POULTRY WASTE AND SHALLOW WELL WATER UTILIZATION: IMPLICATIONS ON URBAN AGRICULTURE IN LAGOS METROPOLIS

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CERTIFICATION

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DEDICATION

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ACRONYMS

ACGS	Agricultural Credit Guarantee Scheme
ADP	Agricultural Development Project
DFFRI	Directorate for Food and Rural Infrastructure
FAO	Food and Agricultural Organisation
ICMSF	International Commission on Microbiological Specification for Foods
IDRC	International Development Research Centre
IWM	Integrated Waste Management
LASEPA	Lagos State Environmental Protection Authority
LSADA	Lagos State Agricultural Authority
LSWC	Lagos State Water Corporation
LSWMA	Lagos State Waste Management Agency
NACB	Nigerian Agricultural and Cooperative Bank
NAPEP	National Agency for Poverty Eradication Programme
NGO	Non- Governmental Organisation
OFN	Operation Feed the Nation
PW	Poultry Waste
SWW	Shallow Well Water
UA	Urban Agriculture
WHO	World Health organisation

Abstract

This study was carried out to investigate the pattern and determinants of poultry waste and shallow well water utilization and their implications on productivity and on farmers' health. It analyzes the socio-economic attributes and gender differentials of poultry waste and shallow well water users and further determines the effects of farmers' socio-cultural variables on poultry waste and shallow well water management practices. It also relates poultry waste and shallow well water constituents with malaria infections and reported cases of gastro-intestinal infections among farmers and appraises institutional and agricultural framework for poultry waste and shallow well water utilization for urban agriculture in the study area.

Using ecohealth framework, socio-economic survey was carried out with the administration of three hundred structured questionnaires. Field experiments were conducted to determine the impact of poultry waste and shallow well water utilization on productivity and samples of poultry waste and shallow well water were collected and tested for selected microbiological and physiochemical elements to determine their quality and constituents in relation to reported health problems among farmers. Blood and Stool samples of farmers and non-farmers were collected and examined for the presence of causal coliforms and bacteria, and medical experts were consulted for the possible implications of the findings on the health of the sampled persons. Shallow wells were also examined for presences of mosquito larvae, while blood samples of both resident farmers and non farmers were collected and analyzed for Malaria parasite infection. Focus Group Discussions were organized and series of community and farmers associational meetings were attended to capture community's views. Officials of government agencies were also interviewed in addition to personal discussions and observations. Maps of the study area were generated from high resolution imageries and Global Positional System and analyzed with Geographic Information System to determine the spatial perspectives of poultry waste and shallow well water utilization. The information gathered was analyzed using both descriptive and inferential statistics

The results show that over 60% of the respondents are economically active and within dependable age groups More men use poultry waste and shallow well water than women but women are better managers of poultry waste. The size of land holding accounts for the highest

factor that influence shallow well water utilization in Alapere (r=.155) and Tejuoso (r=.231). Level of education account for the greatest impact in Barracks with r=.228 while vegetable types accounts for the highest at Ikeja (r=.155). Religion has the greatest influence on the management of shallow well water (application- PV=0.223, treatment -PV=0.230 and storage - PV=0.182). The number of farms a farmer owns accounts for the highest influence of poultry waste utilization in Alapere (r=.339), level of education of farmers contributes the largest influence in Barracks (r=.248), farmers experience r=.085 in Ikeja while seasonal variation makes the highest in Tejuoso farm with r= .383. Farmers' income, religion and age influence the pattern of poultry waste management.

Field trials estimations and chi-square test show significant variation in the quantity of poultry waste (PV=3.48) and crop yield (PV7.82) as both values are greater than the 0.05. Although net return for exotic crops is high in all study locations, statistical analysis shows significant positive relationship between Net Return and size of land holding for vegetable crops in Alapere (significant value of 0.000) and negative relationship in Barracks (0.015).These values were found to be less than 0.05 sig. level

There are no significant differences in malaria infections between farmers and non-farmers in the study area. Comparison of the averages of *Escherichia Coli* infection on farmers and non-farmers using Wilcoxon text provides Z-value that shows a significant infection level between farmers and non-farmers. Poultry waste and shallow well water are badly managed due to lack of skill and risk education, lack of monitoring and evaluation of the activities by relevant government institutions and agencies as well as loose synergy among relevant stakeholders.

CHAPTER ONE

1.0 INTRODUCTION

1.1 Urban Agriculture and Development

Urban agriculture (UA) can be defined as the variety of agricultural activities that take place within the urban sphere of influence. It includes not only animal husbandry and horticultural activities but aquaculture, floriculture among others which influence the urban ecology in both positive and negative ways, and also affect the socio-economic well being of the urban people (Arm, 1994; UNDP, 1996). Urban agriculture is similar to rural agriculture through its pursuit for improvement of quality of life by those involved in it but differs in its form, style, value, intensity and closeness to the urban built-up area (Council for Agricultural Science and Technology, 2002, Smit and Nasr, 1992).

In most African cities, urban agriculture has become an important economic activity owing to urbanization process, lapses in rural agricultural activities and rural-urban migration which in turn have left many mouths to be fed and many persons to be employed in the cities (Fairholm, 1997, Mortimore, 1993, Ress, 1997). Urbanisation process has brought strains and stresses on the urban food systems and the national economy of African cities. According to Redwood (2004), poverty and food insecurity are becoming grave problems in most developing cities. Food and Agricultural Organization cited in UN press briefing (1997) estimated that unless progress is accelerated in food supply, there could be more than 680 million hungry people in the world by 2010, with more than 250 million of them in sub-Saharan Africa.

With the rapid expansion of cities, urban agriculture has been recognized as an adaptive strategy in recent times because it contributes appreciably to poverty alleviation and urban food security. For instance, food production from urban agriculture accounts for 33% of the total consumption by squatters in Lusaka, Zambia, while Cairo reported over 80, 000 livestock production within the city. Kampala has over 70% of her poultry needs produced inside the city while the metropolitan area of Bamako is self-sufficient in vegetable products and even export some of the products into other regions for consumption (UNDP, 1996; Redwood, 2004).

According to Drechsel and Kunze, (2001), urban agriculture has become a significant activity in recent times because it offers opportunities for urban waste reuse, water management, urban land economies, biodiversity conservation and improvement of the city ecology (Mougeot, 2000; Nugent, 2000). It has also brought cheap produce close to the urban market thus reducing transportation distance and cost as well as related post-harvest losses (Mensah et al, 2001). Socially, urban agriculture contributes to a sense of self and community reliance and represents an important opportunity to regain cultural and horticultural knowledge (Nabulo, 2002).

With these recorded growth in urban agricultural activities, one notable factor that has been attributed to its success has been the adoption of some techniques that make sustainable organic waste reuse and small scale water supply possible. While the adoption of these techniques has been beneficial in terms of cheap and easy access to water, low cost manure and increased agricultural output, concern for their spatial variation in quality and suitability for food production, as well as their health and environmental implications have remained a topical research issue in recent times.

Birley and Lock (1999) have asserted that the health and environmental risk associated with urban agriculture include contamination of crops; heavy metals from soils; breeding pathogenic organism due to irrigation by water from polluted streams or inadequately treated waste (water and organic solid product); human diseases transfer from disease vector attracted by agricultural activity; occupational health risk for workers in food producing and food processing industries, apart from the destruction of the urban biodiversity due to agrochemical input.

Empirical studies in Kenya, Ghana and Uganda have reported among other factors organic waste reuse such as animal and human excreta, municipal waste and wastewater for increased yield in urban agriculture (Mensah et al, 2001; Kilelu, 2003, Nabulo, 2002). There have also been reported cases of small-scale water techniques such as shadoof, wash bore, deep wells and shallow wells in urban agricultural practices in these cities. In Lagos, urban agriculture is an informal economic activity and there is limited information as well as uncertainty about issues related to the pattern of organic waste reuse and improved water management for urban food production particularly vegetable crops.

According to Olakulehin (2004), 'both consumers and producers need more information about types of agricultural inputs, sources of contamination, ways of diminishing them and suitable choice of product depending on the type of inputs. This concern has raised challenges for sustainable social, economic, health and environmental development for men and women whose livelihood depend on urban agriculture. The challenges have also created blurred perspective about where and why waste and water are integrated into urban agriculture especially vegetable crops in Lagos.

1.2 Urban Agriculture: World Perspective

Urban agriculture throughout the world is not a new phenomenon but has attracted focus in recent times because it is undergoing a transformation in response to political, economic, environmental and technological changes. According to UNDP (1996), the emerging role of urban agriculture in the contemporary world is just beginning to be understood and quantified. The growth of urban agriculture has also been attributed to the legacy of historic practices; development of agricultural technology; rapid urbanisation and the increased number of low income segment of the growing urban residents who has to find ways to sustain themselves.

While scholars in both developed and developing countries (Mougeot, 2000, Cofie et al 2005) have supported the fact that rapid urbanisation have promoted the practice of agriculture in the cities , others have refuted this statement pointing that the development of agricultural cities has rather created urbanisation and cities. Be that as it may, an important issue in contemporary urban agricultural practices is that its practices has influenced different farming systems, related land uses, water management, solid and liquid waste management and infrastructural management all over the world. Although, geographical elements created a great diversity which makes generalization difficult, it has brought relief measures to poverty, unemployment and environmental problems especially in the developing nations. A presentation of its practices in the different regions of the world would provide a clear insight into the uniqueness and what is obtainable in the different continents of the world.

1.2.1 Urban Agriculture in Asia

Like any other urban function, urban agriculture has been a normal activity since the 19^{th} century in most Asian cities. It has developed into one of the world's greatest modern intensive farming systems and well developed waste recycling system for agricultural use. For instance China developed specific urban development strategy that includes partial self reliance in vegetables and protein thereby defining some land region for urban agricultural land use (Honghai, 1992). Other factors that have enhanced urban agriculture in Asia include:

- Effective Non-Governmental Organisation activities which promote livestock, vegetable and fruit production for small urban farmers.
- Well coordinated forward linkages between local industries and urban producers in Philippine and Pakistan.
- Well developed integrated urban agricultural system (poultry-Fishing- vegetable productions)
- Promotion of urban waste and vacant land for small scale production and provision of free technical advice and seedlings by government
- Strong synergy between farmers and consumer support groups
- Well developed tax system that favours small scale farmers.

1.2.2. Urban Agriculture in Latin America

In Latin America, urban agriculture has developed through research for highly sustainable agricultural production. They have been able to adopt agricultural technology from Asia and Non-Governmental Organisations have provided support on bio-intensive technology to small urban farmers. There is high promotion of small scale production by charity and religious organisations in Brazil and Panama. Most of the social welfare activities imbibe urban agriculture practices in Sao-Paulo. Through transfer of technology, farmers are able to grow vegetables in boxes, on house tops and in green houses and hydroponics are practiced in difficult and fragile terrain in Mexico. The formation of the Latin America urban Agriculture Network has also promoted the urban agriculture industry (Cruz and Medina, 2004).

1.2.3 Urban Agriculture in United States of America and Europe

Urban agricultural practices in Europe and United States of America have great similarities therefore both regions shall be treated under the same sub-heading. Urban agriculture is a significant sub-sector of food and agricultural system that support home garden and community garden in both regions. For instance, farmers are organized into cooperative groups in Germany and Denmark to protect their interest on locally grown produce, while in America, the American Community Gardening Association works in unity to do same. There is also the Sustainable Agriculture Movement that promotes self reliance and community farming in France and England. In both regions, public policies further support urban agriculture and create conducive environment for farming through research.

1.2.4 Urban agriculture in Africa

Although the economy of African countries is predominantly rural agricultural system, urban agriculture has become a significant economic activity because of its proximity to major consumer market and its advantage of reducing transport, storage and food preservation cost (Cisse et al 2005). Decline economic development indicators as a result of poor performance in rural agriculture, rural-urban migration, undernourishment and malnutrition have also increased its practices. However, recent emergence of the impacts of urban agriculture especially as it alleviates poverty, economic and environment crises has raised keen interest in urban agriculture to public authorities, civil society, professionals and researchers in most African cities.

For instance, in Nouakchott (Mauritania), urban agriculture covers about 150 hectares and it's the only source of income for over 6,000 people and provides over 100 full-time jobs. In Dakar (Senegal), about 80% of the demand for fruits and vegetables is supplied by urban agriculture practices in Niayes zone. In Cotonou, (Benin) producers make more than 300million CFAF of gross profit per annum from urban agriculture. In Ghana, Uganda, Kenya and many other African cities government has began to establish urban agriculture in its developmental policies and programmes through the support of international donor agencies such as International Development Research Centre (IDRC), Resource Centre on Urban Agriculture and Food Security (RUAF), Food and Agriculture Organisation (FAO), International Water Management Institute (IWMI) and World Bank. Despite the emerging increase in urban agriculture practices in Africa, its adoption into government policies and programmes has been highly minimal based on the different operating conditions and modes of interaction between the actors involved.

1.3 Urban Agriculture in Nigeria

In the fifty years of Nigerian National Agricultural Development Planning, urban agriculture has not been promoted as a feasible economic activity that has impacts on urban food security and urban poverty alleviation (Ezedinma, 1995). This situation has been attributed to the town planning laws that derived entirely from the pattern of colonial era, where provision was not made for agro-residential activities. As a matter of fact, urban farming was recognized as a form of hobby where an individual decides to plant a few stands of perishable plants and vegetables around the home (in the garden) to beautify the residential environment. This was of course confined to the residence of European civil servants and merchants. Food supply was therefore believed to be solely a rural affair, although, there were great potentials for urban agriculture.

Government efforts to increase food supply and alleviate poverty were therefore concentrated on rural agriculture and on food importation. Strategies adopted by the government include Operation Feed the Nation (OFN), Green Revolution, Directorate for Food Road and Rural Infrastructure (DFFRI) and Better Life Programmes. Others are National Poverty Eradication Programme (NAPEP) and Agricultural Development programmes such as Agricultural Development Authority (ADP), Nigeria Agricultural and Cooperative Bank (NACB), National Land Development Authority and the Agricultural Credit Guarantee Scheme (ACGS). It was assumed that these espoused programmes would turn around the sagging fortunes of Nigerians especially the poor and the hungry. These programmes neither considered the potentials in, nor took cognizance of urban agriculture in both the agricultural and poverty alleviation programmes (Agriscope, 2000; Olusanya, 2002).

Consequently, urban poverty situation increased and degenerated to several other food related problems such as hunger, malnutrition, diseases like Kwashiorkor, AIDS (Acquired Immune Deficiency Syndrome) and Cholera. For example, in the 1970s urban poverty in Lagos was put at 6% as against 2.5% for the whole of Nigeria (Ojo, 1991). The reasons given for this drastic change include;

a. rapid population growth as a result of natural increase and accelerated rural- urban migration;

b. economic recession due to economic environmental decline in economic growth; and

c. the impact of structural adjustment policies e.g. a reduction of government spending, increasing taxation and currency devaluation.

The instances mentioned above made living more difficult for the urban people, particularly the poor majority of whom are largely women. This situation further led to increasing number of urban people venturing into urban agriculture with increasing utilization of poultry waste and well water sources as important agricultural inputs for vegetable production in many parts of the country. In several cities like Lagos, Port Harcourt, Kaduna, Enugu, Jos, Ibadan etc, one can see rows of carefully tendered vegetables and flowers of different kinds on river banks, proposed sites for factories, waste ground, and road sides while there are many patches of land where Chicken, Sheep, Goat and small Cattle are kept. There are many urban groups of individuals who are into marketing, transporting and processing of these urban agricultural products, thereby sustaining their livelihoods from it.

1.3.1 Waste Utilization in Urban Agriculture

The utilization of livestock waste (Cattle, Sheep, Goat, Poultry) for agriculture in general and in urban agriculture has been a traditional source of manure for food production in Nigeria. In the pre-colonial era, the use of livestock waste for food production was highly effective and efficient because there was less reliance on modern agricultural technology like hybrid feeds, insecticides and chemicals for animal rearing and production. Introduction and adoption of inorganic manure {brands of NPKs 15:15:15, 20:10:10, 27:13:13, triple super-phosphate and urea} and other agro-chemicals during the period of colonialisation created affordable access to the inorganic manure. However, the 1990s recorded restricted access to inorganic manure through hoarding and high price and there was problem in obtaining sufficient quantities of inorganic fertilizer such that farmer especially urban farmers were left with no other alternative than livestock waste or traditional fertilizer such as poultry waste for food production.

With the agricultural sector becoming relatively modern by the 1990s, waste from livestock production has become a mixture of agrochemicals and chemical from cleaning and treating diseases associated with animal production. With this development, it is expected that waste from livestock used for food production such as vegetable is treated to increase yield and minimize diseases transfer from animal to human before used as it is done in Havana, Cuba. In Havana, organic manure used for all agricultural activities are collected, treated and distributed by government to all urban farms. Ironically, this is not so in Nigeria, because treatment facilities are unavailable and collection, packaging, transportation and distribution of waste used as manure is not properly coordinated and monitored for food production in Nigeria. For instance a vehicle hired to transport untreated animal waste to farms could also be used to transport food stuff such as Gari and dry fish.

Apart from this, most waste management activities in Nigeria are mainly concerned with reduction of public health hazards, dust and obnoxious odours (Taiwo and Osinowo, 2001). Moreover, adequate management scheme for efficient collection and treatment of livestock waste for food production requires much investment which is not often available and if available, is used for more prioritized sectors like, health care, road construction and education. The decision to integrate waste into urban agriculture specifically and agriculture in general has thus been left as the sole responsibility of the individual farmer who knows little or nothing about the possible health and environmental impact that could be inherited from the use of animal waste. Even recent public campaign against the consumption of poultry products as a result of *Avian Bird Influenza* attack on consumer did not consider the use of poultry waste for vegetable production which is barely cooked before consumption.

1.3.2 Water Utilization in Urban Agriculture

Traditionally, many farm families in Nigeria cultivate small areas through irrigation activities during dry season, using water manually drawn from wells and streams. Yet, developed irrigation schemes in Nigeria have not been brought into production fully enough to accommodate small scale farmers who form majority of Nigerian agricultural sector. For instance a distribution of over 55,000 water pump sets in 1999 through the activities of Agricultural Development Projects (ADPs) and National Fadama Development Projects (NFDP) funded by the World Bank did not accommodate small land holders (FAO, 2000), because it was based on farmers with an equipped area of about 1ha.

This also means that private and small land holders' such as commercial vegetable and other urban agricultural enterprises were not part of the beneficiaries. This pattern of inconsistence distribution of government assisted infrastructure could provide a possible explanation for the utilization of shallow wells, wastewater and even untreated waste for urban food production in Nigeria. In another opinion, the poor access to adequate and quality water for irrigation and other farm activities especially washing of vegetable crops according to FAO (1997), could be attributed to a number of factors including: i)Lack of coherent irrigation sub sector development policy and strategy; ii) insufficient attention to management systems; iii) inadequate funding, including low cost recovery; iv) high capital and operating cost; v) inadequate farm support services; vi) poor operation, repair and maintenance; vii) low level of project ownership acceptance by direct beneficiaries; viii) uncertain financial and economic viability and ix) unequal distribution between men and women. Because of these lapses farmer-owned and individual operated irrigation schemed in loan packages have been advocated for.

From the foregoing account, the motivation for this study derives form the need to understand the importance and dangers inherent in poultry waste used as manure. It is also to bring to fore the significance of shallow well water used for irrigation and their impacts on productivity and human health.

1.4 Statement of Problem

According to Mensah et al (2001), poultry waste represents a valuable organic waste and shallow well offers a major water source for urban agriculture in most African cities. A pilot study carried out in Lagos by the researcher revealed that poultry waste and shallow well water are the dominant and major agricultural inputs for urban agriculture especially in the production of indigenous and exotic vegetables. Despite the high use of poultry waste and shallow well water, little or no effort has been made to investigate their management techniques, factors influencing their utility, impact on yield and hazards associated with their uses.

This state of affairs indicates that no conscious effort has been made to clearly understand the utilization and management pattern of poultry waste and shallow well water for urban agriculture, problems associated with their acquisition, handling, seasonal variations, organization and farmer's perception as well as their implications on yield and on farmer's health. Consequently, poultry waste and shallow well water utilization in urban agriculture is faced with numerous challenges, some of which are high transportation and conveyance cost, exposure of farmers to health hazards, high cost of production and poor yield.

Following the seriousness of poultry waste and shallow well water problems, intervention taken by Lagos State Government in addressing the problems according to the Head of Extension office at the Lagos State Agriculture Development Authority has been to subsidize the cost of industrial manure, wash-bore and tube- wells to farmers. Another effort is the allocation of extension officers to agricultural areas to monitor and ensure safe utilization of all agricultural inputs including the integration of poultry waste and shallow well water in crop production. These government interventions lofty as they were, were bugged down by poor funding, undefined institutional responsibility and were highly concentrated at the rural areas. Other drawbacks include absence of research-driven efforts on poultry waste and shallow well water utilization, together with poor manpower and technical development for proper management.

Unfortunately, with all these measures poultry waste and shallow well water utility problems persist. They have manifested in the form of seasonal scarcity and wastage of production time in search of poultry waste and water for urban agriculture. Other consequences of the poultry waste and water problems have been conflicts among farmers due to competition in demand and shortage in supply of water and manure, psychophysical stress, poor yields, ineffectiveness of poultry waste, pest and disease attacks on crops, post harvest wastage and discouragement in urban agricultural practices together with health and environmental problems. According to Okpala (2003), the uncertainty about inputs and health impact of urban farming is mostly responsible for the general apathy towards urban agriculture. It is also responsible for inadequate organizational and authority supports, leading to high production risk, which undermines efforts made by urban poor for survival.

In addition, the manner of poultry waste and shallow well water utilization for UA has become necessary considering the recent threatening news on bird flu (Avian influenza) attacks on poultry birds in Nigeria and its subsequent transmissions and death of about 20 persons in China and Turkey (Punch 15th November, 2005). Morse (1990) has also reported that pooling of water and unmanaged stagnant water have often been related to the spread of insect-vector borne diseases and it is likely to harbor suitable microbe habitats that are harmful to humans who have direct contact with such stagnant water.

On the account of these, there is need for standard procedure, control, monitoring and supervision to ensure quality control of waste used as manure, and water for irrigation especially during the dry season. The spatial dimension of the situation needs to be defined in order to seek for possible solution that can suit the different farming communities. This study is therefore a response to the need for information to address problems related to the pattern of poultry waste and shallow well water utilization and their determinants as well as the influence of gender and socio-economic attributes of users on management pattern. It is also to enunciate the economies of vegetable production, impact of poultry waste and shallow well water on crop production and on farmers' health among others.

1.5 Research Questions

Specifically, this study attempts to answer the following fundamental research questions;

1. What is the pattern of poultry waste and shallow well water utilization for urban agriculture and what are the determining factors for their distributional pattern in the study area?

2. What are the socio-economic attributes and gender composition of poultry waste and shallow well water users in urban agriculture and how do these attributes affect their management pattern?
3. What are the determinants of demand and supply of vegetable crops in the study area?
4. What are the impacts of poultry waste and shallow well water on crop yield and net revenue?
5. To what extent does net revenue per unit area of specific crop influence size of holding under crop competition in the study area?
6. What are the associated health implications of the utilization of poultry waste and shallow well water for urban crop production?
7. What are the possible management interventions to reduce health risks in the use of poultry waste and shallow well water for farming in the urban setting?

1.6 Aim and Objectives of Study

The aim of this study is to examine the significance of poultry waste and shallow well water utilization for urban agriculture, and their implications on vegetable crop yield and farmers' health in Lagos metropolis.

To fulfill this task, the specific objectives set for this study are to:

1. Examine the spatial pattern and determinants of shallow well water and poultry waste utilization and their impact on productivity in urban agriculture in the study area.
2. Analyze the socio-economic attributes and gender differentials of poultry waste

and shallow well water users in the study area.

3. Determine the effects of socio-cultural variables of farmers on the management pattern of poultry waste and shallow well water in urban agriculture in the study area.

4. Examine the influence of price on the demand and supply of vegetable crops in the study area.

5. Investigate the relationship between poultry waste and shallow well water constituents and reported health problems among farmers in the study area.

6. Appraise institutional framework for poultry waste and shallow well water utilization in urban agriculture.

1.7 Research Hypotheses

1. There are no spatial differences in the quantity of poultry waste utilization and crop yield in the study area.

2. Net return per unit area is not a determinant of size of land holding in the study area.

1.8 Justification and Significance of Study

The choice of this study was borne out of the growing importance of urban agriculture in most developing cities including Lagos and its significant role in urban food security, urban job creation and alleviation of urban poverty. It is further borne out of farmers' limited access to important agricultural inputs such as industrial manure and quality water supply, and the poor management pattern of available and accessible manure and water (poultry waste and shallow well water) for urban agriculture in Lagos. Accordingly, the need to systematically and geographically investigate the relevance of poultry waste and shallow well for urban agriculture could form a scientific and realistic framework for understanding the utilization of poultry waste and shallow well water for urban food production.

Furthermore, the study is expected to bring into sharp focus the extent to which adopted management and utilization practices affect crop yield and farmers health. This could trigger a better management and treatment options that would replace existing techniques, enhance healthy crop production, increase urban food security, and alleviate urban poverty and sustainable development. Lastly, the need for this study was also propelled by the dearth of information and data on the integration of poultry waste and shallow well water in vegetable production in Lagos and similar cities in the developing countries.

1.9 Scope and Limitation of Study

The study employed ecosystem approach to human health (ecohealth) methods to provide a coherent assessment of poultry waste and shallow well water utilization for urban agriculture in Lagos metropolis. It covers the utilization and determinants, social and gender characteristics of users, together with role of net return in the vegetable production pattern by crop type. The study further examines the association between socio-economic indices of farmers and management patterns, influence of price on demand and supply of vegetables and also focuses on the implications of poultry waste and shallow well water utilization on reported health problems among users and on crop yield.

The scope of the study is therefore limited to the activities of commercial vegetable farmers in four farming communities in Lagos. The socio-cultural variables examined were also restricted to age, gender, ethnic background, educational attainment, religion and income, while management indices adopted were limited to application, treatment and storage methods. These were indices that were observed to influence poultry waste and shallow well water management from pre-test findings. The clinical analyses which involved taking samples of farmers' blood and stool were also limited to volunteer farmers and non-farmers (control group). This was because it was very difficult to obtain formal approval from the Lagos University Teaching Hospital (LUTH) for ethical considerations, and most farmers and non-farmers were reluctant to be subjected to malaria test for the fear and uncertainties about the actual diagnosis the researcher was carrying out for.

There were insinuations that the tests were meant for ascertaining respondents' HIV/AIDS status. For the stool test, there was an overwhelming response to the collection of the specimen bottles but poor riposte. Many health problems were identified among farmers during pilot survey, but due to limited resources and time for this study only malaria and stomach disorder were selected for detailed investigation. The choice of nutrient elements (Nitrogen, calcium, Potassium, Phosphorous, Magnesium and Sulphate) in poultry waste and shallow well water was informed by the fact that these variables are the most valuable needed nutrient for balanced vegetable production (LaMotte, 1985).

The research had maximum farmers' cooperation because permission was sought from leaders of farming communities, who introduced the researchers to all members. Farmers associations' monthly and weekly meetings, in addition to ceremonious occasions were regularly attended for observations and discussions on relevant issues related to health, economies of vegetable production and poultry waste and shallow well water management. Questionnaire was also administered to seek for consumers' perception and consumption pattern around the four study locations. Because leadership style was autocratic, attention was therefore given to researchers, whenever, a leader directs that the researchers should be attended to.

1.10 Description of Study Area

1.10.1 Physical Settings

In terms of geographical location, Lagos Metropolis lies within latitudes 6°23'N and 6°41'N, and longitudes 3°9'E and 3°28'E. It covers an area of about 1,140km^2 out of the Lagos state total area of about 3577km^2. It lies within the humid tropical, sub equatorial zone. It therefore has a tropical climate with distinct dry and wet seasons. Mean annual rainfall is 1800mm with eight to ten months rainy period and short dry season, with humidity of about 80%. Day temperature in metropolitan Lagos varies between 21°C-24°C, with an annual mean temperature of 27°C (See Figure 1.1).

Radiation balance over the area is generally positive due to the coastal location which causes high cloud density and blocks most of the counter long-wave radiation. Also, the high relative humidity reduces the long-wave radiation from ground surfaces, although increasing the temperature of the air greatly, such that the afternoons are usually very hot and labour may be quickly sapped of human energy.

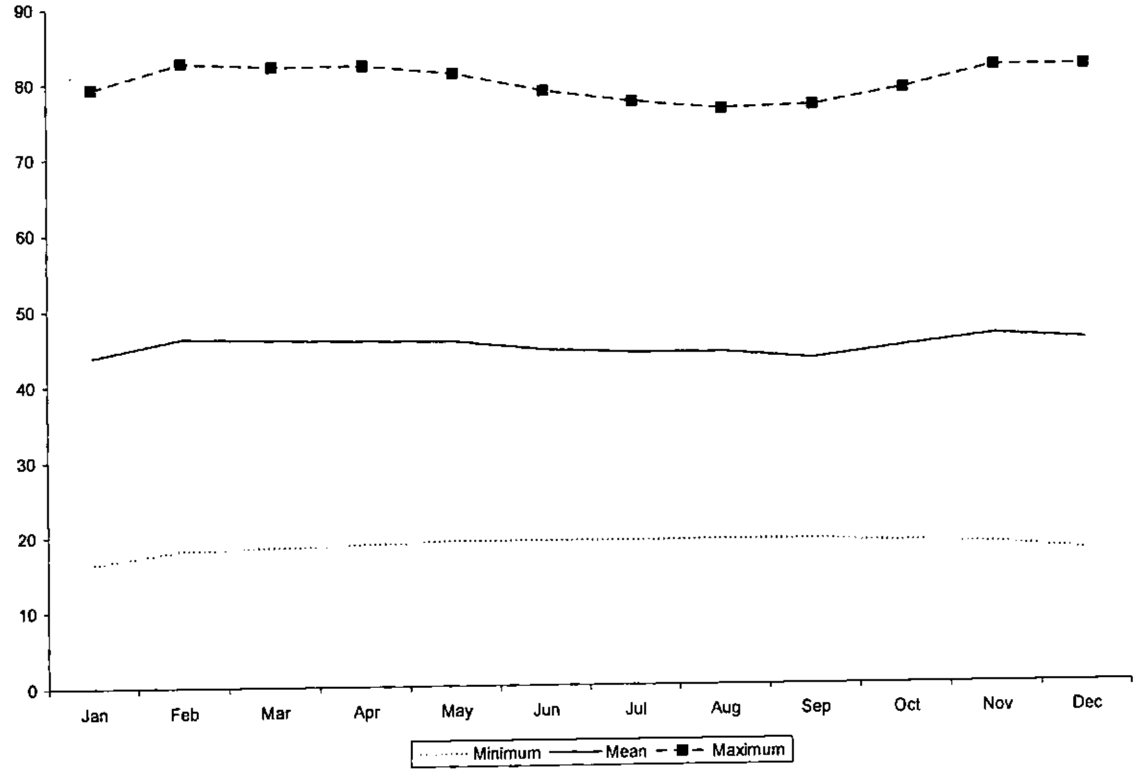

Figure 1.1: Maximum, mean and Minimum Temperature in Lagos Metropolis

Source: National Atlas 1978

Solar radiation is higher in the wetter months but with much steeper gradients than in January when the 'harmattan' reduces solar radiation in the area, and may not be below 200 l/ day. The feature of this climatic elements cause dry and wet seasons which consequently influence the magnitude of poultry waste and shallow well water utilization for vegetable production in the study area.

The relative humidity varies between 80% and 100% which may drop to about 70% in the afternoon during the dry season. Rainfall is torrential, occurring between April and October while coastal effects may stagger this from April to December. Annual rainfall averages is 1800mm with over 80% falling in the rainy seasons (See figure 1.2). Due to its latitudinal location, Lagos experiences two maxima rainfall which makes water abundant through the year.

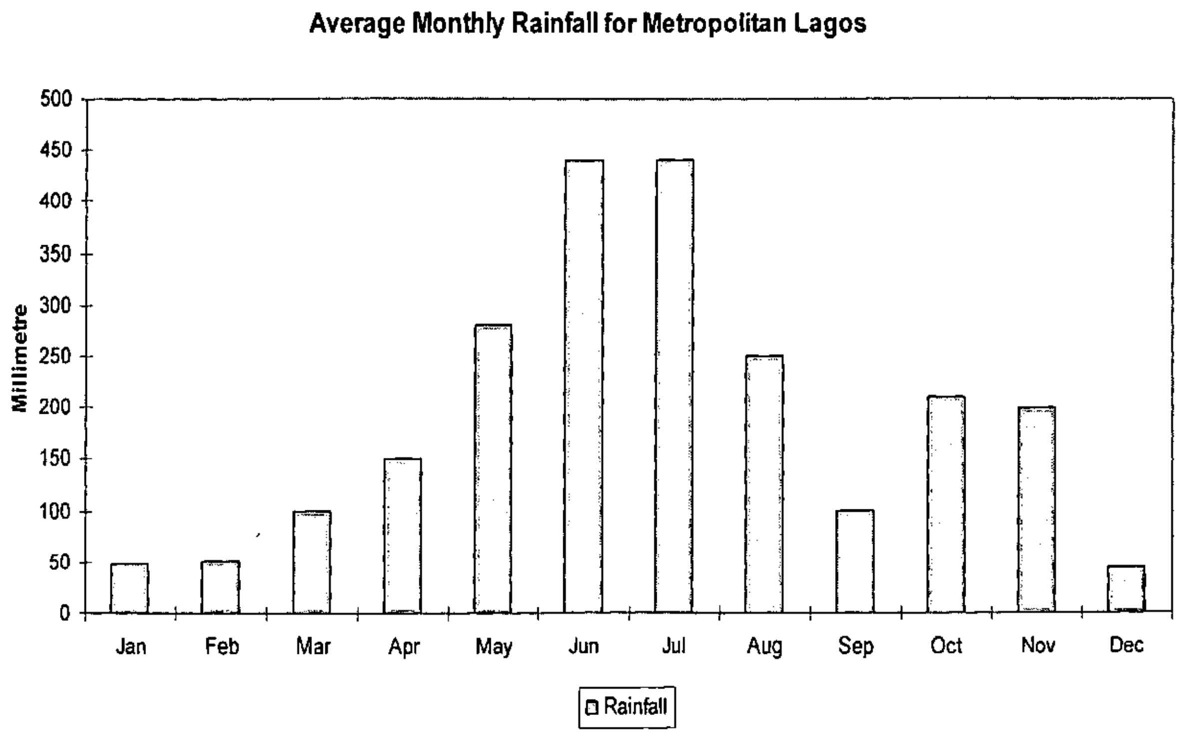

Figure 1.2: Average Monthly Rainfall in Lagos Metropolis

Source: Lagos State Regional Map as cited by Nigeria: Giant in the Tropics 1993.

The geology of Lagos metropolis shows two prominent formations, namely, recent coastal deposit and coastal plain sand. The lower formations occur along the estuaries of rivers and lagoons and consist of soft alluvial deposit and sediments of organic materials. The latter dated to the Oligocene/Pleistocene geological periods are predominantly located on the northern parts of the study area. Surface lithology is made up of sedimentary formation with sandy loam composition with deep, medium, weathered fine grain sands and sand silt (National Atlas, 1978).

