harmless organic fertilizer and further package it for sale. Such financial investment may be done in an expectation of returns and therefore farmers (predominantly peasants) may have to pay for faecal compost, if they accept its use for farming. Thus whether farmers will be willing and capable to pay for faecal compost as an alternate soil ameliorant to inorganic fertilizer, and also, the amount they will be willing to pay for market value addition to faecal compost was a question worth seeking answers to. Using choice experiment methods, this study was designed to find solutions to the questions of what the levels of farmer's knowledge and perceptions are, on the reuse of faecal waste and related organic manures as well as their willingness to pay for faecal compost. Answers to these questions were sought for through answers from the following **research questions**.

1.3 Research Questions

1. Do farmers know of faecal waste as an important source of soil amelioration?
2. What are farmers` perceptions on faecal waste reuse for agriculture?
3. Are potential users of faecal compost willing to pay for its use?
4. What factors influence farmers' willingness to pay for faecal compost?

Answers to these research questions were sought for through the following objectives

1.4 Objectives

1.4.1 Main Objective

The main objective of this study was to analyse the Knowledge, Perception and Willingness to Pay for faecal waste reuse in agriculture by farmers in the Shai Osudoku and Ningo-Prampram District of the Greater Accra Region

1.4.2 Specific Objectives

1 To assess farmers knowledge on faecal waste reuse for agricultural purposes.

2 To analyse farmers perception and acceptability of faecal waste reuse for agricultural purposes.

3 To estimate farmers willingness to pay for faecal compost.

4 To investigate the factors affecting farmers willingness to pay for faecal compost.

1.5 Justification

For an improvement in the livelihood of rural households; who are mostly agrarian and according to Hogrewe et al., (1993), are characterized by, minimal or no infrastructure and low incomes, there is the need for research and developments that seek to promote improvements in their environment and health as well as their income.

Even though there is a great business potential in the latrine value chain including generation of fertilizer for agricultural use, this benefit(s) are not being realised because information on the economic potential of the resource is woefully inadequate. This suggests an urgent need for research that will expand on this value.

The rapid urbanization in many Sub Saharan countries is an indication of an ever increasing pace of structural transformation. The shift of the labour force towards urban centre due to rural-urban migration also aggravates the problem of food production and supply shortages as opposed to high demand of the same both in rural, peri-urban and urban communities. This increasing demand has led to the recognition of the contribution of agriculture to providing food security, employment, income generation as well as the productive management of idle and under-utilized lands Nyapendi et al., 2004). However high cost of chemical fertilizer hinders the maximization of land resource value and hence the need for research into alternative, cost effective source of soil nutrient cannot be overemphasised. Such research and development are even more relevant if it could have a direct or indirect effect on the environmental health of the people.

Consumer perception and willingness to pay are vital indicators to success in both new and existing markets and for setting optimal price strategies (Balderjahn, 2003). In promoting ecological sanitation it is very important that adequate demand and marketing research are conducted to give meaningful indications of sustainability. Many authors have discussed the potentials of consumers' willingness to pay and their perception of value in focusing market response to price changes and the determination of demand of a product (Monroe, 2003; Nagle and Holden, 2002; Simon, 1992). Willingness to pay analysis help give indication to suppliers on what specific product consumers prefer or otherwise, at what form, and cost they will be willing to acquire the product. According to Anderson et al., (1993), managers consider the knowledge of customers' responses to different prices as a cornerstone of marketing strategies, particularly in the areas of product development, brand management, among other marketing strategies.

1.6 Scope of Work

This study investigated farmer's knowledge and perception as well as their willingness to pay for faecal compost. This study fits into the application of economics and marketing principles to both environmental sanitation and agricultural resource management in developing economies. The study forms part of the sanitation business and demands analysis section of the Sustainable Sanitation (SUSA) Ghana project objective of improving the livelihood and environmental health of rural and peri-urban dwellers in Ghana. The study was conducted in some agricultural communities in Dangme West District (currently Ningo-Prampram and Shai Osudoku Districts) in the Greater Accra Region of Ghana.

1.7 Organization of Study

The study is organized into five main chapters. The first chapter, titled Introduction captures the background to the problem under study and states the problem and research questions. It also contains the main and specific objectives of the study, a justification for the study, as well as the section indicating how the study is been presented.

In the second chapter, literature related to the study is reviewed. The third chapter is dedicated to the methodology where the theory, mathematical and empirical basis of the study is explored. Whiles chapter four covers discussion of results, the final chapter covers the conclusion & recommendation of the study.

CHAPTER TWO

LITERATURE REVIEW

2.0 Introduction

This section of the study covers the review of literature relevant to the study. It covers literature on the concepts of ecological sanitation and relevant theories such as the theory of demand and willingness to pay, with much emphasis on the Choice Experiment (CE).

2.1 Current World's Sanitation Situation

Improved sanitation facilities are used by less than two thirds of the world population (UNICEF/WHO, 2008). The global picture however presents greater disparities between regions (ibid). Virtually the entire population of the developed region use improved facilities, but in developing regions only around half the population use improved sanitation. Out of the 2.6 billion people in the world who do not have access to improved sanitation facilities, by far the greatest number is in Southern Asia, but there are also great numbers in Eastern Asia and Sub-Saharan Africa (Hiruma, 2007). Meanwhile, disparities in improved sanitation also exist between rural and urban households in these countries (UNICEF/WHO, 2008). As at the year 2004, access to improved sanitation was more than twice as high in urban areas than in rural areas. Whiles coverage of 80% was realised in urban areas rural areas around the world recorded 39 % improvement in sanitation and currently, 77% of the 2.6 billion people lacking access to improved sanitation live in rural settlements. According to the UNICEF/WHO (2008), only in industrialized countries is urban and rural coverage comparable. Table 2.1 below, shows the regional distribution of improved sanitation coverage in the world by the UNICEF & WHO (2008).

Table 2.1 Regional Sanitation Progress towards the MDG Sanitation Target

Regions not on track (%)	Coverage in 1990 (%)	Coverage in 2006 (%)	Coverage needed in 2006 to be on track (%)	Coverage needed by 2015 to achieve the MDG target (%)
Southern Asia	21	33	46	61
Sub-Saharan Africa	26	31	50	63
Commonwealth of Independent States	90	89	93	95
Developing regions	41	53	60	71
Oceania	52	52	69	76
World	49	58	62	75

Source: WHO/UNICEF, 2008

The removal and safe disposal of excreta and wastewater from washing, bathing, and other domestic uses are critical health and environmental needs of people in developing world among peri-urban and rural settlers. In many developing countries, surface and groundwater contamination is widespread, and the resulting environmental degradation is apparent along rivers and sea/coastal areas (Hogrewe, et al., 1993).

Most communities in Ghana overwhelmingly lack adequate arrangements for waste disposal. Where sewers exist, they are virtually always open drainage canals. The ground by the side of the shelters or in alleyways serves as a frequent substitute for urinals.

2.2 Environmental and onsite sanitation

Environmental sanitation – refers to the control of environmental factors that form links in disease transmission. Subsets of this category are solid waste management, water and wastewater treatment, industrial waste treatment and noise and pollution control (Wikipedia). Environmental Sanitation promotes health, prevents disease transmission, eliminates breeding places of insects and rodents that may be carrier of diseases and also improves the quality of life (UERMMMC NSTP, 2008).

On-site sanitation–this is the sanitation practice in which the collection and treatment of waste is done where it the latrine is deposited (. Examples are the use of pit latrines, septic soak tanks which does not require emptying. On-plot/site latrines are the first and major methods of disposal of human excreta in households especially in urban areas (Nkansah, 2009). Improper handling of excreta could however cause transmission of excreta-related pathogens and diseases through routes such as contact with infected stool and other contaminated sources which include water, soil, fingers, flies and food (Singh, 2003).

On-site latrines have become the dominant form of sanitation in many developing countries. Wagner and Lanoix, (1958 and other experts Black and Fawcet, (2008); Stoner, 1977; Esrey, 2001; Lettinga et at., (2001); Zeeman and Lettinga, (2001); El-Gohary, (2002); Otterpohl, (2002); Mgana, 2003) have offer reasons why on-site sanitation is widely used among urban, peri-urban and rural households. These include the following

1. The on-plot latrines are relatively cheap to build and operate,
2. The acute shortage of water

3. Lack of essential resources such as human, financial and technical resources to provide sustainable conventional sewerage for the majority of urban dwellers in developing countries.
4. Very few towns and cities in the developing countries can afford conventional sewerage systems.
5. The need for reuse possibilities for the faecal sludge removed from the on-plot latrines.

2.3 The Linkage between Sanitation & Agriculture [Ecological Sanitation]

To achieve the purposes of improved sanitation and improved agricultural productivity, experts have over the years have advocated for the use of an approach that incorporate reuse of sanitation products and by-products into the sanitation management systems. Also organic agriculture is one among the longest spectrum in production methods that are supportive of the environment (Narkhede et al., 2011) and thus the concept of ecological sanitation is very relevant.

The Concept of ecological sanitation

Ecological sanitation is an approach that tries to emulate nature through the recycling of nutrients and water from human and animal wastes in a hygienically safe manner. An introduction to Ecological sanitation help recover and recycle the nutrients from the excreta and, thus, creates a valuable resource to reduce the need for artificial fertilizers in agriculture (Cumming, 2008).

The practice of ecological sanitation eliminates the creation of black-water and eliminates faecal pathogens within the human surrounding. The Ecosan latrine, therefore, represents a conceptual shift in the relationship between people and environment, built on the necessary link between people and soil. The technology helps to maintain healthy humans and a natural environment by using affordable and appropriate technologies, and matching the needs of people in urban centres (mostly consumers of agricultural products), peri-urban (partly producers of food commodities and consumers) and rural areas (mainly producers of commodities).

2.4 Safe Use of Excreta in Agriculture

The reuse of human excreta in agriculture is noted to be captured in centuries past and many studies have been conducted in several aspects of waste reuse. According to the WHO/UNICEF, (2001) people both in rural and urban areas have been using human excreta for centuries to fertilise fields and to maintain the soil organic fraction. Use of faecal sludge and other human waste in both agriculture and aquaculture is up to date, very common in China and south-east Asia as well as in various African countries including Ghana (Cross, 1985; Timmer and Visker, 1998; Visker, 1998; Timmer 1999; Strauss et al., 2000; Cofie et al., 2009). Even in some European countries there is the change in the sanitation paradigm from flush-and discharge to recycling of urine (Larsen and Guyer, 1996; Otterpohl et al., 1996). The safe use of faecal waste as organic fertilizer is highly if not absolutely, dependent on the effective treatment of faecal sludge whether on-site or off-site. According to the IWMI and SANDEC, (2002), several pathogens that pose health threats to human life are

contained in untreated faecal matter. These organisms must therefore be eliminated in other to obtain faecal compost safe for agricultural use.

According to the World Health Organization WHO (1989), the agricultural use of excreta or excreta-derived products such as stored or dewatered faecal sludge or co-compost can only result in an actual risk to public health if all of the following occur:

(a)That either an infective dose of an excreted pathogen reaches the field pond, or the pathogen as in the case of schistosomiasis) multiplies in the a field or pond to form an infective dose;

(b) That this infective dose reaches a human host;

(c) That this host becomes infected; and

(d) That this infection causes disease or further transmission

The pathogens likely to persist in faecal matter after excretion have various levels of survival strength and according to the IWMI and SANDEC, (2002), among the pathogens that are likely to be present in faecal matter, Ascaris (Ascaris eggs) is the pathogen known to have a longer survival period with a die-off period of 10-12 months under 20 to 30^{0c}. Notwithstanding, the die off period can be altered through the exposure of faecal sludge to sun or UV light due to the fact that the die off period of pathogens is influenced mainly by dryness and temperature of the sludge (ibid).

2.5 Potentials of Faecal Matter as an Agricultural Resource

The use of human wastes contributes significantly to agricultural productivity and income generation, notably so in the fast-growing urban fringes of developing countries. Excreta reuse can offer several benefits to farming households as it provides fertilizer for crops and thus reduce the importation of commercial fertilizer, it also provides good soil conditioning and it is also an integral part of nutrient recycling in different types of farming systems (Jensen et al., 2005).

Excreta are a rich source of organic matter and of plant nutrients such as nitrogen, phosphorus and potassium. Each day, humans excrete in the order of 30 g of carbon (90 g of organic matter), 10-12 g of nitrogen, 2g of phosphorus and 3 g of potassium. Whilst faecal matter contains organic matter, most of the nitrogen (70-80 %) and potassium are contained in urine. Phosphorus is equally distributed between urine and faeces (Drangert, 1998,).

According to Drangert, (1998), the fertilising equivalent of excreta is, at least, nearly enough for a person to grow its own food. Meanwhile as mentioned earlier, the potentials of faecal matter as an input resource is not limited to its nutrients potentials but also, its organic matter content, which serves as a soil conditioner and humus replenishing agent. This attribute of faecal compost is a very distinctive property not shared by chemical fertilisers (IWMI & SANDEC, 2002).

2.6 Market Potentials of Faecal Matter Reuse

Historically, according to Global Development Foundation, **2012**) people have rejected sanitation solutions offered by governments, donors, and NGOs when they are too expensive, unpleasant to use, or difficult to maintain. New investments in sanitation technologies including latrine design, pit emptying, sludge treatment, and the disposal or reuse of waste have the ability to make sanitation services safe and cheaper for everyone. These innovations can be made sustainable by stimulating demand for improved sanitation services among the poor and by developing safe processes for waste management that will provide a new generation of entrepreneurs with good jobs and incomes (Global Development Foundation, 2012).

Areas to benefit from improved sanitation practices and excreta reuse includes the health of people, general increase in productivity due to healthy population, boosting of tourism revenues, safeguarding of water resources and boosting agricultural productivity (UN Water 2008). However, according to its fact sheet four (4), the UN water (2008), the management of waste is very crucial if the health, social, and economic benefits of improved sanitation is to be fully realised. It concludes that the conventional sewerage can be supplemented with ecological sanitation technologies that make use of the nutrients in human waste. Many countries especially in Asia have taken advantage of the market potentials and thus agricultural production absorbs about 90% of the faecal reuse sector. Also Chinese farming communities have proved open to the idea of urine diverting, or 'dry', toilets that facilitate the reuse of excreta as fertilizer (UN Water, 2008); possibly because it offers extra benefits than the conventional sanitation facilities.

2.7 Perceptions on Waste Reuse

Perception about a product is one of the reasons that can influence people's preference and willingness to pay. It is reported for instance that peri-urban vegetable farmers in China acknowledge that customers prefer excreta-fertilised rather than chemically fertilised vegetables and thus vegetables grown on excreta-conditioned soils yield higher sales prices (IWMI&SANDEC, 2002). Table 2.2 below show the weighted average indexes for some perceptions on co-compost by Ghanaian users and non-users of faecal compost (Cofie et al., 2009).

Table 2.2 Users and non-users perception on excreta reuse measured in Weighted Average Index

Factors	WAI *a* of Users	WAI of Non-Users
Excreta is good for soil structure	1.47	0.63
Excreta is an important source of nutrients	–1.40	0.76
Excreta causes odour problems	–1.50	–1.60
Excreta poses health risks	0.50	0.70
Excreta is unfriendly to the environment	–0.60	–0.77
Excreta causes food contamination	–0.93	–0.26
Excreta deposited on farms has low quality (as perceived through visual appearance)	–0.33	0.90

WAI= weighted average index. (Cofie et al., 2009).

From the Table it could be seen that user assign more positive grading of compost than non-users. People who have used-experience consider faecal compost as an important soil nutrient resource and also having the ability to improve the soil physical structure.

Knowledge on a product developed through longer years of use could also influence perception and acceptability of the product. In Ghana, farmers who have longer years of experience in the reuse of human excreta more easily identify diseases to be associated with poorly treated human excreta than those with little experience in its use (Seidu et al., 2009). The same way farmers with longer experience in waste water farming in Accra & Kumasi generally rate risk lower than those who had been farming (using waste water) for less than 2 years (Keraita et al., 2008a).

2.8 The Theory of Demand, Consumer Behavior & Utility Maximization

Economic demand is basically defined according to Pearson, (1981) and White, (1997) as the willingness to pay (WTP) for a particular level of service. Thus according to Ahlersten, (2008) demand is not only about actual purchases or how much consumers actually buy but also how much in quantity they are capable and willing to pay for, at a particular time. Several factors affect the demand and willingness to pay for a product or service some of which are the price of the product, the quality, income levels of decision maker, tastes, number of buyers and expectations about the future.

The demand decision of a consumer is rooted in the theory of utility maximization. Thus a consumer may purchase a good or service depending on the benefit (utility) that the individual hope to obtain from consuming that good/service. Assuming an individual with a the utility function

$$u\ x.q \qquad 2.1$$

Where x represents the vector of market goods and q for a vector of non-market goods e.g., public goods or services. The set of affordable alternatives is just the set of bundles that satisfy the consumer's budget constraint y and the vector of prices $p = (p_x, p_q)$. Note that the individual maximises utility by choosing a level of x but the level of provision of q is not under the consumer's control (Fisher, 1996). Against this background, the problem of preference maximisation can be stated as:

$$max\ u\ x.q \qquad s.t \quad px \leq y \qquad \mathbf{2.2}$$

Under a non-satiation assumption, the above equation can be rewritten as

$$max\ u\ x.q \qquad s.t \quad px = y \qquad \mathbf{2.3}$$

Solving the constraint problem in equation 2.3 give a demand function as below, which is a single valued function of prices, income and the good under valuation.

$$x_i = h_i(p, q, y) \qquad \text{i =1,.....n,} \qquad \mathbf{2.4}$$

$$u(p, q, y) = u[h_i(p, q, y)q] \qquad \mathbf{2.5}$$

From the ordinary demand function, equation (2.5) is the indirect utility function that gives the maximum utility achievable at given prices and income

$$u^1 = v(p, q^1, y) > u^0 = v(p, q^0, y) \qquad \mathbf{2.6}$$

$u^1 > u^0 and$ q^0 Stands for status quo level (the level of choice when consumer decides not to choose the newly introduced choice) whereas q^1 for the hypothetical good under evaluation

From equation (2.6), two well-known measures of utility changes can be deduced following (Hicks, 1939), that is, the Hicksian Compensating Variation (CV) and Equivalent Variation (EV) measures of welfare changes.

$$v(y - WTP, p, q^1) = v(p, q^0, y) \quad \textbf{2.7}$$

$$v(y + WTP, p, q^0) = v(p, q^1, y) \quad \textbf{2.8}$$

Whiles equation 2.7 is appropriate for measuring willingness to pay (WTP), equation 2.8 is rather utilized in policies aimed at arranging appropriate compensation schemes. It measures what is referred to as the willingness to accept (WTA).

2.9 Consumers' Willingness to Pay

The WTP concept generally refers to the economic value of a good to a person (or a household) under given conditions (Gunatilake et al, 2007). Willingness-to-pay values provide essential information for assessing economic viability of projects, setting affordable tariffs, evaluating policy alternatives, assessing financial sustainability, as well as designing socially equitable subsidies (Brookshire and Whittington, 1993; Whittington, 2002a; Carson, 2003; Gunatilake et al., 2006; Van Den Berg et al., 2006).Willingness to pay (WTP) is the amount that must be taken away from a person's income while keeping his utility constant: as shown in equation (2.7) above. Where V denotes the indirect utility function, y is income, P is vector of prices faced by the individual, Z is other socio-economic characteristics, and q_o and q^1 are the alternative levels of the good or quality indexes with $q_1 > q_0$, indicating that the new good is preferred (Alberini and Cooper, 2000).

Consumers' preferences and WTP can be elicited using either revealed preference (RP) or stated preference (SP) data. Under certain circumstances, stated preference data provide some advantages over revealed preference data. One of the main differences between the two systems is the origin of data and data collection method; whiles revealed preference data are obtained from the past behavior of consumers stated preference data are collected through hypothetical surveys (Merino-Castello, 2003).

2.10 Stated Preference Verses Revealed Preference Elicitations

Economic valuation techniques are not only valuable as a policy decision-making tool but also as a marketing research technique. In the former case, we refer to the social valuation of a public initiative such as the construction of a dam or a new environmental or health program. However, these techniques are also widely used as a marketing research tool because they allow on understanding what it is about a product or service that drives customers' interest and influences their final purchase decision (Merino-Castelló 2003). Two techniques used for evaluation are the stated preference and the revealed preference techniques.

Revealed preference rather aims to deduce people's willingness to pay from observed evidence of how they behave in the face of real choices (Pearce & Zdemiroglu, 2002).

Stated preference techniques rely on asking people hypothetical questions, as in a market research interview. It is a preference data derived from surveys (Louviere et al., 2000) The aim is to see how people respond to a range of choices, and thus to establish the extent of

collective willingness to pay for a particular benefit (or their willingness to accept payment in exchange for bearing a particular loss).

Stated preference is based on what people say rather than what they do, but it is more flexible than revealed preference and can potentially be applied in almost any valuation context. Hypothetical payment scenarios can be defined in great detail in order to produce conclusions about people's willingness to pay for either specific aspects of a good or the entirety of goods, services or other things that are relevant to the decision. The choice experiment CE and the contingent valuation method CVM have been the most popular stated preference methods in recent literature (Ibid).

2.11 The Choice Experiment (CE)

Arising from conjoint analysis commonly used in marketing and natural resource evaluation, the choice experiment have been used for marketing analysis, transportation and psychology literature by many researchers [Louviere, (1988a); (1988b); Batsell and Louviere, (1991); Hanemann, (1999); Hensher, (1994); Bennett & Blamey (2001); Abou-Ali & Carlsson (2004); Kanyoka et al (2008)]. The choice experiment is consistent with random utility theory and is an alternative to Contingent Valuation (CV) as a method of eliciting consumer's willingness to pay.

The CE technique differs from contingent ranking in terms of the nature of the choice task; in the former approach, respondents make pair-wise choices: in the latter, they are asked to

rank a series of alternatives. The approaches also differ somewhat in terms of the statistical models employed (Beggs et al. 1981; Veisten, 2007).

The Choice experiment technique is an application of the characteristics theory of value (Lancaster 1966), combined with random utility theory (Thurstone 1927; Manski 1977). The choice experiment have strong association with the random utility approach to recreational demand modeling using revealed preference data (Bockstaell et al. 1991). Respondents are asked to choose between different bundles of goods, which are grouped or described in terms of their attributes, or characteristics, and the levels that these take. One of these attributes is usually price (Hanley et al 1998). Thus the price attribute of the option to be chosen is the respondent's willingness to pay for that option.

2.12 Designing Choice Experiment

In any CE study, a number of important decisions are made at the design stage. These include the number of attributes,

- The numbers of levels to allow each attribute to take, what these levels should be, and how both levels and attributes should be described. It is advised that, minimum number of attributes selected should be two, because price and any other product attribute must be included in order to calculate the willingness to pay. The maximum number of attributes should also be five, because a larger number of attributes typically leads to choice experiments with more choice sets, which are difficult to administer and also quickly result in respondents' fatigue or information overload (Zhifeng et al 2009).

- A bid vehicle (that is, a way of expressing the price of the environmental good) must be established, just as in Contingent Valuation Method, and the levels this takes. In addition, a decision must be made over whether to allow each attribute to enter choices on its own, or also in combination with other attributes (Verma & Plaschka 2005).

Choice experiment can be treated in three stages (Verma & Plaschka, 2005); the first stage of the design process is to understand the relevant attributes of the goods in question. This can be achieved through literature, discussion with suppliers of the good in this case sanitation service provider, key informant interview reconnaissance survey among others. At this stage one important attribute to seek information about is the appropriate prices for the proposed options in the choice sets. This is necessary if research is interested in knowing suppliers ability to accept the WTP amount of respondent. Thus marching demand to supply and determining how much subsidy would be needed to achieve the equilibrium price if it necessary.

Studies conducted by Cofie & Doulaye (2008) shows that a large number of farmers (83%) have positive perceptions and were willing to use co-compost. However, the actual amount farmers were willing to pay was (0.1 to 3.0 US$ per 50kg bag) which was far below the realistic sale value of compost if production cost was taken into consideration.

The second stage is to design experiment that asks respondents to select one out of two or more options in a series of choice sets. The choice set can take different forms (Louviere et al, 2000; Verma et al, 2004; Train, 2003; Although different types of design strategies have

been developed for various design strategies, no general agreement has been reached on what is the best design of choice experiments.