1.10.2 Population and Urbanization

Urbanization process has continued in the municipal Lagos with increasing population and socio-economic activities (Odumosu, 1999). The population rose from 230,256 in 1956 to 650,000 in 1963 (Oyeleye, 2001) and Odumosu (1999) quoting United Nations (1989) declared that Lagos metropolis has an estimated 7,377,000 out of a population of 8,157,000 for the state in 1999. This gives over 90% of the state population and with UN-Habitat projection of the population of Lagos to be over 24 million by 2015 (see Figure 1.3), there is certainly the need for corresponding strategies to equate the accelerated population growth. The rapid population growth that has taken place in Lagos since 1963 has been very significant not only for urbanisation process in Nigeria but also in the world (Lagos Mega city and other Nigerian Cities Report, 2004).

According to Akintola-Arikawe (1993), the density value for built up areas in Lagos is estimated at 20,000 persons per sq km, while minimum density is about 1,590 persons per sqkm. According to Ehingbeti (2001), most inhabitants of Lagos suffer from a combination of protein, vitamin and essential minerals deficiency, as well as malnutrition with most prevalent diseases being malaria, and diarrhoea. These deficiencies can be solved in part by regular consumption of fresh vegetables. The high concentration of people also provides ready market for the numerous vegetable producers that are ubiquitous along favoured parts of the city area. The social and economic consequences of the situation are felt widely not only in the health sub-sectors but in human and agricultural resource sectors.

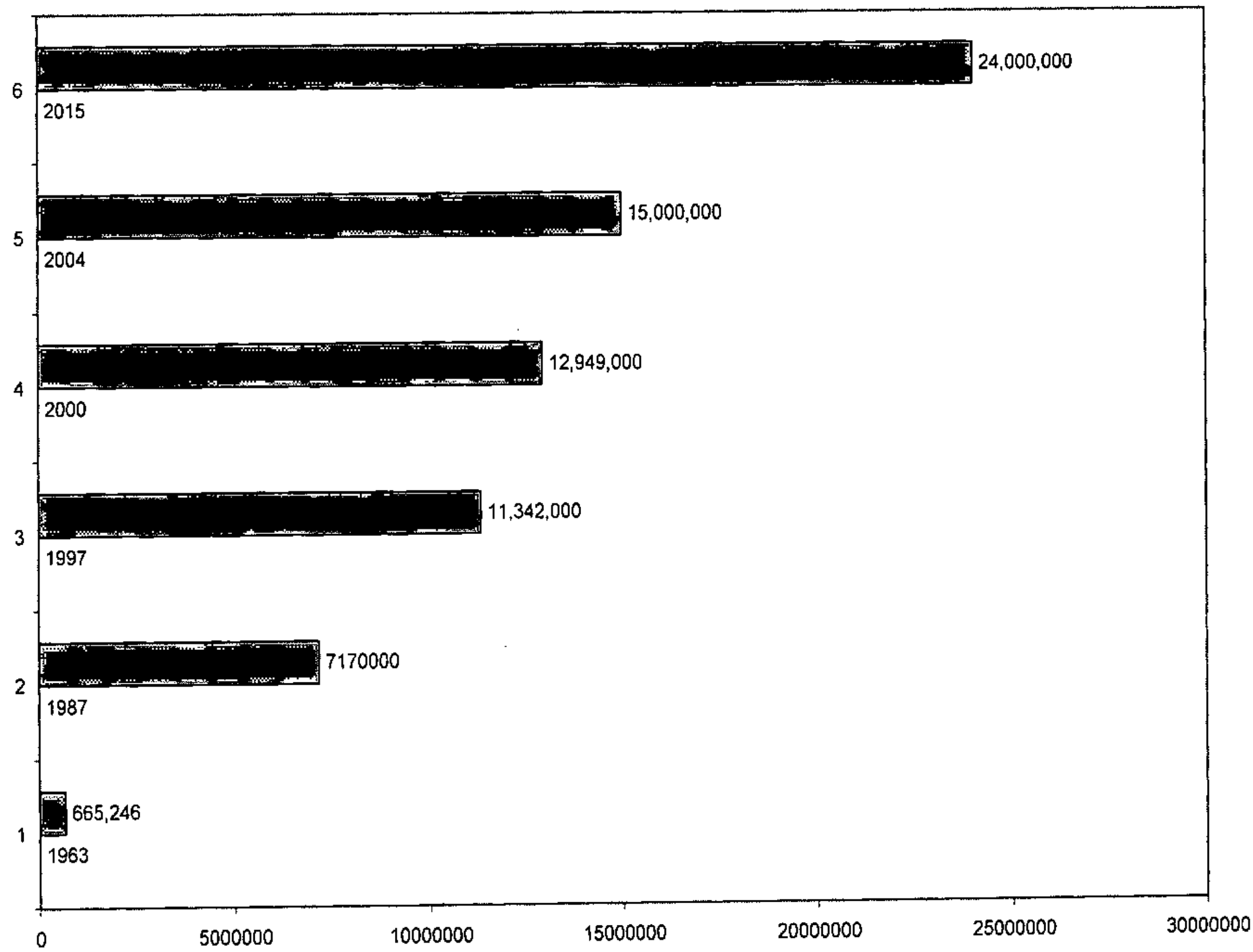

Figure 1.3: Population Growth in Metropolitan Lagos from 1963 to 2015.

Source: *Lagos State Regional Map as cited by Nigeria: Giant in the Tropics 1993 and UN-Habitat (2001)*

1.10.3 Urban Agriculture in Lagos

Lagos economy is highly dependent on service sector which accounts for over 80% of the total government revenue. Notwithstanding, urban agriculture provides occupation for about 6% (Oyeleye, 2002) of the economically active population in various sub-sectors. Table 1.1 shows that urban farm practitioners are involved in livestock (cattle, poultry, goat/sheep, dog, piggery and fishing), non-traditional farming (snail, mushroom, bee keeping, herb and spice) and in crop production (vegetables, floriculture, pepper, okra). Most of the farmers practise farming all year round indicating that fresh produce from farms is available throughout the year in Lagos

Table 1.1 Types of Urban Agricultural practices in Lagos Metropolis

S/N	Types
1	Cattle, sheep and goat rearing
2	Poultry keeping
3	Dog keeping and piggery
4	Vegetable, herbal and spice farming
5	Fishing
6	Mushroom
7	Bee keeping
8	Snail keeping
9	Maize, plantain, fruits and other farm produce within the urban environ
10	Processors and marketer of agricultural products within the urban area
11	Floriculture

Source: Lagos State Agricultural Development Authority (2004)

Although the contribution of urban agriculture is relatively minimal when compared to other urban economic activities, its positive roles in the lives of farmers has been possible through the integration of poultry waste and shallow well water utilization and their recent impact on productivity especially since industrial manure and municipal water supply are out of the reach of the urban farmers. The utilization of poultry waste and shallow well water for urban agriculture in Lagos has also brought relief to the pressure on some food items such as local and exotic vegetables and medicinal herbs to urban household, hotels and foreign owned restaurants. The utilization of poultry waste and shallow well water for urban agriculture has further reduced the quantity of municipal waste management problems and pressure of water supply on Lagos State Water Agencies.

1.10.4 Description of the Study Sites

As depicted in Figure 1.4 Lagos state is divided into three agricultural blocs (Eastern, Western and far Western) by the Lagos State Agricultural Development Authority. However, the western bloc was focused upon in this investigation because it falls roughly within the metropolitan area of the state. The map further shows that there are ten agricultural circles and cells within the western bloc. Of these circles, four were selected for detailed investigation owing to the intensity of urban agricultural activities within these agricultural circles. These are Alapere, Barracks, Ikeja and Tejuoso.

As presented in Table 1.2 and Figure 1.5, **Alapere Farm** is located at the Northeastern part of the metropolis and at the extreme end of the third mainland bridge, opposite Estate Bus stop, Alapere. The land was formerly owned by the government but has been sold to private individuals and organizations such that cultivated land is combined with completed and uncompleted buildings where some farmers live (multifunctional land use system). Observation shows that the farmland had once been a dumpsite for municipal waste, as layers of buried refuse (Nylons, broken bottles, metal scraps) were noticed at

Ikeja Agricultural GRA Farm The actual location of this farm is around Owode-Onirin axis of Ikorodu road, but acquired its name because it lies within an area supervised by Ikeja extension agricultural circle. It is an area reserved by the government. A larger part (65%) of the land belongs to the state government while about 35% belongs to indigenous inhabitants called "Omo Oniles". It is popularly called "Ikeja Government Reservation Area farm (GRA)". Indigenous vegetables are the main crops grown in the farm.

Tejuoso Farm is located at the centre of Lagos metropolis very close to Tejuoso central market at Yaba. The land belongs to Federal Ministry of Sports (FMS), hence it is located directly at the back of FMS housing estate. It is the smallest of the sites and majority of the cultivators are seasonal farmers sharing similar features with Alapere. Both exotic and local vegetables are produced in the area.

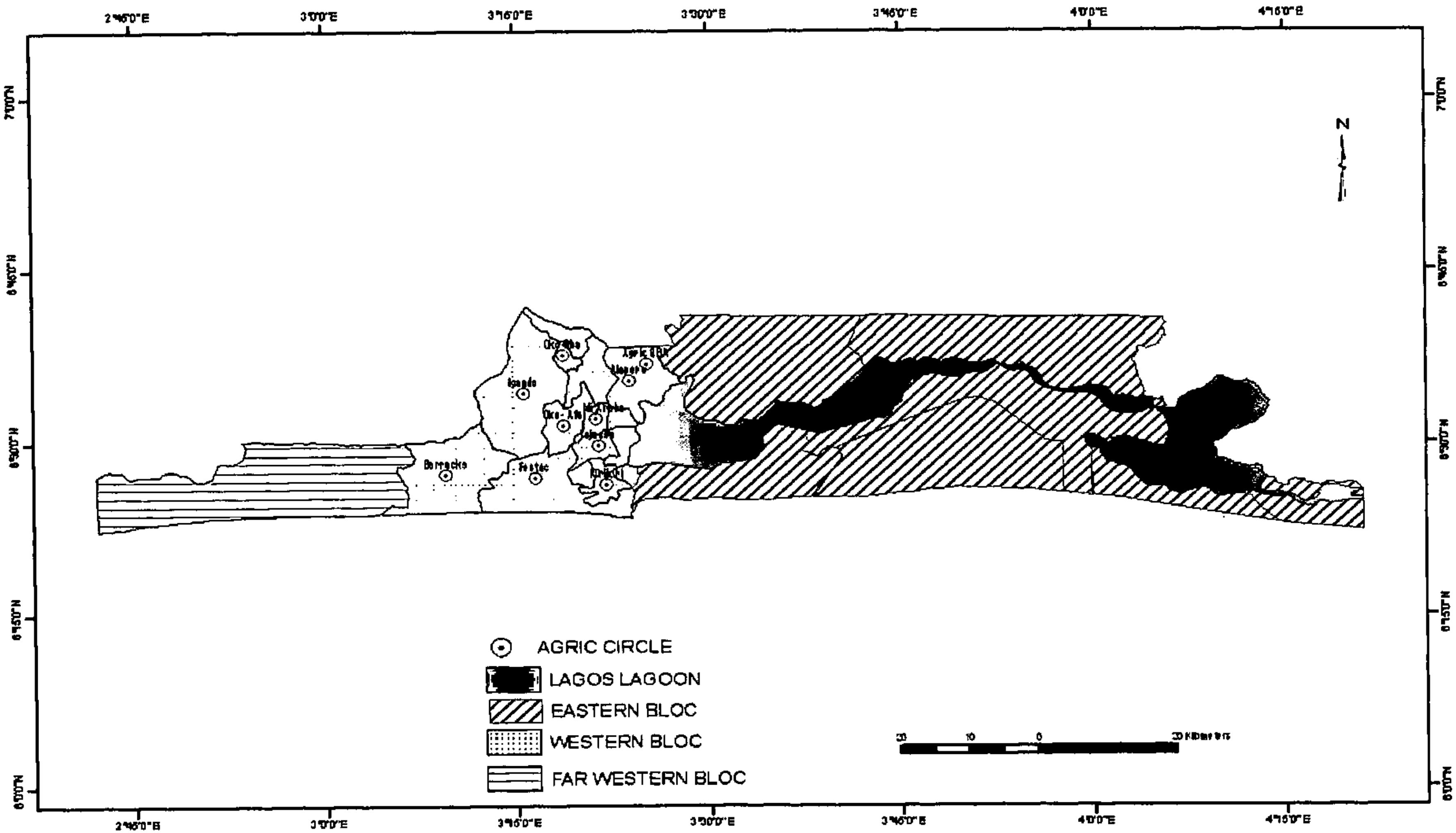

Figure 1. 4 Urban Agricultural Circle as delineated by Lagos State Agricultural Development Authority 2004

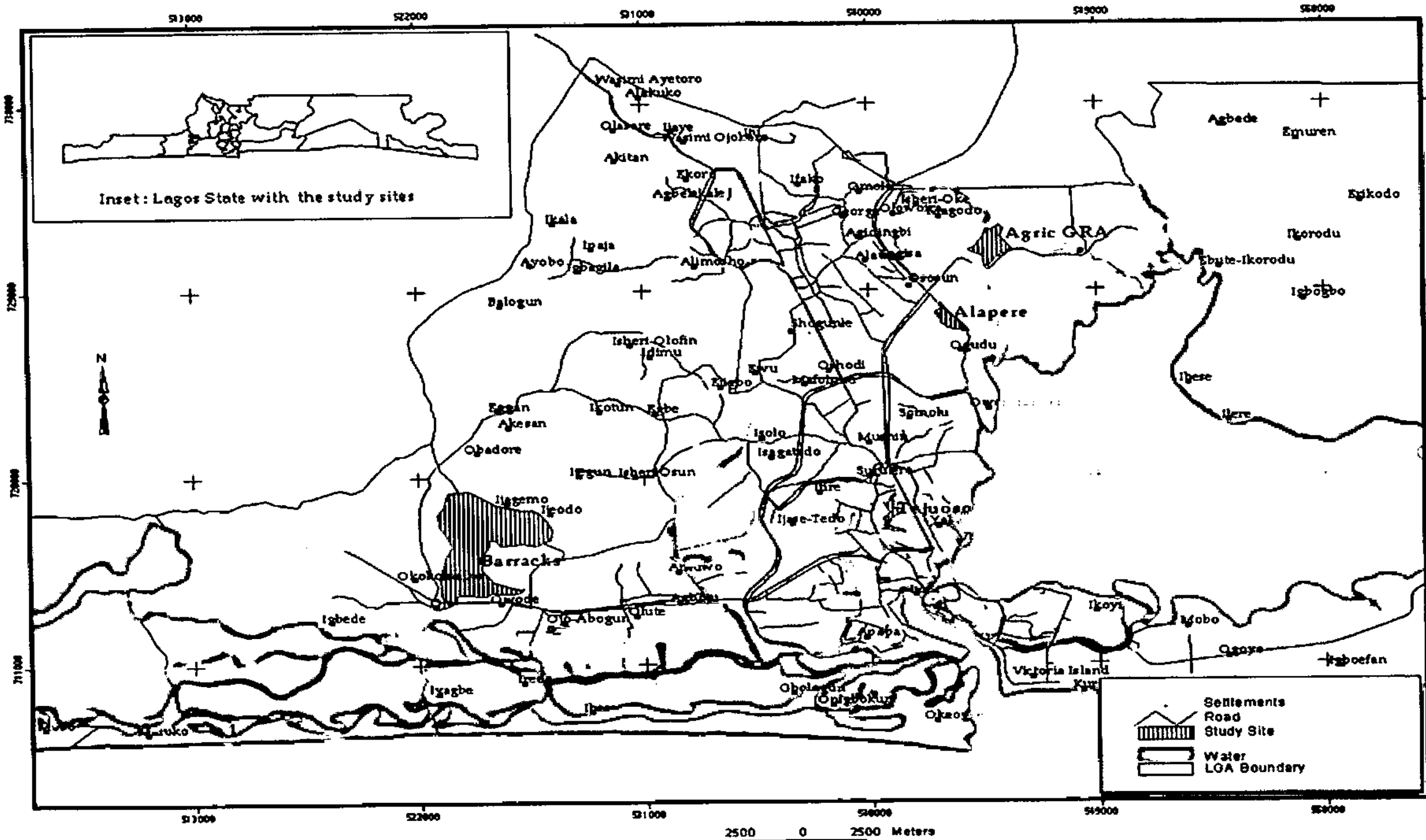

Figure 1.5: Metropolitan Lagos Showing the Study Locations

CHAPTER TWO

2.0 Literature Review and Conceptual Framework

2.1 Literature Review

This chapter reviews relevant literature and present them in sections. Four aspects of inquiries were found to be relevant to the study of poultry waste and shallow well water utilization. These are: relevance of urban agriculture, shallow well water utilization and management, poultry waste utilization and management as well as the implications of poultry waste and shallow well water utilization on crop yield and on farmers' health

2.1.1 Relevance of Urban Agriculture

Urban agriculture is increasingly becoming a prominent economic activity in many cities globally including Sub-Saharan African nations due to its tremendous potentials to improve the livelihood of the urban poor and its contributions to local food security, which has emerged as a result of magnified and rapid urbanisation (Gbadegesin, 1991; Maxwell, 1995; Mougeot, 2000).

With rapid urbanisation coupled with obnoxious economic and structural adjustment policies, massive unemployment and urban food insecurity are increasingly becoming major urban problems (Lee-Smith, 1999; Sawio et al 2001). These policies and programmes have had disproportionately negative impacts on the poor as they led into rising food prices, decline of purchasing power, decline of local currencies, persisting unemployment and reduced public expenditure on social service and infrastructure mainly in the urban areas (Mougeot, 1996; Kilelu, 2003). Moreover, some urban dwellers take up urban agriculture as a means of cushioning the effect of the hardship emanating from these government policies and programmes. Aside from this, urban agriculture contributes to a sense of community reliance and represents an important opportunity to regain cultural and horticultural knowledge (Nabulo, 2002, Mougeot, 2005).

Urban agriculture has also been conceptualized as a tool for developing cities into healthier, greener, more livable and sustainable urban landscape because of the growing hunger, malnutrition and environmental management problems (Sawio et al 2001; Cruz et al 2001). With its potential power to tackle urban environmental problems, urban agriculture offers an opportunity to manage environmental problems in urban areas through recovering and reusing organic waste including solid waste and wastewater (Drechsel et al (2001).

Woodsworth (2001) has also stressed that the benefits of urban agriculture include the mitigation of storm water runoff, oxygen production, noise reduction and temperature control through shade and transpiration (Rees, 1997). Urban agriculture enhances urban land economies as ideal lands unfit for urban construction activities are put into fruitful use.

However, the re-use of organic waste such as poultry waste and shallow well water have in no small measure added to the benefits that urban agriculture offers to the urban community in most African cities particularly in Lagos. This is because poultry waste and shallow well water act as a means of improved input nutrients for urban agricultural production, which consequently impacts positively on income, livelihood and values for those involved in urban agriculture (Drechsel et al, 2000). In spite of these lofty values, there exist little empirical data and information that provide clear linkage on the implications of poultry waste and shallow well water utilization for urban agriculture.

2.1.2 Water utilization for Urban Agriculture

Water is an important resource that enables crops to grow well especially in an intensified agricultural area, arid and semi arid areas. It is of major importance to both rural and urban agriculture such that a community without adequate and quality water for agriculture is characterised by hunger, poverty, war and conflict and nutritional and food insecurity. In Africa, south of the Sahara particularly Lagos, urbanisation process has put immeasurable pressure on fresh water demand for industrial, domestic and institutional uses (Redwood 2004; LSWC, 2001) such that water demand for urban agriculture is obtained from all kinds of sources. These include piped borne, wash bore, grey water, black water, deep well, shallow well and wastewater from municipal drains (Obuobie et al 2006).

According to Redwood (2004) available water for urban agriculture is less a function of availability than that of municipal managerial and governance capacity. It is a function of proper planning which is unavailable in most developing societies. The cost of accessing urban water for food production in unserved urban areas is most times prohibitively high and intermittent, and gives rise to a situation which creates a high cost of access and exposes users to public health.

The proneness to water problem often accentuates diverse water management techniques that have less concern for positive impacts. Parts of such methods are the use of watering can, hosepipe, buckets, motorized pump and surface hand sprinkler. While it might seem obvious that these water sources are relatively adequate for agricultural purposes, the standard guidelines for water quality (physical, chemical and biological), volume and seasonal variations in food production are not clearly understood and incorporated in national policy in most Sub Saharan Africa due to the increasing concentration on managing demand (FAO, 1998).

Thus, the pressure on water demand creates problem of inadequate access for all year production and reduces the dependence of urban agriculture on water for perennial production. This state of affairs confirms Food and Agriculture Organisation's observation in 2000 which stated that Nigeria is among nations that are technically unable to meet her food needs from rain fed production at low level input and appear likely to remain so even at intermediate levels of input at sometimes between 2000 and 2025 (World Bank, 2003). This state of water crisis calls for research and policy attention.

As Daniels and Daniels (2003) argued, managing any form of water for food production is ideal but care must be taken to prevent polluted water sources, because unhealthy water spreads disease and poses varieties of health threats to humans. Mensah et al (2001) investigating water quality in Accra between 1992 and 1998 showed many cases of shallow well contamination with high percent of *Escherichia Coliform* population, exceeding the internationally acceptable threshold level of 100 ml^{-1} for crops likely to be eaten raw such as vegetable crops.

Methods of water conservation, preservation, treatment and application as well as water quality in urban agriculture therefore, need to be investigated to close the gap created by lack of coherent information on the utilization of water for urban agriculture.

2.1.3. Waste Utilization for Urban Agriculture

Waste utilization for agriculture including poultry waste is not a new phenomenon in Africa but a traditional method of providing nutrients for plants, enhancing soil quality and creating livelihood for farmers (Onibokun, 1999). The utilization of waste for urban agriculture has recently become an important phenomenon in developmental research due to its role in curbing urban food and unemployment problems for the growing urban population. Recent studies have provided evidences of environmental, social and economic contributions of waste utilization for urban food production. However, a major problem to contend with remains how waste (wastewater, municipal waste, cattle waste, poultry waste etc) can best be managed for healthy food production with minimal negative health implications (Allison et al 1998).

One of the principles of Agenda 21, adopted in Rio in 1992, is that sound waste management should include safer recovery of any form of waste and the promotion of environmentally sound waste treatment that enhances integration of and changes to a more sustainable pattern (UNEP, 2004). This principle has been accepted by most countries including Nigeria who were signatories to the concept. In Ghana, the concept of Integrated Waste Management (IWM) has evolved and is slowly becoming accepted by decision makers (Cofie et al, 2006). IWM relies on a number of approaches to manage waste, including all aspects of waste management, from generation to disposal, and all stages in between with proper consideration of technical, cultural, social, economic and environmental factors.

The application of animal manure such as poultry/pig manure and cow dung or human excreta directly to the soil according to Cofie et al., 2005 requires an organized composting or co-composting of the animal manure with other forms of solid waste for efficient productivity in urban agriculture. The process also requires microbial degradation that releases useful nutrients in organic waste for soil improvement and plant growth.

The organic composting involves a process of decomposing or breaking down organic waste materials (by micro-organisms such as bacteria, protozoa, fungi, invertebrates) into a valuable resource called compost. Composting is done at different scales (large, medium, and small) by various people (municipalities, NGOs, communities, individuals). The nutrient recycling loop concept developed by Drechsel at al (2002) becomes very helpful explanatory devices in the process of proper waste management (see Figure 2.1). The recycling loop is represented by various segments: urban waste generation, waste processing, compost demand for agriculture, along with an economic feedback mechanism and finally the legal, institutional and communal settings throughout the loop.

However, as lucrative as the nutrient loop might appear, issues related to its numerous segments has raised concern. For instance, Drechsel et al., (2002) argued that it might be difficult to achieve an effective management practices considering the many factors that influence waste utilization coupled with its associated constraints. Notwithstanding, the recycling loop gives the required framework and potential best practice for planning composting for urban agriculture (Cofie et al, 20011; Danso et al (2005).

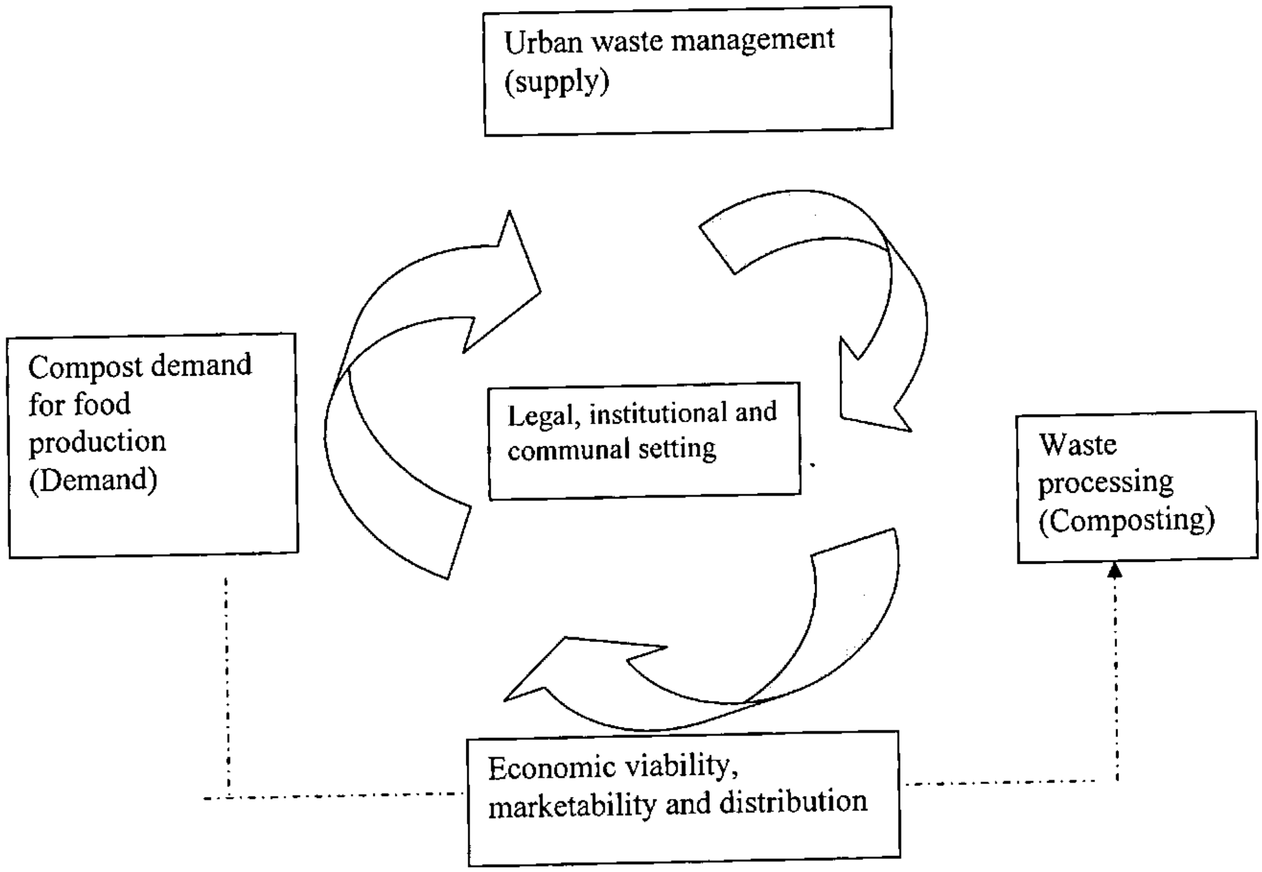

Figure 2.1 Concept of Nutrient Cycle Loop and Waste Management as Developed by Drechsel, 2002.

Studies have demonstrated the usefulness of the framework in some African cities. For example, Cofie et al (2006) used the framework to produce compost from human excreta in Northern Ghana. In Nigeria particularly Lagos there exists less composting activities and thus waste management activities do not conform to the standard rules and regulations guiding the integration of waste for food production. Safety pre-cautions are absent and procedures for adequate treatment or composting regulations are not adhered to such that poultry waste reuse poses serious threat to human health. The smell and sight of poultry waste are offensive and often become breeding ground for a variety of pests, rodents and also generate polluted runoff into water ways and to the environment (Zeeuw, 2000).

According to Cairncross and Feachem (1983), waste utilization for urban food production can encourage transmission of faecal-oral infections including diarrhoea and dysenteries. It can also promote diseases associated with rats such as plague, endemic typhus and rat bite fever. With the limitations in waste integration into urban agriculture, literature on this has been restricted to investigation of animal waste quality (Kiango and Amend, 2001; Drechsel, 2000), without emphasis on its implications on productivity and on the health of farmers. It is based on these that this study intends to examine the importance of poultry waste and shallow well water in urban agriculture in Lagos Metropolis.

2.1.4 Implications of Waste and Water Utilization on Yield and Health

Shuval, (1990); Zeeuw, (2000); Kilelu, (2003) and Redwood (2004) have stressed that there is no direct comparable information about the burden of disease for each category of health risk, however, an important global contention has been that health risk associated with inadequately treated waste and water pollution is an important concept in urban agriculture. While health consideration can be looked at from microbiological, physical and chemical perspective, Cornish et al (1999) speculated that microbiological contamination assumes a better explanatory avenue for investigating health issues relating to urban household, human and animal wastes. According to Kilelu (op cit), most of the health threats linked with urban agriculture are tied to social, cultural, political, economic, technological and environmental factors in addition to poor handling and application of agrochemicals.

The central health issue is that inadequately treated waste and water may contain pathogens (bacteria, viruses and protozoa) and helminthes that cause gastro-intestinal problems and other illnesses in humans (Brunt and Patrick, 1985; Lardinois and Klundert, 1994). For instance, in 1999, New York State suffered its worst out break of *Escherichia coli* (*E.Coli*) where over 1,000 cases of food poisoning were confirmed. The source was traced to a 12-foot-deep well that stood at 83 feet away and that provided water for food vendors which may have been polluted after heavy rain swept manure from barn area into the well (Daniels and Daniels, 2003).

According to Shuval, et al, 1986 cited by Redwood (2004), a cholera epidemic in Jerusalem was directly linked to vegetables irrigated with the city's wastewater in 1970. In Dakar, an outbreak of typhoid in 1987 was also linked to farmers who were using unsafe water to irrigate their gardens. There is no doubt that associated health risks are a major constraint on the unchecked use of either waste or water for irrigation.

According to World Health Organisation (2003), pathogenic transmission from polluted waste or water is much more dangerous and prolific in places where adequate hygiene and housing are at a relatively high level. When pathogens are introduced (say via contaminated produce) into a moderately wealthy neighbourhood, the level and rate of transmission is extremely high.

Another problem is posed when accumulation of chemical nutrients needed for plant growth exceeds the required quantity for plant growth and for human consumption. This could result from inorganic and organic sources. Nutrient pollution includes excess nitrates, phosphates, potassium that come from chemical fertilizer, human and animal wastes. High levels of nitrate are potential health hazards to plants, livestock and man. Sources of nutrient contamination include on-plot septic systems, sanitary and storm water system, inadequate barnyard drainage, poorly constructed and maintained manure storage, unrestricted livestock access to water pools and wells and over application of fertilizers and manures (Daniels and Daniels 2003).

High concentration of these nutrients has been linked to growth retardation and discoloration of human teeth. More problematic is the use of the waste manure and water without any treatment whatsoever and without its prior knowledge of its health threat. Often, this water is mixed with groundwater and inorganic fertilizers and where farmers have direct contact with them, they however, pose significant health risk (Flynn 1999).

One obvious reason why urban authorities have not incorporated urban agriculture into their policy framework according to Redwood (2004) and Okpala (2003) is due to its potential negative impact on public health. This study therefore adopts microbiological examination for identifying health problems associated with the use of poultry waste and shallow well water utilization.

2.1.5 Guidelines for Safe Waste and Water Use for Agriculture

World Health Organization (WHO) guidelines published in 1989 and revised by Blumenthal et al (2000), considered microbiological parameters measurable to avoid infection hazards in the use of waste and water for food production (see Table 2.1). The guidelines stipulate among others that *faecal Coliforms* for unrestricted food production that are likely to be eaten raw should not exceed 1000/100ml. However, a clearer guideline given by Westcot (1987) while writing for FAO, recommended 1000/100ml as appropriate for vegetable irrigation; 10,000/100ml as potentially safe; 100,000 as heavily contaminated that require treatment before usage; and 1,000,000/100ml as extensively contaminated and highly unsuitable for irrigation. Further, European Union values up to $10*10^6$ *E.Coli* per 100g of hand cheese made from untreated milk as permissible, while International Commission on Microbiological Specification for Foods (ICMSF) permits some food to be eaten raw to contain around $10*10^4$ *faecal coliform*. The consensus on the acceptable standard has remained questionable because of the interest of the different groups and institutions.

However, while the WHO standards are somewhat flexible, the capability of many countries to attain them seems limited by cost. Factors such as energy costs, operation and land costs can impede the implementation of treatment solutions. Not only does cost limit the capability of poorer countries to achieve these standards, but the treatment process itself removes many of the fertilizing benefits of the waste (Kilelu, 2003; Redwood, 2004).

Table 2.1: WHO Microbiological Guidelines for Treated Wastewater use

Group	Reuse Condition	Exposed Group	Irrigation Method	Faecal Coliforms (Geometric Mean no per 100ml)
Unrestricted Irrigation	Irrigation of crops likely to be eaten raw (vegetables and salad), sports fields and public parks	Workers, consumers public	any	<=1000
Restricted Irrigation	Irrigation of cereal crops, industrial crops, pasture and trees	workers	Spray and sprinkle	10,000 -100,000

Source: After Blumenthal et al (2000) cited in Cornish (2002).

In spite of this debate about what exactly is realistic and appropriate required standard, the WHO guidelines have become an important basis for policy on waste and water use in many countries. While the developed nation have been able to meet up reasonably with the required standards, most developing nations have not been lucky. With the inability of most developing countries to bear the cost of treatment of waste and water to ensure safe usage, Drechsel (2001), has pointed that health dangers are still present and the development of low-cost treatment systems is still the preferred long-term solution. More recently, experts have suggested a step-by-step approach taking into account the best possible options based on the capacity of the relevant sanitation authorities

This argument, while important, is only relevant in places where treatment is possible (Redwood, 2004). As already noted, urban agriculture using poultry waste and shallow well water is very common and continues regardless of national or local policies prohibiting their use. There are no regulations and the few available regulations are simply ignored as there is little enforcement mechanism that bears on farmers using both resources, once both resources are discovered as cheap (free) source of fertilizer or water, people use them regardless of the health consequences and often, regardless of what kinds of laws are in place prohibiting its use (Niang, 2000).

2.2 Conceptual Framework

In a transdisciplinary research like this, which cuts across subjects and allied with disciplines like agriculture, health, waste and water management with geography at its background, an integrated approach that enabled sustainable development is required. The location of agricultural production concept and ecosystem approach to human health (ecohealth) which allow the integration of issues related to agricultural, socio-economic, health and ecological systems have therefore been adopted as the major conceptual framework of this study.

2.2.1 Location of Agricultural Production

The concept of location of Agricultural production by J. Von Thunen (1862) as cited in Oyeleye, (2001) is very relevant in this work. This concept is related to David Ricardo's idea of rent because both considered economic factors as important in the production of agricultural crops. Ricardo on one hand sees rent as excesses or surplus returns from high quality land over a lower quality one when equal resources of inputs are applied. His idea of rent is therefore understood as the differentials in return arising from the variations in the quality of land.

To Ricardo, fertility of the land is not uniform and increased difficulty in cultivation decrease return because the cost of cultivation at the marginal land goes up, and the market price of product must cover the marginal cost of production. This according to him affects the economic rent for the products. His major concern was on labour and capital cost that affect marginal cost of cultivation.