The third stage is the use of econometric models to determine the various choices made by the respondents. At this stage the marginal willingness to pay which in ordinary terms represents respondent's valuation of each attribute of the good (Verma et al, 2004)

2.13 The Contingent Valuation Method (CVM)

The CV method has been used for several willingness to pay studies including [Brookshire and Whittington 1993; Cummings et.al 1986; Griffin and Briscoe 1995]. As was originally proposed by Ciriacy Wantrup (1947), the CV method was known to have the methodological ability to eliciting the views of consumers about how they value the goods they consume. In its first usage, Ciriacy elicited what he termed as "the extra market benefit that are public good in nature, generated from the prevention of erosion. (Ibid) After its introduction, by Ciriacy the CV was used by other scientist including, Portney 1994, and Haememann, 1993.

CV studies convey useful information reliable by standards that seem to be implicit in similar contexts, like market analysis for new and innovative products and the assessments of other damages normally allowed in court proceedings (Arrow et al. 1993). According (Altaf and Hughes, 1994) the CVM valuation method is a survey approach for obtaining useful demand information. When carefully designed to mimic to mimic empirical situation, the CV survey could yield useful information even in complex applications involving the estimation of use and non-use values (Arrow et al., 1993). In many developed countries, the

CVM has been used to determine the benefit of environmental improvement and the improvements in some other public goods (Cummings et al., 1986; Mictchell and Carson, 1989)

2.14 Contingent Valuation Verses Choice Experiment

To test for the validity of a model, it is required that the estimates from the model should agree to some extent, with economic theory, intuition and prior experience (based on empirical evidence). According to Hausman (1993) the increasing popularity of CE types of surveys is partially in response to recognized challenges of contingent valuation by the NOAA Panel1 in 1990, and its ability of easily identifying the trade-off among different product attributes as compared to other approaches. Thus theoretical conclusions pass the CM as a better stated preference model than the CV. Comparing the results that could be obtained from CM and CV may show for instance that, the contingent valuation is unable to determine the implicit prices of attributes of faecal compost. Thus farmer's willingness to pay for faecal compost could only be assessed under the assumption that, faecal compost comes not as a composite product with some relevant attributes which could affect farmer's choice. However, it was important that farmer's marginal willingness to pay for possible improvement in the good be solicited for as it may come with extra cost though it may offer additional utility.

The choice experiment was adopted for use in this study due to its advantages over its alternative model CV.

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1 **The NOAA panel**
Set up in the early 1990s in the U.S., to review the CVM. A concrete background for the panel was the controversy surrounding the so called Exxon Valdez incident, with a large oil spill off the Alaska coast, in 1989. In that case, WTP data obtained from CVM studies were brought to court. These studies were contested, and the entire CVM seriously questioned.

CHAPTER THREE

METHODOLOGY

3.0 Introduction

In the preceding chapter, literature on some concepts and theories relevant to this work were explored. In this chapter of the study, the applied forms of the theories and concepts related to the study, the methods and procedures of data collection and analysis among other methodological issues are discussed.

3.1 Conceptual Framework

The need for improved sanitation in developing economies is an issue that cannot be overemphasized. In developing countries, many households lack improved sanitation facilities and existing ones are sometimes poorly managed. Meanwhile, according to Water Aid (2008), Access to improved sanitation does not technically solve the problem of poor sanitation. The challenge of poor sanitation has its limit, not in collection but also the disposal of the waste collected either faecal waste or industrial waste. In the case of faecal waste, the environment is much more polluted when untreated faecal matter is indiscriminately disposed into the environment. These challenge, demands an approach of sanitation mechanisms that incorporates reuse. Following the principles of sustainable development; recirculation of nutrients in agricultural land is one of the big challenges of our time. Many researchers (Morgan, 2004; Schönning and Stenström, 2004; Winblad and Simpson- Hébert, 2004; Smet and Sugden, 2006.) however believe that the concept of ecological sanitation could help address this challenge.

Ecological sanitation as explained in the previous section, involves a cycle which begins with containment, where excreta are held in the sanitation installation. The waste is then sanitised through one or several processes which cause pathogen die off, the resultant safe soil conditioner and fertilizer is then recycled and used to assist crop production. The process is as described in figure 3.1 Adopted by Boot 2007 from Esrey and Andersson, 2001.

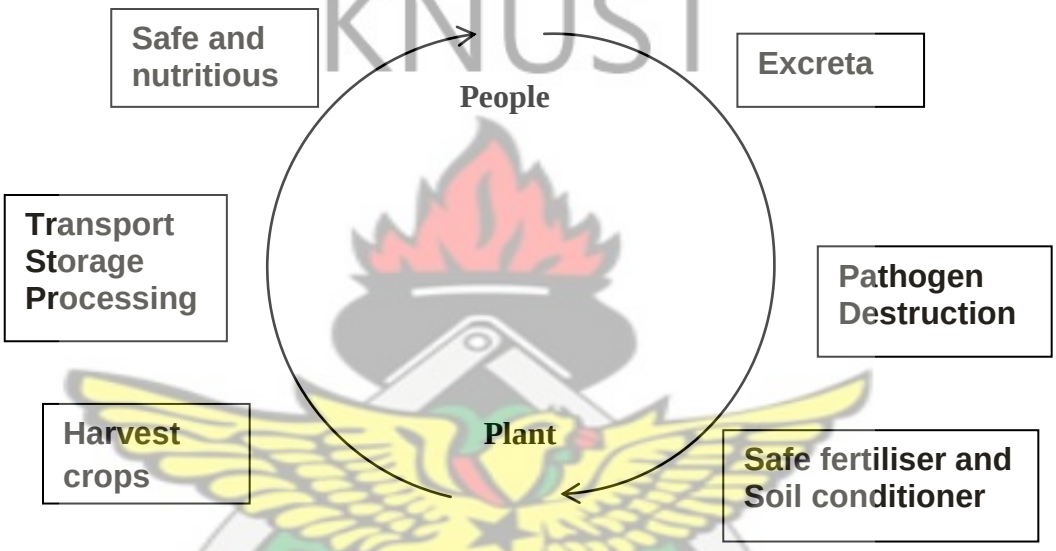


Figure 31: *The Principle of Ecological Sanitation [Boot, 2007]*

In agricultural economic terms, reuse of faecal waste has the capacity to reduce the cost of food production, increase the quality of produced food and also improve the financial and physical health of rural folks through the substitution of the expensive chemical fertilizer used by poor farmers with faecal compost (an organic fertilizer) and also the diversion of faecal matter collection and disposal threats to the production of valuable farm resource.

3.2 Theoretical Framework

The acceptability or willingness to pay for a quantity of faecal compost is assumed to be dependent on the valuation of the product by the target users. Thus in the face of options, a farmer may select that alternative he most prefer based on some guiding principles such as reduced cost or increased benefits. According to Varian (1999), consumers when free to decide their action will choose to acquire/consume goods that give them pleasure or utility and they will not consume goods they dislike.

To determine the level of patronage in terms of effective demand, it is important to observe the price at which many consumers will be willing to buy the product. Figure 3.2 demonstrate the relationship between price and quantity of product/service demanded. The figure demonstrates that, when the price goes up, the quantity demanded or says the number of people demanding the good reduces and the vice-versa. This follows the basic economics principle of price and demand

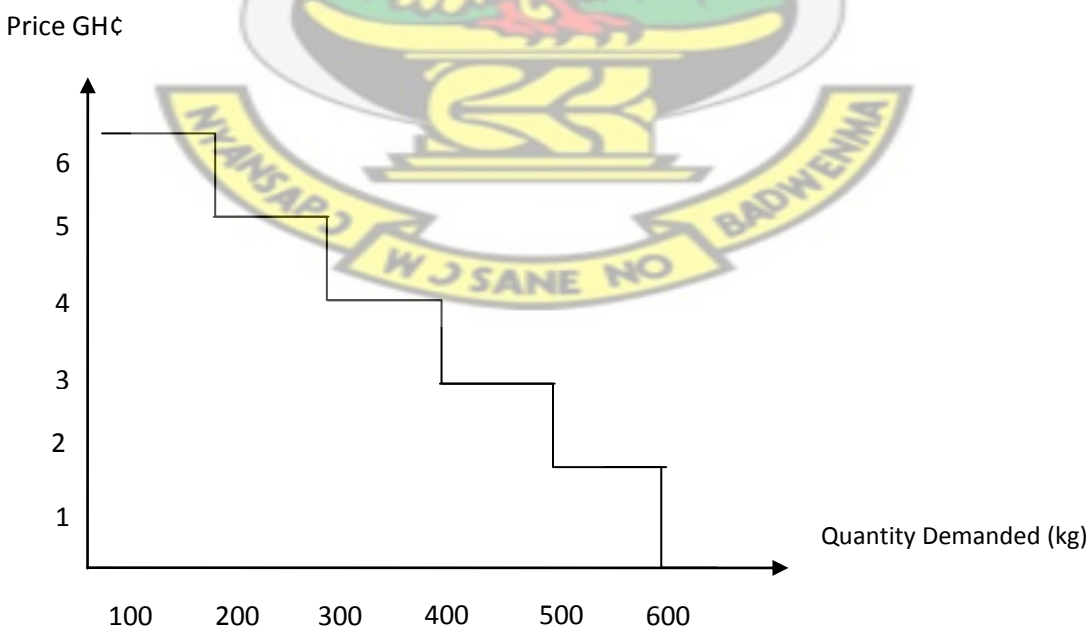


Figure 3.2 Reservation Price –Demand for Faecal Compost

Meanwhile other factors other than price equally affect demand of a product. With regards to a product like faecal compost, other factors such as socio-cultural orientations and price of other fertilizers among others may affect demand by farmers. That notwithstanding, the theory of choice assumes that an individual (choice maker) makes a choice of a product over the other after she has rationally evaluated all alternatives.

Willingness-to-pay values could provide crucial information for assessing economic viability of faecal compost production and marketing, as it has proven to be in other studies (Brookshire and Whittington, 1993; Whittington 2002a; Carson, 2003; Gunatilake et al., 2006; van den Berg et al., 2006)

The Willingness to pay is the maximum amount that an individual state they are willing to pay for a good or service (Brookshire and Whittington, 1993). Using the choice data, implicit prices that farmers are willing to pay for any improvement in the market value of faecal waste can be estimated.

3.3 Empirical Framework

3.3.1 Choice Experiment

Choice experiment (CE) asks subjects to choose between scenarios that are described by attributes of the good in question. Choice experiment is therefore a combination of Lancaster's (1966) characteristic theory of value and McFadden's (1974) random utility theory. According to Robert and Estelle, (2010) choice experiments (CE) has emerged as a

preferred stated preference technique in recent literature for estimating the economic value of environmental goods and services.

In this study, respondents are assumed to make trade-offs between attributes of various sets of faecal compost options; thus the frame of reference was made explicit to respondents via the inclusion of an array of attributes of the product; this also enables implicit prices to be estimated for attributes. The choice model (Equation 1) consists of two independent and additive parts; observable V_{ij} and unobservable (ε_{ij}) components (Verbeek, 2004).

$$U_{ij} = V_{il} + \varepsilon_{ij} \qquad 3.1$$

According to Green, (2007), in a Conditional Logit Model, 'the utility functions are conditioned on observed individual's choice invariant characteristics, Z_i and attribute of the choices which includes a price attribute necessary for the estimation of the willingness to pay for that choice $X_{ij}^{'}$, as well as a constant α_j known as the alternative specific constant (ASC) and so V_{ij} can be written as in Equation 3.2.

$$V_{ij} = \alpha_j + \beta^{'} x_{ij} + \varsigma_j^{'} Z_i \qquad 3.2$$

The ASC is the parameter that measures 'no choice' alternative. A significant parameter/ coefficient for the ASC practically means that, some farmers have no preference for any of the choice set. Absence of this constant in the model means that no status quo option was provided or in the choice scenarios or none of the respondents were unwilling to accept or pay for one of the option provided.

The error terms (ε_{ij}) of the model is 'assumed to be independently distributed across utilities' making the probability of individual *i* choosing alternative *j* as given in Equation 3.3, and their probabilities as presented in Equation 3.4 where y_i = the index of the choice made.

$$if \quad \Pr ob(U_{ij} \succ U_{iq}) \; for \; all \; q \neq j. \qquad 3.3$$

$$then \quad P(y_i = j) = \frac{\ell^{V_{ij}}}{\sum_{q=1}^{j_i} \ell^{V_{iq}}} \qquad 3.4$$

The model has an assumption that all (ε_{ij}) is independent across respondents. Thus the error terms of the choice sets should not relate to each other. This property is called Independence of Irrelevant Alternatives (IIA). The conditional logit specification implies that selections of an option from the choice set must obey the `independence from irrelevant alternatives' (IIA) property. This assumption means that the relative probabilities of two alternatives being chosen from a choice set are unaffected by the introduction, or removal, of other alternatives in that choice set. In other words, if an alternative in our choice set is preferred to another alternative in the choice set then introducing a third alternative with different attribute level must not change the preference or the choice for the initially preferred option irrespective of how improved the other choice set is. Therefore, whether option A or B is better should not be changed by the availability or absence of another choice option.

This assumption places some limitations to the application of conditional logit model to mimic empirical choice situation because when different options of the same product is presented to a choice maker, his choice for one of the option is surely influence by the presence or absence of other options available.

There are several possibilities for removing IIA violations and also improving the model fit. However as suggested by Rolfe et al. (2000) and McConnel and Tseng (2000), the inclusion of interactions between socio-economic characteristics of the choice maker and attributes of the product is a simple but important step for estimating more accurate models of choice to both improve model fit and relax the IIA assumption by introducing heterogeneity in the choice problem.

Another condition that forms the basis of the use of interaction terms in the conditional logit model that set for analysis is, by following the examples of Walker, (2001) where the theory of choice is extended to include the cognitive process of attitude and perception or some characteristics associated with a choice maker and his choice behaviour. According to models (Ben- Akiva et al., 1999), including interaction terms allow for more realistic representation of behaviour in the choice process, with a better predictive power, producing consistent and efficient estimates of the parameter, and also fill the gap between behavioural theory and discrete choice.

Following the conditions above, two models were used for the analysis of the choice data. A basic conditional logit model, which includes choice as a dependent variable and the attributes of the faecal compost as the independent variables (fig 4.6) and hybrid conditional logit model having the interaction of some choice attributes and some socio-economic characteristics of the choice maker and his experience with faecal or related organic compost use (fig 4.7).

The estimation of trade-off between attributes is as shown in equation seven (3.5) also referred to as the implicate price IP estimation. This gives an indication of the value farmers attaches to an addition of a packing option or label to the specified kilograms of faecal compost under valuation.

$$IP = -\frac{B_K}{\beta_C} \quad \text{.....3.5}$$

3.3.2 The choice Elicitation procedure:

To be able to efficiently solicit for farmers willingness to pay for faecal compost, the research went through several processes; from determination of the appropriate attributes of the product and the financial value that should be attached to each of the attributes through formation of choice set designed orthogonally with SPSS version 20, to the formation of choice scenarios that was seen to have minimal cognitive burden on respondents and finally the elicitation process.

3.3.3 Determinants of attributes and levels of attributes:

Prior to the design of the choice sets, a short qualitative study was conducted in which some selected vegetable and arable crop farmers in the study areas and Kumasi were interviewed to seek information on the appropriate price that a 50kg worth of faecal compost should cost. This was done alongside interviews with faecal compost productions experts from the Valley View University in Oyibi to also establish the cost associated with the production faecal compost. The essence of this exercise was to obtain a price measure which in addition to being realistic for farmers could also give an important demand indication to entrepreneurs who may be interested in faecal compost production. After the process, attributes such as price, packaging and labeling were found to be the most relevant attributes

for elicitation of willingness to pay. Other attributes such as smell, and nutrient content were dropped from the choice scenario because it is assumed that, the former would remain constant if only faecal matter is well processed and the fact that enough evidence is not available to show how the nutrient content of faecal compost could be varied.

3.3.4 The Product

The product that was presented for hypothetical choice elicitation was a 50kg weight of fecal compost, well processed to eliminate all pathogens that could be harmful to human health and packaged with a label indicating the application procedures and nutrient compositions of the organic fertilizer.

This product was then redefined according to their marketing attributes as which was hypothesised to influence farmers' choice for the product as below.

1. Package-
    a. 50kg Faecal compost without a package
    b. 50kg Faecal compost with a package

2. Package and label
    a. 50kg of Faecal compost packaged but not labeled
    b. 50kg of Faecal compost packaged and labeled (with nutrient composition and application guide).

3. Price
    a. 50kg Faecal compost sold at GH 5
    b. 50kg Faecal compost sold at GH 10
    c. 50kg Faecal compost sold at GH 15

Faecal compost in the form(s) described above is non-existent in significant quantities in the study area and the entire country and hence the justification for the application of stated preference procedure to determine farmers willingness to pay for it.

3.3.5 Design of choice set and scenarios:

Through the use of SPSS, an orthogonal design was employed to combine the different attributes of the product and their levels in a random order after which these choice scenarios were used to form choice sets that were presented for farmers to make a choice among each choice sets. A status quo option was also included in the choice set. This option was necessary to create an alternative choice for a farmer who is not willing to make any choice and thus not willing to accept or to pay for any of the faecal compost 'packages' presented.

3.3.6 Choice Elicitation Process:

The questionnaire for the field survey was designed in a way that will reduce cognitive burden to the barest minimum and to also reduce the probability of a farmer assigning a false value to an attribute or their entire willingness to pay. To prevent these problems the survey instrument was divided into sections and socioeconomic and related questions were asked after the elicitation process. In addition to this, sample of faecal compost from the Valley View University were presented to respondents before they made their choices. Also the preceding question to the choice questions was the determining factors which are conditional to the farmers' choice of accepting faecal compost or otherwise. By so doing farmers are will less likely choose the status quo option as a way of dodging choice making.

Implying also, that farmers would (all things being equal,) choose the status quo if they in fact dislike all the other options.

3.4 Variables and their Definitions

Table 3.1 Description of Dependent and Independent Variables with their Apriori expectations

VARIABLE	Description	Apriori Expectation
Dependent Variables		
Choice	Farmers choice of faecal compost option	
WTP	Farmers WTP for faecal compost	
Independent variables		
Age	Continuous Variable (years)	Negatively related to WTP
Gender	Dummy Variable: male =1, Female=0	Males will have higher WTP than females
Income	Continuous variable Household income per month	Income Positively affect WTP & Choice
Education	Continuous variable; number years in education	Education positively affect WTP
Household size	Continuous variable, number of people in a household	Negatively related to WTP
Farming Experience	Number of years engaged in farming	Positively related to WTP
Knowledge on faecal compost	Whether Respondents have heard of faecal compost as an important organic fertilizer	Positively related to WTP
Knowledge on Cow dung	Whether Respondents have heard of Cow Dung as an important organic fertilizer	Positively related to WTP
Knowledge on Poultry manure	Whether Respondents have heard of Poultry Manure as an important organic fertilizer	Positively related to WTP
Price	Price of 50kg of Fecal Compost	Negatively related to WTP
Package	Addition of a packing option to the 50kg Fecal Compost	Positively related to WTP
Label	Addition of a label to the 50kg packaged Faecal Compost	Positively related to WTP

3.5 Source of data

Data was obtained through primary and secondary data sources. The primary data was collected through interviews using a pre-tested structured questionnaires and key informant interviews. Secondary information was obtained from the Dodowa Health and Demographic Surveillance System (DHDSS), books, journal, published and unpublished reports and other online information sources.

3.6 Population

The target population, the unit of analysis and the survey population for this study were the farming households and the decision makers of these farming households were selected and interviewed.

3.7 Sampling Techniques

Both purposive and simple random sampling procedures were employed in the study. Purposive sampling procedure was used in selecting the survey districts and communities in the study area. The justification for the former is the presence of the Sustainable Sanitation (SUSA) Ghana Study in the districts. SUSA Ghana project was a sanitation research study with funding from DANIDA with the main aim of identifying existing barriers to improved sanitation and propose business models for providing hygienic latrine technologies and waste management solutions that can be used in poor, rapidly urbanizing townships in Ghana.

Communities selected purposely for the study were Dawa, Konikablu, Salom, Fiankonya, Ayenya and Ayikuma in the Dangme West District (now Shai Osudoku and Ningo Prampram District). These towns were selected purposively because of the level of agriculture activities as compared to the other communities.

Simple random cluster sampling was then used to select two hundred households from the selected communities under study. Thus communities with higher population size had higher sample size than those with relatively lower population size. The sampling frame was obtained from the Dodowa Health and Demographic Surveillance System (DHDSS).

3.8 Method of Data Collection

Prior to the actual data collection, a reconnaissance survey was conducted after which a questionnaire for a rapid appraisal was developed and administered through a structured questionnaire. In the latter, data on cost of acquiring the deferent types of existing organic manure/compost was established. These figures helped to determine the price attributes of the faecal compost used for the choice experiment.

3.9 Methods of Data Analysis

Both descriptive and inferential statistical analyses were used to analyse the data. Tables, charts and graphs were used for descriptive analysis while the chi-square values for maximum likelihood estimation were used for inferential analysis

Descriptive Analysis

Analyses of household demographic /socio-economic characteristics were analyzed using charts, cross tabulations and graphs.

Inferential Analysis

The Chi-square values for likelihood ratio were used to test the hypothesized factors that affect household's choice for faecal compost. The use of a basic conditional logit model and hybrid conditional logit models were employed for the analysis of choice data.

3.10 Description of Study Area

The study was conducted in the Dangme West District now (since 2013) administratively demarcated into two districts namely the Ningo-Prampram and the Shai-Osudoku Districts.

The district is one of the ten districts in the Greater Accra Region located in the south-eastern of Ghana

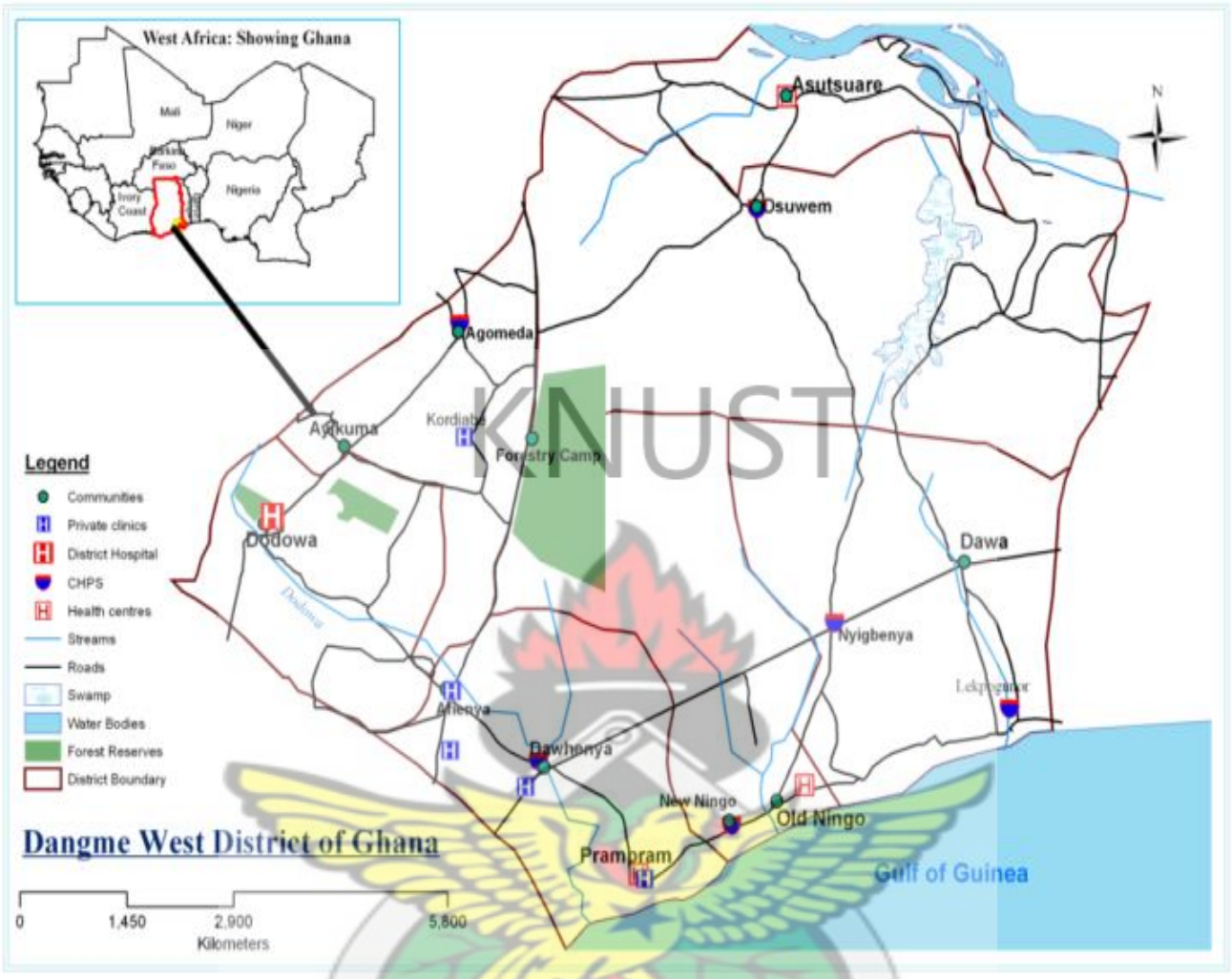


Figure 3.3 The Demographic Map of then Dangme West District

The study was conducted in the Dangme West District now (since 2013) administratively demarcated into two districts namely the Ningo-Prampram and the Shai-Osudoku Districts.