Thunen on the other hand, described how land use pattern emerges over a flat plain surface of uniform fertility and equal transport facility, given that only one market exists. He made basic assumptions to simplify his model. These are:

- Existence of isolated state where there are no external links or interactions
- A state dominated by a single large urban market
- Isotopic surface with uniformity in soil fertility, climate and easy transport from all directions.
- The existence of only one form of transport (horse and cart)
- Cost of transport was proportional to distance
- Farmer is an economic man wishing to maximize profit and having perfect knowledge of the needs of the market

With these assumptions, he demonstrated how and why agricultural land use varied with distance from a market, based on economic rent (ER) which gives the difference between revenue received from crop grown on a piece of land and the total cost of producing and transporting that crop. In other words, he described how gross income derived from the cultivation of a given piece of land minus all the cost of production except the cost of land determines land use around a central market area using economic rent (Oyeleye, 2001). The Thunen model is expressed as follows: R=E (p-a) –Efk where:

R	=	economic rent or net return per unit of land
E	=	yield per unit area of land
P	=	market price per unit of commodity
A	=	production cost per unit of commodity
F	=	transport cost per unit distance for each commodity and
K	=	distance

He further demonstrated that economic rent for a single crop (Figure 2.2) will be at maximum at the market (O) where there is no transport cost, and will also decrease with distance from the market with diminishing returns until the farmer ceases production as revenue and cost become the same (Z).

As depicted in Figure 2.3, he explained that in a situation where two crops are produced or in a competitive environment, the crop with the highest economic rent located near the market (between O and E) extends until its marginal rent equals marginal cost at F.

This means that the crop that gives the higher return dominates the farmscape close to the settlement, it is only succeeded by crop 2 between E and G. The land occupied by crop 2 will further extend production until its marginal rent equals marginal cost at the G intercept beyond which it will be unprofitable to remain in production. The analysis can be carried further to include three or more crops as depicted in Figure 2.4. Von Thunen used this concept to arrive at six concentric agricultural landuse zones around the central market as presented in Figure 2.5. Thunen added some modifications later in an attempt to make the model more explicit and realistic. The analysis, according to Oyeleye (1973) showed the importance of such factors as differentials in transport facilities.

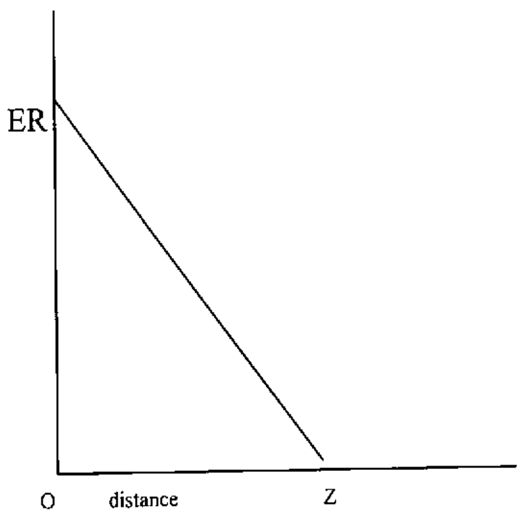

Figure 2.2: Relationship between Economic Rent and Distance

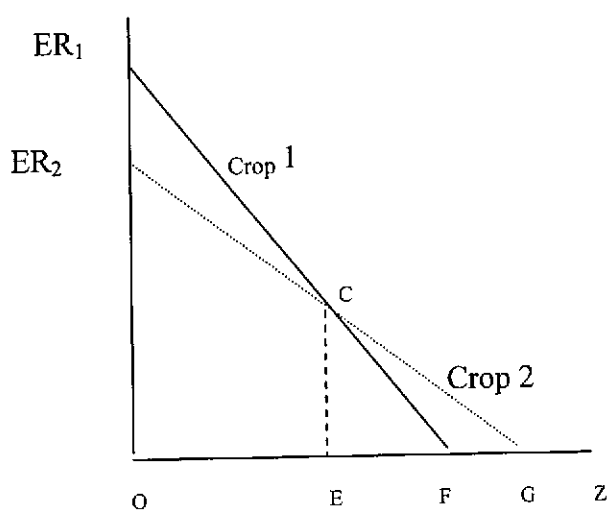

Figure 2.3: Two Crop Model Comparing the Relative Competitive Abilities of Two Crops for Location

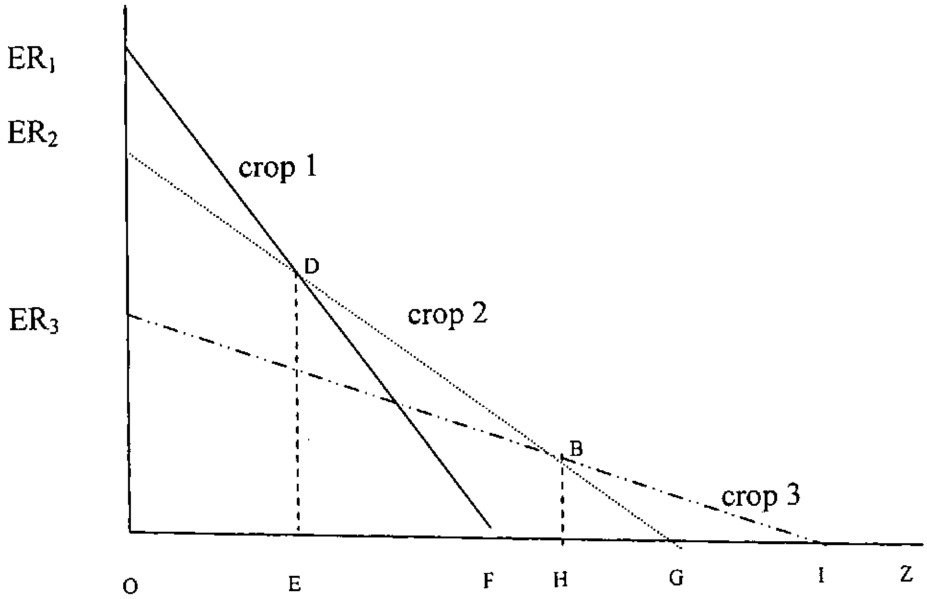

Figure 2.4: Three Crop Model Comparing the Relative Competitive abilities of Three Crops for Location

Source: Oyeleye, 1973 and Waugh, 1995.

However, Thunen's concept has been subjected to criticism by notable scholars because of its failure to take into account the influence of non-economic factors such as land tenure system, settlement pattern and technological development which can also affect agricultural landuse. Other basis for criticizing the concept has been on the unrealistic basic assumptions of the concept and its irrelevance in some situation. For instance, it has been argued that there is a long link between real life experiences and theoretical construct. Notwithstanding this concept has been built upon by Hoover (1937), Losch (1954), Dunn (1954) and Brinkman (1935). The concept has also been found relevant in West Africa where firewood is a major source of household fuel. For instance a study by Prothero (1957) and Mortimore (1967) in Northern Nigeria tend to confirm this. Griffin (i973) also confirmed its relevance in Uruguay

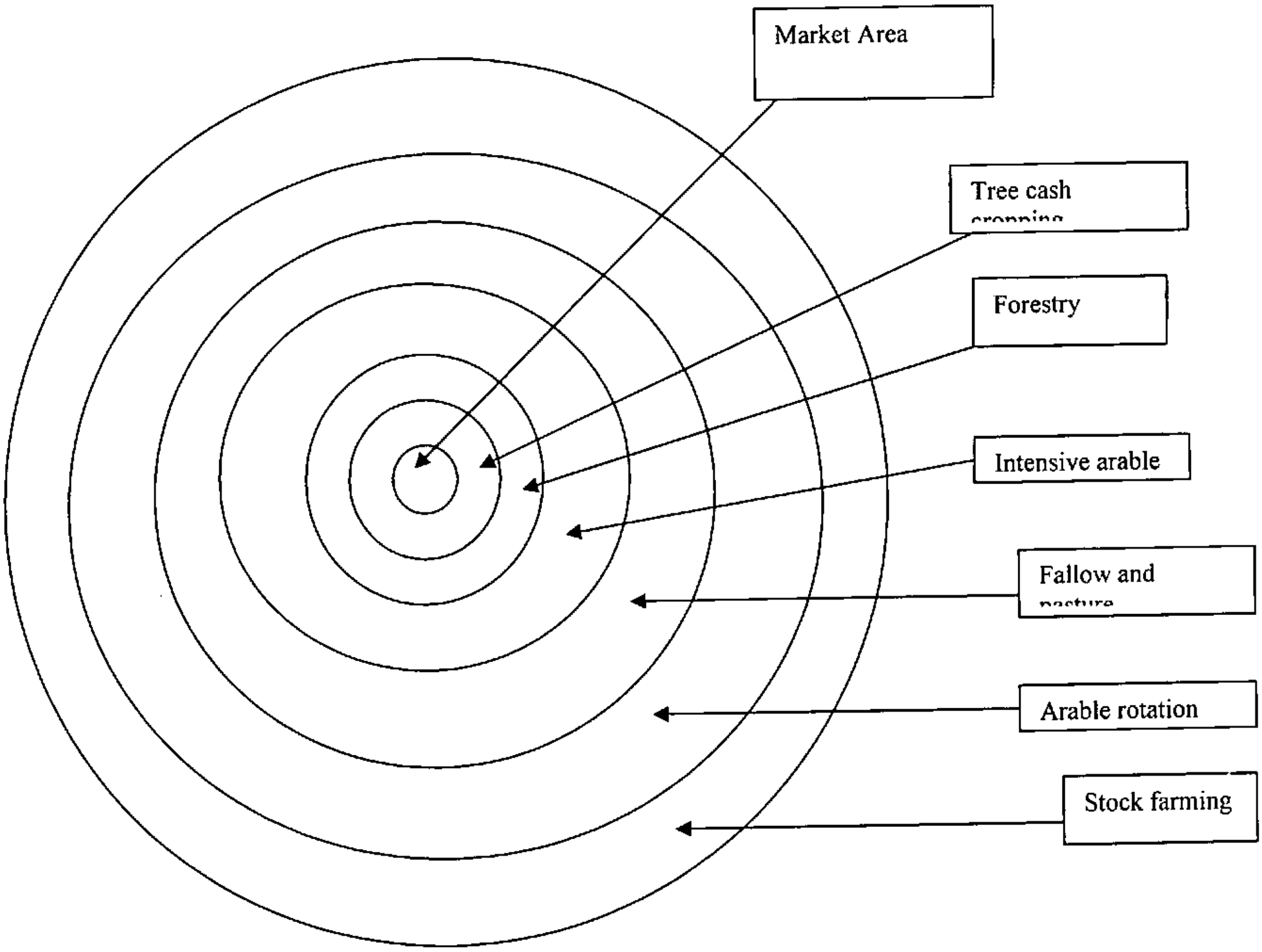

Figure 2.5: Land Use Classifications as Derived by Von Thunen Using Economic Rent Model

Source: Waugh, 1995

The intent of this concept to the study of poultry waste and shallow well water utilization rests on the fact that variations in cost and returns operate in the poultry waste, shallow well water and the end product which is vegetable cultivation is also subject to locational variation. All these create differences in the relationships between economic rent and land use for the different crops being cultivated. Therefore, the net revenue concept appears important to determine cropping patterns and land use competition amongst different crops. This means that the crop with the highest net revenue is likely to dominate a larger proportion of farmers' farmland and vice-visa. This study therefore employs the principles of economic rent or net return to bring to the fore the mechanism of land allocation amongst various vegetable crops. It thus postulates that the crops with the greatest economic rent make the highest bid for land nearest the settlement.

2.2.2 Ecosystem Approach to Human Health (Ecohealth)

2.2.2.1 The Development of Ecosystem Approach to Human Health

Another relevant concept is the Ecosystem Approach to Human Health which developed as a result of International Development Research Centre's (IDRC) participation in the movement towards heightened concern with the links between health and the environment. Before then, series of meetings such as the 1972 United Nations Conference on the Environment in Stockholm, 1987 Eco-development in Brundtland, United Nations conference on the Environment and development in Rio de Janeiro in 1992 and World Summit on Sustainable development in Johannesburg in 2002 have been held to express concern for the state of World's health and environmental conditions that impede human development. The deliberations at these conferences placed much more emphasis on the social and economic aspects of sustainable development of which human beings- men and women were seen as main actors.

Like the IDRC, World Health Organisation also took responsibility for an action plan on health and environment with several issues at the intersection to health, the environment, and development such as water contamination, air pollution and the management of toxic substances. IDRC on the other hand created programmes at the crossroads of development of practices in public health and in ecosystem health that takes holistic and dynamic approaches. This practice evolves with the experience of partners in the developed and developing nations who are working on development issues affecting local communities. The pattern IDRC adopted to actualize her objectives thus attracted the adoption of IDRC's Ecosystem Approach to Human Health to this study.

2.2.2.2 *The Concept and Attributes of Ecosystem Approach to Human Health*

Ecohealth is a process oriented and dynamic concept that seeks to provide better understanding between the complex ecosystem (biophysical, socio-economic and cultural) and how these interactions influence the prevalence of health problems and well-being among human populations. It is part of sustainable development process that promotes positive action on the environment that improves community well being and health. As depicted in Figure 2.6, ecohealth suggests that improved human health, living condition and sustainability of the ecosystems could be achieved by identifying ecosystem management strategies and understanding the socio-economic and cultural conditions (Lebel, 2003).

Thus, ecohealth emphasizes that health as a resource for every day life, goes beyond personal lifestyle alone but includes political, economic, cultural and social status of man (DePlane et al 2004). Ecohealth believes human activities alter social and ecological context and have positive and negative effects on individuals and communities involved. The concept suggests that its activities or project inherently involves three core elements, namely, Transdisciplinary, Community Participations and Social Relations and Gender.

iii. Social relations and gender,)

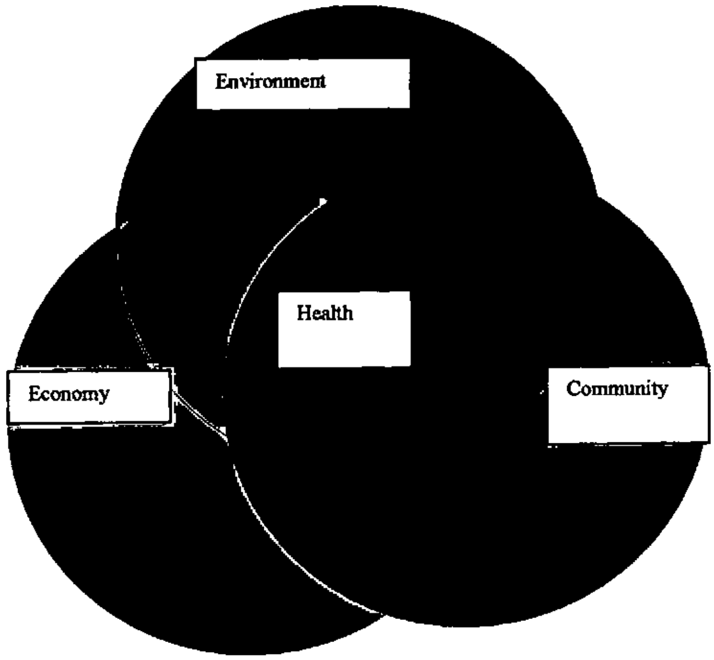

Figure 2.6: *Ecosystem approach and its elements (cited from Gilles et al, 2001)*

Trans-disciplinary element: This involves the management of human activity and the environment using transdisciplinary framework that send a clear signal that looks at various aspects of a problem closely. This implies the participation of not only the scientist but also the community representatives and other actors who in addition to processing knowledge of problem at hand have a role and stake in its solution. It implies the inclusion of specialists, individuals and decision makers from the locality of study in order to allow the articulation of social problems addressed in scientific process (Crescential, 2004).It gives all actors the right to be heard and thereby share their unidisciplinary research that characterised the experimental science such as chemistry, physics and mathematics. It also differs from interdisciplinary approach which studies phenomena at the intersection of two disciplines that are usually close to each other such as the overlap between biology and chemistry that gives biochemistry. Nor is it equivalent to multidisciplinary, in which researchers from different disciplines work side by side thereby enriching their own understanding as a result of their colleagues' input.

Community Participation: According to Lebel (2003), extensive body of experience has shown that there can be no development without community involvement. This is because participatory research gives equal weight to both local and scientific knowledge. Through this means, feasible solutions are identified by exchanging and sharing ideas, concerns and needs of the community people. It targets community representatives and involve them directly in the research process, taking the different social groups into account and facilitating negotiations. This type of research goes beyond the simple verification of hypothesis and leads to action. Community members are seen as protagonists and agents of change since community members have a role and stake in solution to any existing problems.

Gender and Social Relations: Gender and social relation approach is an important aspect of ecohealth because it revolves around the men and women whose life is determined by economic, social and cultural factors. Understanding the qualitative and quantitative differences between the communities' social groups helps to reinforce development action programmes. Gender and social relations also focus on the way male and female relations affect the health of individuals since men and women do things differently. In

Lebel's (2003) view, gender goes beyond biological differentiation of man and woman. Gender dimensions cover cultural characteristics that define the social behaviour of men and women and the relationship between them. The sharing of roles and responsibilities can affect human health. It is believed that research that takes cultural and socio-economic differences into account will naturally lead to consideration of the concept of equity.

2.2.2.3 Relevance of Ecohealth to Development Research

Ecosystem Approach to Human Health has contributed to diversity of experiences in the emerging field in both developed and developing nations. The contributions have focused on the value of integration of knowledge from many fields, e g. biochemistry, sociology, economics, medicine, public health and agriculture. For instances ecohealth approach has been used to study and expand research on dengue fever in Asia and Latin America. It has been useful for assessing impact of new technology on human health and environmental pollution in Pretoria, South Africa. It has also borne fruit in situations involving each of these problems. In Mwea region of Kenya, better control of the malaria-carrying mosquito has been achieved by modifying agricultural practices. In Oaxaca, Mexico, deliberations involving scientist, community groups and government decision makers have led to the introduction of community actions that have essentially wiped out the region's use of DDT. In the highlands of Yubdo Legabato, Ethiopia, extensive community involvement has enabled the local population to break the vicious cycle of poverty and malnutrition.

Nevertheless it has been argued that ecohealth concept creates many challenges on how to link researchers and the community people. For instance some communities have had bad experiences with researchers who failed to develop local capacity and it also gives the perception that development comes from the outside.

This study adopts this concept because the pillars are not independent of each other but predispose links between human activity and the impact of the activity on human health. In addition, the approach is not rigid and can be designed to fit specifications and peculiarity of the study community. The synergistic interactions between the underlying factors define the pathways for study of poultry waste and shallow well water utilization in urban agriculture in Lagos. This is because the topic of this research has diverse dimensions that attract participatory, transdisciplinary and gender approaches and analyses.

2.2.3 Definition of Terms

Exotic vegetables: These are vegetable of foreign origin that are held valuable by people of high class in the society. Examples are lettuce, spring onions, dheal, radish, parsley and India spinnage among others.

Farmers: This refers to urban cultivators utilizing poultry waste and shallow well water for vegetable crop production.

Farm community: This means a group of farmers who share common interest and also work together in the same locality

Health Implications: Negative entanglement or change in health status that is related to urban farming activities

Local or indigenous vegetables: Vegetables that are known by and held valuable by the indigenous people. Examples are 'Tete' (Efo), Ewedu, Bitter leaves, Water leaves and Ugu.

Poultry waste management: This refers to the ways by which fowls' or birds' excreta are used as inputs within urban agricultural system especially in respect of treatment, conveyance, storage and application.

Shallow well water: Shallow well water is the water obtained from a sink on the earth's surface usually at a low depth for irrigation purpose

Shallow well water management: It refers to manner into which water from a sink is obtained from the earth's surface and integrated into agricultural activities. In the study, shallow well water management includes storage, treatment, conveyance, application and infrastructure.

Urban Agriculture: This is defined as the variety of agricultural activities that take place within the urban and peri-urban spheres of influence.

Urban farming: The term is used synonymously with urban agriculture.

CHAPTER THREE

3.0 RESEARCH METHODOLOGY

This section discusses the data collection methods and analytical tools adopted for this study. These are questionnaire administration, field trials, laboratory investigations, Focused Group Discussions, in-depth interview and discussions with relevant stakeholders.

3.1 Type of Data Gathered

This study employed an integrated method consisting of both secondary and primary sources of information. Secondary source of information consists of records of Lagos State Ministries and Agencies. Primary sources of information on the other hand were gathered through questionnaire administration (see appendices I and II), informal discussions, in-depth interview, field experiment, laboratory analysis, Focus Group Discussions, direct observation, visitation and consultation with experts. The flow chart analogy on the steps taken to collect data for the analyses is presented in Figure 3.1 and the details are discussed below:

3.1.1. Data Source and Collection Procedure

3.1.1.1 Secondary Source

Valuable information pertaining to roles and responsibility of relevant organizations were retrieved and extracted from annual and quarterly reports, flyers and magazines of the Lagos State Ministry of Urban Development and Physical Planning, Lagos State Agricultural Development Authority (LSADA), Lagos State Ministry of Environment

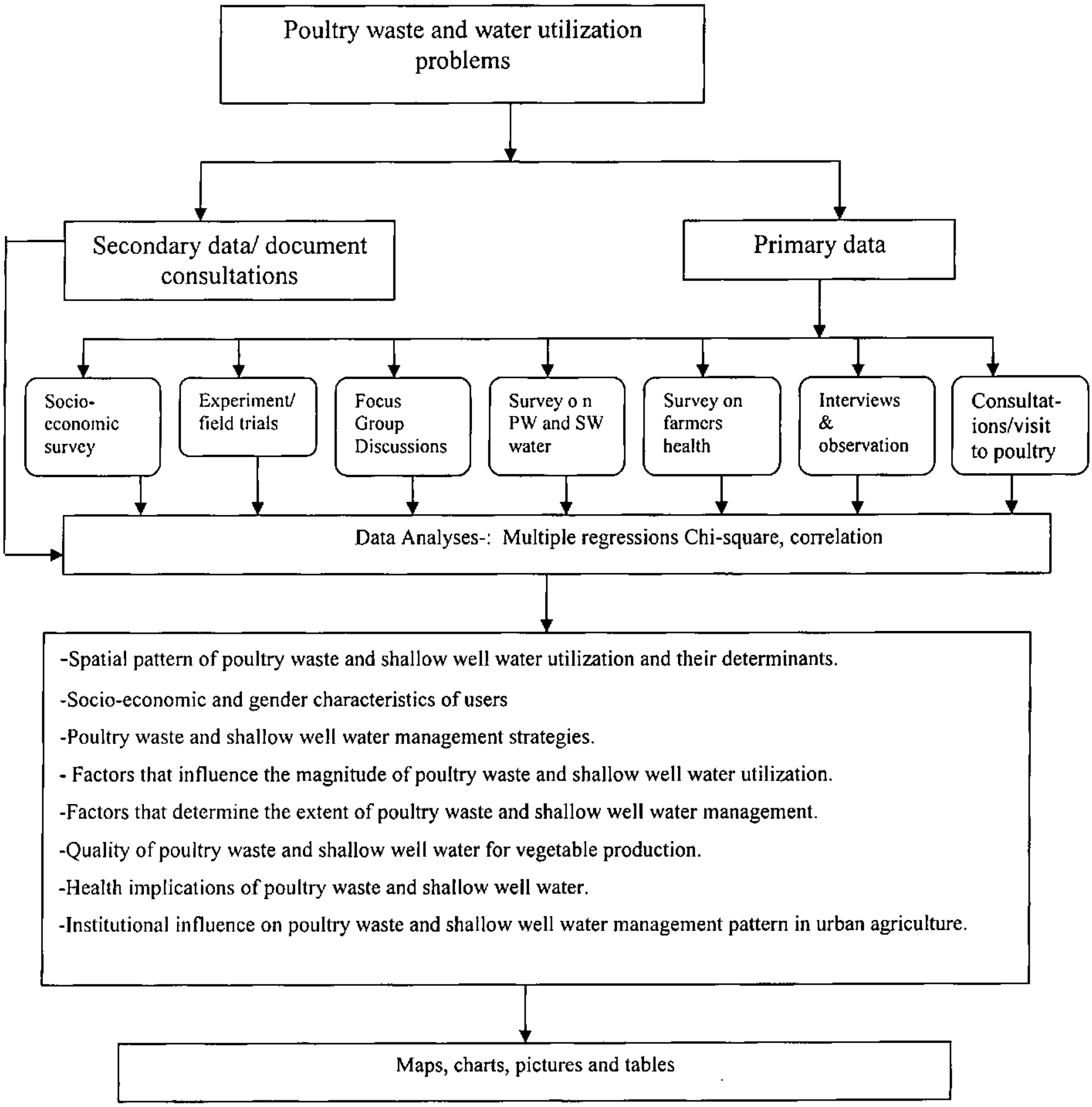

Figure 3.1: Flow Chart of the Research Methodology

which comprises of Lagos State Environment Protection Agency (LASEPA), Lagos State Waste Management Authority (LAWMA) and Lagos Water Corporation (LSWC).

These are either partial or full regulatory arm of the State Agricultural Development Organizations charged with the responsibility of overseeing, monitoring, distribution of agricultural resources such as manure, water, seedlings, pesticides, extension services, to ensure compliance with set standard for the operation of food production.

3.1.2. Primary source

The study started with a visit to Lagos State Agricultural Development Authority (LSADA) headquarters where the locational addresses of vegetable farm sites within the metropolis were obtained. Eight (8) of the ten urban agricultural circles were visited and surveyed to determine the extent of vegetable farming activities in each location. Of all visited locations Alapere, Barracks, Ikeja and Tejuoso were found to have vibrant and viable commercial farming activities with vegetables being the most commonly planted crop. A reconnaissance survey also revealed that the contributions of these four farm communities to urban food security and local economy were relatively reasonable compared to other locations. These factors guided the choice of these sites.

Lists of total registered farmers at each location were collected and their numbers were as follows: Alapere -192, Barracks- 200, Ikeja- 193, and Tejuoso-170. Since the registered farmers in each farm are between 170 and 200, a random sampling technique was employed. From each farm site, 40% of farmers were randomly selected using the table of random numbers. This produced the following: Alapere -76, Barracks-78, Ikeja- 77, and Tejuoso-68 and which gives an average of 75.

Seventy-five (75) questionnaires were therefore administered on each farming community and another twenty (20) questionnaires to consumers who live close to the urban farms. This was done with the assistance of seven trained field assistants (four undergraduates and three semi-literate farmers). The service of the semi-literate farmers was engaged in order to overcome language and other ethical barriers since most of the farmers in the study area were non-literate in Western education. Face to face interview schedule method was employed to administer the questionnaires on every Saturday. This lasted for twelve weeks. This method of questionnaire administration was adopted to enhance high response rate which at the end was 100%. The high response rate of farmers to the questionnaire was further facilitated by the support given by leaders of farming communities and associations.

The questionnaires consisted of both open and close ended questions that gave respondents chance to express their views about integration of shallow well and poultry waste as inputs into their farming activities. The focus of the researcher was firstly on practising farmers and secondly on vegetable consumers; therefore, at the first stance, farmers were approached at their farm plots. With concern for gender equity in the questionnaire administration, all women farmers on site at the time of survey at Alapere, Tejuoso and Ikeja and all male workers at Barracks were included in the sample. A total of 300 questionnaires were administered in the four farm sites in Lagos metropolis with 198 males and 101 females. The questionnaire was sub-divided into four major parts. Firstly, information was requested on the socio-cultural and economic characteristics of farmers. Secondly, questions on poultry waste management, thirdly on shallow well management and lastly on gender, indigenous technical knowledge and on environment.

At the second stance, a total of 80 questionnaires were administered to urban households (20 questionnaire per farm sites) who live around urban farms focusing on issues related to the economies of vegetable consumption such as the influence of price of vegetable crops on demand as well as the perception of consumers about agricultural inputs such as poultry waste and shallow well water.

3.1.3 Selection of Health Indicators

Symptoms of four main illnesses were identified through questionnaire administration as main health problems suffered by farmers in all the study sites. They were symptoms of respiratory infections, malaria, stomach- related illness like dysentery and diarrhoea and dermatophytes infections on skin, toe and hand. These were summed and ranked, with the first two selected for analyses. The selected health problems are malaria and stomach disorder. Causal pathogens were therefore examined for in sampled poultry waste and shallow well water as well as on farmers and non-farmers to determine infection levels.

3.1.4 Sampling Procedure for Poultry Waste and Shallow Well Water

Shallow well water: To avoid contamination from other sources, 20mls sterilized syringes were used to take water sample from 40 different shallow wells (10 from each site) and mixed in a clean bowl. At each site a sample of 200mls were poured in a sterilized bottle and transported to the Microbiological Laboratory of the Department of Microbiology of University of Lagos for analysis. Part of the mixture was used for the microbiological analysis and the rest was taken to the Chemistry Department of University of Lagos for physiochemical analysis.

Poultry Waste: Four samples of poultry manure from four different sources at each farm site were collected with sterilized spoons into foil papers. These were tied and labelled with celotape and taken to the Microbiological Laboratory of University of Lagos for single and combined analysis after dilutions. The left over of the poultry waste was taken to the Chemistry Department for physiochemical analysis.

3.1.5 Field Experiment, Observations and Informal Discussions

Twenty farm beds were hired at Alapere and Barracks agricultural locations for on-farm experiment in order to quantify, the amount of poultry waste and shallow well water for production output per unit area. Land allocations for particular kinds of vegetables were also marked out on the farm to enable the researcher estimate the net return (NR) of local and exotic vegetable crops. This enhanced the researcher's regular visits to the farms, improved discussion with farmers and engendered observations that are related to farmers' behaviours and life styles. The opportunity further provided avenue for attending weekly and monthly meetings of farmers' association. Informal discussions were held with 15 non-farmers who reside in the farm neighbourhood, six poultry waste brokers, consumers and marketers. The information obtained provided insight into personal perspectives pertaining to the impact of poultry waste and shallow well water utilization on yield and on farmers' health.

3.1.6 Participatory and Focus Group Discussions

Non-conventional Focus Group Discussions were held at each farm site on meeting days of farmers' associations. This was to enable farmers to participate actively in the discussions and also to present the laboratory results for deliberations on possible, feasible and practicable solution to farmers' priorities and needs. The meetings gave the farmers avenue to air their views on pertinent issues on poultry waste and shallow well water utilization and also provided possible mitigation measures to minimize negative health impact on farmers. The distribution and participation of individuals at the FGD are as shown on Table 3.1.

Table 3.1: Number of Farmers and Non-Farmers that Attended FGD at Study Location

Study Sites	Male		Female		Total
	Farmers	Non-Farmers	Farmers	Non-Farmers	
Alapere	30	2	6	1	39
Barracks	2	1	42	3	48
Tejuoso	38	1	2	0	41
Total	**70**	**4**	**50**	**4**	**128**

Source: Field Survey, March 2005.

3.1.7 Interview, Consultations with Experts and Visitation to Poultry Farms

Experts were consulted and laboratory results (of sampled poultry waste, shallow well water) were presented to them for their perceived views about relations between poultry waste and shallow well water utilization for agriculture and their causal impacts on the identified health problems. This was to gather vital information through participatory and action research that deepened our understanding of the health implications of poultry waste and shallow well water use. Those consulted were: Laboratory Scientists, Medical Doctors, Dermatologist, Sociologist and Animal Scientists, Economist and hydrologist. Interviews were held with head of extension officers and extension workers assigned with responsibilities to cater for farmers' advisory needs by Lagos State Agriculture Development Authority. Staff of Lagos State Waste Management Agency, Lagos Water Corporation and Federal Ministry of Environment and Lagos State Environmental Protection Agency were also interviewed in order to assess the extent of their regulatory roles regarding safe poultry waste and shallow well water management and utilization for urban agriculture, especially as they concern crop yield, health, sanitation and environmental hazards.

Two poultry farms were visited at Shashi (Lagos Metropolis) and Badagry (sub-urban Lagos), in order to relate the activities of poultry waste utilization with source of poultry waste and also to observe and obtain in-depth information on poultry waste generation, transportation, storage and packaging to urban vegetable farms.

3.2 Analytical Framework

Since the objectives of the study were to examine the factors responsible for the spatial distribution of poultry waste and shallow well water utilization for urban agriculture; influence of socio-economic characteristics of farmers on management pattern and the implications of poultry waste and shallow well water on the health of users and on productivity, several analytical model were employed to synthesize these relationships. In addition, two main hypotheses were tested to ascertain whether there are variations in the quantity of poultry waste used and crop yield among the study locations, and if there is any relationship between Net return per unit area and size of holding of cultivated crop types in the study area. Several tools were employed to analyze the findings of this research. These include:

3.2.1 Inferential Statistical Analysis

Four major statistical tools within the framework of Statistical Package for Social Science (SPSS) were employed. The tools are Pearson Multiple Regression, Chi-square test (X^2), Kendall's tau and Wilcoxon Correlation tests

1. Multiple Regression was adopted because of its capacity to simultaneously assess the effects of several causal factors. It was employed to determine the partial and net contributions of the selected factors that influence the spatial distribution of

poultry waste and shallow well water utilization in the study area. The regression model is represented by

$$Y = a + bX + bx_1 + bx_2\ bx_3 + \ldots\ldots.. bx_n$$

Where *a* = Y intercept and *b* = the slope of line where *a* and *b* are constants.

The Y = dependent variables are represented by poultry waste utilization on one hand and Shallow well water utilization on another hand.

While X to X_n = number of independent variables and these are represented as follows: Age of farmers, size of holding, monthly income, number of fragmented farms, experience, educational level, seasonal variation, vegetable types and availability of alternative manure among others.

2. Chi square (X^2) test was adopted because of the classified nature of the data sets. This was also used to examine the influence of farmers' socio-economic attributes on poultry waste and shallow well water management. The socio-cultural data set was classified into age, income, ethnicity, gender, educational level and religion, while the management data set was classified into application, treatment and storage. This Model for X^2 is statistically represented as

$$X_2 = \frac{(O-E)^2}{E}$$

Where O = Observed frequencies

E = expected frequencies

Chi-square technique was also used to test the variation in the quantity of poultry waste utilization and crop yield in the study locations.

3. Kendall's tau correlation test- examined relationship between net return per unit area of production and the size of land holding of the cultivated crop types.

4. Wilcoxon test was also adopted to determine the differences between the averages of malaria and gastro-enteritis infections between farmers and non-farmers are significant. Wilcoxon test is a t- test model used to determine averages between two related samples. Other statistical tools employed in the research include: graphs, tabulations and descriptive methods.

3.2.2 Laboratory Analysis

The services of laboratory scientists were employed for the microbiological, physiochemical and for the clinical analyses.

a. Microbiological Analyses

The presence of Bacteria in shallow well water and poultry waste samples were determined using Nutrient Agar (NA) while Mac Con key Agar (MCA) was used for Total and faecal coli form counts. The Central Forming Unit (CFU) were counted and stained to unveil type of microorganism and the results were compared to WHO acceptable standard limit. Shallow wells were examined on sites and samples were taken to the laboratory for further observations and analyzed for presence of mosquito larva. The details of the procedure are:

Fungi characteristics: All samples (water and manure) that were analyzed for fungi contents were cultured using Potato Dextrose Agar (PDA). Thirty-Nine (39) gram of PDA powder was dissolved in 1000mls distilled water, brought to boil in water bath. It was autoclaved at 121^0 C for 15 minutes; cool to 45^0 C. Antibiotic was added to the medium to inhibit growth of bacterial growth. Serial dilution was done to 10^{-3} before pouring into sterile plates, spread evenly with a sterile glass spreader so that organism will not overlap each other and incubated for 3 to 5 days.

Bacteria characteristics: All samples (water and manure) that were analyzed for bacteria contents were cultured using Nutrient Agar (NA). Twenty-Eight (28) gram of NA powder was dissolved in 1000mls distilled water, brought to boil in water bath. It was autoclaved at 121^0 C for 15 minutes, cool to 40^0 C. Serial dilution was done to 10^{-6} before pouring into sterile plates, spread evenly with a sterile glass spreader so that organism will not overlap each other and incubated for 24 hours.

b. Clinical Analyses

Stool samples of farmers and non-farmers were collected and were taken to Nigerian Institute for Medical Research (NIMER) Yaba for microscopic, culture and sensitivity analysis using the Mac Con key agar. This was done in order to examine and compare the characteristics of the pathogen presence in farmers and non-farmer stool. The services of laboratory scientists were employed and free malaria test were declared at each farm sites for both farmers and non-farmers who reside at farm neighborhoods. This was done to compare the malaria parasite infection levels of farmers and non-farmers. The procedures for the laboratory analyses are:

i. ***Determinant of Malaria Parasite in Blood:*** Thick and thin blood film were prepared from a standardized finger prick blood. The thick and thin smear was made by spreading the blood on a clean slide. Each slide was labelled with code of individual, from whom the blood was collected and the smear was allowed to dry under shade. However safety measures were ensured by using one sterilized lancets and capillary tube per individual. Guinsa staining techniques was employed in the processing and the slides were examined under an optical microscopic with X100 objectives under oil immersion for identification.

ii. ***Determinant of Faecal Coliforms in stool***: Stool samples of farmers were collected for both dry and wet seasons in sterilized bottles and subjected microscopic, culture and sensitivity methods. They were cultured for Faecal Coliforms contents using Mac Con key Agar (MCA). 52gram of MCA powder was dissolved in 1000mls distilled water, brought to boil in water bath. It was autoclaved at 121^0 C for 15 minutes, cool to 45^0 C. Antibiotic was added to the medium to inhibit growth of bacterial growth. Serial dilution was done to 10^{-3} before pouring into sterile plates, spread evenly with a sterile glass spreader so that organism will not overlap each other and incubated at 44.5^0 C for 24 (faecal Coliforms) and at 37^0 C for 48 hours (total Coliforms).

c. *Physiochemical Analyses*

The nutrient elements present in both shallow well water and poultry waste were determined using methods listed in Table 3. These parametres were chosen because they are the main nutrients needed for proper vegetable growth. Results were then compared with a brand of NPK 20:10:10 inorganic fertilizer commonly used by farmers in the study locations.

Table 3.2: Methods for Analyzing Physiochemical Elements

	Nutrient	Methods
1	Nitrate	This was determined using Hach 2000 Spectrometer against the raw sample blank at wave length of 500nm
2	Phosphorous	This was determined using Hach 2000 Spectrometer against the raw sample blank at wave length of 430nm
3	Sulphate	This was determined using Hach 2000 Spectrometer against the raw sample blank at wave length of 450nm
4	Potassium	Potassium was determined using Atomic Absorption Spectophometer against the blank at 766.5 weight/length
5	Magnesium	This was determined by titrating 100ml of water sample with standard solution of EDTA*(Disodium salt) using Eriochrome black T indicator and subtracting calcium contents from it.
6	Calcium	This was determined by titrating 100ml of water sample with standard solution of EDTA (Disodium salt) using Murexide as indicator
7	Chloride	This was carried out by titrating 100ml water sample with standard solution of silver nitrate using potassium chromate as indicator

Source: Chemistry Department University of Lagos- 2005 * Ethylene Dramine Tetra-Acidic Acid

CHAPTER FOUR

4.0 INSTITUTIONAL FRAMEWORK FOR POULTRY WASTE AND SHALLOW WELL WATER MANAGEMENT IN URBAN AGRICULTURE

In this chapter, the roles and responsibilities of relevant formal and informal institutions as well as their specific contributions to the pattern of poultry waste and shallow well water management and utilization in Lagos metropolis are assessed. It highlights the efforts being made by these institutions to ensure proper and safe integration of poultry waste and shallow well water into urban food production.

4.1 Roles of Formal Institutions in Poultry Waste and Shallow Water Management for Urban Agriculture

Urban agriculture and its associated poultry waste and shallow well water management activities are complex issues pertaining to food production, income generation, health, water management, waste management and environmental management which a single agency or institution may not be able to adequately handle (Obuobie, 2006). There are therefore many important stakeholders with regards to poultry waste and shallow well water utilization in urban agricultural practices in Lagos. They are the State Ministry of Physical Planning and Urban Development, Lagos State Water Corporation, Lagos State Waste Management Authority, Lagos State Environmental Protection Agency (LASEPA) and Lagos State Agricultural Development Authority (LSADA) an implementing arm of State Ministry of Agriculture. Others are NGOs, Universities and Research Institutions. However, this study focuses on four formal institutions. This is because of the paucity of relevant data and information on the activities of the other institutions.

4.1.1 State Ministry of Physical Planning and Urban Development

The Lagos State Ministry of Physical Planning and Urban Development is the regional body that has the mandate to facilitate and regulate municipal resources including an equitable and efficient land administration. It shapes the pattern of land use, built environment and protect the natural environment to solve and prevent challenges of urbanisation including, shelter, food security and other basic needs of life. It also deals with the physical, social and economic development of the municipal region part of which is urban agricultural activities (Mubvami and Mushamba, 2006).

A discussion with the physical planning officer (31st January, 2006) in charge of Lagos city, revealed that there are no specific rules for land allocation for urban agriculture in the state's urban development policy. Existing municipal policies do not fully and directly support urban agriculture due to the 1978 Land Use Act which makes no provisions for the use of urban land for crop production. The basic element of the Act is that government owns all lands and their allocation within the state.

The land use act according to Ojo (1991) was meant to encourage greater utilization of the nation's land resources for increased food and agricultural production which includes urban agriculture if interpreted literally. As he stated further, the policy was mainly concerned with land allocation for rural agricultural activities because of the perception that agriculture could only be meaningful in the rural areas. According to the officer, urban land development simply means the construction of urban structures for commercial, residential and for industrial purposes (urban and regional Planning Decree 1998).

However, a recent realization of the benefits of urban agriculture to some urban individuals, coupled with the international and regional appreciation of the contribution of urban agriculture to urban food security, job creation and poverty reduction, urban agriculture has received some little support through the state bye-law. This is in terms of granting users' right permit to interested farmers at a reduced price or in some cases free. The users right for a plot of land costs about ₦2,000 per acre per annum (as is the case in Ikeja GRA farm) as against private rate of between ₦10,000 to ₦20,000 (interview with community head of farmers association in Alapere, February, 2005).

This rate although cheap if compared with private rate, only a handful of farmers (6%) is beneficiaries (see Table 4.1). For instance, it is only a few farmers (about 10%) in Ikeja GRA farm that are privileged to have access to the land through this offer, while the rest (about 90% of the farmers) have access through private individuals, private and public organizations who had acquired the land from the state government. Although this government support could enhance and promote urban agricultural practices, it is largely limited, negligible and mostly concentrated in the rural areas. It also shows that the agricultural policies are rigid and lack responsiveness to social and economic issues of human development especially as related to urban agriculture.

According to Mubvami and Mushamba (2006), the urban land laws are often old fashioned based on colonial models of land laws that are archaic and which leave no room for maneuvering at the local levels. It is further argued that the authorities are often ill equipped, understaffed and the positions and physical plans designed by planners are not often built into decision-making process and if they do, they lack resources to implement them.

Table 4.1: Land Ownership Acquisition Method

Farm Site	Ownership of Land	Land Acquisition Method (%)			
		Purchase**	Lease/Rented from individual and organizations	Free	Inheritance
Alapere	Private	6	63	31	0
Barracks	Military Government	52	48	0	0
Ikeja (GRA)	Government	0	6	0	0
	Private	6	65	0	21
Tejuoso	Sport Ministry	0	100	0	0

Source: Field Survey 2005

** *Making just one payment over land till one quits the farm.*

The inadequate and limited access to urban land for agriculture further compels a large number of urban farmers to acquire land from private and organizational land owners who charge exorbitantly and further evict farmers at will and without noticed. This trend which leads to loss of productive resources and time, also undermine the efforts put forward by the poor urban farmers to make a living. This condition further propels urban farmers to cultivate unplanned and fragile land areas of the municipality, where there are no provisions and access to adequate source of quality water. Such unplanned lands are usually poor, low quality and sometimes expensive to maintain and cultivate. It also influences the magnitude and extent of the utilisation of agricultural inputs such as water manures and fertilizers needed for high productivity.

4. 1.2 Lagos State Agricultural Development Authority (LSADA)

The Lagos State Agricultural Development Authority (LSADA) came into being in 1987 and was scheduled as a regular parastatal of Lagos State Ministry of Agriculture and Cooperatives in April 1995. It is an agricultural extension-implementing arm of the Lagos State Ministry of Agriculture and Cooperatives with the objectives of reaching out to as many farmers as possible for improved and better agricultural practices. As at November 2005, the Authority had a total of 131 front-line extension agents who service farmers in the State.

The office of the head of extension field activities is responsible for coordinating all extension activities in the state. Specifically, the office carries out the following activities:

- provision of technical support to the agricultural extension agents, in particular; seeing that recommendations are effectively transmitted to farmers and that the farm problems encountered by them are appropriately solved.
- ensuring that quality training & technical guidance are received by farmers.
- organizing training / workshops / study tours etc for farmers, intending farmers etc.
- creating enabling agricultural extension services for optimal agricultural production in the state.

With these objectives, LSADA officials are expected to maintain the performance of all agricultural development and their impacts, manage day to day activities under their jurisdictions and also provide frontline extension services through regular visit and farm demonstrations. It is also expected that an extension officer posted to an urban agricultural area will liaise with all partners and institutions and receive financial support to solve problems farmers encounter.

He is also expected to give advice that could help solve such problems and further provide training and education on improved farming methods, better waste recycle and management options, water management, risk education, proper treatment and application techniques, nutrient contents of manure and conservation methods etc so as to increase yields.

From the above listed responsibilities, it is obvious that LSADA roles are enormous and diverse. This study therefore limits its assessment on their roles as they are related to poultry waste and shallow well water utilization which form the main focus of this research. The assessment is made under the following sub-headings-:

4.1.2.1 Extension Services Activities of LSADA

Information gathered through interview held with the head of the extension services (18th February, 2005) revealed that LSADA recognizes urban agriculture in Lagos. In his statement, the authority offers extension services to ten farm circles within the metropolis and these are Kosofe-Alapere, Ikeja GRA, Mushin-Idiaraba, Ojo-Barracks, Surulere-Tejuoso, Adelabu, Oko-Oba, Apapa-Kirikiri, Amuwo-odofin- Festac, Oke-Afa. These are organized group of farmers who have registered with LSADA. The services they provide include extension service- field visit, training and field experiment, sales of seeds, inorganic fertilizers and irrigation facilities. LASDA also liaise with other organizations to give technical and productive assistance to urban farmers.

Nevertheless, information obtained through Focus Group Discussion with farmers revealed that extension service roles are rarely met. As one of the farmers at Barracks farm asserted "we no dey see government people sometimes for four months. Even when they come, dey no dey fit help us with the problems wey we get" (Focus group Discussion held in Barracks, January, 23rd 2005). This statement was also confirmed by the heads of farmers' association in Alapere, Tejuoso and Ikeja Farms.

Farmers' inadequate access to extension agents and services according to ASP coordinator (Federal Ministry of Environment, Abuja (Interview held on 7th of June 2006) is due to lack of fund, inadequate inputs and equipment, bureaucratic bottlenecks, absence of research-driven efforts and dearth of data and information. Other constraints mentioned by the Head of Extension officers are lack of commitment and cooperation among farmers, poor manpower, corruption and inadequate technical development (NFD 2005).

It is also due to the bias, general apathy and inadequate policy support for urban agricultural activities in the state. For example, out of about one hundred and thirty-one (131) extension officers in the state, only five extension officers are allocated to urban agricultural areas in the state. This allocation as presented in Table 4.2 gives minimum and maximum ratio of one extension agent to 200 farmers and one to 435 respectively.

The implication of this allocation pattern is that urban farmers have inadequate access to extension agents. Problems that demand quick and prompt attention are often aggravated and become destructive. Urban farmers are therefore left to seek for solutions to some teething problems haphazardly leading to poor urban agricultural management and practices. This situation further leads to poor production output.

Table 4.2: Ratio of Extension Officers to Farmers in the Study Area

Site	Number of Registered Farmers	Number of Extension Agent	Ratio of Extension Agents to Farmers
Alapere Ikeja	192 193	1	1/385
Barracks	200	1	1/200
Tejuoso Idiaraba Adelabu	170 120 145	1	1/435
Oke-Afa Festac Cele	72 136 92	1	1/300
Oko-Oba, Kirikiri	165 132	1	1/297

Source: Field Survey February, 2005

4.1.2.2. Water and Irrigation Facilities Activities of LSADP

The provision of water for urban agricultural activities in Lagos is carried out by LSADA in collaboration with National Fadama Development Project (NFDP) Phases 1 and II. This is based on the recognition that physical, economic, environmental and health impacts of shallow well water utilization on producers and on the urban agro-ecosystem has a long term and more devastating impact. For instance it is believed that the presence of shallow wells encourages the breeding of certain pathogens and micro-organism that could be harmful not only to shallow well users but also those living around farming environment especially in areas where sanitary facilities are inadequate or totally absent. Again, drudging processes enhances quick siltation which makes shallow well more expensive to maintain apart from the physical energy required for the drudging activities.

Based on the identified problems associated with shallow well water utilization, motorized pumps and wash bore construction were offered and supplied to interested farmers at government subsidized prices. Farmers were also encouraged to obtain wash bore facilities through instalmental payment that stretches through three year period.

For example, the market price for the construction of wash bore ranged between ₦150,000 to ₦450,000 . Depending on the depth of the aquifer and the brand of the pumping machine required. In this stance, it is offered to urban farmers at between ₦50,000 and ₦60,000. As lofty as the government offer is, only a few farmers have access to the motorized pumping machine and the borehole in the study area.

In the same vein, inventory assessment indicated that it is only Barracks out of four study locations that has a significant number of farmers that have access to wash bore facilities at the subsidized rate. More than 50% of the respondents in Barracks claimed to have purchased the facilities from the open market. Alapere has just six boreholes with only three functioning. Tejuoso has one while Ikeja has none.

In response to the reason for the poor acceptability level of government offer, the head of extension office argued that the number of motorised pumps supplied by the government were very few compared to the number of request that were made. For instance out of the 492 pumps distributed in 2000/2003 season by NFDP-1 for Lagos State only 4 were allocated to urban farmers.

Other observed reasons for minimal purchase of government wash bore are the negative socio-cultural perception of urban farmers, strict pre-conditions for the opportunity as well as land insecurity problems. For instance, most of the farmers in Lagos are seasonal farmers of the Hausa cultural background who do not perceive the need for constructing expensive and permanent facilities on a land that does not belong to them, and from which they can be ejected without notice and without compensation.

Moreover, most of the Hausa farmers in Tejuoso and Alapere are seasonal migrant farmers who cultivate for just six months in a year and return to their place of origin for another six months. This pattern of movement does not encourage durable and permanent investment in water infrastructure for urban agriculture. Availability of cheaper and alternative source of water like River Ogun in Ikeja farm, and Canal for Alapere and Tejuoso farms discourages farmers from embracing the government offer. The belief is held also by farmers that the use of pumping machine destroys tender plants because of the force it exerts during irrigation process (FGD, January, 2004).

4.1.2.3 Fertilizer and Manure Inputs Activities of LSADA

Although, parts of LSADA's responsibilities are the procurement and distribution of fertilizers, pesticides, herbicides and insecticides, it does not have any formal and solid strategy for the integration of poultry waste, solid waste and wastewater into urban agriculture in Lagos. On one hand, knowledge and activities of soil improvement and soil management are basically entrenched in the distribution sales and application of inorganic manure. On the other hand, based on their local and traditional knowledge farmers believe that the utilization of animal manure including poultry waste, cattle dung, pig dung and goat and sheep waste are significant nutrients in softening and improving the quality of agricultural soils (Howard and Kid 1991; Pasquini and Alexander, 2005).

Notwithstanding, one major constraint to the effective distribution of inorganic manure according to the head of extension services is inadequate supply of the products. There is swift and epileptic variation in the demand and supply of the product due to the activities of hoarders and smugglers. The cost is therefore high and far above government subsidized price. For instance a bag of 50Kg NPK is procured for ₦2,850 instead of the government approved rate of ₦1,550 for the same product. Even with the escalated price, urban farmers do not have access to it when needed. The high use of poultry waste thus becomes the last resort as it is easily accessible and cheap (a bag of average size of poultry waste of 50kg sells for ₦300).

The inability of LASDA to effectively support urban farmers in the provision of inorganic manure encouraged the utilization of poultry waste for food production. Its associated problems which include negative health and environmental impacts, inadequate supply, mishandling during distribution, loss of important nutrients are also recognized. The negative health impact among others has however raised more threat to users and consumers of the final product due to improper and inadequate treatment, lack of treatment skill and personnel, inadequate space for treatment and equipment and laboratory for determining quality of poultry waste.

For example it takes four weeks to manually and adequately treat and compost poultry waste before it can be ready for use. This process, as some farmers have pointed out, is too cumbersome and demanding, in terms of time, human and material resources. With this combination of factors, it becomes obvious why poultry waste is haphazardly integrated into urban agriculture in Lagos.

4.1.3 Lagos State Water Corporation

The corporation was established to develop, regulate and manage the municipal water resources and also to ensure efficient and effective water supply for all purposes including domestic, industrial and agricultural water need. However, research results revealed that Lagos water corporation does not have policy agenda for urban agricultural areas. No water quality-monitoring program is available for agricultural activities. Like land distribution activities, water is considered priority for urban households, industrial and commercial purposes.

There is water scarcity for urban food production leading to indiscriminate use of water and exposure of users and consumers to health risk, although, it is acknowledged that sites of most urban farms are located outside the planned urban areas where the state water infrastructure is available. The corporation has been unable to extend water services to urban agricultural areas because agricultural activities fall outside of their jurisdiction.

4.1.4 Lagos State Waste Management Agency (LAWMA)

LAWMA is responsible for efficient and effective management of liquid, gaseous and solid waste. They have the ability to make byelaws to give legal backings to their functions. At the early state, the agency does not have any form of affiliation with urban agricultural activities as a stakeholder in urban waste management system. The activities of the agency were restricted to urban waste (solid) collection, transportation, recycling and disposal activities. Waste sorting, reuse, composting and recycling activities do not include waste management for manure generation for agricultural practices despite, the high biodegradable content and composition of urban waste.

With about 17 million kg of waste generation per day (GreenNews, 2007) coupled with the numerous waste management challenges in Lagos, in addition to the realization that the use of inorganic manure is harmful to human, the Lagos State government in 2002 partnered with a foreign organisation and established ten compost sites. Of the ten compost sites only one- the Earth Care is functioning in Ikorodu.

At both international and local levels the output from this established-compost, has been proved to promote and improve soil texture. It also improves soil structure, aeration and increase water retention capacity because compost manure is the best mulches and soil amendment used as alternative to inorganic and untreated manure if properly mixed. According to the Manager, Earth Care produces between 400-700 tonnes per day. They use materials such as Algae, Seaweeds, Lake Moss, egg shell, Newspaper and sawdust. It was also gathered that less poultry and animal waste are used as input due to the high possibility of disease transmission (Green News (2007).

However, as good as this composting activity seems, a major constraint for full, effective and efficient operations has been lack of information and low awareness about its existences among farmers.

4.1.5 Lagos State Environment Protection Agency (LASEPA)

In general the State Ministry of Environment which is represented by Lagos State Environmental Protection Agency (LASEPA) is the main player in monitoring the use of resources that could pose health and environmental threat. Field analysis revealed that habitually, most of the monitoring activities of the agency are not carried out especially as related to poultry waste and shallow well water management for urban food production. LASEPA's activities are entrenched only in monitoring and minimizing industrial pollution and its effect on the urban environment. There is therefore no check of any form on the utilization of poultry waste for food production. Lack of checks on the use of animal waste to ensure safe use of waste for food production has exposed the entire urban community to health threat, since the products from such farms are sold in the open market.

For instance, intervention proposed by the government to curb the bird flu attack on poultry birds and poultry workers and its transmission and death on those that come in contact with it, did not consider the use of poultry waste for vegetable production. In an interview with an Environmental Officer of the agency (7th of June 2006), he asserted that the agency's activities are presently limited to environmental pollution emanating from industrial activities.

4.2 Roles of Informal Institutions

Collective roles according to Moss (1997), is important in any informal setting because it motivates and facilitates social and moral economy and also provides social bonds for attaining collective outcome. Such collective association and dense social network give way to informal agreement by ensuring that agreements are kept and all concerned members have one voice. The investigation into the roles of the informal Organization in poultry waste and shallow well water focused on Lagos State Vegetables Farmers Associations and Vegetable Farmers Cooperative Society.

4.2.1 Lagos State Vegetable Farmers Association

The association is made up of all registered farmers who regularly pay their dues and also attend association meetings and functions. The structure of the association is as depicted in Figure 4.1. The Community Chairman reports to Local Government Chairman who in turn reports to the state Chairman. Activities and decision-making are highly decentralized and each farm community has its own autonomy. Within each farm community there exist sub groups based on gender, personal interest or ethnic association. But they all belong to the larger vegetable farmers' association. We therefore have sub-groupings such as the women group, cooperatives group and ethnic group

The Chairman, Secretary and the Treasurer form the executive members of the association members at the community level, but the responsibility of regulating farmers' activities lies largely with the Chairman and the Secretary. They are assigned with the roles of protecting the interest of farmers in the state. They serve as a single contact point for farmer's welfare and development avenue through information sharing, conflict management and agricultural input mobilization, sanitation and environment management of the farming community.

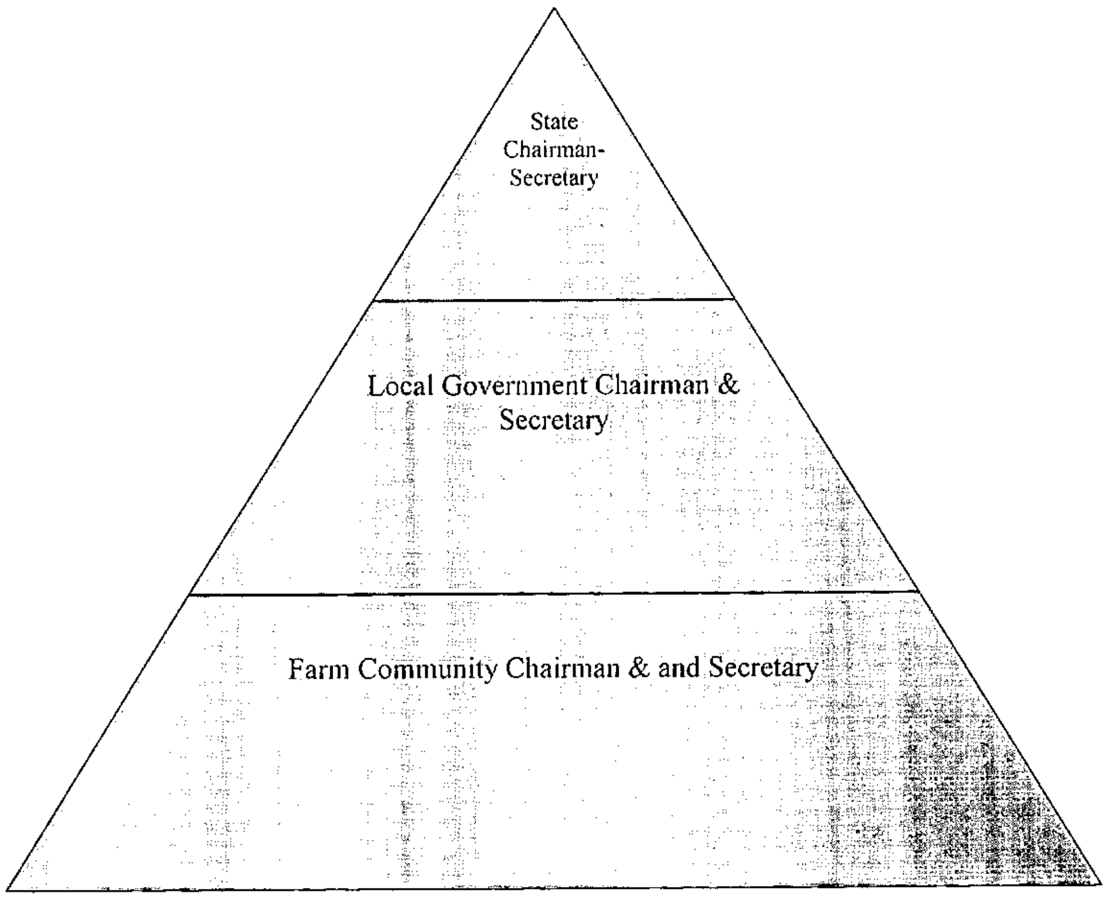

Figure 4.1 Structure of Levels of Vegetable Farmers Association in Lagos State

Activities related to shallow well water and poultry waste utilization for vegetable production are carried out as discussed below:

a. *Existing Arrangement for Access to Shallow Wells Water*

Members of Farmers' Association adhere to certain rules and also enjoy some benefits. Members are expected to attend association meetings and functions regularly. They have automatic access to other members' shallow wells especially during dry season. Members of the association can only report a member to the police after executive members must have exhausted all means of amicable settlement when there is misunderstanding among members. Members also mobilize each other as labour for the construction of wells and also assist one another with watering instruments like watering cans. Due to this collective effort there are no restriction to what volume of water, what quantity, the frequencies of collection and standard hygiene to be maintained during irrigation.

Membership ties are the main factor for collectivity and access to informal rules and regulation in the study area. Such ties bind farmers together and are conveniently used as a conduit through which farmers have access to water for irrigation. Farmers that belong to the same association share information about other important issues that affect their production activity, especially technical information. They also support each other during ill health, external harassment or in case of accident or death (Sithole, 2000).

b. Arrangement for Access to Poultry Waste

Another benefit members enjoy is access to cheap poultry waste for urban agriculture. Members operate through self-help approach. Members contribute monies to selected members who travel to sources and buy poultry waste in bulk. The poultry waste is then distributed among members at a lesser price.

4.2.2 Vegetable Farmers Cooperative Society

The cooperative society is a body of vegetable farmers that give financial and material resources to members. They are voluntary, democratically controlled and self-managed and location specific and highly influenced by gender, language, scale of production and place of origin. However, the basic objective is usually organizing people of the same needs into groups with their responsibilities including;

a. Daily, weekly and monthly contributions
b. Collection of loan from formal and informal financial institutions
c. Acting as collateral security to members

Although, the functions of a cooperative and association members differ, the regulations of the latter are relatively more binding on all farmers while the former is usually a voluntary membership. The study further discovered that the benefits of membership (either farmers association or cooperatives) are location specific. The advantages found, if compared to non-member correspond with Abban (2003) findings in Accra, Ghana who espoused revealed that gross revenue of a member of association are usually four times higher than non-association member who incur eight times the cost of production than an association member.

4.2.3 Production Techniques

There is no clear cut production technique in the study locations because of the differences in the socio-cultural background, experience of farmers and vegetable types. There is either exotic or non-indigenous vegetable which is consumed raw in salad such as lettuce and spring onions and traditional or indigenous diets vegetable like Tete (*Amaranthus*). Because different plants require different care and nutrients such as availability of water, days of transplanting and manure. This requirement hence motivates several intercropping strategies by farmers for effective and efficient vegetable production in the study area. The crops cultivation and their intercropping pattern as well as the operational processes are as presented in Tables 4.3 and 4.4. Mixed cultivation can take the form of planting a major crop like Lettuce and combining it with Spinage

Table 4.3: Crop types and crop combination for mixed cropping activities in Lagos

Main crops	Circles of production per year	Crop Combination for Mixed Cropping
Garlic	6-8	Tete / Green pepper
Lettuce	6-8	Tete/ spring onions
Spring Onions	5-7	Lettuce / Green pepper/ garden egg
Tete	9	Curry leaves/ Okra
Ewedu	9	Okra
Water leave	10-12	Bitter leaves
Bitter leave	10-15	Water leaves
Indian spinnage	10-12	none

Source: Field Survey, 2005

Table 4.4: Number of days for different operational activities

Crops	Sowing	Transplanting	Weeding	irrigation	Poultry waste application	Harvesting	Gestation
Lettuce	1	7th day	Thrice	Twice a day	Twice	once	76 days
Tete	1	5th day	Twice	Thrice a day	once	twice	35 days

Source: Field survey, 2005

In addition to the above mention activities, the filed observation further revealed that some farmers cultivate either exotic or indigenous vegetables alone, while some cultivate both at the same pace. However, further analysis depicted that:

i. Thirty percent (30 %) of vegetable products is distributed by market women. Who resell

ii. Twenty (20%) is bought by distributor and supplier to hotels, restaurants and eateries

iii. Five percent (5%) is purchased by representatives of hotels, restaurant and eateries

iv. Six percent (6%) and Thirteen percent (13%) are bought by Individuals for household needs and medicinal processors respectively.

v. Twelve percent (12%) is purchased by urban food and medicinal hawkers

vi. Three percent (3%) is bought by foreign individuals

vii. Four percent (4%) is bought by urban farmers who supply restaurant, hotels and eateries and

viii. Seven percent (7%) is marketed by urban farmers who retail in the urban market

The involvement of this group of persons in the distribution and marketing of vegetables depict the extent urban agriculture impact on the local economic development and the livelihood of the people in the study area. Often time, the marketing and distribution strategy is such that vegetable distributors travel from one urban farm to another in an attempt to get a reasonable quantity of vegetables to meet the needs of their customers and also to increase profits. While about 70% of the marketers are women come from urban market, only 25% are men. The existing pattern of vegetable distribution in the study area compare to what is obtainable in Accra, Ghana, shows that a wide difference exist between them. This is because in Ghana, farmers sell their produce strictly to middlemen who are solely responsible for distributing the vegetables to consumers and market women within the City (Obuobie et al 2006). In this type of setting, farmers are not allowed to sell their product to any other persons except the middlemen.

- *Climatic and Nutrient requirements for the growth of vegetables.*

The environmental condition for lettuce production is mild temperate climate with average rainfall range between 25mm to 152mm and average annual temperature between 21.11° C to 25. 55° C. It requires a reliable nutrient and well combined nutrient properties of about ratio 4:1:4 of NPK (Nitrogen, Phosphorus and Potassium). *Amaranthus* on another hand requires tropical climate of relatively high temperature (24° C to 30 ° C) and high rainfall that ranges between 40mm to 250mm. It needs about ratio 3: 1: 1.5 NPK for ensuring proper feeding of plant and maximum production output. (LaMotte, 1985). These geographical conditions could provide explanation for why urban farmers apply more water on *Amaranthus* than lettuce.

However, field survey revealed that the combination of NPK used for the production of Lettuce in the study area does not conform to this mix. This required that farmers should be knowledgeable on crop nutrient needs and requirements for effective production. For instance it is required that a farmer cultivating lettuce should be knowledgeable to know the status of the soil on which he is carrying out it production activity at all times. This means that if soil test shows that a soil has about 30% of Nitrogen, then only 70% of this would be required for proper plant growth. It also implies that the organic content of such soil should be given a constant consideration in order to maintain the best level of balance in ensuring high yield on constant basis.

Contrary to this assertion, field observation showed that farmers are not knowledgeable on proper soil management and method of manure application is crop based irrespective of the status of the soil at the time of sowing. The situation has trigged difficulty in sustainable vegetable production such that farmer's record poor yield and farm lands are often abandoned especially when soils do not respond to manure application.

- Production cost of lettuce and Spinage (per plot)

An attempt was made to estimate the cost of producing vegetable through field experiment and using two types of crops (lettuce and Spinage) in two of the study sites. The estimations per plot (0.06 ha) is as presented on Table 4. 5. This shows that there is variation in the cost of production between sites and between crop types.

Table 4.5: Estimated cost of Vegetable production in Lagos ((a plot = 60ft by 120ft = 0.06ha)

Inputs	Cost of production per plot			
	Alapere (Site A)		Barracks (Site B)	
	Lettuce	Amaranthus (Tete)	Lettuce	Amaranthus (Tete)
Cost of land	10,600	10,600	9,675	9675
Bed preparation	3,975	3,975	3,600	3,600
Seed/ Seedlings	5,300	2,650	3,600	1,800
Poultry waste	3,842.5	2,782.5	4,752	3,095
Care (watering, weeding and hired implement)	21,890	21,890	21,200	21,200
Pesticides	1,325	1,325	900	900
Inorganic fertilizer	662.5	662.5	450	450
Total	49,595	45,449	44,235	40,725

Source: Field Estimation, 2005

CHAPTER FIVE

5.0 CHARACTERISTICS OF POULTRY WASTE AND SHALLOW WELL WATER USERS

This section presents results of the characteristics of respondents in the four study locations. It focuses on farmers' socio-economic indices, gender differentials, crop types, cropping pattern, land holding and influence of the economic rent on farmers' production.

5.1 Socio-Economic Characteristics of Respondents

Urban agricultural activity like any other agricultural systems depends on several groups of interacting variables. But, in order to examine the differences in socio-economic characteristics of poultry waste and shallow well water users in the study area, thirteen socio-economic characteristics of the respondents were selected. The variables and data as presented in Table 5.1 show that majority of the poultry waste and shallow well water users in Lagos urban farms fall within economically active and dependable age group (18 -60 years). Locational differences in Figure 5.1 depicted that there are more young (youth) farmers in Alapere than in other farms.

There are more married farmers in Barracks (82.7%) and Tejuoso (74.3%) than in Alapere (56%) and Ikeja (65.3%) farms. Majority of the farmers have an average of 5 persons per household except Tejuoso which has an average of four persons per household. Higher numbers of farmers in Barracks (82%) agreed to utilize poultry waste for food production because they found it difficult to acquire inorganic manure.

Table 5.1: Characteristics of Study Population

Variables	Alapere	Barracks	Ikeja	Tejuoso
Number of plots per farmer	1.8	4.7	3.9	1.5
Ratio of male/female	7:1	1:4	2:1	11:1
Average age of farmers	30.4	39.2	38.0	34.7
Average number of fragmented farmlands per farmer	2.2	4.3	3.8	2.3
Ratio of exotic / local Vegetable	3:1	1:5	1:3	5:1
a. Reason for using PW {low cost (%)}	61	82	61	51
b. Reason for utilizing SW water {low cost (%)}	73	51	55	81
Educational level Secondary and above in % term	17	49	25	9
Average monthly income (₦)	12,404	15,690	18,958	11029
% of Married Farmers	56.	82.7	65.3	74.3
Average years of Experience per farmer	8.5	7.4	8.1	8.8
Family size (%)	4.8	5.4	4.6	4.4
Type of farming (ratio *FT/PT)	3:1	8:1	7:1	8:1

Source: Field Survey, March 2005.

*FT= Full time, PT= Part time

Other reasons given for the high rate of poultry waste and shallow well water utilization for urban agriculture include easy accessibility of poultry waste compared to its alternatives. It is also due to poor effects of continuous use of inorganic manure. Such effects include degraded soil matrix, invasion of weeds, soil acidification and poor crop yield. Reasons given for shallow well water utilization comprise of cheap construction cost and affordability.