The district is one of the ten districts in the Greater Accra Region located in the south-eastern of Ghana.

The district covers about 40.5% of the total land size within the Region. The districts are about 40.8 kilometers away from the national capital, Accra. The vegetation is mainly

coastal savannah; however the districts boast of a forest which is located in Dodowa popularly known as the Dodowa forest. Most communities in the district are scattered.

Vegetation and Agriculture

The predominant vegetation in the area is that of the herbaceous savannah spread with shrubs and short shaft, a characteristic of the Sahelian type. The vegetation remains dry during a great part of the year, particularly southward, except for the short rainy season. The devastating effects of the seasonal brush fires that invade most of the parts of the Districts, particularly during the dry season, depreciate the quality of the vegetation.

Farming is dependent on climatic factors, which makes very vulnerable the farmers of the Districts. Harvest failure remains a very recurring phenomenon, not to say common, even in the wettest parts of the Districts.

At present, 45,600ha of the two Districts' area are used for farming, of which about 2,200 hectares is under irrigation. In spite of a relative large variety of activities led within the territory of the Districts, farming remains the main activity of the household heads for 68 % of the sample as shown in the figure below. This situation could be explained by the rural characteristic of the Districts.

Crops produced in these districts includes maize, cassava, rice, tomatoes, garden eggs, okra, pepper, watermelon, sugarcane, banana, pineapple, pawpaw and exotic vegetables (for export). Tree crops grown are mainly mangoes with a few small- scale cashew plantations in some areas of the Districts. Livestock production comprise of cattle, sheep and goats with a large local poultry population, some medium scale holdings (ASAS, Sapporo Farms, Ratio

Farms etc.) and few commercial holdings (e.g. Gateway (AAH) McBaron for Ostiches, Farmer George for broiler production among others.

The chart below shows the main occupations of the household heads of the sample

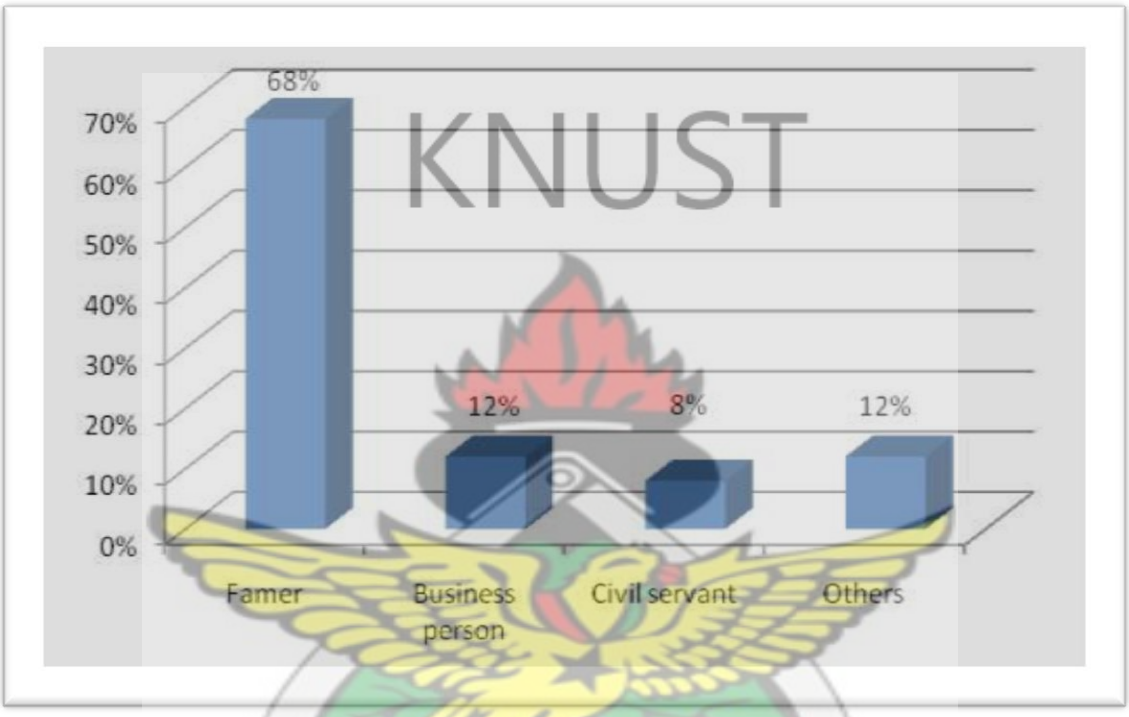


Figure31.4 Main occupations of the household heads

Source: 2008 household survey, MLG, RDE, Ghana

Soils

The predominant soil in the Districts concerns the black clay soils classified as a series of Akuse. The soils are greatly elastic when they are wet, but become hard and compact when they are dry and they split vertically from the surface. This makes the soil a bit unsuitable for cultivation, which besides, is limited to growing subsistence crop. Black clays are considered as being the most suited to mechanized irrigation.

Urban/rural duality

The formally Dangme West District has a strong rural tendency. According to the 2000 population and housing census, the majority of the District population, namely 73,959 persons (76.4 %), live in the rural areas; against 22,850 persons (23.6 %) who live in the urban areas. However, it is to be emphasized that the proportion of the population living in the urban regions (on the basis of the forecasts) increased from 32 % to 35.5 % in 2005. This improvement of urbanization will have as a corollary, the increase of the needs of people living in the urban areas, in terms of access to basic social services.

Table 3.2 Summary of the Demography of Dangme West District

Demography	
HDSS surveillance pop	116,288 at the start of 2012
Surveillance area	1,528.9/sq km
Population density	71.3
Households	22,343 in 376 communities
Sex ratio	87 males: 100 females
Household size	4.9

Source: DHDSS, 2012

Information and data on the districts were obtained from, the DHDSS, The Dangme West District profile at the Ghanadistricts.com and of the Ministry of Local Government, Rural Development and Environment (MLG, RDE), water and sanitation plan.

CHAPTER FOUR

RESULTS AND DISCUSSION

4.0 Introduction

This chapter of the study presents the results and discussions of the study. Whiles the first part deals with the descriptive analysis of the variables in the study like the major socio-economic and demographic characteristics of respondents, the second parts presents the answers obtained from the research questions which were understudied. In the later, results are discussed in relation to the specific objectives set for the study. These include the use of conditional logit model to analysing the responses obtained choice experiment. Non-parametric analysis were also utilised in analysing the knowledge and perceptions of farmers on the use of faecal and related composts.

Table four below shows some socio-economic characteristics of the respondents interviewed in the study.

4.1 Socio-Economic Characteristics of respondents.

The Table 4.1 below shows some basic socio-economic characteristics of the farmers interviewed in this study. Some variables measured include respondent's age, household size and household's income. From the table, the maximum and minimum ages measured were 74 and 19 years respectively and an average of 47.74 years old approximately 48 years.

Table 4.1 Table showing the Socio-economic Characteristics of Respondents

Variables	Max	Mean	Min	SD
Age	75	47.75	19	1.124
Household size	20	6.43	1	3.294
Household income	450.00	161.9750	20.00	111.493
Years in education	12	2.125	0	.0352027
	Options	**Frequency**	**Percentage%**	
Gender	Male	163	81.5	
	Female	37	18.5	
Marital Status	Single	38	19.0	
	Married	148	74.0	
	Widowed	14	7.0	
Educational Background	No formal Education	86	43.0	
	Primary/Junior High	80	40.0	
	Secondary	34	17.0	
Primary Occupation	Crop Production	188	94.0	
	Animal Husbandry	1	0.5	
	Others	11	5.5	
Ethnicity	Ga Dangme	187	93.5	
	Ewe	7	3.5	
	Akan	6	3.0	
Form of Labour Mostly Used	Hired Lab	35	17.5	
	Household Lab	51	25.5	
	Both Equally	114	57.0	
Sanitation Facility in Use	Pit Latrine	65	32.5	
	VIP	11	5.5	
	OD	116	58.0	
	Public Toilet	8	4.0	

Source: Field Survey, 2012

The average households size of the respondents interviewed was 6.43 approximately 6 people per household. The maximum and minimum household sizes were 20 and 1 respectively.

Percentage frequencies of Gender, Marital status, Educational Attainment, Primary occupation and Ethnic Background were also measured, in which with Gender, males were 81.5% while females were 18.5%. This might have been so because in most rural and peri-urban homes men are usually the decision makers and hence, unless purposively sampled, males are more likely dominate studies in which the household's decision maker is interviewed. With Marital status, most of the respondents interviewed were married (74%) while fewer of 7% had divorced and 19% single. This confirms why the average house size is large as most of the household members are children of the respondent.

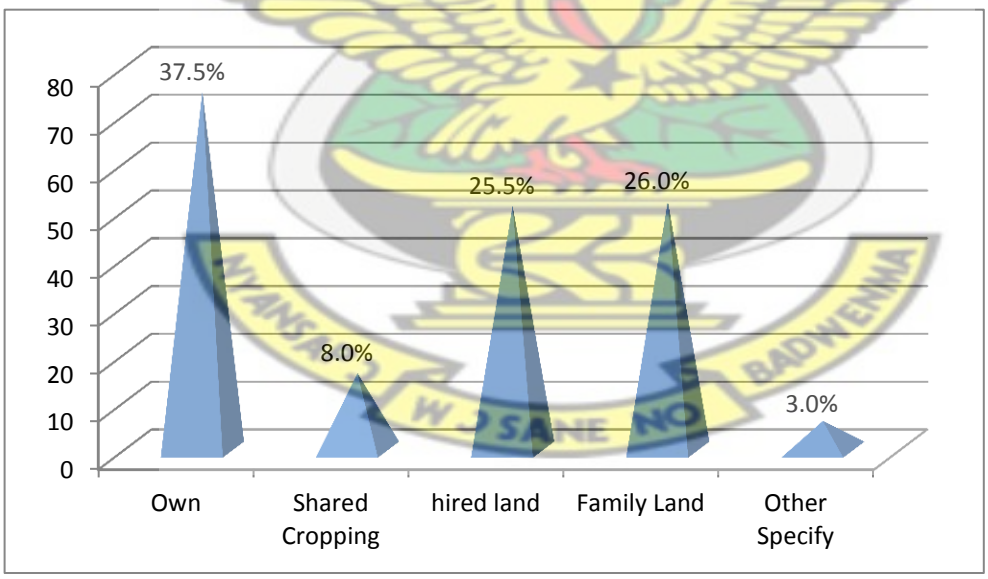
Farmers educational level were measured at four levels; No Educational Level, Primary/ Junior High School, Senior High/O/A level and tertiary/Post-secondary Education. However none of the respondents interviewed had tertiary education. From Table 4.1, 43% of the farmers interviewed did not have any form of formal education. Whiles 40% had obtained some form of Primary/Junior high Education, only 17% of the respondents had obtained Secondary High/ some Post-Secondary Education. When measured as a continuous variable, farmers average years of schooling was only 2 years.