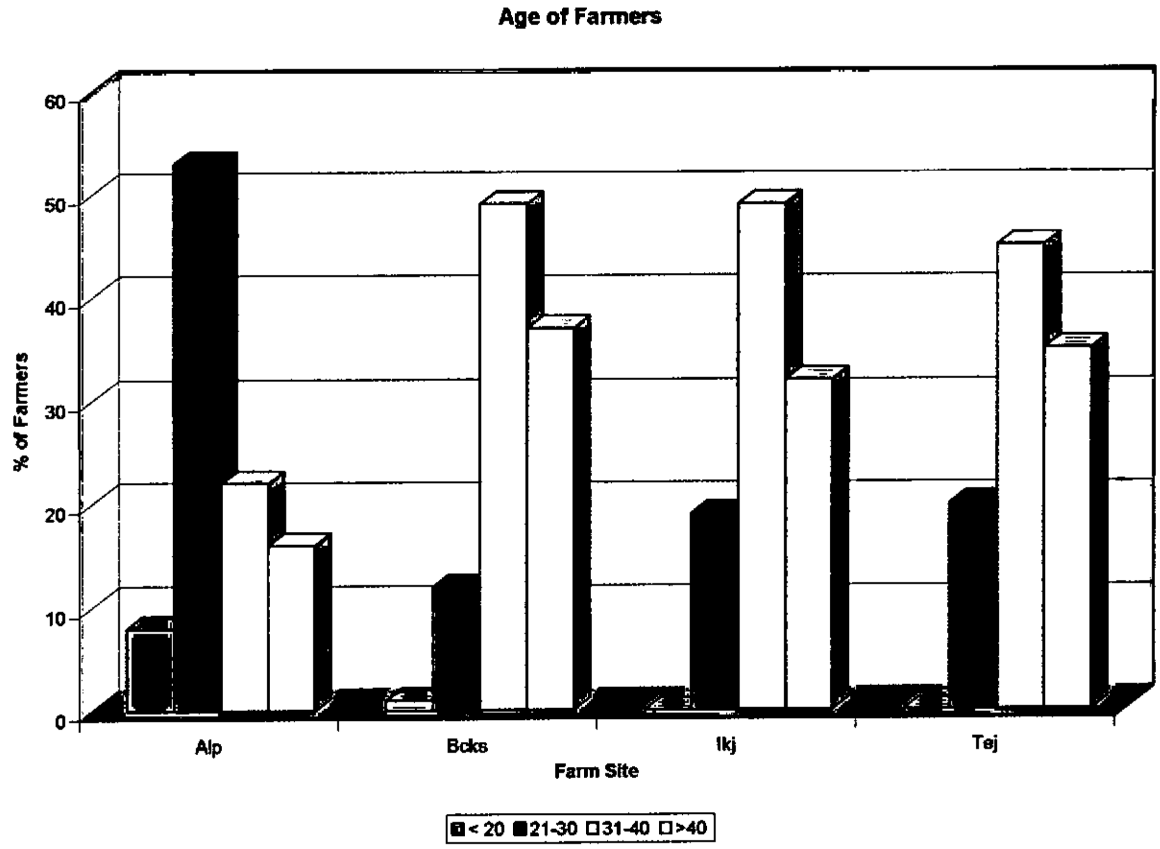

Figure 5.1: Age Characteristics of Urban Farmers

Ethnic background of poultry waste and shallow well users is depicted in Figure 5.2. It shows that 55% and 47% of the farmers in Tejuoso and Alapere are Hausas respectively while Yorubas dominate Ikeja. There is no particular ethnic group that distinctively dominates Barracks farm community. This distribution pattern exhibited by the ethnic background of the farmers also responds with farmers' religious background. This is because there is strong link between the Hausas and Islam religion. Majority of the respondents in all the farm sites have education level below secondary school level except in Barracks where 49.3% of the farmers obtain secondary education and above.

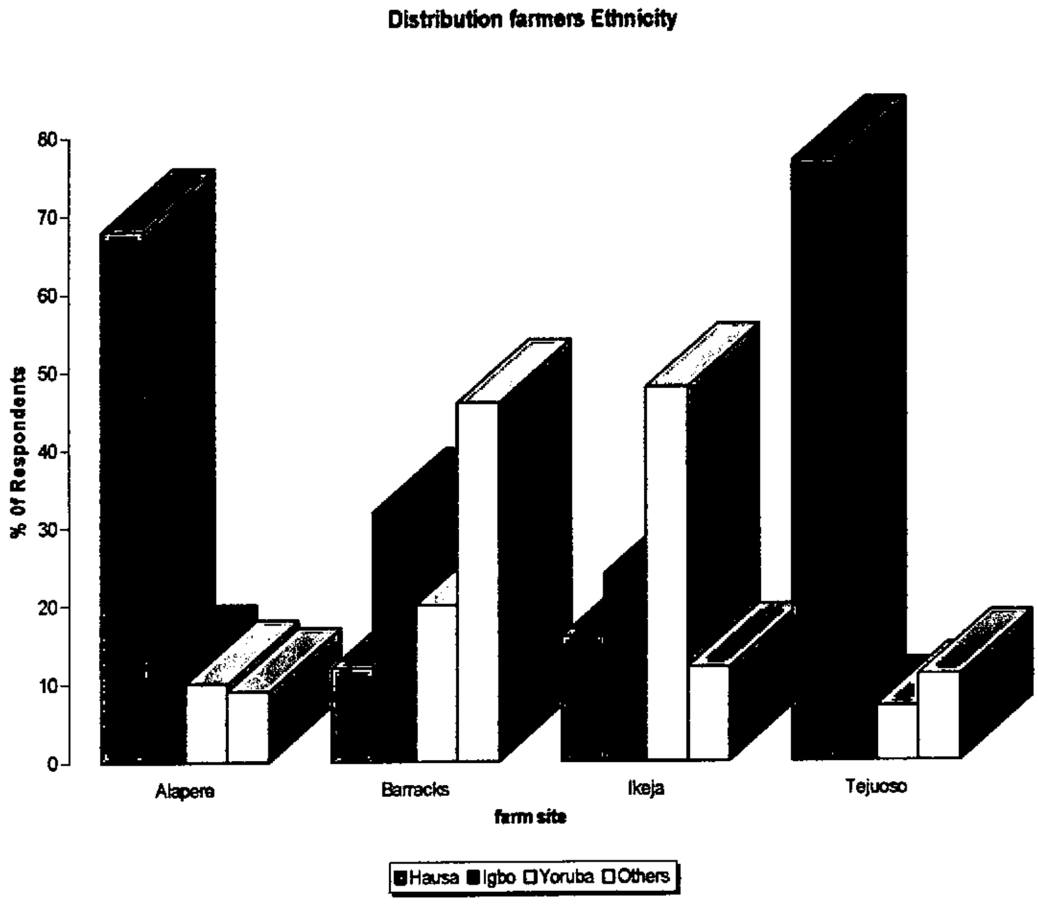

Figure 5.2: Characteristics of Farmers' Ethnicity

Urban agricultural activities including poultry waste and shallow well water utilization provide Income-generating avenue that sustain farmers' household. The ratio of full-time to part-time farmers in each location shows 3:1, 8:1, 7.1 and 8:1 for Alapere, Barracks, Ikeja and Tejuoso respectively. As depicted in Figure 5.3, average monthly income for all study locations is higher than Nigeria's minimum wage of N7,500 in 2006. This result further shows that urban agricultural activities using poultry waste and shallow well water can be an improved food production strategy for meeting the increasing urban population growth.

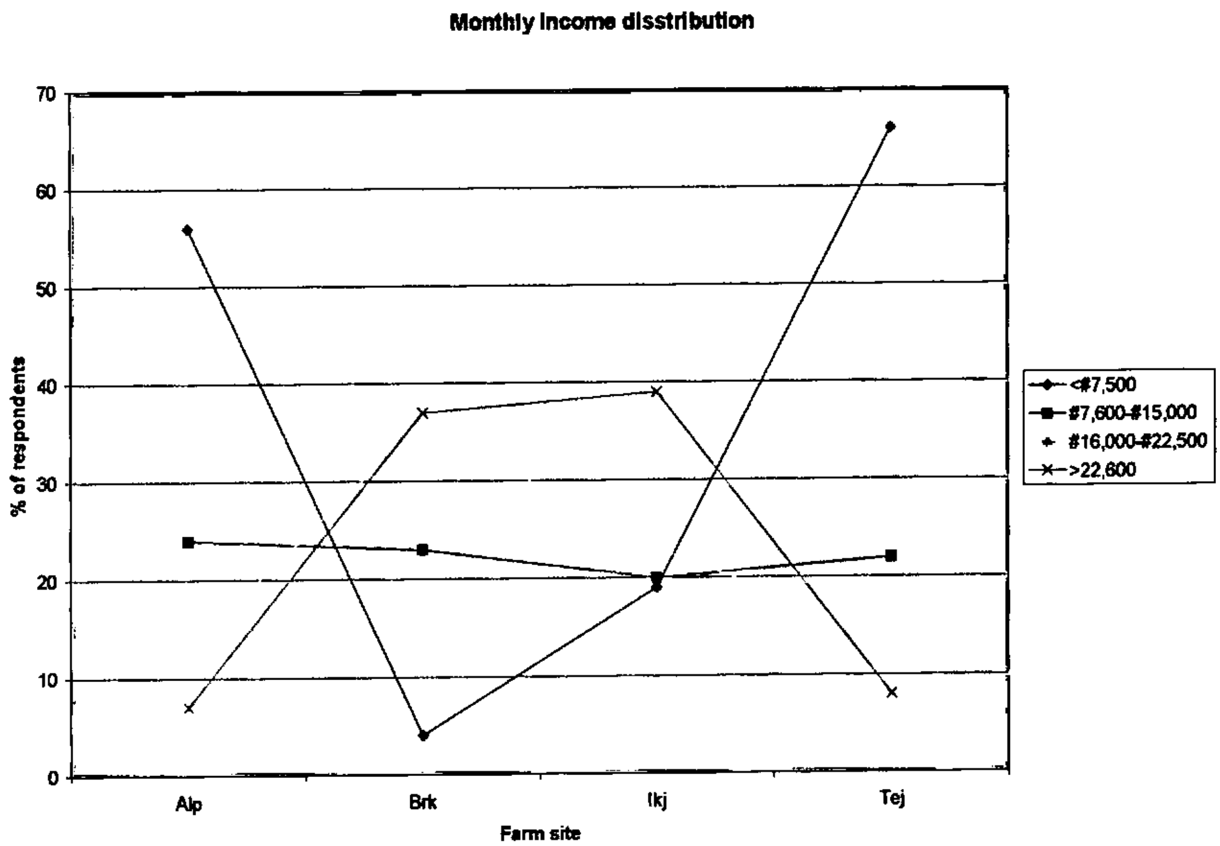

Figure 5.3: Characteristics of farmers' Income

The information gathered further revealed that farmers engage in urban agriculture for diverse reasons. The distribution of the reasons for their participation in urban farming is as presented in Figure 5.4. These reasons are unemployment, profession and to supplement other sources of income as well as for recreation.

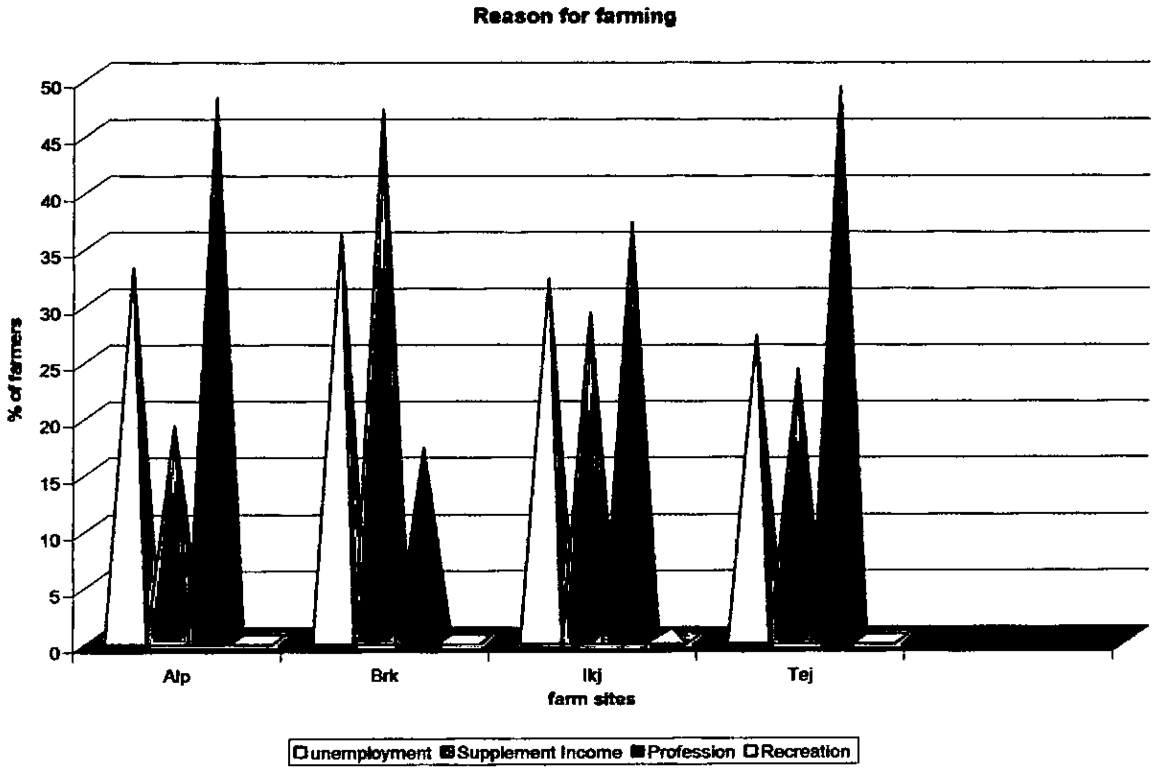

Figure 5.4: Characteristics of Farmers' Reasons for Participation in Urban Agriculture

5.2 Gender Characteristics of Respondents

Gender analysis on some aspects of the data shows that generally there are more men than women (see Figure 5.5). However geographical distribution of respondents by gender as presented in Figure 5.6 revealed that, there are more women farmers in Barracks than men with ratio 4:1, Whereas there are higher number of men farmers than women with ratio 11.1 in Tejuoso, 7:1 in Alapere and 2.1 in Ikeja The reason for this gender disparity in Alapere, Ikeja and Tejuoso may be attributed to the fact that men had more access to land in Tejuoso, Alapere and Ikeja farms.

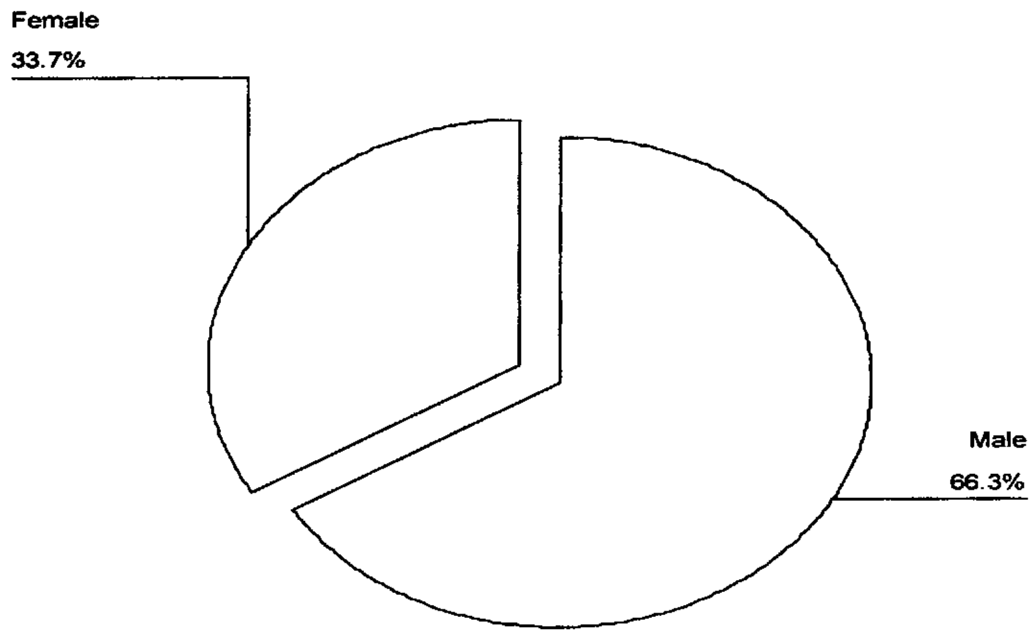

Figure 5 .5: Gender Characteristics of Respondents

Initially, women were more into marketing of urban agricultural products. In Barracks, women were more because more men were into formal employment. This opportunity provided women with less access to land for urban agriculture.

Average size of land holding for women is 4.6 plots in Barracks and 0.5, 1.2 and 0.3 plots for women in Alapere, Ikeja and Tejuoso. This means that, women occupy smaller plots of land than men. Similarly, majority (96.5%) of the female respondents cultivate local vegetables such as Amaranth SP, while 67.3% of male farmers cultivate exotic vegetables such as lettuce, spring-onions which have more financial value than local vegetables.

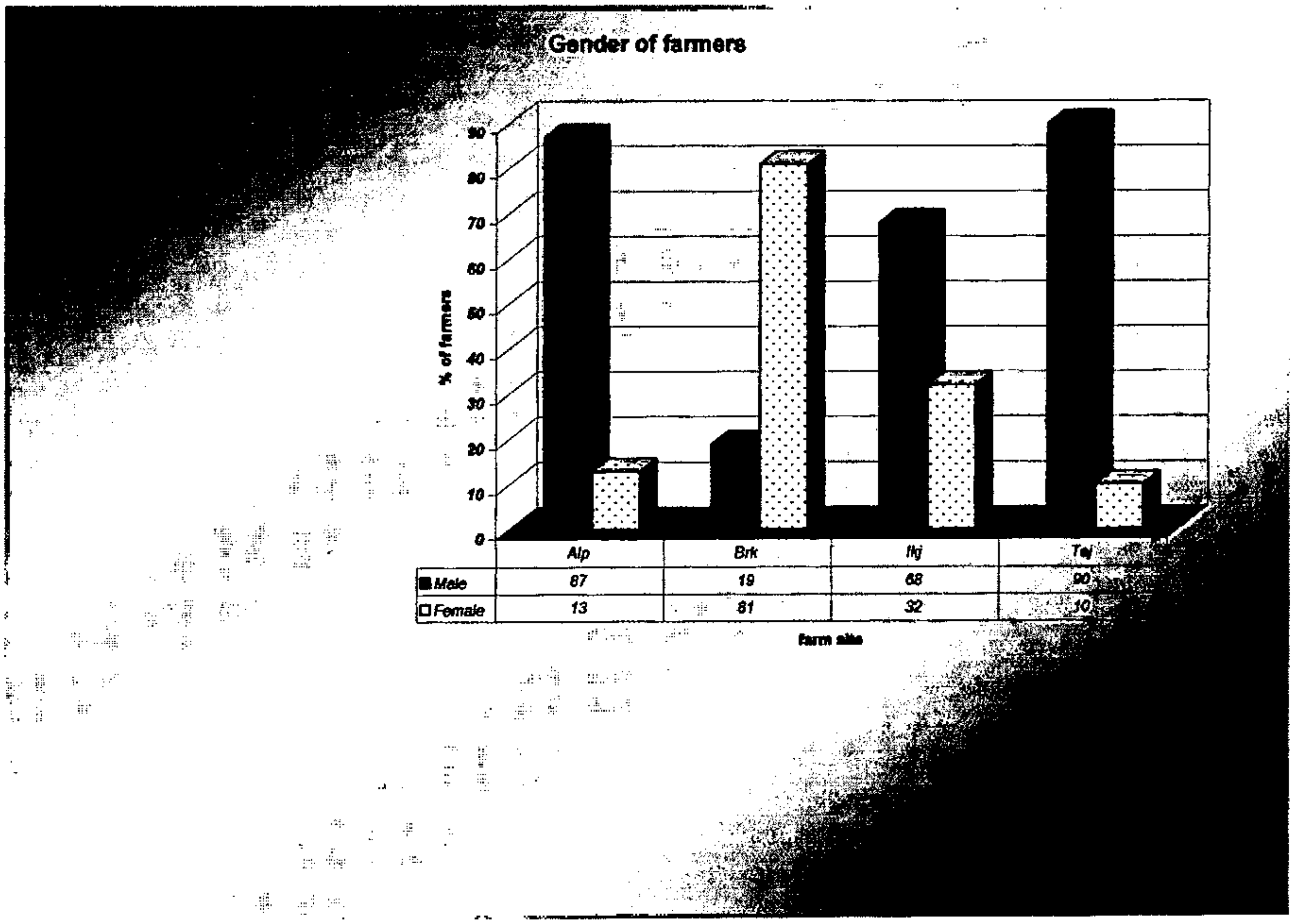

Figure 5.6: Distribution of Farmers by Gender in each Study Site

Furthermore, about 40% of women have children below four years of age whereas 52% of men have children above 10 years of age. This finding could relatively mean that men spend more on children than the women because of the demand for school fees, books and other needs which younger children do not require at their age.

The study also revealed that about 61.3% of women employ household labour while men employ more farm labourers. This could also imply that the use of household labour can impact negatively on the human and intellectual development of children such that their interest in formal education may be reduced. It might likewise provide less time for the household labourer especially children to do their school work and assignment.

Generally, more women earn less than ₦10, 000 per month except in Barracks where we have 45% of the women earning above ₦22, 000 per month.. This suggests that more women have less access to the relevant agricultural production factors such as land and water and agricultural inputs increase production and hence majority earns less. This is evidenced in Barracks where access to land and other infrastructure encourage high production and high income.

As depicted in Figure 5.7, both males and females are involved in all stages of crop production in Lagos, although the degree of involvement varies with farm operations and post harvest activities. Inspite, disparity in the distribution of agricultural resources if corrected could possibly propel and advocate for the essence of the women involvement in urban agriculture for poverty alleviation and food security. This is because women are caregivers and the quality of well being they possess largely determines the livelihood and quality of the well being of their household. This in the long run influences the social economic and sustainable development of the society.

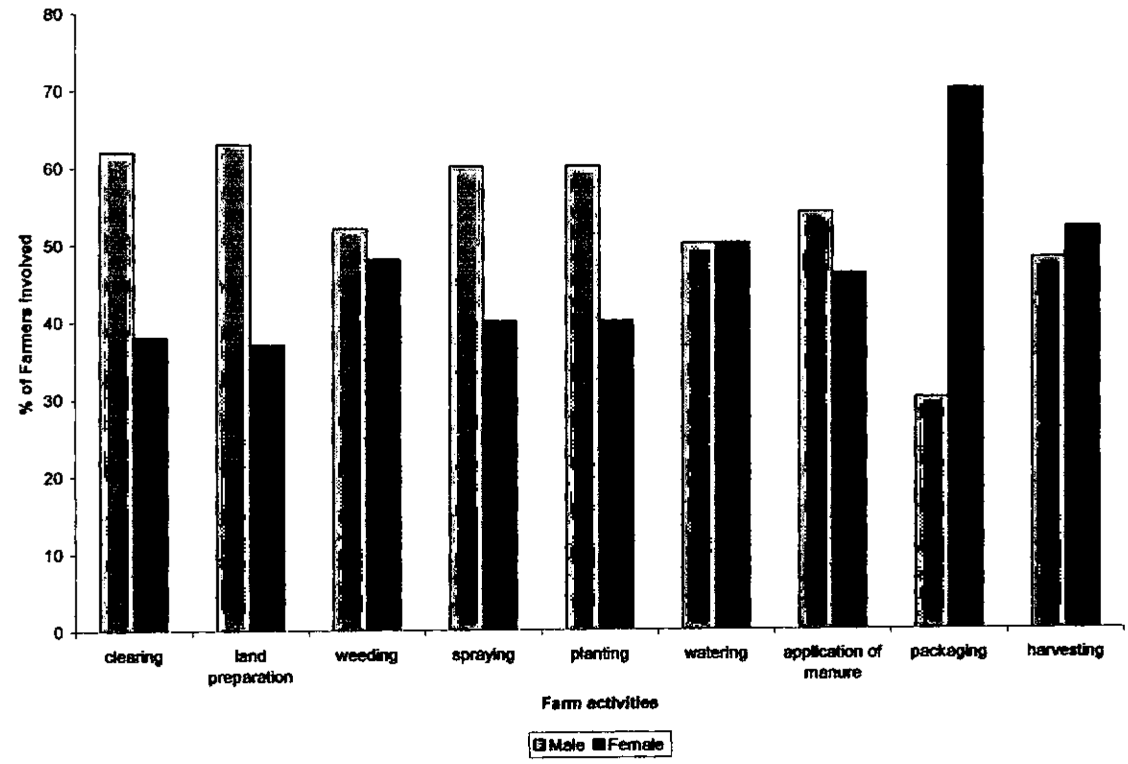

Figure 5.7: Gender Involvement in Productive Activities

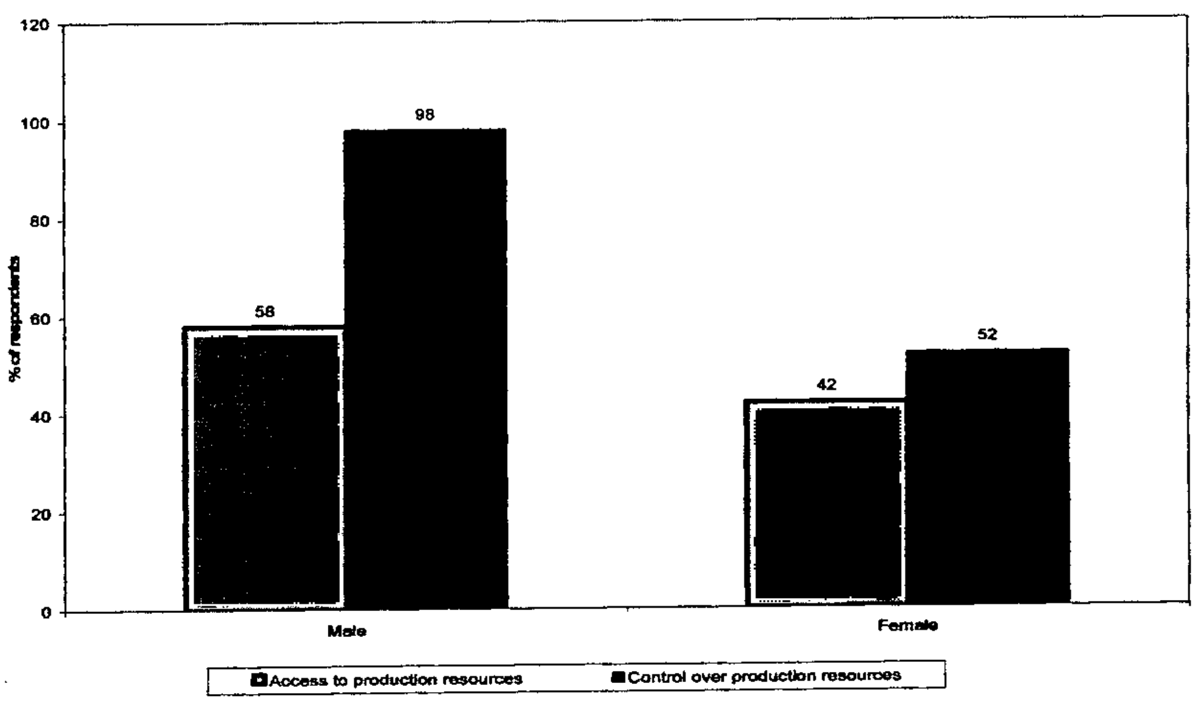

Figure 5. 8: Access and Control over Productive Resources by Gender

5.3 Farm Size and Land Holding Characteristics of Respondents

The data presented in Table 5.1 and Figure 5.9 show that Ikeja and Barracks maintain large land holdings with average of 4.7 and 3.9 plots per farmer. This is because they are located at the peri-urban area, where competition from other landuse activities (commercial, residential, industrial and recreational) is less. In Alapere and Tejuoso size of land holdings is small ranging from average of 1.8 to 1.5 plots per farmer because they located at the core metropolitan area.

The data similarly show that respondents maintain non-continuous and fragmented land holdings either within the same farm site or in other sites, in order to maintain a reasonable and desirable farmland. On the average a farmer owns 2.2, 4.3, 3.8 and 2.3 fragmented portions of lands at Alapere, Barracks, Ikeja and Tejuoso respectively.

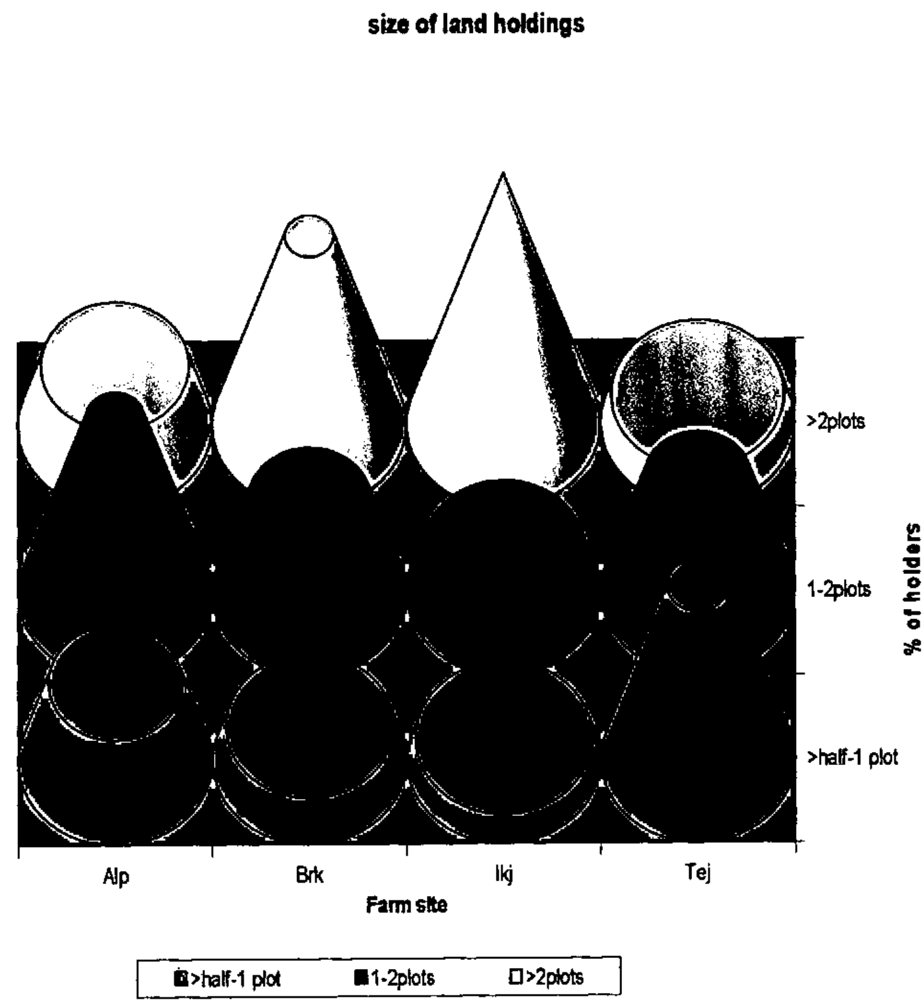

Figure 5.9: Distribution of Farm Holdings

5.4 Risk Management in Urban Agriculture

Decision making on risk management and adoption of innovations in urban farming is found to be very low. This is because it is believed that taking risk and adopting new innovations involve capital which is beyond what small urban farmers can afford. So urban farmers are unable to consider attaining some desired level of moderate comfort, but instead are preoccupied with survival. Another reason is that the small size of the farm leaves no room for experiment and improvement frequently requires. It does not also provide incentives needed in order to overcome the aversion to the risk. Risks on water and waste manure lead to mismatch between water and manure, and crop need as well as difficulties in expanding hybrid production.

This implies that limited access to land does not encourage urban agricultural expansion and intensification is limited due to lack of innovations and equipment. Knowledge on risk management is therefore minimal as there is little awareness on insurance and risk management.

5.5 Sources of Fund for Urban Agriculture

Support (financial and service) for urban agriculture can make a difference to farmers because lack of access to financial facilities could hinder producers ability to acquire loan, material, implement and equipment which may increase the returns and investment or add value through better processing, storage and packaging. It could also help to minimize the risk involved. There is need for access to working capital for maintenance of small investment and for potential expansion.

Most of the urban farmers face limited access to credit and investment. An interview with financial institution officer revealed that providing finance to small farmers is too risky because small scale farmers lack collateral needed for bank loan.. Other reasons are due to non-literate in Western education and lack of knowledge of procedure for accessing loan. At times cumbersome nature of filling loan forms deters illiterate farmers from applying for bank loan. However, the sources of fund for agricultural practices in study area are as depicted in Figure 5.10. It revealed that about 20% of the farmers have access to financial support from the formal financial institutions and Non-governmental Organisation has the least support for urban farmers.

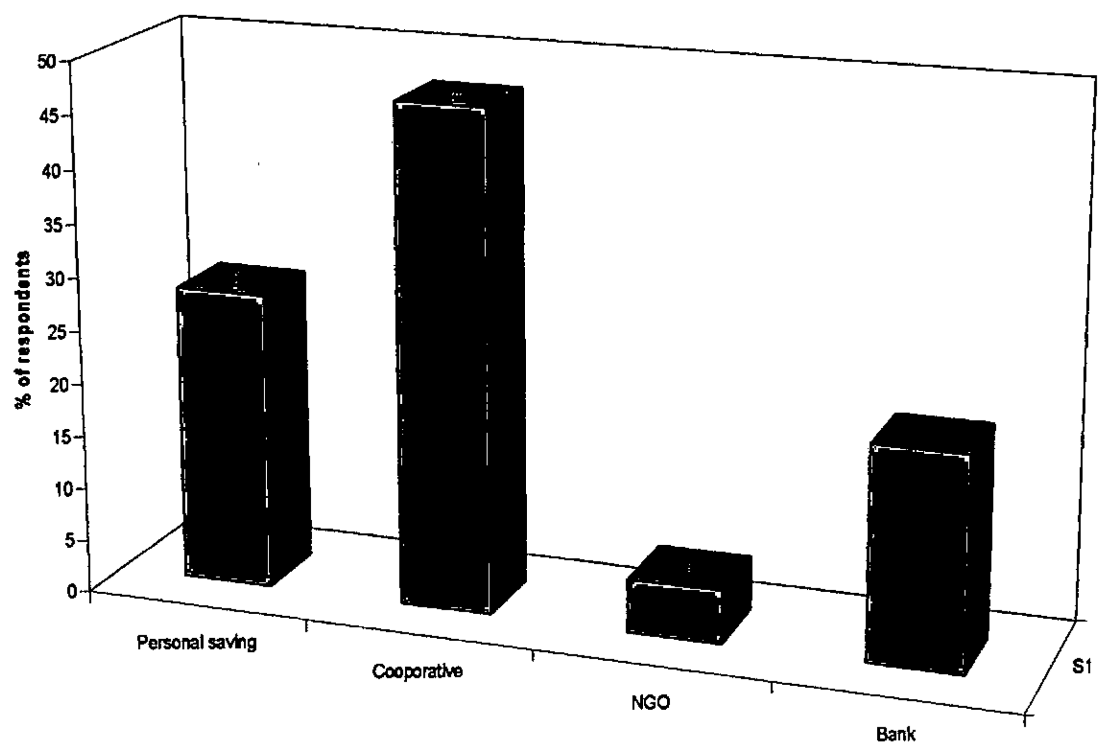

Figure 5.10: Source of Fund for Urban Agriculture in Lagos

Table 5.2: Types of Vegetable Crops Produced in the Study Area

Exotic	Area of greater production	Local crops	Area of greater production
Lettuce	Alapere & Tejuoso	Water leaf	Barracks
Spring onions	Alapere & Tejuoso	Amaranth spp (Tete)	Barracks/Ikeja
Parsley	Alapere	Ewedu C Oliferus	Ikeja/Barracks
Dheal	Alapere	Okra	Ikeja
Radish	Alapere	Bitter leaf	Barracks
India spinnage	Alapere	Fluted pumpkin	Barracks
Aloe Vera	Alapere	Tomatoes	Ikeja/ Barracks
Garden egg	Barracks	Lemon grass	Ikeja/ barracks
Green pepper	Ikeja		

Source: Field Survey March 2005

5.6 Influence of Net Returns on Vegetable Production

In order to determine whether net return per unit area of crop influences the cultivation of crop types, Von Thunen model was used to estimate the net return of two types of crop in the study area. The model is represented by equation R = E (p-a) – Efk (where R = Net Returns, E = yields, p = revenue, a = cost, f = transport cost per unit distance, and k= distance). Using a plot (60ft by 120ft) as land per unit area for two types of crop (exotic and local), the result as presented in Table 5.3 and Figure 5.11 show that the net return for exotic crops is higher than indigenous crops in all the study sites. As such, it is expected that exotic vegetables should be a dominant cultivable crop in all the study locations. In contrast, it is only in Alapere and Tejuoso that the model has certain approximate reality. The model does not necessarily operate in Barracks and Ikeja in spite of the high net returns for exotic crops.

A simple linear regression test was carried out, with the null hypothesis that; there is no significant relationship between net return and size of land allotted to crop types in the study area. The summary of the model as presented in Table 5.4 depicts that R has a value of .909 for the relationship between net return and size of land allotted to the production of indigenous crop, while R has .996 value for the relations between net return and size of land for exotic crops.

Using the R^2 value the result shows that net return accounts for 82.6% for the cultivation of indigenous crop while it accounts for 99.3% for exotic crops. At the 0.05 significance level one can assume that there is no relationship between net return and the cultivation of indigenous crops ($P > 0.05$). However, the findings show significant relationship ($P < 0.05$) between net return and cultivated exotic crops in some sites. One reason that could be deduced for the outcome of this result is that the model's assumptions are not realistic in the study area. For instance, socio-cultural structure of Lagos market affects demand and supply for exotic crops. Other factors responsible for pattern of the result include the high perishability of exotic vegetables, absence of storage facilities, and high cost of production in addition to differences in the bio-geophysical characteristics of the locations.

Table 5.3 Estimated Yield, Cost, Revenue and Net Returns of Two Crops per Unit Area

Farm site	Vegetable types	Yield per unit area (E)	Revenue per unit area (₦) (p)	Cost of production per unit area (₦) (a)	Net Revenue per unit area (₦) (R)
Alapere	Lettuce	3,578	159,000	38,955	120,045
	Tete	2199.5	92,750	35,245	57,505
Barracks	Lettuce	2,736	99,000	34,560	64,440
	Tete	1,890	54,000	31,050	22,950
Ikeja	Lettuce	2,160	99,000	34,740	64,260
	Tete	1,890	54,000	30,960	23,040
Tejuoso	Lettuce	3,445	172,250	38,955	133,295
	Tete	2,385	106,000	34,980	71,020

Source Field Survey, March 2005

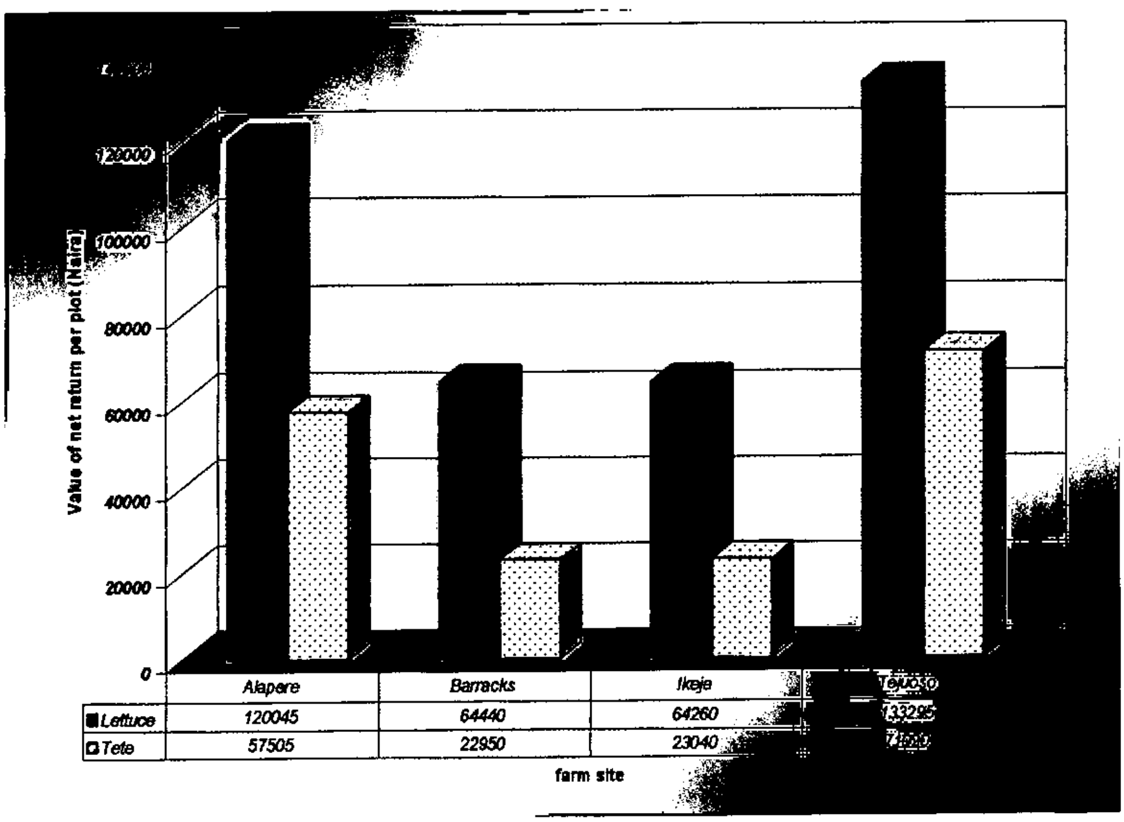

Fig 5.11: Comparison of the Net returns of Lettuce and Tete in Naira

Table 5.4: Regression Test on the Relationship between Net Return and the Cultivation of Crop Types

Types of crops	R	R Square	Adjusted R	Std Error of the Estimate	coefficients		Remark
					t	Significance level	
Indigenous	.909	.826	.739	337.076	3.081	.091	P> .05
Exotic	.996	.993	.989	25.909	16.273	.004	P< .05

Source: Data Analysis, 2005

5.7 Cropping Pattern in Urban Agriculture

Urban agriculture in the study area is manually operated and therefore rely heavily on traditional tools such as hoes, cutlass, head pans, buckets and diggers. Cultivation practices are rotational and mixed cultivations. However, the mixed and rotational cultivation systems do not consider the nutrients requirements and need of vegetable crops that are either mixed or rotated. Rather, the concern for the existing cultivation systems rest on maximizing land use, increased crop production and profit.

The findings further show a distinct pattern of vegetable cultivation through out the year depending on assumed travel pattern of foreigners. For instance, Discussions with community leaders revealed that more of exotic vegetables are cultivated between September and March (period 1) while less of it is cultivated between April and August (period 2) each year. During the second period, farmers assume that foreigners especially the whites, who are the main consumers of exotic vegetables usually, travel to their home country for summer holiday. And thus the patronage which is needed to sustain their business becomes low.

5.8 Impact of Land, Labour and Capital on Urban Agriculture

Generally and like other production systems, urban agriculture entails producing food and services to satisfy human wants. It also involves the use of resources such as capital, labour, land and entrepreneur needed to produce or cultivate or provide services. For instance land is a vital and major resource for agriculture. Labour is needed for irrigation, harvesting, weeding etc while capital is needed inform of money and implement, tools and machines for effective and efficient production. The impacts of urban agriculture on factors of production in Lagos are as presented below:

5.8.1 Land: The growth of human settlement creates a competition between urban land and agricultural activities because of scarce urban land water and other resources. According to Mushamba et al (2003), land for urban agriculture is either not available or when available it may not be accessible and when accessible it may not be usable.

Notwithstanding, investigations has revealed that land use for urban agriculture has created certain impacts on Lagos economic development. These include:

a. protecting lands for land owners who are not capable to put their land into use. Provision has to be made for security men to look after such land areas to prevent other people from encroaching and claiming such lands, thus minimizing conflicts over such a land.
b. Reducing hideouts for miscreants and government expenditures on maintaining the urban green areas. Without the use of urban land for agriculture, the limited

state resources would have been expended for cutting of grasses and bushes. The existence of such bushes would have attracted miscreants in Lagos.

c. Enhancing the atmospheric oxygen need of the city. This is because plants expel oxygen into the urban atmosphere which most often is depleted due to high number of Lagos resident population and industrial activities.

d. Allowing ideal, waste and fragile lands to be put to productive uses. The practice of urban agriculture on lands unfit for construction has stimulated the use of wetlands around River Ogun, Alapere, Oke-Afa Tejuoso areas to be put to use for agriculture, It has also allowed unused lands belonging to government institutions and department and private developers in Volks, Barracks, Epe, Ikorodu, Kirikiri, Stadium, Iyana-Iba and other areas to be used. Some of the farmers are staff like security men, cleaners, and messengers etc who farm to supplement their income.

e. Enhancing the beauty of the city. The use of open spaces to practice horticulture, flower gardens promotes greening of the environment and conservation of biodiversity.

5.8.2 Labour

Labour is another important factor in urban agricultural practices in Lagos because of the vital function it performs. Field survey showed that one urban farmer hires at least one paid labourer per day especially for the high energy demand of the farm practices such as daily irrigation, stumping and well construction work. This means that a farm with two thousand farmers would require another two thousand people as labourers. Apart from the direct labour, the practice of urban agriculture also has indirect impacts on labour. There are countless number of urban dwellers involved in sales of seeds, manure, pesticides, cooked food around farms and farm implements. There are many other individuals involved in the distribution, marketing, processing and transportation of products from urban farms, without which they would be jobless. Urban farmers also use family labour, permanent as well as casual labourer. Farmers use family labour because most of the farms are family owned and so most of the labour are provided by the farmers' households especially the women farmers. Casual labour is also hired at peak periods of work load and for expansion.

Further more, there is seasonal geographical mobility of labour in urban agriculture in Lagos, mostly among the direct labourers. For instance, there is higher number of labour during dry season, while the number reduces significantly during rainy period due to the need to migrate for economic and family considerations. It therefore means that urban agriculture contributes to employment generation activities of the state.

5.8.3 Capital

Urban farmers require not too large capital due to the smallness of most urban agricultural practices. However, capital requirement for urban agriculture sometimes entails liquid capital used specifically to refer to as money for all sources used for production. There are other types of capital such as social and fixed. However, this study has restricted its analysis to circulating or money capital, because of the complexity of dealing with other forms of capital.

One of the impacts of urban agriculture on capital is that it contributes to the capital build up of the state, through direct and indirect payment made for the use of certain public and private facilities. Although urban agricultural practices is informal activity in Lagos, the payment of levy on electricity, water, waste and others such school and hospital bills by urban farmer, enhance government revenue generation.

CHAPTER SIX

6.0 PATTERN, MANAGEMENT AND IMPLICATIONS OF SHALLOW WELL WATER ON HEALTH

Generally, agriculture including urban agriculture is the largest consumer of water, and it is a means through which plants nutrients are transmitted for plant survival. According to Food and Agriculture organization (2002) water is the source of food security. Adequate and easy access to qualitative water supply for food production encouraged healthy productivity with implications for poverty reduction. This section therefore examines the spatial distribution of water supply for urban agriculture with specific focus on shallow well water utilization in Lagos metropolis. The chapter assesses the factors responsible for shallow well water distributional pattern and also evaluates its management practices. In addition, it determines shallow well water quality and its implications on production output, as well as the influence of socio-economic characteristics on the management pattern in the study area.

6.1 Distribution and Determinants of Shallow Well Water Utilization

The analysis on water utilization was focused on dry season irrigation activities, a period when demand for water is usually high. The distribution of water sources for urban agriculture as indicated in Figure 6.1 shows that over 85% of the urban farmers in Alapere, 94% in Tejuoso, 53% in Ikeja and 40% in Barracks source water for irrigation from shallow wells. The information gathered from the questionnaire further reveals that

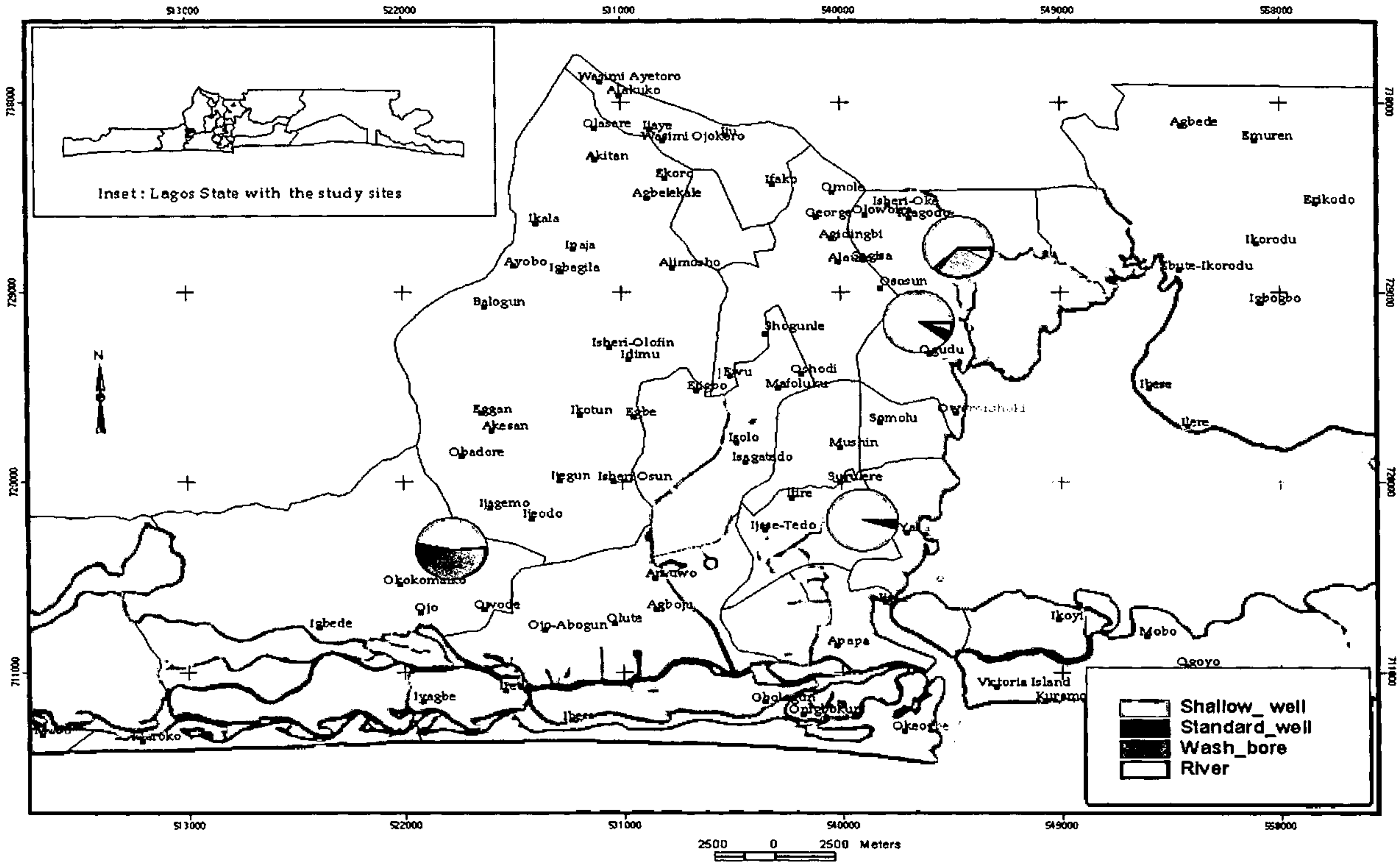

Figure 6.1: PATTERN OF SHALLOW WELL WATER UTILIZATION IN LAGOS METROPOLIS

majority of the farmers utilize shallow well water for urban agriculture in Alapere and Tejuoso because shallow wells are cheap to construct and highly affordable to farmers. Farmers in Barracks farm utilize less shallow well water due to the existing land tenure arrangement which encourages investment in alternative source of water such as wash bore. In Ikeja farm, the presence of river Ogun provides alternative water source for farmers.

In order to statistically determine factors that described the spatial pattern and extent of shallow well water utilization, Pearson Regression model was employed. This model is a test of the strength of the net as well as partial contributions of the various factors that could be responsible for the distributional pattern of shallow well water utilization in the study area.

The empirical regression test was therefore conducted using level of education, farmers' experience, number of farms, monthly income, size of land holding and vegetable type being produced independent variables (Xs) and the quantity of shallow well water utilization as the dependent variable (Y). The results are presented in Tables 6.1and 6.2 and reveal that the estimations of the proportion of variance accounted for by combination of all the independent variables (regression) using percentages, are 3.2% in Tejuoso, -1.5% in Ikeja, 1.8% in Barracks and -.5.6% in Alapere.

Table 6.1: Regression Value for Shallow Well Water Utilization in the Study Area

Sites	Regression coefficient	R Square	Adjusted R squares	Percentage	Standard Error of Estimate	(ANOVA)	
						Significance level	F Value
Alapere	.180	.032	-.056	-5.6%	.485	.897	.368
Barracks	.259	.067	.018	1.8%	.573	.561	.816
Ikeja	.316	.100	-.015	-1.5%	.702	.308	1.220
Tejuoso	.332	.110	.032	3.2%	.689	.226	1.404

Source: Field Survey March 2005.

This result implies that the combined factors provide only 3.2% and 1.8% explanation for the extent to which shallow well water is utilized for urban agriculture in Tejuoso and Barracks. The negative signs of the model in Alapere and Ikeja also imply that the combined factors are disincentive to the shallow well water utilization in the Ikeja and Alapere.

Table 6.2: Value of Standardized Beta Coefficient by Site

Independent variables	Alapere		Barracks		Ikeja		Tejuoso	
	Beta value	**Significant level**	**Beta value**	**Significant level**	**Beta value**	**Significant level**	**Beta value**	**Significant level**
Constant	1.223	.000	2.190	.000	2.592	.000	1.726	.008
Level of Education	-.040	.753	**.228**	.067	-.222	.083	-.118	.322
Farming Experience	.079	.630	.003	.979	.078	.520	-.170	.153
Number of farms	-.122	.350	.106	.391	-.051	.704	.103	.383
Monthly income	-.002	.989	.118	.348	-.116	.354	-.050	.679
Size of holding	**.155**	.332	-.075	.565	.111	.371	**.231**	.049
Types of vegetable	-.029	.849	-.089	.473	**.155**	.202	.089	.452

Source: Field Survey, March 2005

However, a consideration of partial contribution of each independent variable using standard Beta coefficient reveals that size of land holding has the greatest influence in Alapere (r = .155) and in Tejuoso (r = .231). Level of education has largest influence in Barracks (r = .228) while types of vegetable planted (r = .155) makes the highest in Ikeja (see Table 10). This means that there is a spatial variation in factors determining the extent of shallow well water utilization for urban agriculture in the study area. For instance while size of the land a farmer owns influences the extent of shallow well water utilization in both Alapere and Tejuoso, level of education of the farmers and the type of vegetable or crop a farmer cultivates provide an explanation for the extent to which shallow well water is used in Barracks and Ikeja farms respectively.

6.2 Functions of Shallow Well Utilization for Urban Agriculture

The study also reveals that shallow wells for urban agriculture in the study area make water available for irrigation through out the year especially where there are no alternative sources of water supply. It makes the poor farmers have access to water where the cost of procuring wash-bore is high and unaffordable to the farmers. The use of shallow well water for urban agriculture makes cultivation less expensive to farmers.

Shallow well water utilization provides water during dry season for food production. It also preserves the indigenous knowledge and practice of the local people in crop production since it is a traditional practice.

Through its applications, operations, maintenance and other related activities it creates job opportunities to landless and relatively inexperienced farmers. Shallow well activities provide income-generating avenues to some urban poor and therefore sustain non-farmers' livelihood in the urban community. Income realized from dry season production which is made possible by the utilization of shallow well water improves farmers' well being as they would have been idle during dry season.

Observation from the field survey also revealed that shallow well is useful to Lagos farmers for purposes other than irrigation. Majority of respondents in Alapere (74%) and Tejuoso (82%) claimed that shallow well water is used for washing vegetables before they are sold. In addition resident farmers and labourers alike use shallow well water for bathing and for laundry purposes. It is also used for washing farm implements.

The presence of shallow well water reduces the length of time farmers would spend sourcing and fetching water for irrigation It also reduces water demand pressure on the urban municipal authority. It is therefore a mechanism for reducing farmers' water pressure on farm activities.

6.3. Management Practices of Shallow Well Water for Urban Agriculture

The management of any resources natural or human determines the extent of positive or negative impacts or outcome. Management practices are also a function of a combination of indices such as social, institutional, economic, political, cultural and physical. This fact this study recognizes, and therefore limits analysis to assessing methods of shallow well water management using few selected sub-sets.

Another reason for examining the management practices of shallow well water is to gain a deeper knowledge and understanding of the adverse effects and problems associated with shallow well water utilization for urban agriculture in the study area. This is with a view to developing better management options that will boost water provision and water accessibility for urban agricultural practices. Five indices of the management practices were therefore enunciated. These are ownership, conveyance, application, conservation and storage.

6.3.1 Ownership and Instrumentation

A survey of ownership reveals that shallow well is by purchase (24% in Alapere, 40% in Barracks 8% in Ikeja and 18% in Tejuoso), construction {68% in Alapere, 59% in Barrack, 54% in Ikeja and 74% in Tejuoso) and inheritance from family member or from boss to apprentice. Construction of shallow wells is done with local implements such as diggers, shovels and cutlass. Averagely, construction of a shallow well with a depth of about 12 feet costs about ₦2,700. On the average, a farmer has two shallow wells in Alapere and one shallow well in Barracks, Ikeja and Tejuoso. Competition for water among farmers increases during dry season as most shallow wells become exhausted. More production time is therefore lost to sourcing water.

6.3.2 Conveyance and Application

As depicted in Figure 6.2 and 6.3 conveyance and application of shallow well water for irrigation is mainly manual in all locations (Alapere 95%, Ikeja 82%, Tejuoso 97%), except in Barracks where only 25% of the respondents agreed to use mechanized irrigation techniques. Most of the farmers (75%) used aluminum can of sixteen litres for irrigation. This bucket is acquired at an average price of N1900 each. The disparity in water application and instruments is necessitated by land insecurity system which discourages farmers from investing in water infrastructure for irrigation.

Plate 6.1: Drudging of Water from shallow well and blooming of algae on the surface of the shallow well

Plate 6.2: Shallow well water application method

6.3.3 Treatment and Storage

Knowledge of water storage and treatment gives some level of distinctiveness. Apart from the use of *Azdinachta* (Dongo-yaro) leaves to repel or reduce the activities of biting insects in the wells in Alapere and Tejuoso farms, there are no other treatment techniques for shallow well water. Shallow well serves as means of conserving and storing water. The only technique for having access to regular and adequate water supply is by increasing the depth of shallow wells. There is no particular rule for the depth of a shallow well rather it is the level of the aquifer that dictates the depth of any shallow well.

Findings further revealed that farmers concentrate more and draw water from shallow wells located closer to drains, canals and rivers that flow through the farm during scarcity periods. There is therefore concentration of shallow wells near either artificial or natural sources of water in Alapere, Tejuoso and Ikeja than in Barracks. The concentration of farmers on few shallow wells during this period enhances communal sharing system, although time and physical energy required for water drudging increases.

6.4 Implication of Shallow Well Water on Productivity and Net Revenue

Productivity of an activity determines the economic and social value of the individual or household that engages in such an activity. It also influences the level of re-investment as well as importance and contribution of the activity to the urban economy. This fact therefore prompted the study to examine the implications of shallow well water on crop yields, and on revenue in two location {Alapere and Barracks)} of the four study locations using farm experiments.

The estimation of crop yields and quantity of shallow well water used per unit area in the two locations are as presented in Tables 6.3 and 6.4. The data show spatial variation in the quantity of shallow well water, crop yield and revenue. The outcome depicts a corresponding increase in shallow well water on crop yield and consequently on revenue. Another interesting outcome of the experiment shows that exotic vegetables require more water than local vegetables in both Alapere and Barracks.

Table 6.3: Input and Output of Shallow Well Water and Poultry Waste Utilization for Field Trials

Site Alapere (A)							Site Barracks (B)					
1*	2*	3*	4*	5*	6*	7*	2*	3*	4*	5*	6*	7*
Spring onions	3x 9	5	2320	3.2	80	11.3	4 x 10	5	2416	4.4	83	14.2
Lettuce	3x 9	5	2160	2.9	75	13.5	4 x 10	5	2320	4.4	80	15.0
Amaranth spp (Tete)	3x 9	5	1120	2.1	35	8.3	4 x 10	5	1120	3.0	35	10.1
Oliferus (Ewedu)	3x 9	5	1360	2.1	42	7.5	4 x 10	5	1360	2.8	40	9.4

1*= vegetable type, 2*= size of bed used for experiment in (feet), 3*= Number of beds, 4*quantity of shallow well water in (litres) 5*= quantity of poultry waste in (kg), 6*= gestation period in days, 7* quantity of yield in(kg)

Source: Field Survey, March 2005

Table 6.4: Estimation of Shallow Well Water Quantity, Vegetable Yield and Net Revenue per Unit Area

Alapere (site A)				Barracks (site B)		
Farm site	Amount of Water in litres	Yield per unit area (kg)	Net Revenue (N)	Amount of Water in litres	Yield per unit area (kg)	Net Revenue (N)
Lettuce	572,400	3,578	159,000	417,600	2,700	64,440
Tete	296,800	2199.5	92,750	219,600	1,890	22,950

Source: Field Survey, March 2005

6.5 Shallow Well Water Quality

The study also assesses the quality of shallow well water to ascertain its impact on productivity and on health of those farmers who have direct contact with it. Although, there is a general belief that shallow well water is often polluted through seepage from underground water and other agro-chemicals, run-off and overflow of municipal drains, canals and rivers, literature has revealed that shallow well water provides relatively a better alternative source of water for urban agriculture.

Analysis of the quality of water is important in this study because knowledge of the nutrient composition of the water used for irrigation could provide information that would prevent or minimize excess applications of certain chemicals and fertilizers for crop production. It could also give a fore knowledge on the extent to which water for irrigation in urban agriculture in Lagos conforms to the World Health Organisation acceptable standard for irrigated crops that are likely to be eaten raw.

Although, the quality of water can be assessed through physical, chemical and microbiological means depending on the objective of the study has limited itself to seven physiochemical and *faecal Coliform* (Microbiological) concentration in shallow well water were used in the study area. The study focused on microbiological analysis because of the poor hygiene and absence of sanitary facilities in all the study locations. The choice of the seven-physiochemical variables was to determine the extent of plant nutrients circulation within the farm vicinity and into the shallow wells.

The result as presented in Table 6.5 shows that shallow well water in Ikeja has a more concentration of Nitrate (NO_3), Phosphorous (Po_4) and Sulphate. The concentration of these elements could be due to the presence and effects of river Ogun, through the release of run off of wastewater (both domestic and industrial) together with run-off from accumulated inorganic and organic fertilizers. By contrast, shallow wells at Alapere have more concentration of Magnesium and chloride.

Result from microbiological analyses as presented in Figure 6.4 show that the average faecal coliform concentration in all sampled shallow well water in all study locations is high, exceeding WHO's 1.0×10^3 acceptable limit for irrigated crops. The high level of coliforms found in the water samples signifies that shallow well water is of poor quality, polluted and therefore could pose greater health risk to farmers especially those who have direct contact with shallow well water.

Table 6.5: Mean Concentration of Nutrients Elements in Shallow Well Water mg/l (ppm)

Parametre	Alapere	Barracks	Ikeja	Tejuoso
Nitrate	1.88	0.62	42.89	0.43
Phosphorous	0.87	1.75	22.1	0.82
Sulphate	37.15	8.60	45.4	0.06
Magnesium	53.75	11.05	2.01	0.43
Potassium	6.95	0.73	12.29	0.86
Calcium	1.8	3.53	30.20	5.05
Chloride	97.5	16.05	20.5	38.0

Source: Laboratory analysis March 2005

.The presence of high coliforms in shallow well water could be attributed to absence of sanitary facilities and improper disposal of excreta in the farm environs. Over 85% of the respondents attested to this assertion. Another possible factor is the continuous movement and stepping in and out of the shallow well during irrigation process.

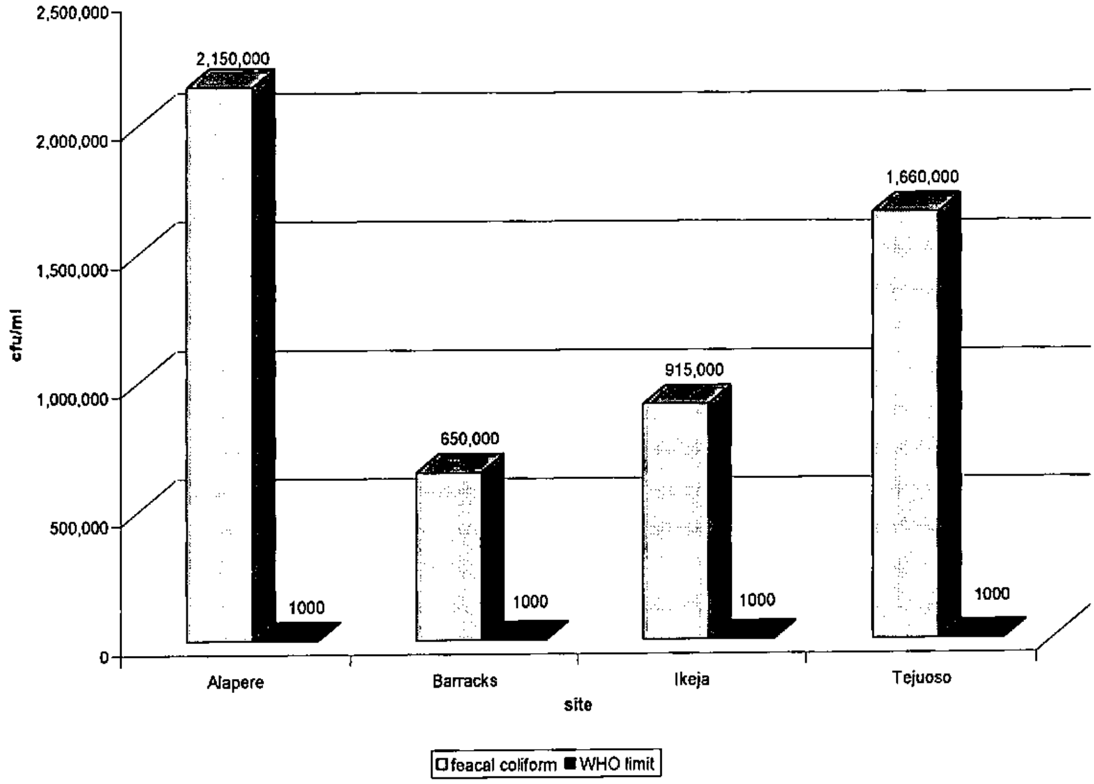

Fig 6.2: Average concentration of faecal Coliform per cfu/ml in Shallow well water at study locations

6.6 Influence of Farmers' Characteristics on Shallow Well Water Management Practices

As expected, the study revealed that there are combinations of factors affecting the ways in which shallow well water is integrated into urban agriculture. To make a scientific support for this assertion, an attempt was made to examine the association between selected farmers' socio-economic characteristics and selected shallow well water management practices using Chi-square technique. The socio-economic characteristics are age, gender, religion, income, ethnic background and educational level. On the other hand, the management indices include treatment, application and storage practices.

The choice of Chi-square technique was informed by the nature of the data subsets which are in groups. As depicted in Tables 6. 6 the result of the analysis shows that there are no significant associations between age, educational level, gender and income characteristic of farmers and some shallow well water management variables. However, the relationship seems to be a little more between religion and shallow well water management. The relationship between religion and shallow well water management variable could probably be as a result of the fact that most water lifting activities are carried out by farm labourers' majority of whom are Muslims.

Table 6.6: Association between socio-cultural characteristics of farmers and shallow well water management practices

Socio-cultural. characteristics	Management Indices	Chi-square Value	Probability value @ 0.05			
			Observe PV	P stand	Remark	
Age	Application	8.261	0.041	0.05	PV <P	Not significant
	Treatment	7.523	0.057	0.05	PV >P	Significant
	Storage	4.798	0.000	0.05	PV < P	Not significant
Gender	Application	31.037	0.000	0.05	PV < P	Not significant
	Treatment	1.160	0.282	0.05	PV > P	Significant
	Storage	41.270	0.000	0.05	PV < P	Not significant
Ethnicity	Application	9.567	0.022	0.05	PV <P	Not significant
	Treatment	3.940	0.268	0.05	PV >P	Significant
	Storage	46.407	0.000	0.05	PV < P	Not significant
Educational level	Application	24.383	0.000	0.05	PV <P	Not significant
	Treatment	3.817	0.576	0.05	PV > P	Significant
	Storage	44.214	0.000	0.05	PV <P	Not significant
Income	Application	1.236	0.744	0.05	PV >P	Significant
	Treatment	32.112	0.360	0.05	PV >P	Significant
	Storage	21.613	0.010	0.05	PV <P	Not significant
Religion	Application	3.003	0.223	0.05	PV >P	Significant
	Treatment	2.938	0.230	0.05	PV >P	Significant
	Storage	8.849	0.182	0.05	PV >P	Significant

If PV ≥ P =significant; if PV ≤ P = Not significant

Source: Field Survey March 2005

6.7 Health Implications of Shallow Well Water on Users

The state of health of any person including farmer affects his productivity. It could create more cost implications at the long run on the farmer's productivity and on the provider of health facilities, and further limits sustainable agricultural development if negative. Birley and Lock (1999) stated that many causes of negative health impact of urban farmers can be traced to poor management of the agricultural inputs like shallow well water which acts as a breeding ground for vector borne disease such as mosquitoes. It is pertinent to note that, malaria infection was highly complained of by farmers as one of the most commonly reported health problems among the users of shallow well water in Lagos. An attempt was therefore made to seek for microorganisms responsible for the reported health problems in shallow well water (mosquito larvae) and in the blood samples of farmers. Blood samples of resident non-farmers (control) were also collected to allow comparative analysis.

6.7.1 Malaria Infection

Malaria is the most common vector-borne diseases and it is transmitted by anopheles mosquitoes in most African cities. There are over fifty species of mosquitoes with each specie having a unique combination of breeding site preferences and behaviours. Generally, it is believed that mosquitoes breed in relatively clean stagnant water. This unique feature of malaria development has given room for its association with the practice of urban agriculture and its irrigation activities have provided suitable breeding sites for mosquitoes.