Other interesting variables measured were the forms of labour farmers mostly used, the Sanitation facility used and ethnic backgrounds. With farm labour source, most respondents (57%) uses both hired and household labour equally however, the use of household labour only (25.5%) is seen to be higher than hired labour only (17.5). This could also be explained

by the higher household size in the rural and peri-urban households. Thus higher number of household size will increase the number of household labour force as compared to household with fewer members

Open defecation happens to be the most (58%) subscribed sanitation practice followed by pit latrine (32%). The finding on higher percentage on the use of open defecation confirms an initial baseline report by SUSA in 2011. The closeness of housing to bushy environment coupled with the scattered nature of settlement in the study area may be the major contributing factor to open defecation.

Figure 4.1 displays the form of land tenure arrangements practiced by the farmers interviewed



Most of the farmers interviewed (37.50%) owned their own land. whiles about 25.50% and 26.0% depending on hired and family land respectively with 8.0% practicing shared cropping.

4.2 Farmers Knowledge on the use of Faecal and Related Compost for Agricultural Purposes

Table 4.2 Descriptive statistics showing farmers experience with faecal compost and related composts

KNOWLEDGE OF POULTRY MANURE			
Level of Knowledge	**Frequency**	**Relative Percentage %**	**Total Percentage %**
Heard	190	95.0	95.0
Heard & Used Before	7	3.68	3.5
Heard, Used before & Still uses	2	28.57	1.0
KNOWLEDGE OF COW DUNG			
Level of Knowledge	Frequency	**Relative Percentage %**	**Total Percentage %**
Heard	199	99.5	99.5
Heard & Used Before	85	42.5	42.71
Heard, Used before & Still uses	64	75.29	32.0
KNOWLEDGE OF FAECAL COMPOST			
Level of Knowledge	Frequency	**Relative Percentage %**	**Total Percentage %**
Heard	64	32.0	32.0
Heard & Used Before	13	20.3	6.5
Heard, Used before & Still uses	2	15.38	1.0

Source: Field Survey, 2012

Table 4.2 above, shows the experience of farmers with faecal compost and other related composts. From the Table, it could be seen that among the three organic fertilizers presented;, cow dung records the highest percentage of farmers' experience both in terms of hearing about it as a source of plant nutrient and its application to food crops production.

Out of the 200 farmers interviewed, 199 (99.50%) of them have heard of cow dung as a good source of soil nutrient among which 85 (42.50%) of them have actually applied on their fields before and 64(32.0%) of them still using cow dung for farming purposes. This is different in the case of poultry manure and faecal compost. With faecal compost, only 64 (32%) out of the 200 farmers interviewed have heard of faecal compost (FC) as an organic fertilizer. Out of this number only 13 (6.20 %) of them have applied FC on their field before and only 2 (1.0%) people still use it. That of Poultry manure is 190 (95.0%), 7 (3.5) and 2 (1.0%) for knowledge on Poultry manure as fertilizer, actual application on field by farmer and continues application respectively.

4.3 Sources of information about faecal compost

Table 4.3 and figure 4.4 below display the various sources that farmers who have heard or used faecal compost before, obtained the knowledge on faecal compost as an organic fertilizer.

Table 4.3 Farmers Source of Knowledge on Faecal compost

Sources of Information	Frequency	Percentage %
Through Extension Education	14	21.87
Heard from the media	30	46.87
Heard from/Used by a friend/relative	14	21.87
Cannot remember	6	9.37
Total	**64**	**100**

Source: Field Survey, 2012

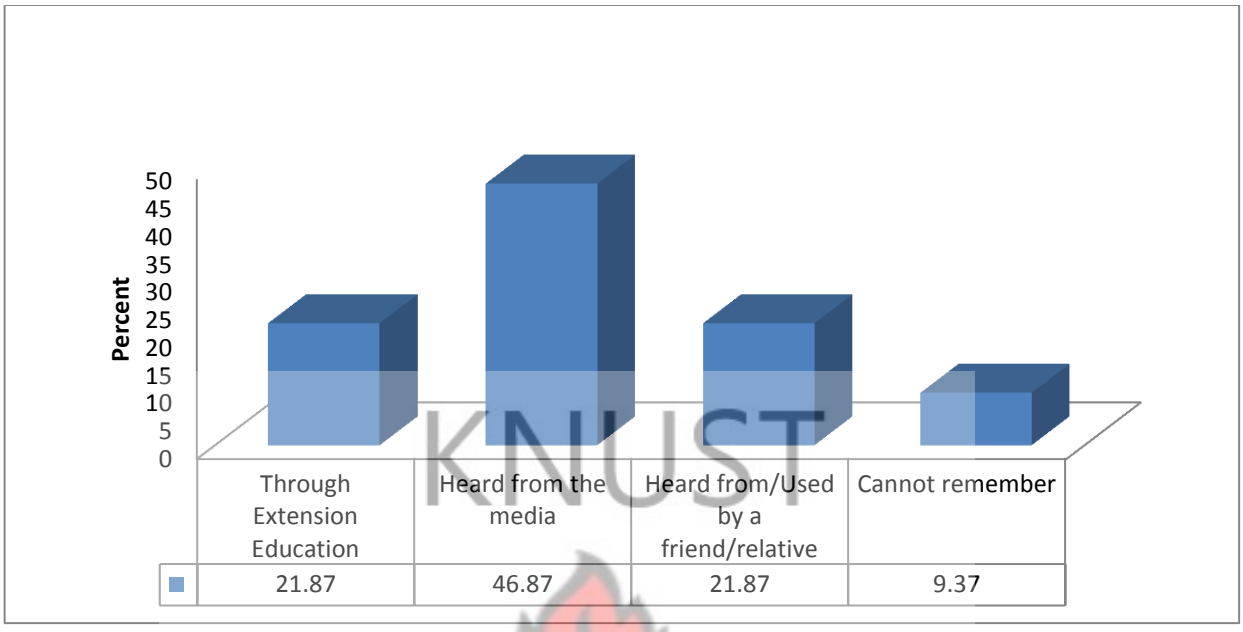


Figure 4.2: Source of famers' information about faecal compost

Source: Field survey, 2012

Table 4.2 shows that media tops (46.87) the source of information farmers get on faecal compost as an organic fertilizer followed by extension of education and family and friends which both scores (21.87%) out of the 360 respondent who had heard about faecal compost and (9.37%) of farmers who have heard of faecal compost do not remember where they first heard it for the first time. Keraita et al 2010; Obuobie et al., 2006 and Boholm 1998) confirms that the media is the main source of knowledge in the use of waste by farmers.

4.4 Farmers perception of faecal compost

Table 4.4 Farmers responds to some assertions on Faecal Compost

	Percentage of responses				
STATEMENT	Strongly disagree %	Disagree %	Don't Know %	Agree %	Strongly Agree %
Faecal Compost has a foul Smell	2.0	34.5	12.0	**51.0**	0.5
Use of faecal compost for farming may have detrimental effect on human health	1.0	**47.5**	15.5	34.5	1.5
It is culturally Unacceptable to use compost made from human faeces	**48.5**	31.5	15.5	4.5	-
Traces of faecal matter could be found in food when faecal compost is used	1.0	18.0	**70.5**	10.5	-
Use of Faecal Compost will be Labour intensive	-	8.5	**62.5**	28.5	0.5
Faecal Compost is rich in nutrient than other animal and plant based composts	0.5	4.5	36.5	**44.5**	14.0
ReuseReuse of Faeces could help reduce sanitation problems	3.0	28.0	15	19.0	**35.0**
Some Consumers may reject Food if they know it was fertilised with faecal compost	3.5	**33.5**	24.0	32.0	7.0

Source: Field survey, 2012

Table 4.5 The Maximum, Minimum and the Average Index of farmer's perception

STATEMENTS	MINIMUM	MAXIMUM	MEAN	STD. DEVIATION
Faecal Compost Smells	1	5	3.13	.970
It has Detrimental Effect to human Health	1	5	2.88	.954
It is Culturally Unacceptable To Use {FC}	1	4	1.76	.875
The Use of FC leaves Traces of Faeces In Food	1	4	2.91	.564
FC is Bulky and Labour Intensive When Applying	1	5	3.21	.590
FC richer in Nutrients than other animal/ Plant Compost	1	5	3.67	.790
FC Use Could Help Reduce Sanitation Problems	1	5	3.55	1.302
Many Consumers would reject Food Items Produced From {FC}	1	5	3.06	1.038

Source: Field survey, 2012

Perception of farmers about faecal compost was assessed and the results are shown in Tables 4.4 and 4.5. While Table 4.4 measures farmer's perception to some assertions on faecal compost, Table 4.5 represents the same information using mean index in which farmers perception was measure within a likert scale of 1 to 5. On health issues, most farmers (47.5%) disagree to the assertion that the use of faecal compost could have health effects on

farmers whiles 34.5% of farmers interviewed show an agreement to the statement. Also most farmers (70.5%) don't know for a fact if traces of faecal matter could be found in food produced from faecal compost.

On perceived cultural perceptions of FC, 48.5% of farmers strongly disagree while 31.5% disagree cumulating to about 80% of respondents' disagreement with the statement that it is culturally unacceptable to use faecal matter to produce useful soil nutrients. Meanwhile, 51% of farmers interviewed agree that faecal compost could produce a foul smell with (34.5%) of farmers showing disagreement to the statement. According to Keraita et al., (2010), bad odour from excreta was mentioned as a major problem by users and also the main reason why non-users were reluctant to use excreta on their lands. Even though this assessment was on faecal sludge, farmers interviewed for this study initially mistook faecal sludge for faecal compost and this could be the reason why they perceive faecal compost to be a smelly substance. Seidu et al., (2009) in the study of excreta use by farmer in the Northern part of Ghana also reports that farmers perceive dry excreta (cake) and odourless sludge irrespective of the treatment duration, as to posing no health risk.

On nutrients capacity and its application, most farmers (44.5%) interviewed with a mean index of 3.67 believe that faecal compost may be richer in nutrient than other animal and plant compost/manures. A study by Danso et al., (2006) showed that, farmers who acknowledged that co-compost is a good soil ameliorant gave the presence of fecal matter in it as one of the reasons for their position. Also according to findings by Cofie et al., 2009 on adoption and impact of excreta use for crop production in southern Ghana farmers, both users and non-user of faecal matter for farming, perceive excreta as being good for

maintenance of soil structure. However farmers do not know whether faecal compost application would be relatively more labour intensive than other organic and inorganic fertilizers

Other knowledge and perceptions that were sought out from farmers include consumer rejection of food produced with faecal compost and the perceived impact of faecal matter reuse on community sanitation. Contrary to the findings by Preneta, (2013) that no participant in his interview among Sierra Leonian farmers expressed any concern about not being able to sell crops that were grown with compost made from fecal sludge, 32.0 % of the respondents in this survey rather think that Ghanaian consumers could reject food crops fertilized with faecal compost. Respondents mean index was (3.06).

4.5 Analysis of WTP *(CM)*

Conditional Logit model was used to analyse the factors that affect farmers' choice for faecal compost. As was indicated earlier, two models were run for the choice experiment data. One with the attributes of faecal compost only and the other with the attributes and the socio-economic characteristics of the respondents

Model 1: Choice Attributes only

Table 4.6 Basic Conditional Logit Estimate of Choice with Choice Attributes Only

Variables	Co-efficient	t-values	Sig Level	Marginal WTP
Price	-2.964644***	-22.04	0.000	
Package + Label	5.566769***	21.49	0.000	1.87 (.97)
Package	3.629384 ***	16.54	0.000	1.22 (0.64)
Label[¥]				0.652
LR χ^2	2921.86		0.0000	
Pseudo R2	0.8040			
Log likelihood	-305.82675			

Source: Field Survey ***significant at 1%.**

Tables 4.6 shows the conditional logit estimates of choice against product characteristics and also the marginal willingness to pay for faecal compost attributes. The basic conditional model and the hybrid conditional model (Table 4.7) both satisfy the theoretical basis of choice models built on Lancaster theory of value in which it is assumed utility is derived from the underlying characteristics or attributes and on the Random Utility Model Viney et al., 2002, . It could be seen from both models that, the alternative specific constant (ASC) did not appear in this estimation. The reason to this is that, during the choice elicitation, all the respondents made choice of at least one of the choice packages other than the status quo. This could be interpreted as having a 100% acceptance and willingness to pay for faecal compost by the farmers in this survey. Thus none of the respondents show unwillingness to choose and hence pay for one of the faecal compost packages presented in the choice set.