To confirm this assertion, forty (40) shallow wells, ten in each of the study-sites were examined in the farms and in the laboratory for presence of mosquito larvae. The result shows that shallow wells do not breed mosquito larva in all study locations. This finding was also affirmed by a consultant parasitologist who variously asserted that mosquitoes do not breed in relatively dirty, polluted and regularly disturbed water. The absence of mosquito larvae in all sampled shallow wells according to them could be attributed to the unstable nature of the wells as a result of irrigation activities.

The distribution of reported cases of malaria among farmers especially those that live in the farm environment in the four study locations as presented in Figure 6.3. The result shows very high reported cases in all the study area. However, laboratory analyses for malaria parasite as depicted in Figure 6.4 and 6.5 revealed that non-farmers are more infected with malaria parasite than farmers in all the four study locations.

Comparison of the results from questionnaire survey and clinical analysis reveals that farmers are less infected with malaria parasite than non-farmers who reside around the farm environs. According to one of the consultant parasitologist, the fact that most health problems begin with symptoms of malaria makes person complain of malaria at the slightest ill health. In his expert opinion, the ability of mosquito to infect an individual depends on a combination of natural and human factors part of which are: species of mosquito (either Anopheles Culex or Aedes); susceptibility of the farmer to local parasite or infection, their predilection to enter house to feed on the human host; the effect of meteorological conditions and the speed of development of the parasite and the vector.

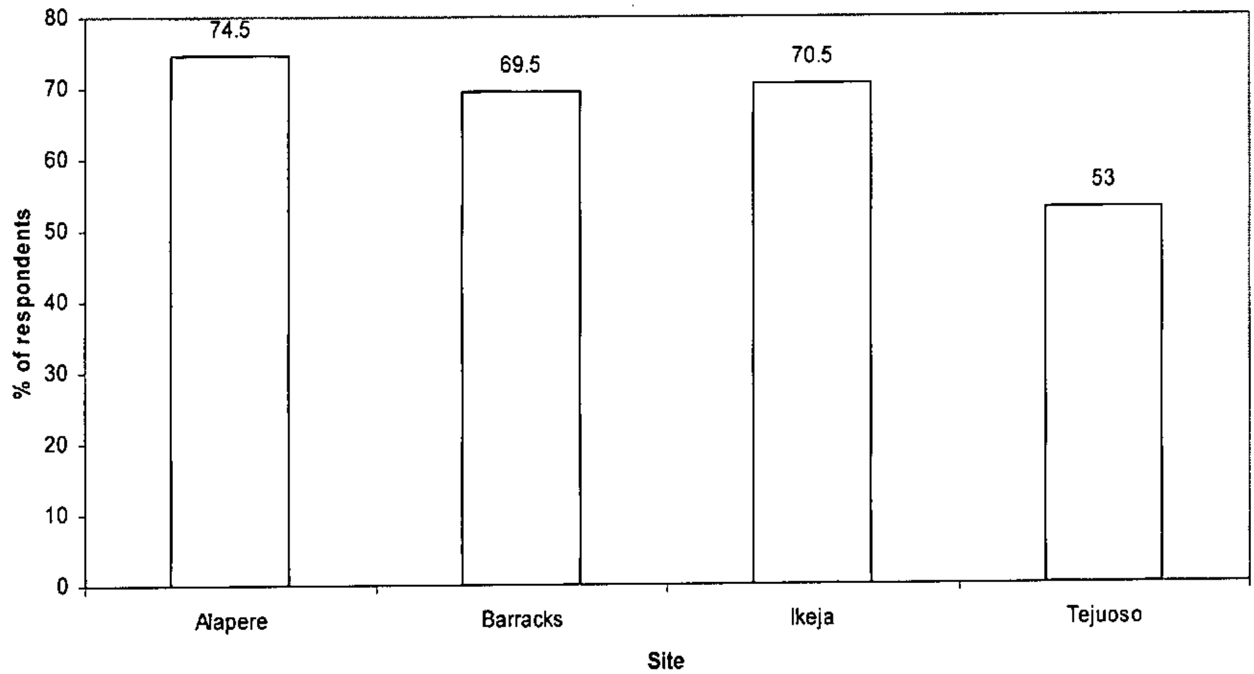

Figure 6.3: Percentage of Reported Cases of Malaria in Farmers in the study Area

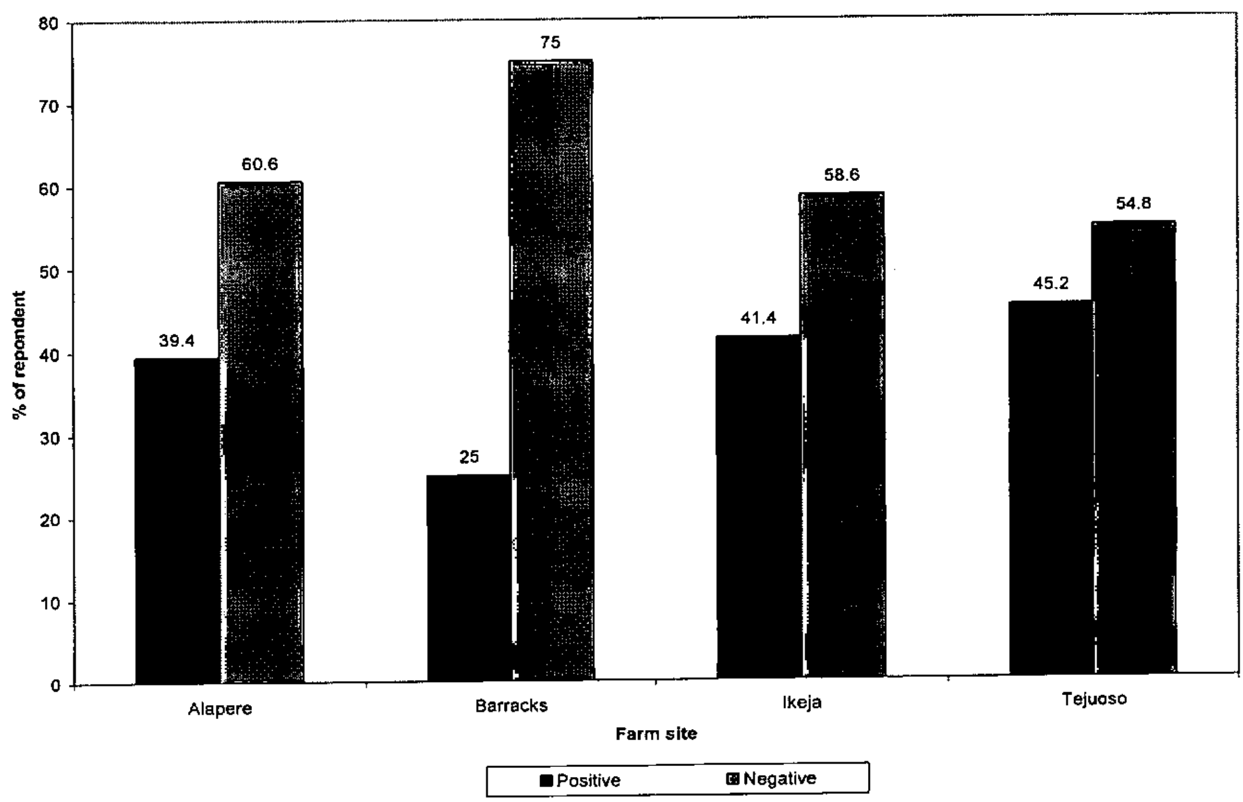

Figure 6.4: Percentage of Resident Farmers with Malaria Infection after Laboratory Analysis

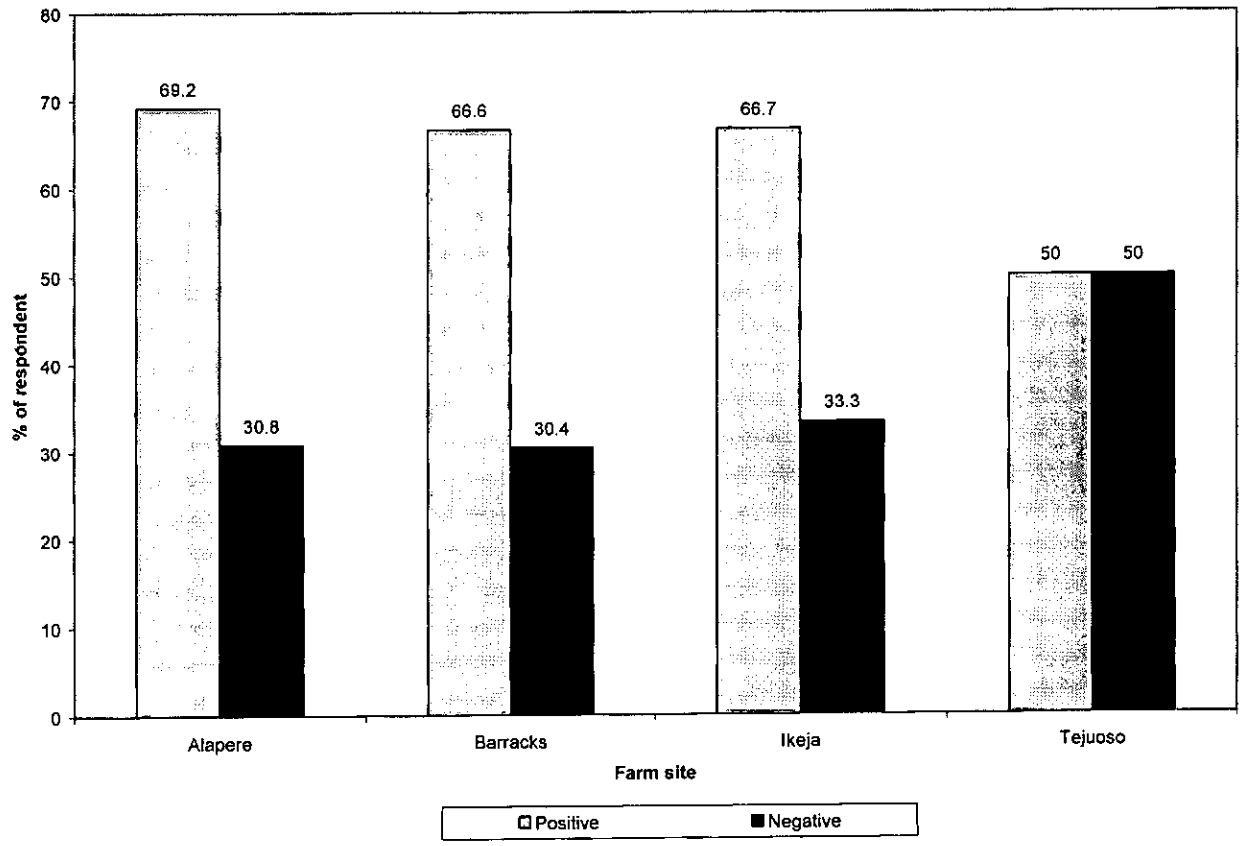

Figure 6.5: Percentage of Resident Non-Farmers with Malaria Infection after Laboratory Analysis

Another explanation for the low malaria infection rate among farmers is that there are high rates of self medication among urban farmers. Most farmers' consults herbal and drug hawkers and some times link ailment to spiritual origin.

However, comparison of the laboratory results of infected farmers and non-farmers in each study site is as presented in Figure 6.6. This depicts a variation of 30%, 41.2%, 25% and 4% in Alapere, Barracks, Ikeja and Tejuoso respectively on one hand. On another hand the average differences using Wilcoxon test gives Z-value derived from the two sums as depicted in Table 6.7. The result shows that there are no significant differences in malaria infections between farmers and non-farmers in the study area.

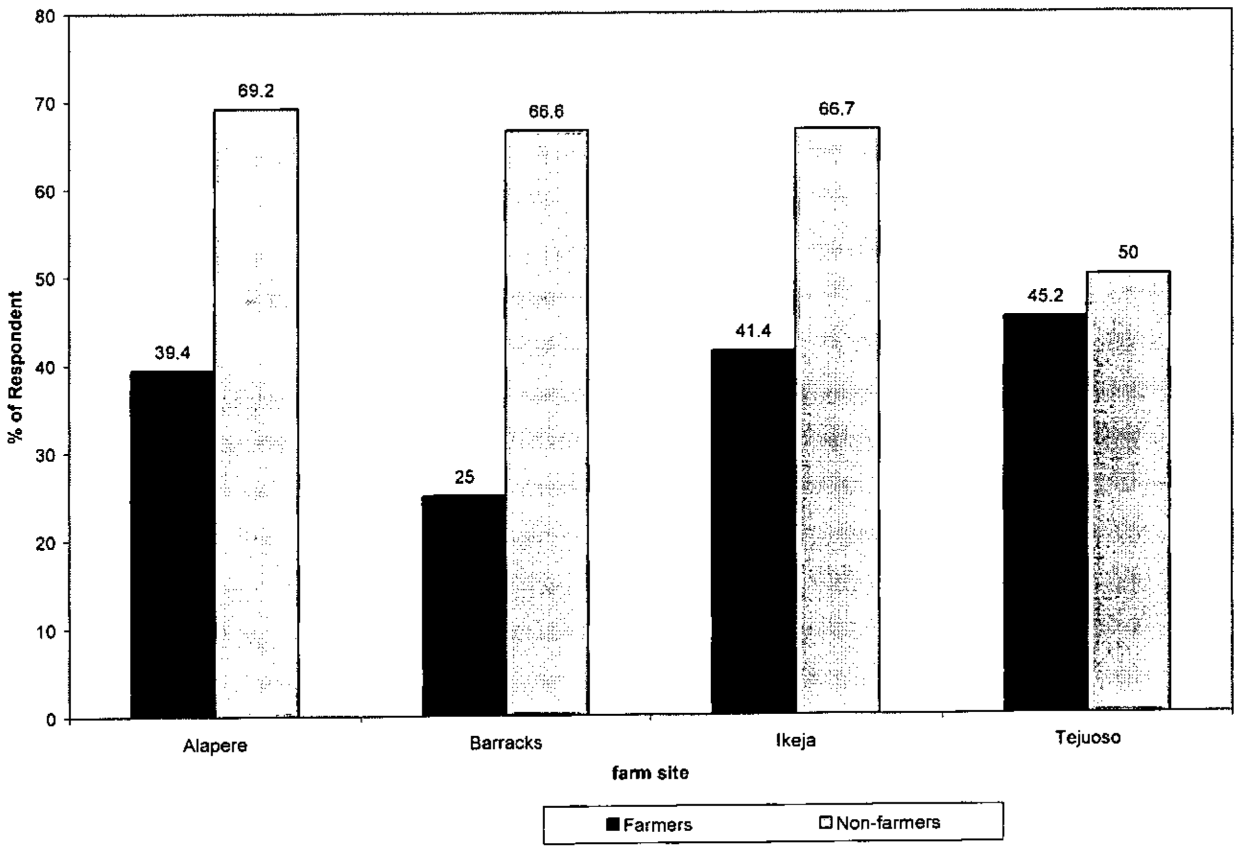

Figure 6.6: Comparison of farmers and non-farmers malaria infection level in the study area

Table 6.7: Wilcoxon Test on Malaria Infection Level on Farmers and Non-farmers

Study Site	Rank for the two sums(Z-value)	P-value
Alapere	-1.000	.317
Barracks	-1.890	.059
Ikeja	-1.732	.083
Tejuoso	-1.732	.083

If PV ≥ P =significant; if PV ≤ P = Not significant

Source: Field Survey, March 2005

CHAPTER SEVEN

7.0 PATTERN, MANAGEMENT AND IMPLICATIONS OF POULTRY WASTE ON HEALTH

This section presents the analysis of the spatial pattern of poultry waste utilization and factors responsible for its distribution. It discuses the management practices, quality and implications of poultry waste on production and on the health of the farmers. Lastly, it highlights the influence of some socio-economic characteristics on management pattern in the study area.

7.1 Pattern of poultry Waste Utilization and its Determinants

The utilization of poultry waste for urban agriculture is one of the numerous soil management techniques in most cities. The spatial distribution of poultry waste utilization as depicted in Figure 7.1 shows that over 66% of farmers use poultry waste for crop production in all the four urban agricultural locations in the study area. The reasons for the identified pattern are based on the perceived quality of poultry waste, its accessibility and high cost of industrial manure.

In order to statistically determine factors that describe the spatial pattern of poultry waste utilization in the study area, eight independent variables were selected, namely, level of education, experience, income, size of farm holding, numbers of farms, type of vegetables, seasonal variation and availability of alternative manure. These variables were selected and analyzed using Pearson Regression Model. The result is as depicted in Table 7.1. As the analysis reveals, the estimations of the proportion of variance accounted

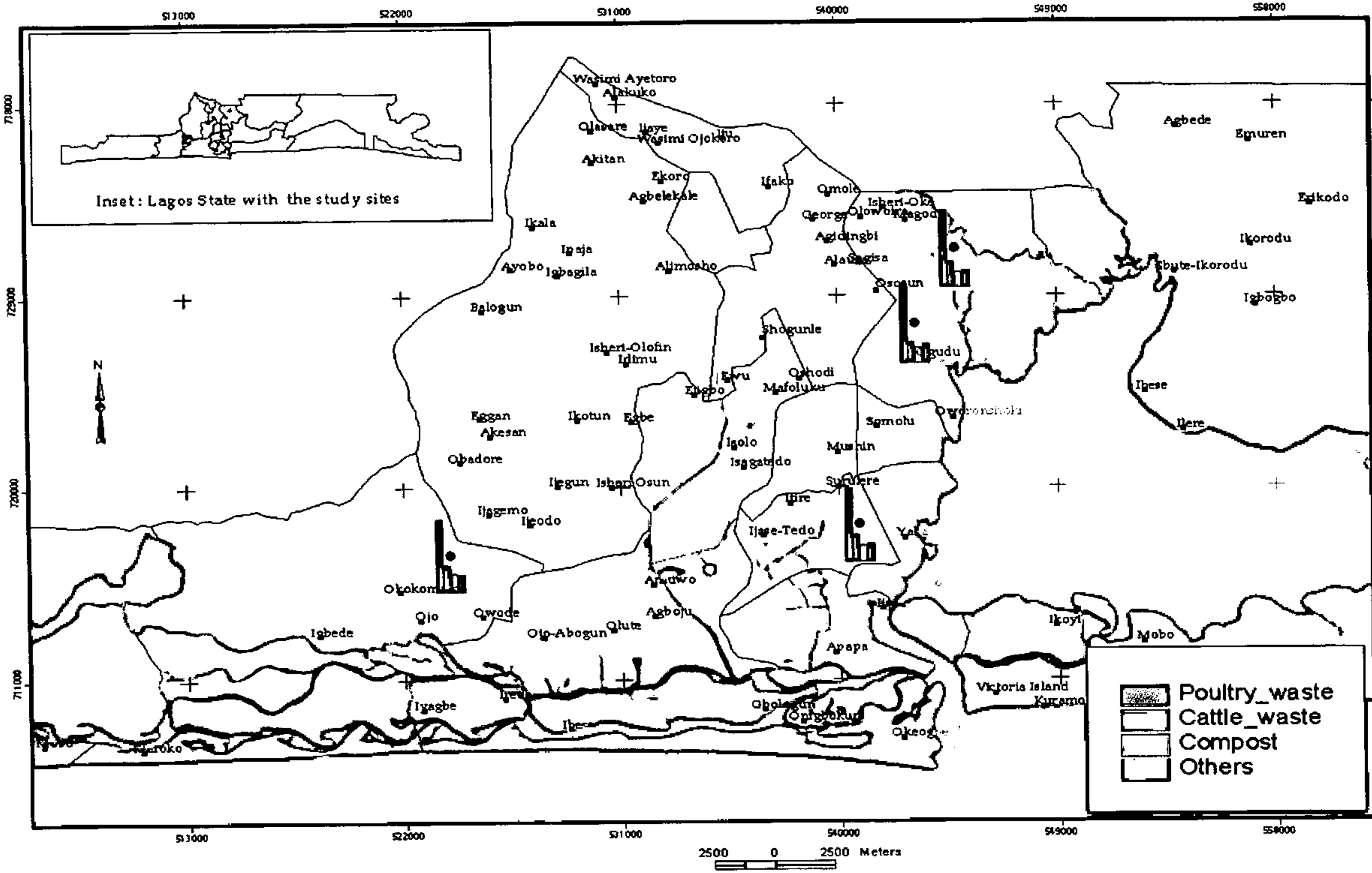

Figure 7.1: PATTERN OF POULTRY WASTE UTILIZATION IN THE STUDY AREA

for by a combination of all independent variables (Regression) are 11% in Alapere, 8% in Tejuoso, -11% in Ikeja and -1% in Barracks. This implies that net variables that influence pattern of poultry waste utilization are positive at Alapere and Tejuoso while at Ikeja and Barracks the influence is inversely related. The outcome of the analysis could probably be as a result of the small size of land holding in both Alapere and Tejuoso relative to Barracks and Ikeja.

Table 7.1: Regression Value of Poultry Waste Utilization in each Farm Locations

Sites	Regression coefficient	R Square	Adjusted R squares	Percentage	Standard Error of Estimate	(ANOVA)	
						Significance level	F value
Alapere	.472	.223	.110	11%	.796	.057	1.979
Barracks	.324	.105	-.019	-1%	.901	.578	.844
Ikeja	.176	.031	-.110	-11%	1.097	.990	.221
Tejuoso	.447	.200	.089	8 %	.672	.085	1.800

Source: Field Survey, 2005

However, assessment of individual variables using Beta coefficient as shown in Table 7.2 reveals that the number of farms a farmer owns has the greatest influence in Alapere, with r = .339, level of education of farmers contributes the largest influence in Barracks with r= .248, farmers experience produces r = .085 in Ikeja while seasonal variation makes the highest contribution in Tejuoso farm with r = .383.

7.2 Functions of Poultry Waste in Urban Agriculture

Traditionally, poultry waste is known to be used as manure for soil amendment and plant nutrient in many rural settings. As far as an average Lagos urban farmer is concern, poultry waste is used for both physical and nutrient needs and purposes. A focus group discussion with the Association of Women Vegetable Farmers reveals that 'the soil at Barracks is highly loose, and one can hardly make any meaningful cultivation without the use of poultry waste". This means that apart from providing nutrients for plant it softens the soil and also allows the crops especially vegetables to produce leafy shoots and greenery in Lagos.

The study also shows that poultry waste increases the strength of the soil and reduces the quantity of scarce inorganic fertilizer required for production. As one of the farmers asserted, "poultry waste softens the ground and allows one to have bountiful harvest".

Table 7.2: Value of Standardized Beta Coefficient by Site

Independent variables	**Alapere**		**Barracks**		**Ikeja**		**Tejuoso**	
	Beta value	*Significant level*	*Beta value*	*Significant level*	*Beta value*	*Significant level*	*Beta value*	*Significant level*
Constant	1.646	.015	1.66	.061	2.277	.050	1.743	.012
Level of Education	-.060	.699	**.248**	.068	.078	.568	.136	.254
Farming Experience	.084	.478	.065	.596	**.085**	.524	-.203	.101
Number of farms	**.339**	.007	.010	.938	.073	.608	-.146	.208
Monthly income	-.0432	.723	-.018	.889	.045	.741	.033	.776
Size of holding	-.169	.282	-.062	.654	-.071	.610	-.109	.336
Types of vegetable	-.061	.668	.038	.754	-.056	.693	-.074	.524
Application of other manure	.288	.023	-.026	.838	.011	.937	.142	.248
Seasonal variation	-.239	.070	-.181	.152	-.101	.460	**.383**	.002

Source: Field Survey, 2005 (N=75 at each site)

Similarly, poultry waste makes land reclamation possible as its application increases the quality and quantity of organic matter in soil and improves soil texture, diversity and activities of micro-organism.

Another important function of poultry waste as identified by the farmers in the study area is its persistence in the soil. According to Mr. Iwapa (Secretary to Alapere Vegetable farmers association) 'the effects of poultry waste is felt up to two to five weeks when a crop is planted. It is quite unlike inorganic fertilizer which disappears within few days of application. Like shallow well water, poultry waste management in urban farming provides job opportunities for brokers and dealers in poultry waste business especially the unemployed.

It provides additional source of income to farmers who sell on retail within the farm community and also encourages social ties in the farming community as resources are pooled together for the purchase of poultry waste in bulk, leading to lower price. The use of poultry waste for vegetable production reduces government efforts (physically and economically) on urban waste management.

7.3 Management Practices of Poultry Waste for Urban Agriculture

7.3.1 Sources and Instrumentation

The data show that 75% of poultry wastes is sourced from outside Lagos environs (Ikorodu, Abeokuta, Sango-Otta Ijebu-Ode, Badagry), while 25% are sourced within Lagos metropolis (Ikeja, Shashi, Ojo, Agege, Oko-Oba). There are two types of poultry waste namely- dry and wet poultry waste. Dry poultry waste is a mixture of bird excreta and urine, sawdust and other chemicals used for treating birds, while wet poultry waste does not contain liters, but have high moisture content.

The information further reveals that poultry waste collection is carried out by farmers and brokers who travel and scavenge for it from one poultry farm to the other till a satisfiable quantity is collected. They use old sacks, shovels and with the assistance of paid labourers. Poultry waste is usually swept, dumped and heaped on poultry farm surroundings.

It is purchased without consideration for its quality and suitability for crop production and there are no standard measures for poultry waste collection and packaging, although the informal nature of poultry waste business is acknowledged. It costs an average of ₦1500, depending on the negotiating ability of both buyers and the sellers to possess a heap that could produce about twenty-five bags, with a mean weight of 45kg per bag. In some cases, poultry waste is offered to farmers free of charge as it serves as a cheap avenue to dispose off waste from the poultry farms.

7.3.2 Conveyance and Application

The data reveal that the cost of transporting poultry waste to farms is the most costly aspect of the poultry waste business because of its weight and bulkiness. The data revealed that, it costs an average of ₦ 5000 to hire a vehicle that carries 55 bags of PW over a distance of about 32 km (Shashi to Alapere). The cost is high because there are no special vehicles designed and assigned for this purpose. A bag of 45kg poultry waste therefore sells for an average of ₦ 300 to farmers. Seventy-five (75) percent of the respondents agreed to apply poultry waste on farm bed with bare hand and without protective gadgets like boots and nose mask, irrespective of the odour that emanates from the poultry waste. Vulnerability to associated health problems is therefore high.

Findings further revealed that the inability of farmers to use protective gadgets is prompted by the ease and convenience during application and not for economic reasons. According to one of the farmers in Barracks, 'I prefer not to wear any protective cloths while applying poultry waste because my bare hand allows me spread poultry waste evenly and carefully '.

7.3.3 Treatment and Storage

Knowledge about treatment techniques builds on sorting, picking and grinding solid particles into fine stuffs to allow easy application. It thus implies that majority (84%) of the respondents do not treat poultry waste before use. According to Seriki (head of Tejuoso farmers and broker of poultry waste), 'treatment of poultry waste involves protecting the poultry waste from direct sunlight in order to retain its nutrient contents. This, according to Seriki, he does by covering his poultry waste with nylon until they are completely sold off'.

Plate 7.1: Storage of Poultry Waste in the Study Area

Plate 7.2: Application of Poultry Waste on Beds

The study further revealed that farmers do not practise the standard composting process and techniques because of lack of skill (64%), insufficient space and time (15%) and paucity of capital (9%). Other reasons are the burdensomeness of the long composting processes required for its treatment (8%), and inadequate access to other needed materials such as ash (4%). Adequate and appropriate treatment entails many stages of composting, turning and heating the poultry waste under temperature of about 55oC for twenty-eight (28) days. Under such period and conditions, the activities of all microorganisms in the poultry waste would have completely become inactive, harmless and safe for reuse (Mensah et al, 2001).

Storage of poultry waste is by heaping (75%) and covering (25%) in Alapere, Tejuoso and Ikeja while in the Barrack, depending on the distance of farm plots to built up area, poultry waste is buried (64%) between farm ridges and covered with leaves. The differences in the storage pattern are attributed to farmers concern for the aesthetics of the environment especially in Barracks.

7.4 Implication of Poultry Waste on Crop Yield and Revenue

A second reason for the field experiment was to investigate the spatial differences in poultry waste utilization on crop yields, and revenue. Estimation of vegetable yields and quantity of poultry waste used per unit area (per plot or 0.06 ha) in two locations (Alapere and Barracks) is as presented in Tables 7.3 and 7.4. The data show spatial differences in the quantity of poultry waste, crop yield and revenue. The outcome depicts a non-correspondence of increase of poultry waste on crop yield and on revenue. For instance, application of higher amount of poultry waste in Barracks (792 kg) produced

2,700kg of lettuce per unit area. By contrast, application of lesser amount of poultry waste (769kg) gave higher yield (3,578kg) of Lettuce in Alapere.

Like shallow well water, the experiment suggests that exotic vegetables require more poultry waste than local vegetables in both Alapere and Barracks. Statistical test on the premise that there is no significant variation in the quantity of poultry waste utilization and yield between the two locations using Chi-square (X^2) Model, shows significant variation between poultry waste used in sites Alapere and Barracks ($P > 0.05$) as well between yields ($P>0.05$) (see Table 7.4). The null hypothesis (Ho) provide less explanation for the variation while the alternative (H_1) is accepted. There is therefore 95% affirmation that there is variation between the quantity of poultry waste used and crop yield in the study area. The disparity in the amount of poultry waste and vegetable yields is not unconnected with spatial differences in the biophysical characteristics of the two locations parts of which are related to nature of soil and extent of biodegradable activities. For instance the texture of soil in Barracks is sandy while that of Alapere is loamy in nature.

Table 7.3: Estimation of the quantity of poultry waste, vegetable yields and net revenue per unit area

Alapere (site A)				Barracks (site B		
Farm site	Amount of Poultry waste (kg)	Yield per unit area (kg)	Net Revenue (₦)	Amount of Poultry waste (kg)	Yield per unit area (kg)	Net Revenue (₦)
Lettuce	769	3,578	159,000	792	2,700	64,440
Tete	557	2,199.5	92,750	540	1,890	22,950

Source: Field Survey, March 2005

Unit area=a plot (0.06 ha)

Table 7.4: Significant value of the variations between quantity of poultry waste and crop yield

	Chi-square Value	Table value (PV)	P stand	Remark
Quantity of PW between Alapere and Barracks	29.30	3.48	$P > 0.05$	Significant
Quantity of yield between site Alapere and Barracks	45.84	7.82	$P > 0.05$	significant

Source: Field Survey, 2005

7.5 Nutrient Quality of Poultry Waste

The quality of poultry waste was determined using seven physiochemical and some microbiological elements, although only three physiochemical elements (Nitrate (N) Phosphorous (P) and Potassium (K) were found to be relevant while considering the nutrient qualities of poultry waste for food production. Apart from this, the consideration of these three elements was to allow comparison with the popular industrial manure (NPK 40: 30:30). The result as presented in Table 7.5 reveals that it is only the nitrate content of poultry waste in Alapere that relatively measures up to that of the common industrial manure in the study area. Phosphorous is high in Tejuoso while Potassium fractions of sampled poultry waste is at the highest in Barracks. Although, the differences in the sources of poultry waste is recognized, it can be deduced that NPK contents in poultry waste is not always consistent and therefore does not provide a standard alternative for urban food production.

The microbiological result depicted in Figure 7.2 also reveals that there is high number of faecal coliforms in all sampled poultry wastes. This exceeds World Health Organization acceptable standard limit of $1*10^3$ for irrigated crops that are likely to be eaten raw. The genus of coliforms found shows that sampled poultry waste is highly contaminated. This finding contradicts Mensah et al's (2001) findings which posit that microbiological activities in heaped poultry waste results in an increase in temperature high enough to reduce the number and activities of coliforms. The presence of high numbers of coliform in sampled poultry waste shows that sufficient composting is not attained.

Table 7.5: Comparison of the nutrient quality of inorganic manure and poultry waste at the study locations

Variable	Value of common inorganic fertilizer (%)	**Alapere**		**Barracks**		**Ikeja**		**Tejuoso**	
		Mean (%)	Range (Mg/l (ppm))	Mean (%)	Range (Mg/l (ppm))	Mean (%)	Range (Mg/l (ppm))	Mean (%)	Range (Mg/l (ppm))
Nitrate	40	**38**	2.72 - 4.93	34	3.88 - 4.31	26	1.2-4.2	29	1.72 - 1.93
Phosphorous	30	27	0.39 - 0.6	25	0.58 - 0.62	22	0.5-0.9	**36**	0.19 - 0.2
Potassium	30	25	17. 3- 30.1	**38**	20.57 – 23.4	30	25.2- 30	**36**	18.3 - 23.1

Source: Laboratory Analysis March 2005

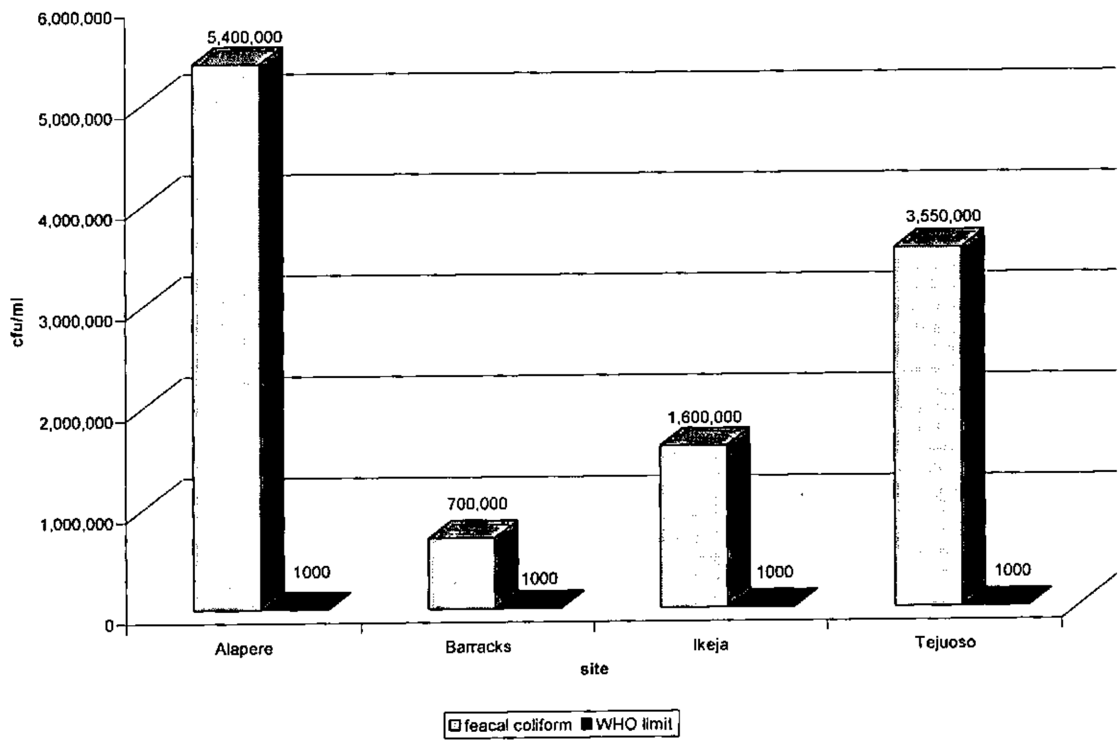

Fig 7.2: Average concentration of faecal Coliform per cfu/ml in poultry waste in study locations

7.6 Influence of Farmers' Characteristics on Poultry Waste Management Practices

The relationship between the socio- economic characteristics of respondents and adopted management practices was examined to determine how poultry waste and shallow well water are integrated into urban agriculture, using Chi-square technique. The choice of Chi-square technique was informed by the subsets of socio-economic and management variables. The variables and their subsets are as depicted in Tables 7.6. The result depicts that there are significant associations between age, income and religion characteristics of farmers and all poultry waste management indices.