[¥] Label was not added into the model independently but was embedded in the Packaged and Labeling attribute. The implicit price of label is therefore taken to be the difference between the packaged only attribute and the Packaged and Labeling attribute.

The results in both empirical choice models show significant conformation to the theory of discrete choice modelling by showing significant linkages between utility functions, observed individual, choice invariant characteristics, *zi*, and attribute of the choices, *xij* (Green, 2007).

From Table 4.6, price, package and label significantly affect farmer's choice for faecal compost. The last column (4th column) shows the marginal WTP which indicates the relative monetary values farmers assign to the attributes of the good under evaluation or in other words, the implicit price for that attribute.

Marginal Willingness to pay

From equation 3.5 the marginal willingness to pay or the implicit price of the attributes of the product presented in this study is estimated as $-\frac{\beta_C}{\beta price}$ where $\beta price$ represents the coefficient of the price attribute and β_C is the coefficient of the attribute whose implicit price is to be determined. From the model, the implicit prices for Package + label package, packaged only and label only were GH₵ 1.87, GH₵ 1.22, and GH₵ 0.66 respectively.

Model 2: Choice attributes and Socio-economic Variables

Table 4.7 Hybrid Conditional Logit Estimate of Farmers Choice for Faecal Compost with Attribute*Socio-economic Variable

Variables	Co-efficient	t-values	Sig Level
Choice			
Price	-3.112***	-21.82	0.000
Package + Label	4.596 ***	4.23	0.000
Package	2.825 **	2.23	0.026
Packaged & Labeled *Gender	-.472	-0.96	0.336
Packaged & Labeled*Income	.010***	4.69	0.000
Packaged & Labeled*Household Size	.162***	2.83	0.005
Packaged& Labeled*Education	-.320***	-2.69	0.007
Packaged& Labeled *Age	-.037***	-3.04	0.002
Package*Income	.004	1.29	0.196
Package*Gender	.087	0.15	0.881
Packaged& Labeled*Use of Cow Dung	1.097*	3.97	0.000
Package *Age	-.029*	-1.68	0.092
Package*Knowledge on Faecal Compost	1.097*	1.87	0.062
Packaged &Label* Faecal Compost	-.464	-1.10	0.273
Log likelihood	**-296.676**		
Pseudo R^2	**0.8321**		
LR (11) χ^2	2919.47		0.000

Source: Field Survey, 2012.
*****Significant at 5%, ** significant at 5%, *significant at 10%**

The implicit price for label was obtain as a difference between the marginal willingness to pay values for package only and package with label. The reason being that, label was seen as an additional improvement over packaging during the product definition.

From the IP estimates, farmers are willing to pay for an amount of GH₵ 1.22 (US$ 0.51) for 50kg of faecal compost to be packaged and are also willing to pay additional GH₵ 0.65 (US$ 0.32) if application instructions and nutrient composition is added to the fertilizer in a

form of a label. The marginal willingness to pay for backpacking plus labeling is GH₵ 1.87 (US$ 0.82).

The interaction terms in the model introduces preference heterogeneity in the multinomial setting and also increase the models fit whiles relaxing the IIA assumption Mazzanti, M , 2001; Greene, 2000; Long, 1997; Maddala, 1987) as indicated in the preceding chapter.

4.5.1 The factors that influence farmers' choice/ willingness to pay Price of faecal compost

From the Tables 4.6 and 4.7 respectively, all the choice attributes were significant determinants of farmers` choice and willingness to pay. From both Tables, the coefficient of price is negative indicating an inverse relationship between price of fecal compost and farmers' choice and willingness to pay. This implies that, farmers' choice and willingness to pay for faecal compost is likely to decrease as the price of faecal compost increases.

Packaging

Both models mentioned above showed a positive coefficient for packaging only and packaged with label attributes, indicating in all cases that farmers appreciates the component of packaging as part of the faecal compost presented and thus the presence of packaging is likely to increase farmers' willingness to pay for faecal compost.

Labeling

Label was added to packaging in the choice profile of faecal compost. The reason being that, label can be seen as further improvement in packaging and the fact that, in the case of faecal compost, a label is meaningfully presented if the product is packaged. As discussed above, both models show significant positive relationship between choice and the addition of a label to packaging.

However, in the hybrid conditional logit model farmers' probability of choosing an option is enhanced if the faecal compost is packaged and much more likely if a label is attached to the packaged fertilizer. Other variables explaining the dependent variable are the interaction of the product attributes and some choice invariant characteristics (knowledge of faecal compost as organic fertilizer and use-experience of related organic fertilizer and farmers socio-economic characteristics) and farmers' socio-economic characteristic.

Knowledge and experience on faecal compost and other organic composts

From Table 4.7, farmers' knowledge on faecal compost interacting with package only yields a positive relationship with farmers' choice which is significant at 10% significant level, while experience with the use of cow dung interacting with packaging plus label also yields a positive relationship with choice. The latter relation implies that farmers with experience in handling cow dung will have a higher willingness to pay for faecal compost which is well packaged and labeled. The reason for this relationship could be due to the fact that, farmers already perceive bulkiness and labour intensiveness as one of the characteristics of faecal compost in this study. Other similar studies like that of Agyarko, (2007) also reported same

findings. Therefore an addition of packaging and labeling may reduce the burden on application hence increasing their assumed utility for using faecal compost. In the former however, farmers who have heard of faecal compost before are likely to assume that they have some level of information on the product already and hence there will be less motivation to make extra financial commitment to an addition of a label to the product. They as a result have higher willingness to pay only for packed faecal compost but not necessarily with a label. This is verified in the coefficient of the interaction between knowledge on faecal compost and package plus label (-.464) though insignificant. Significance in this parameter could have been a sign of a negative signal towards farmers' continuation of value appreciation towards addition of a label after their initial purchase/use.

Household income

Farmer's household income measured in the disposable monthly income shows a positive sign with its interaction with packaged with label attribute indicating that farmers with higher household's income may have a higher willingness to pay for packed and labeling faecal compost. Many studies on willingness to pay like that of Oladele, (2008); Adepoju and Omonona, (2009); , among many other studies all showed this relationship.

Household Size

Household size measured as the number of people in a household was also positively influencing choice of faecal compost through and interaction with package plus label. By intuition, this association could, all things being equal, mean that households with higher number of people to feed will be willing to pay for a new farming input resource that is said to have the capacity to boost yield of crops.

Education and age

From the 4.7, education and age are all significant determinants of choice. As expected, the interaction between choices attribute with age gave an inverse relationship with choice, while the interaction of education with attributes did not satisfy the apriori expectation. From intuition it would be expected that, one's appreciation of value is influence positively by his education level. This could be due to the nature of the data on education. From the descriptive statistics, it is realised that farmers' education level was very low with a mean of only two years. With regards to age, negative relationship implies that; younger farmers have higher interest in alternation soil ameliorant than elderly farmers. This gives a good indication of a sustainable faecal compost demand as its users may have more farming years ahead.

The relationship between age and choice is highly significant with the interaction with package plus label than when it is interacted with package only.

On the other hand many socio-economic variables and knowledge and perception variables are significant (sig $\leq$ 0.01).

All two conditional logit model estimated had an overall significant levels of $\leq$ 0.01. Whiles the basic CL model had a pseudo R^2 of 0.8040 that of the hybrid CL model is 0.8321. Loglikelihood values were -305.82675 and -296.676 for the basic CL and hybrid CL models respectively.

CHAPTER FIVE

SUMMARY CONCLUSION AND RECOMMENDATIONS

5.1 Summary and Conclusion

The objective of this study was to investigate WTP for faecal compost in the Dangme West (now Ningo Prampram and Shai-Osudoku Districts) of the Greater Accra Region of Ghana. Specifically, the study investigated farmers' knowledge and perception, their acceptability and willingness to pay for faecal compost use in agriculture.

Faecal compost in this study was defined as a well processed faecal matter possibly packaged with a label showing the application procedure/nutrient composition. The Choice Experiment method was used to analyse the WTP and their explanatory variables through the use a basic Conditional Logit and a hybrid conditional logit models.

Results obtained shows that more males (81.5%) than females were interviewed. This may be so because most household heads are males and recruitment procedures favour household heads and household`s decision makers. Most farmers interviewed had no formal education, few have had up to secondary education and none had tertiary education. Also when measured as a continuous variable farmers had an average of only two years in education. Both household and hired labour are used by most of the farmers interviewed and almost all the farmer (94.0) interviewed has food crop production as their primary source of employment and hence their income source.

Average age of respondents is 47.75 years and average household`s income per month is about GH¢ 161.98 (US$ 71.04). Only few farmers interviewed were engaged in shared cropping, the rest either own their land, hire land or farms on a family land. Most farmers interviewed resort to the bush as the place of convenience (Open defecation).

Results on the evaluation of farmer's knowledge on faecal compost and related organic fertilizer shows that a moderate amount (32.0%) of farmers have heard of faecal compost as an important organic fertilizer out of which 20.3% acknowledged using some so called faecal compost for farming. Only 15.38% of the people who have actually ever used faecal compost still apply faecal compost on their farm. However, related organic manures like cow dung and poultry manure were much more popular to farmers and most famers who know of cow dung have actually applied it on their land and a considerable percentage of farmers still use (32%) cow dung for crop production.

The results of the sources of knowledge on faecal compost by farmers show that the media dominates in the sources of information to farmers equally followed by friends and extension officers. This finding is similar to results found in some studies by researchers including *Keraita et al 2010; Obuobie et al., 2006 and Boholm, 1998.*

Farmers' perceptions about faecal compost were also evaluated through a non-parametric analysis in which farmers' agreement and extent of agreement to some perceived statements about faecal compost were evaluated. These perceptions were analysed on the groupings of health, culture related perceptions, nutrient capacity and application as well as possibility of

consumer rejection of food commodities produced through the use of faecal compost. Most farmers' expressed disagreement to health related perception that the use of faecal compost could have detrimental effect on farmers.

On culture related perception, famers disagreed almost outrightly, to the perception that, it is culturally unacceptable to use faecal compost for farming purposes. Respondent agreed that FC may have richer plant nutrients than their related sources of plant nutrients.

Even though many respondent acknowledge that the promotion of faecal compost could enhance sanitation situation in communities, they do not know for sure, if consumers will or will not reject food produced from faecal compost.

Through the use of choice experiment, farmers' willingness to pay was elicited and analysed using a basic conditional logit model and a hybrid conditional logit model. Results showed that all the respondents made a choice of one faecal compost package or the other and hence rendering the status quo variable or the alternative specific constant, non-existing in the estimated model. This in other words shows that there was a 100% acceptance of the choice problem by farmers.

Marginal willingness to pay for a package plus label attached to a 50kg weight of faecal compost was, GH¢1.87, that of package only was GH 1.22 and the marginal willingness to pay for label only was GH 0.65.

In the basic conditional logit model, choice was estimated against the attributes of choice namely price, package and package plus label. The model showed that farmers' willingness to pay for faecal compost is higher when the product is packaged and labeled. On the contrary, the higher the price of faecal compost, the lesser farmers will be willing to pay for it.

Further analyses on the factors that determine/ influence willingness to pay were explained in terms of their interactive effect with some attributes of the product. Results showed that household monthly income, household sizes and farmers experience with use of faecal compost were all significant and positively related to choice and willingness to pay.

Interaction of education and age with packaging and labeling however showed an inverse relationship. Thus whilst farmers willingness to pay for a packaged and labeling faecal compost increases among young farmers, farmers level of education (as against our hypothesis) have a negative relationship with choice and willingness to pay. This was explained by the nature of the statistic, representing educational level in the study data.

5.2 Recommendation

Inferring from the results of this study, it is recommended that the Ministry of and agriculture intensify education on alternative soil amelioration especially nutrient content of faecal compost, as well as its use and safety guidelines through its agricultural extension programmes. Meanwhile since the media is the main source of information to most

farmers, a combine educational programme between the media and the MOFA on alternative soil amelioration will be commendable.

On the basis that farmers are willing to pay for faecal compost and even for market value addition, further studies should be conducted in the cost of producing faecal compost through the different types of faecal compost technologies so that private investors in agribusiness create business opportunities out of faecal waste. Also further scientific studies into the specific quantities of faecal compost to apply per crop/the specific organic fertilizer nutrient required for crop growth will be necessary.

In soliciting for people's willingness to pay among rural farmers who have lower education level, the information load in choice experiment should be minimal to avoid cognitive complexities

To ensure sustainability in waste management, studies in sanitation values chain should be encouraged to better improve the end use of faecal and other human waste.

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APPENDICES

Appendixes1. Survey Instrument

Introduction

This questionnaire is to gather information from Farmers and other users of fertilizer on demand for faecal compost. The purpose of this instrument is restricted to academics/research for an MPhil degree in Agricultural Economics in the KNUST. The information obtained would be used solely for the purpose stated above and not for any other purpose. **Please read attached participants consent note to accept/reject participation before the interview begin/otherwise.**

Survey Instrument

Field Worker's Code……. Date of interview……

Name of the respondent…… Community Code……..……

Mobile phone: …….. House ID .....

SECTION A: Compost use/experience and Knowledge by Respondents

1. Do you farm?

1. Yes	2. No

2. How long have you been farming?.....

3. What farming system do you mainly practice?

1.Vegetable Farming	2.Fruit Farming	3.Staple Crop Production
4. other Specify		

4. What kind of land tenure arrangement do you practice?

1. Owned	2. Shared Cropping	3. Hired
4. Family Land	5. other Specify	

5. What is the major problem you face in practicing agriculture?

1. Inaccessibility of inputs	2. High Cost Of Inputs	3. Pest and Disease
4. Transportation/Marketing Challenges	5. other Specify	

6. Use of organic fertilizer for farming

NUTRIENT	1.Heard Before Tick (√) If yes (X) if no	2.Used Before Tick (√) If yes	3.Still Uses Tick (√) If yes (X) if no	4.Source[1]	5.COST/ 50kg GH¢	6.Reason[2] for Using (for yes in 2 & 3)	7.Reason For[3] discontinue use	8.Means[4] of Transport	9. Type[5] Of Labour	10.Challenges[6] Associated With its Usage	11.Evaluation[7]
Poultry Manure											
Cow dung											
Chemical fert.											
Faecal Sludge											
Faecal Compost											
Others Specify											

1. **(a) own (b) untreated compost from public site (c) Treated compost from Public source (d) purchased from unknown source (e) Purchased from a faecal recycling company**
2. **(a). It is cheaper in cost (b). Easy to come by (c). Because of high quality of fertilizer (d). Because it improves land & Yield (e) others Specify……**
3. **(a) Scarcity of supply (b) High cost (c) Low fertility level (d) other Specify ……..**
4. **(a). Private car (b) public transport (c).truck (d).other (Specify…….**
5. **a. household labour ( ) b. hired labour ( ) c. Others Specify ……..**
6. **a). Difficulty in acquisition b). Labour intensive c) High Cost (d. Lack of Technical experience e). Others ……**
7. **1= V. Good 2=Good 3=Somehow Good 4.Poor 5=Very poor**

Which crop(s) do you usually cultivate? eg. Vegetable, fruit, cereal etc.	Which of these fertilizers do you apply to your crop the most[1]	How much in **Kg** do you apply/season	Season in which fertilizer was applied Main season /Minor season	Months in the season Eg.3months, 6 months. 12 months	Do you usually get the required amount **1. Yes** **2. No**

a. Poultry manure b. Cow dung c. faecal sludge d. faecal compost

8. Do you use any of these inputs (multiple choice is allowed).

1. Hired labor	2. Irrigation	3. Pesticide
4. Tractor	5. other Specify	

9. How do you apply (use) the manure/compost that you mostly use in your farm?

……

……

10. At which stage of farming do you have to apply faecal compost?

1. Two weeks before Planting	2. Up to One Month Before Planting	3. After Planting

Section B: Perception and Acceptability of FC

11. When did you hear of faecal compost (year)? .....

12. How did you get to know it?

1. Some people in this community was/still use it	2. Some institution/organization was talking about it
3.Someone in a nearby community was/still uses	4. A family member was/still uses it.
5. From the Media	6. other Specify

13. In your opinion does the food produce using FC pose any health problems?

1. Yes (Go to 14)	2. No (Go to 15)

14. If yes specify those you are aware of.....

15. What other benefits do you derived from the use of FC? (List)……..

……

16. Please indicate the degree to which you agree or disagree with the following statements relating sanitation practices.

PERCEPTION	**Strongly Disagree**	**Disagree**	**Don't Know**	**Agree**	**Strongly Agree**
Faecal Compost Smells	1	2	3	4	5
It Has Detrimental Effect To Human Health	1	2	3	4	5
It Is Culturally Unacceptable To Use FC	1	2	3	4	5
It Has Little Plant Nutritional Value	1	2	3	4	5
The Use Of FC Leaves Traces Of Faeces In Food	1	2	3	4	5
FC Is Bulky And Labour Intensive When Applying	1	2	3	4	5
Faecal Compost may have be rich in Nutrient than other animal/plant compost	1	2	3	4	5
FC Use Could Help Reduce Sanitation Problems	1	2	3	4	5
Many Consumers Would Reject Food Items Produced From FC	1	2	3	4	5

17. Would you oppose the use of FC for farming?

1. Yes	2. No

NB: Show sample of faecal compost to respondent and talk on some benefits of FC as an Organic Fertilizer as well as some challenges in its application.

NB: Show sample of faecal compost to respondent

Unlike chemical fertilizer organic fertilizer which includes faecal compost has no detrimental effect on human health and can equally give high yields as chemical fertilizer. Faecal compost is compost made from feaces; it is produced when feaces decomposes for it to lose the harmful bacteria in it After a complete decomposition, faecal compost looks like black soil. In addition to the characteristics like good soil aeration good soil moisture holding capacity, good nutrient bidding property, research has proven that the human faecal compost is fertile than animal compost and the use of it will reduce the challenges that urban and peri –urban centres face on faecal sludge disposal. Another benefit of using the faecal compost is that it is cheaper to produce and may cause less than the chemical fertilizer and may also be readily available than the other types of organic fertilizer.

On the other hand, the faecal compost is known to be bulky to and quite labour intensive just as the other animal manure are. The following Tables contain choice scenarios from which you are suppose choose from among the options the one you like most. The experience from previous similar surveys is that people often state a higher willingness to pay than what one actually is willing to pay for the good. It is important that you make your selections like you would if you were actually taking a decision to buy the faecal compost. This stated amount exludes Transportation cost Try as much as you can to make your choice irrespective of the previous choice made.

18. Would you be willing to use (continue to use) faecal compost for farming? (for both users and non-users)

1. Yes	2. No

19. If No why? …….

Will you be willing to pay

20.	GH¢ 5.0	1. Yes (go to 21)	2. No (go to 23)
21.	GH¢ 15.0	1. Yes (go to 22)	2. No (go to 23)
22.	GH¢ 15.0	1. Yes (go to 24)	2. No (go to 23)

23. If No (20,21 and 22) how much would be willing .....

24. Looking at your income and other cost of production, what maximum amount would you be willing to for the 50kg of FC

25. What would be your motivation for using FC

1. If I am given education on the fertility and use of FC.	2. If I do a field trial and see how it works.
3. If the price is affordable	4. If the price of chemical fertilizer increases
5. other Specify	

Section C: Measurement of willingness to pay using choice experiment

Choice experiment

ATTRIBUTES	Option A	Option B	Option C	No choice
Price	15	10	5	0
Packaging	Not Packaged	Package without Label	Packaged with label	

ATTRIBUTES	Option A	Option B		No choice
Price	10	5	15	0
Packaging	Not Packaged	Package without Label	Packaged with label	

ATTRIBUTES	Option A	Option B		No choice
Price	10	5	15	0
Packaging	Packaged With label	Not Packaged	Packaged without label	

Section D: personal and household characteristics

26. Gender	1. Male	2. Female

27. What is your age? …….

28. What is your marital status? NB; all respondents not currently married are single

1. Single	2. Married	3. Widowed	4. Living Together

29. What is your household size .....……..…

30. How many of the people in your household are in the following age groups? (Enter the appropriate number of people in each category

1.up to**10** yrs	2. **10-20** yrs	3. **20** yrs & above

31. What is your level of education?

1. None	2. Elementary/JHS/Middle	3. Secondary/SHS/O/A Level	4. Tertiary
	Years	Years	Years

32. What is your primary occupation (tick the right answer)

1. Farming (crop production)	2. Petty trading	3. Formal Employment
4. Self-employed	5. Artisan	5. other Specify

33. What is your secondary occupation (tick the right answer)

1. Farming (crop production)	2. Petty trading	3. Formal Employment
4. Self-employed	5. Artisan	5. other Specify

34. What is your income per month? .....

35. Other incomes apart from household head's income

.....

36. Total households income per month (10 + 11 + any other income)

.....

37. Which ethnic group do you belong to?

1. Ga Dangme	2. Ewe	3. Akan	4. Northern
5. Other Specify			

38. Are you the household head?

1. Yes	2. No

39. Are you major decision maker of the house?

1. Yes	2. No

40. Which form of Labour do you use the most

1. Hired labor	2. household Labour	3. Both
4. Other Specify		

41. What form of sanitation facility do you use?

1. Flash Toilet	2. VIP	3. Pit Latrine
4. OD	5. Other Specify	

42. Source of finance would you go for if you were to build a new latrin?

1. Owned saving	2. Neighborhood	3. Micro Finance
4. Bank Loan	5. Other Specify	

Appendix 2

Informed Consent Form

Introduction

Good …….. My name is …….affiliated to Dodowa Research Centre in the Dangme West District. We are conducting a study about sanitation in your community. We are particularly interested in local views on the different sanitation options available and in use here and to also find out the reusereuse of sanitation by-product for agricultural purpose. The information we gather from this study will be helpful in understanding the preferences and needs of your community for any future water and sanitation projects.

Participation and confidentiality

I would like to ask you to participate in some research about household decisions pertaining to household latrines and sanitation. Your participation is entirely voluntary. Because the research includes topics related to sanitation practices, financial priorities and household matters participation might cause some discomfort for you. Every effort will be made to reduce embarrassment and you can stop your participation at anytime. All the information you provide during participation will be kept confidential and none of the personal information that we obtain which could identify you will be used in any report that is written up. There is no cost to your for participation.

Research Form

This research uses participant observation requiring the researcher to develop a sustained relationship with people whilst they go about their normal activities in order to gather data through observing, participating, listening and talking. It should clearly be understood that once you have agreed to participate, that when you are accompanied by the researcher you are being observed and that these observations are being recorded. If there is any times that you do not feel comfortable either in having the researcher accompanying you or answering any questions, or do not understand what is being asked or how particular observations will be used in the research, feel free to indicate this and the researcher will accommodate your requests.

Benefits and incentives

You will not receive any payment before, during, or after the study. However, when you participate in the study, you will be contributing to the understanding of the issues relating to improving health in the community and the information will help in planning future sanitation activities. The findings of this study may be shared with the community, researchers, health staff, local government officials, and other stakeholders at the district and national levels and will be published in international journals for others to learn from.

You are at liberty to ask any questions. If at any time you have any concerns or issues regarding the study please contact .

Dr. K Ohene Yankyera

Dep. Of Agric Economics

KNUST. Tel: 0244465520

Dr. Margaret Gyapong

Dodowa Research Centre

Tel: 0206301728

Dr. Ben Karaita

IWMI -KNUST

Tel.0244205327

Appendix 3.

Statement by participant

The content and purpose of the study has been read to me and I have been assured of confidentiality of my responses. I have had the opportunity to ask questions. I agree to participate voluntarily in this study and give my consent to the publication of findings.

The researcher may take some picture of your defecation place but only upon your permission.

Additional conditions for my participation in this research are noted here:

Signature/Thumb print of participant _____

Date: ____/____/2012 (Day/month/year)

Statement by the researcher/person taking consent

I confirm that the participant was given the opportunity to ask questions about the study, and all the questions asked by him/her have been answered correctly to the best of my ability. I confirm that the participant has not been coerced into giving consent, and the consent has been given freely and voluntarily.

Name of Researcher/Field Assistant_____

Signature_____

Date ____/____/2012 (Day/Month/Year)