Table 7.6: Association between Farmers' Attributes and Poultry Waste Management Practice

Socio- Cultural. Characteristics	Management Indices	Chi-square (X^2) Value	Probability Value @ 0.05			
			Table Value (PV)	P Stand	Remark	
Age	Application	2.25	0.523	0.05	PV >P	Significant
	Treatment	12.224	0.201	0.05	PV >P	Significant
	Storage	9.964	0.126	0.05	PV >P	Significant
Gender	Application	4.26	0.039	0.05	PV < P	Not significant
	Treatment	15.52	0.001	0.05	PV < P	Not significant
	Storage	8.523	0.014	0.05	PV < P	Not significant
Ethnicity	Application	0.527	0.913	0.05	PV >P	Significant
	Treatment	10.832	0.287	0.05	PV >P	Significant
	Storage	32.634	0.000	0.05	PV < P	Not significant
Educational Level	Application	10.391	0.065	0.05	PV >P	Significant
	Treatment	29.086	0.015	0.05	PV < P	Not significant
	Storage	9.511	0.484	0.05	PV >P	Significant
Income	Application	1.696	0.638	0.05	PV >P	Significant
	Treatment	8.303	0.504	0.05	PV >P	Significant
	Storage	4.920	0.554	0.05	PV >P	Significant
Religion	Application	0.946	0.623	0.05	PV >P	Significant
	Treatment	8.936	0.177	0.05	PV >P	Significant
	Storage	3.467	0.485	0.05	PV >P	Significant

If PV ≥ P =significant; if PV ≤ P = Not significant

Source: Field Survey March 2005.

7.7 Health Problems Associated with Poultry Waste Utilization

Many diseases have been associated with waste utilization as soil amelioration and fertilizer in urban agriculture. This is because most users of waste do not have the skills and capacity for adequate composting techniques, thus poor management of waste which attract communicable diseases to those who have direct contact with such waste has become a common phenomenon. Based on this linkage, this study assesses the relationships between the utilization of poultry waste and reported Gastro-intestinal infections like dysentery and diarrhoea among urban farmers. Although, the study appreciates the fact that the links between a human health problem and human activities are enormous and are influenced by many factors, an attempt was made to seek for microorganisms responsible for gastro-intestinal infections in farmers, through the laboratory analysis of stool samples of farmers and non-farmers (control group).

7.7.1 Gastro Intestinal Infection

Questionnaire analysis revealed that there were less than 25% reported cases of stomach related health problems such as abdominal pain amongst the respondents in all the study locations. However, stool analyses as presented in Figure 7.3 revealed that 46%, 75% 70% and 72% of farmers are infected with Escherichia coli of Salmonella and shigella species in Tejuoso, Ikeja, Barracks and Alapere respectively. Shigella is known micro specie that causes dysentery, gastro-enteritis and other stomach related health problems like abdominal pain in human beings.

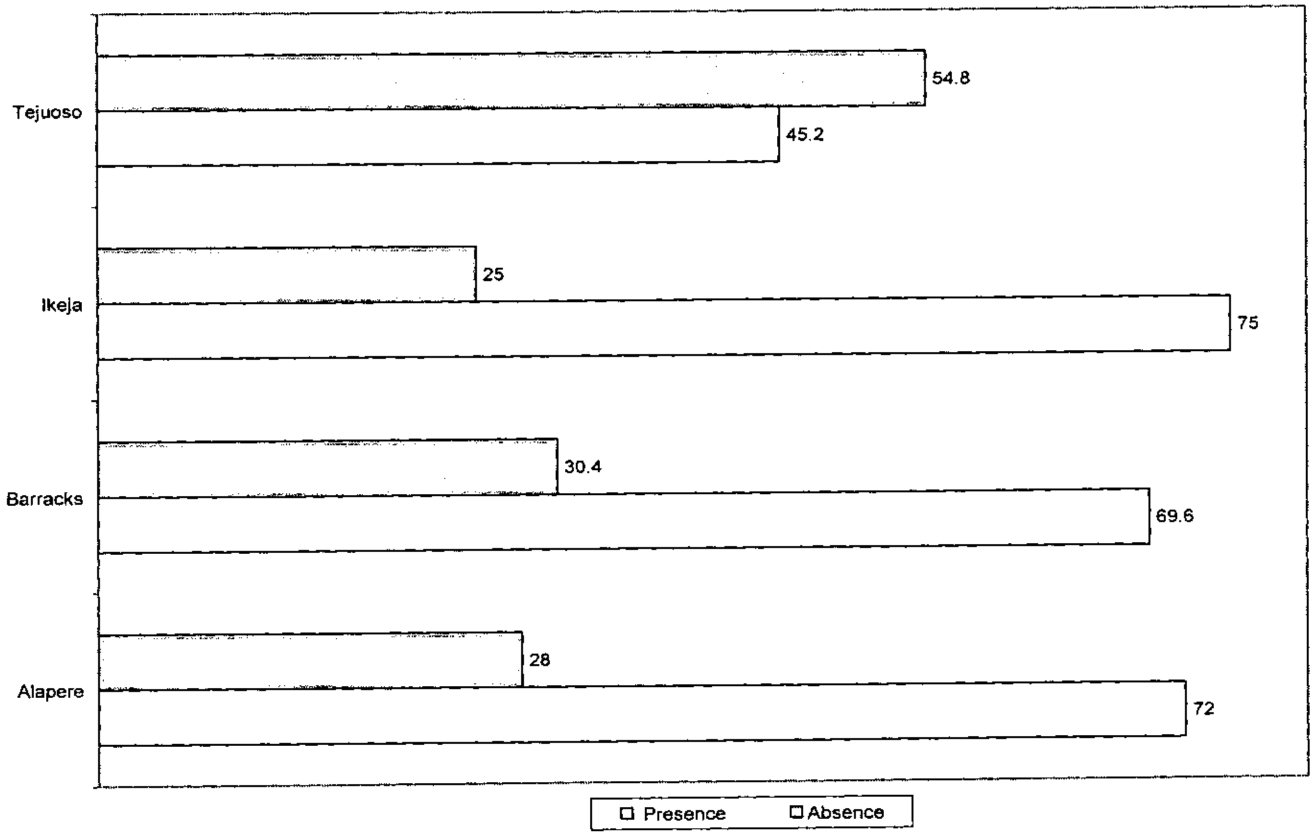

Figure 7. 3: Percentage of resident farmers with E.Coli of Shigella and salmonella after laboratory analyses

Salmonella species are also known bacteria that cause typhoid and diarrhoea in human beings. With evidences of poor personal and community hygiene, together with absences of sanitary facilities in all the study sites, there is therefore greater risk of farmers being infected through oral-faecal route during poultry waste utilization.

The impacts of these microbes in poultry waste could also be felt more on children as they play around when assisting their parents in farm work. Moreover, the roles of scavenging animals like roving rats and houseflies could in addition enhance transmission and expose children to infantile diarrhoea and dysentery.

Comparison of the percentages of farmers and non-farmers infection level as depicted in Figure 7.4 revealed that high number of farmers is more infected with Escherichia than non-farmers in each study sites except in Tejuoso farm. A test of significance using Wilcoxon test, provides Z-value derived from the two sums as presented in Table 7.7. It is only in Alapere farm that infection level of Escherichia coli shows a significant difference between farmers and non-farmers in the study area.

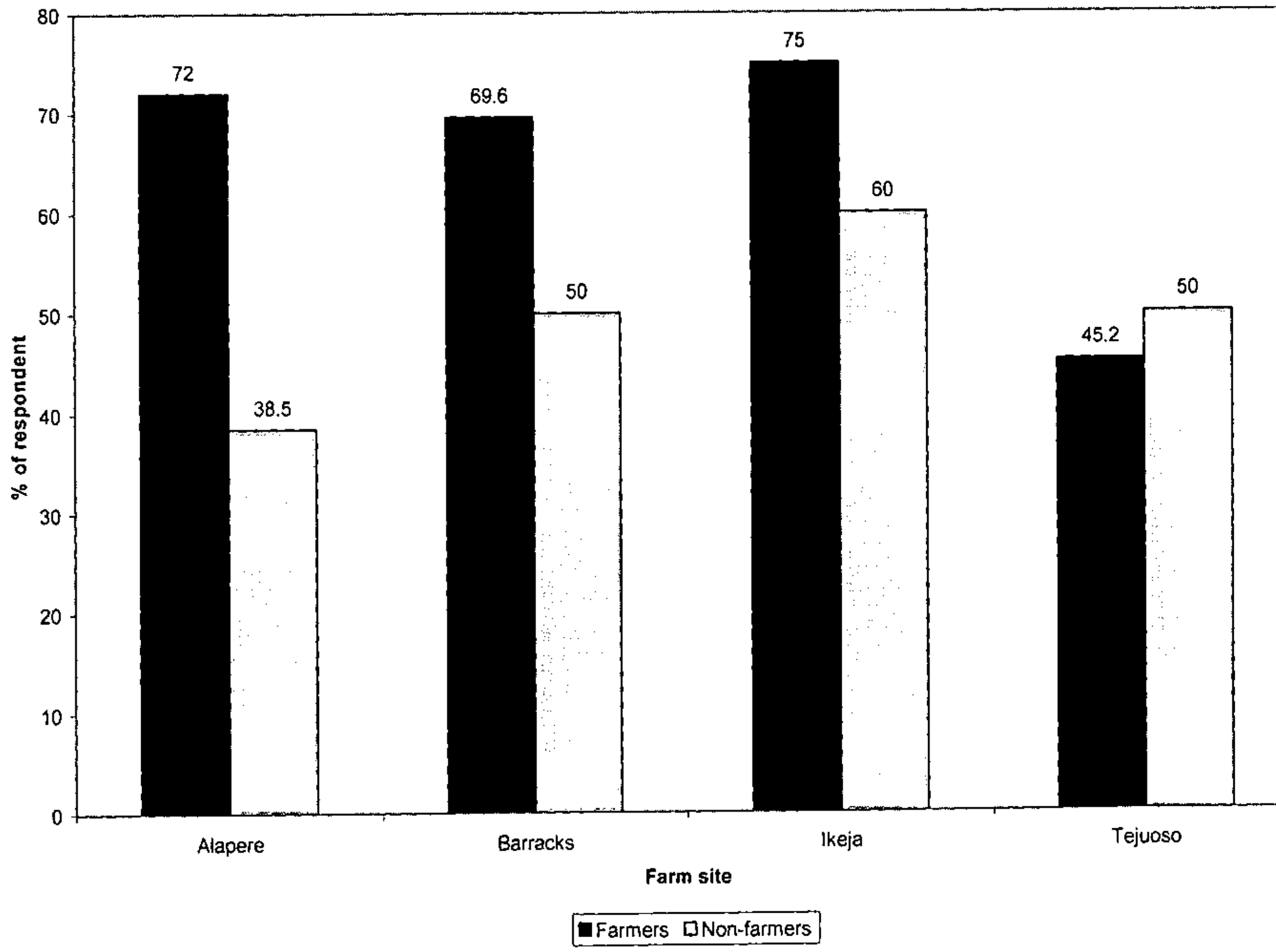

Figure 7.4: Comparison of the presence of E.Coli of Shigella and salmonella stool in farmers and non-farmers' stool

Table 7.7: Wilcoxon test on Escherichia Coli Infection Level on Farmers and Non-farmers

Study Site	Rank for the two sums(Z-value)	P-value
Alapere	-2.828	.005
Barracks	-2.236	.025
Ikeja	-1.414	.157
Tejuoso	-2.000	.046

If PV ≥ P =significant; if PV ≤ P = Not significant

Source: Field Survey, March 2005

CHAPTER EIGHT

8.0 DEMAND AND SUPPLY OF VEGETABLE CROPS IN LAGOS METROPOLIS

Like in the production of any other crop, adequate utilization of poultry waste and shallow well water for vegetable crops are essential inputs for production. The classical economist has argued that the forces of demand and supply that determine what consumers and producers buy and produce. The economics of vegetable is necessary in this study because changes in demand and supply conditions of vegetables as a result of fluctuations in price dictate the importance and the demand for poultry waste and shallow well water utilization for vegetable production as well as the viability of urban agriculture in Lagos. It also influences farmers' revenue or profit, urban food security, urban employment opportunities, poverty alleviation and economic development. This chapter therefore examines the importance of vegetables to urban households. It discusses the economics of production both in the dry and wet seasons, and determines the factors that generally influence the demand and supply of vegetables in the study area

8. 1 Importance of Vegetable to Urban Household

Vegetable is one of the body building and protective nutrients for urban households among others. It is believed to be cheap and more affordable source of plant protein compared to other sources of protein. They are in varying degree of uses and important to different users. Field investigation revealed that vegetable crops are demanded for reasons as depicted in figure 8.1. The finding shows that most vegetables are demanded for household cooking (68%), as herbs (10%), as ingredient for manufacturing (12%) and for sales (10%). High number of respondents patronizes the urban market for their vegetables because they buy in small quantities.

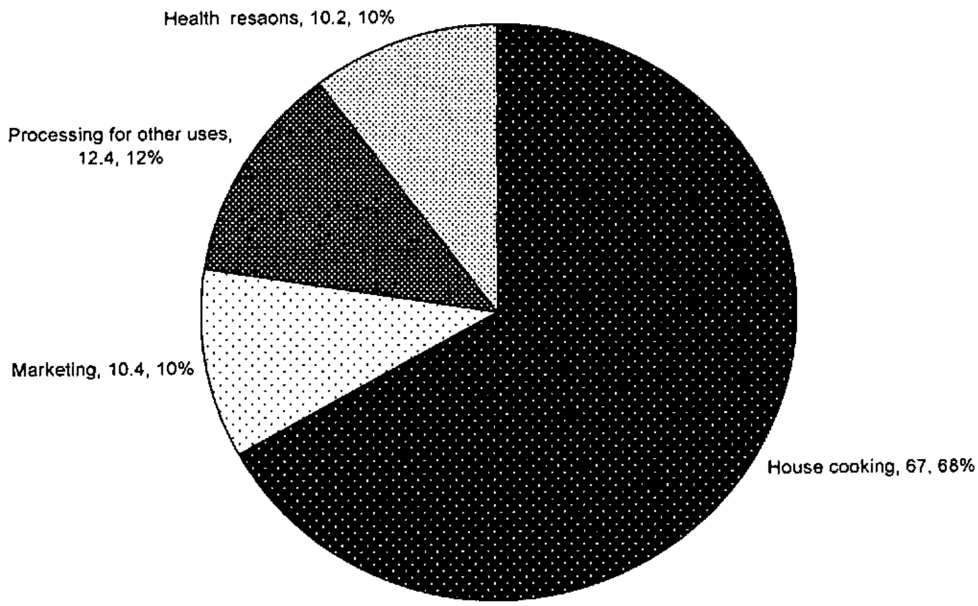

Figure 8.1 Uses of Vegetable Crops in the Study area

Source: Field survey

Respondents purchase their vegetables from urban market (67%), urban farm (18%) hawkers (8.8%) and from vegetable stores ((5.3%). It is worthy of note that over 70% of the respondents are unaware of what agricultural inputs are being used for the cultivation of the vegetables.

8.2 Demand for Vegetable Crops

There are demands for several types of vegetables in the study area. However, the data as presented in Figure 8.2 revealed that high percentage of the respondents (80%) demand more of indigenous vegetables like Water leaves, Spinnage etc. Next in demand are medicinal vegetables (13.4%) like Bitter leave, aloe Vera, and Effiren among others. Exotic vegetables like Lettuce, Cabbage, Dheal and Coriander which are occasionally demanded especially during festive period like Christmas, Easter and Sallah have the least demand (5.1%).

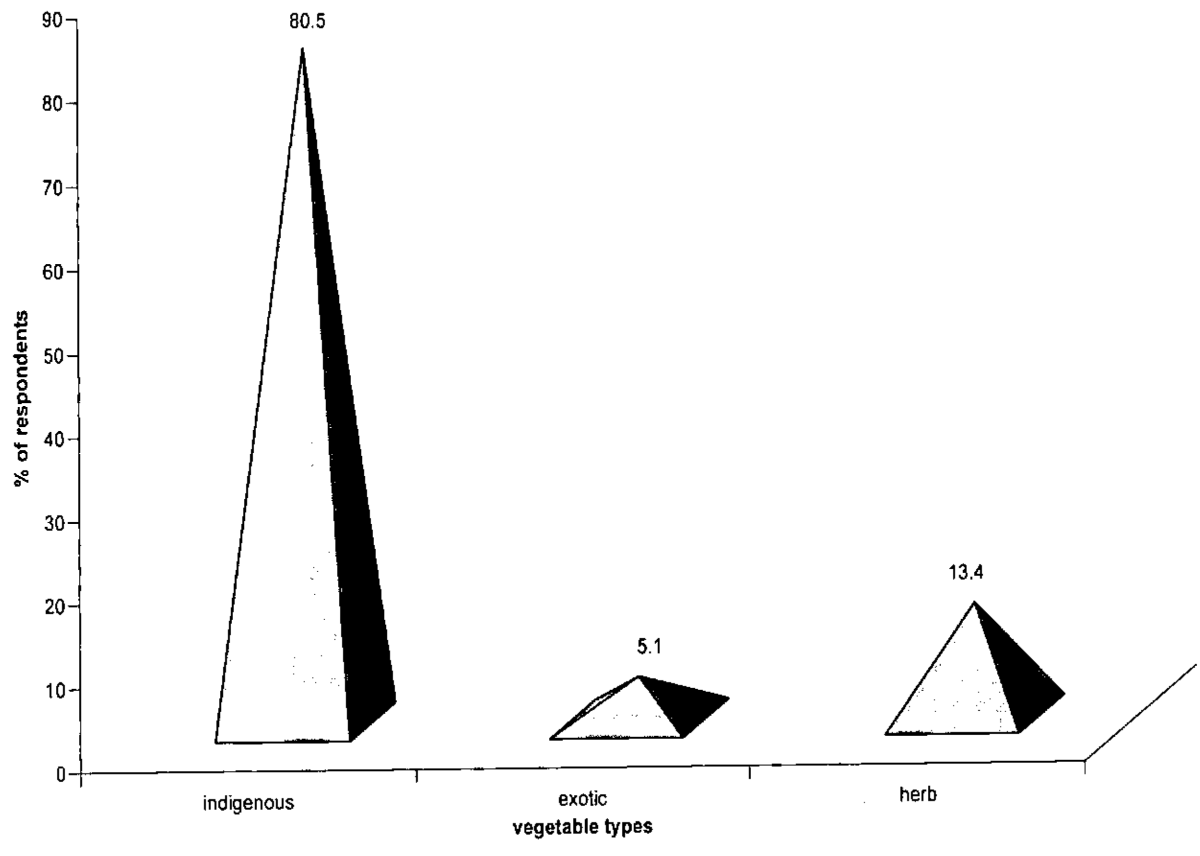

Figure 8.2: Demand for Vegetable Types in Lagos

The high demand for indigenous and herbal vegetables could possibly be attributed to the market which is greatly tilted towards Nigeria traditional crops. An interesting output from this analysis is that there are vast variations in the demand for vegetables between dry and wet seasons due to changes in the average price of vegetable crops. For instance field estimations show that an average of 5 bunches of leafy vegetables (Efo-Tete and Ugu) are demanded per urban household per week in dry season whereas the same household demand for about 7 bunches per week during wet season. This, from economic perspective confirms the assertion on the theory of demand which assumes that the lower the price, the higher the quantity demanded and the higher the price the lower the quantity demanded.

While this assertion might not be over emphasized, further estimation, to determine the amount of urban households' income that is spent on leafy vegetables show that urban household spends an average of ₦207 and ₦95 on leafy vegetables per week during dry and wet seasons respectively. There is therefore about 40% difference in the quantity of leafy vegetables demanded and 140% difference in the amount spent on leafy vegetables between dry and wet seasons.

8.3 Determinant of Demand for Vegetable Crop

There are several factors that influence the demand for a particular good. Vegetable crops are not different. However, only few factors are considered for detailed analysis in this study. This is because they are found to have more and reasonable influence on household demand and expenditure on leafy vegetables than the unmentioned ones.

These are household income, taste and preference for vegetable types, price of vegetables and importance of vegetable to users.

As presented in Figure 8.3, 49.2% of the respondents affirmed that price of vegetables has the greatest influence on demand for vegetables. This is obvious from the seasonal variation as stated earlier as a bunch of vegetable that cost N20 during wet season goes for N50 during dry season. The price differentials of about 150% or N30 make a great deal of impact. The price of vegetable could also be a determinant as a result of absence of alternative to local vegetable in terms of nutrient.

Other factors include are preference for vegetable (32.2%), health problems (13.6%) and household income (5.1%) Taste of vegetable crops influence the demand for the crop because of the preference for it. Nevertheless, about 37% of the respondents agreed that price does not influence the quantity of crop they want to purchase at any point in time. Once they have the need for vegetables they go for it irrespective of the price.

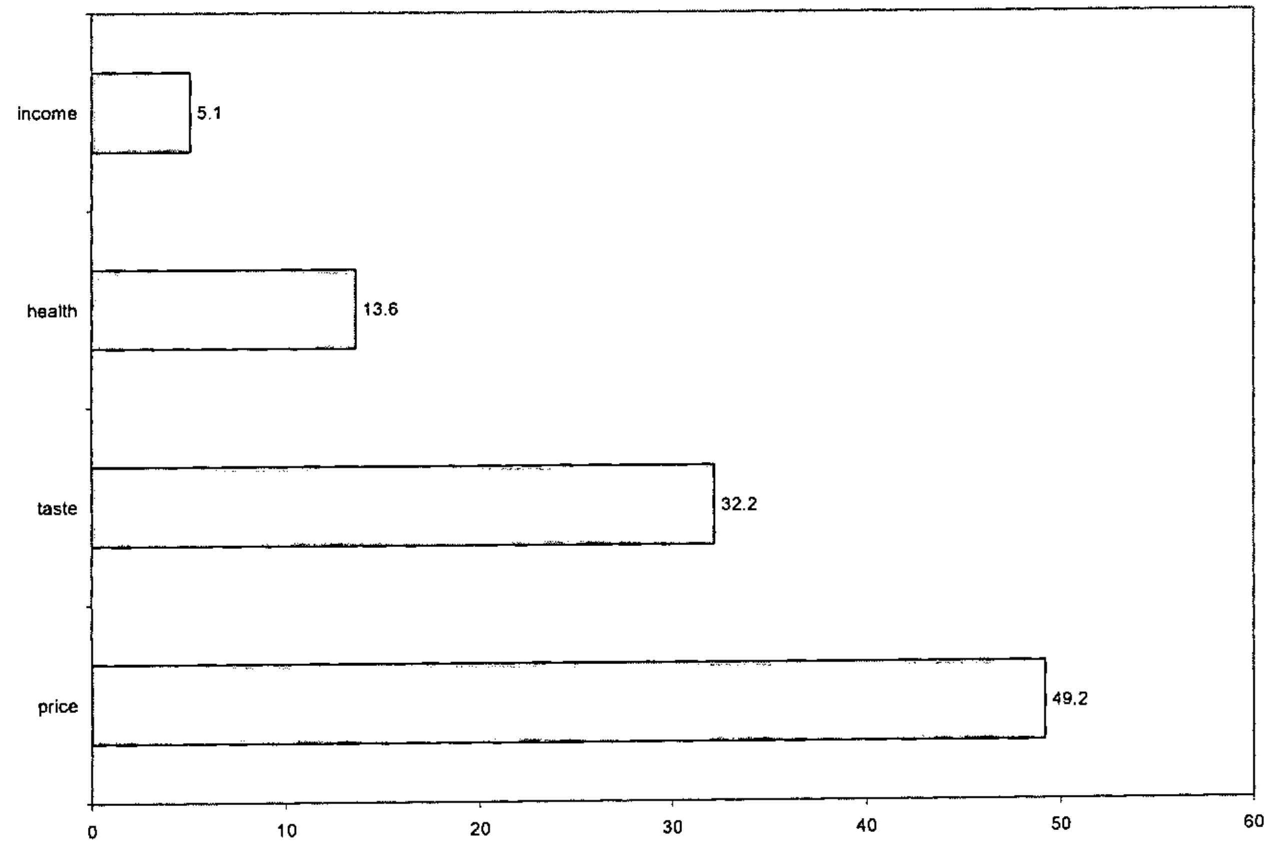

Figure 8.3: Determinants of Demand for Vegetable Crops

8.4 Supply of Vegetable Crops

Supply of vegetable crops into Lagos is from both rural and urban areas from many south western of Nigeria. Large percentage of indigenous and exotic vegetable crops is transported from the surrounding rural setting in Lagos state (Ikorodu, Epe, and Badagry) and Ogun State (Otta, Imeko-Afon, Ipokia, Odeda and Shagamu). These communities are able to supply large quantities of vegetable crops into Lagos because over 85% of the dwellers are into formal agricultural practices and they are mostly beneficiaries of federal and state agricultural policies and programmes. But, the communities lack the necessary market potential to sustain their production. Exporting vegetable products to large urban centre like Lagos, guarantees adequate revenue needed to sustain continuous agricultural production.

Another important source of vegetable supply to Lagos is from urban agriculture farms, located within and at the outskirt of the metropolitan area. There are scattered urban farms in Lagos like in Ojo, Oke-Afa, Alapere, Barracks, Apapa-kirikiri, Amuwo-odofin, Festac, Isolo, Ojota, Mile Twelve, Igando, Oko-Oba, Alagbado, Ikeja GRA areas in Lagos, where relatively large quantities of varying types of vegetable crops are produced and supplied into the growing Lagos market. Unlike the rural supplies, urban supplies experience less wastage, less transportation problems and have easy access to the large urban market.

The information gathered revealed that there is substantial variation in the supply of vegetable into the Lagos market from both the rural and urban areas during dry and wet seasons. While the classical economists have attributed the difference to the fluctuations and changes in price of vegetables, contemporary Geographers see it more as a factor of changes in annual climatic conditions. However, one thing remains certain that availability, accessibility and usability of agricultural inputs which enable farmers to supply agricultural produce to the urban centres have more tasking influence.

8.5 Determinant of Supply for Vegetable Crop

As in the case of demand, there are many factors that influence the supply of vegetable crop in the study area. According to Adebayo, (1991), the determinants of supply could be as a result of commodity's own price, price of alternative commodities, price of factor of production, the goal of the agricultural firm, state of technology and suppliers expectation. However and for the purpose of this research only selected number of factors were examined. These are price of vegetable, price of factor of production, state of technology and producers expectations.

As presented in Figure 8.4, price of vegetables play a significant influence in the supply and production of vegetables to Lagos market. With an average difference of N30 in the cost of purchasing a bunch of vegetable in dry and wet seasons, it can be deduced that there is justification for over 72% of farmers who agreed that the quantity of vegetable produced is a factor of vegetable price, which consequently influence the revenue and profit.

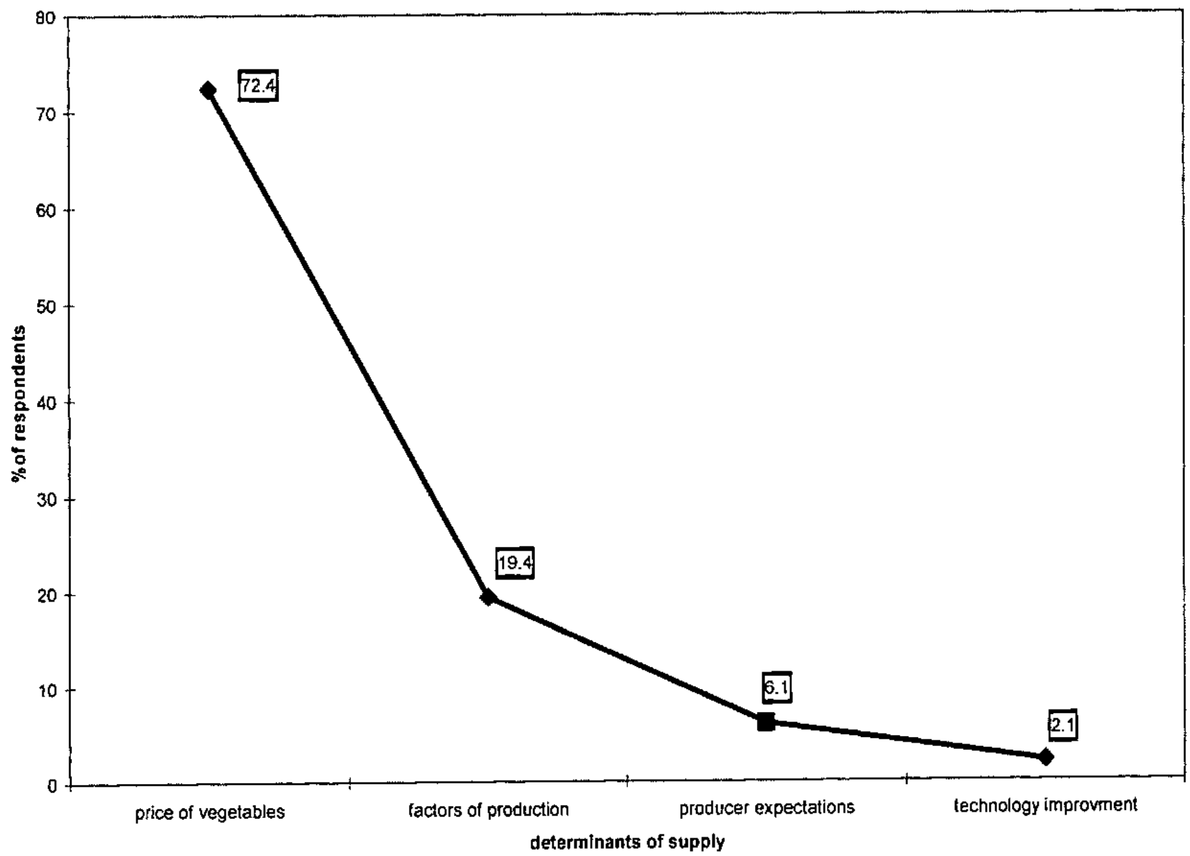

Figure 8.4: Determinants of the Supply of Vegetable Crops

Another ingredient responsible for the difference in price is change in annual weather condition, which enhances abundance of available water for agriculture and yield for about six month of the year on one hand, and scarcity of water during the other six months at the other hand. This fluctuation in the natural environmental conditions affects availability of water all year round creating wet and dry seasons that impact on the supply of vegetable production in Lagos. The second factor is the cost of factor of production like labour, land, manure etc which influence the supply of vegetables. This means that factors that are used in the production process affect the extent to which producers are able to supply a particular quantity at a point in time. For instance the cost of purchasing a bag of poultry waste is usually high during dry season thus affecting the quantity of vegetables supplied at that time. In the same vein, the cost for labour is usually low during dry season than it is in rainy season.

8.5.1 Supply of Vegetable in Wet Season

During this season, price of vegetables is low. Price depreciates due to high influx of vegetables from outside the metropolis and competes with the ones produced in the urban farms. More vegetables are supplied from the rural areas during wet season because they depend on rain-fed agriculture and do not have adequate storage facilities. Thus, rural farmers experience huge harvest such that the supply of vegetables becomes higher than demand leading to fall in price of vegetables. For the urban farmers and in most cases, there is abundant water supply and the utilization of shallow well water becomes less important. For instance, irrigation of vegetables might take place once in a week. They experience less patronage and high labour cost as over 65% of farm labourers travel to their state of origin for a more viable and profitable agricultural production. The situation further makes some of the farmers to divert from the production of vegetable to non-vegetable crops like maize. Earnings and revenue are usually low, utilization of poultry waste is also very low and the vulnerability to flood risk becomes high especially in farmlands close to River banks and Canals.

8.6.2 Supply of Vegetable in Dry Season

Vegetable price during this time is relatively high mainly because there is less supply from outside the metropolis. Since the rural farmers depend solely on rain for their production activities, supply is usually at its minimal. Irrigation activities is thus at its highest in all urban farms. During this period, shallow wells are expanded and demand for poultry waste is very high. As expected demand is high and there is competition for vegetable by consumers and vegetable distributors. Wholesalers and middle-men pay for crops before such crops get mature for harvest.

8.6. Changes in the Price of Vegetables between Seasons

The study also showed that Lagos experience changes in the prices of vegetable crop during the day ordinary day especially when there is delay in the supply of the produce to the market. For instance, a bunch of vegetables could be sold for N20 in the morning and N50 in the evening in the same market depending on the rush for vegetables. There is a change in prices within weeks, festive periods when the residents are preparing to go on National or state strike. Week-ends (Saturdays) are known to be periods when workers have enough time to prepare for the working days, so there is usually rush for cooking items including vegetables. The same is applied to festive periods like in Christmas and Easter celebrations and other periods.

The type of resident a person lives in within Lagos likewise influences the prices at which vegetables are sold. For example price of vegetables in the of low or medium residential areas like Bariga, Mushin, Ketu and Mile twelve are usually lower than corresponding prices of the same quantity of vegetables in high residential areas like Ikeja and Victoria Island.

CHAPTER NINE

9.0 Summary Recommendations and Conclusions

This section highlights the major findings of the study and their implications. It recommends possible measures to limit the negative effects of poultry waste and shallow well water utilization on farmers' health and on urban food crop production. It reports the constraints for sustainable poultry waste and shallow well water utilization and management, identifies the gaps for research priorities and finally makes conclusions based on the findings

9.1 Summary of Findings

In line with the research objectives, the major findings of the study are divided into four sections as stated below-:

9.1.1. Socio-Cultural Characteristics of Poultry Waste and Shallow Well Water Users

The results show that:

- The end products of poultry waste and shallow well water utilization-vegetables crop is very valuable food nutrient in urban households food requirements in Lagos and thus it is highly and regularly in great demand. Every household uses one form of vegetables or the other as food, medicine or ingredient.

- Majority of poultry waste and shallow well water users fall within economically active and dependable age group (18-60 years), who cultivate to fully support or supplement their household income. A higher percentage of them are married with average of five persons per household. Most of them are full time farmers (61% of farmers at Alapere, 82% at Barracks, 62% at Ikeja and 51% at Tejuoso) and earn above the ₦7500 Nigeria minimum wage level in 2006.

- More men are poultry waste and shallow well water users because more women have less access to land and other important agricultural resources and thus occupy smaller and marginal land holdings (0.5 in Alapere, 1.2 Ikeja and 0.3 Tejuoso) Higher percentages (65%) of women utilize poultry waste and are better managers of poultry waste for urban agriculture. All women in Alapere and Tejuoso and about half in Barracks and Ikeja utilize shallow well water in the study area. Over 96.5% of the women cultivate indigenous vegetables, use their households as labourers, incur high production cost in terms of hired labour especially during shallow well water drudging and irrigation process

- Net return per unit area does not influence cultivation of indigenous crop ($P < 0.05$), rather, it influences the cultivation of exotic crops ($P > 0.05$). The reason for this observed discrepancy has to do with socio- cultural structure of the Lagos market which tilts more towards local vegetables. Other reasons are absence of storage facilities and high production cost of exotic crops.

9.1.2. Distribution of Shallow Well Water Utilization and Management Pattern

- There is unequal distribution and utilization of shallow well water in the study area. The reasons for these differences are linked with the discrepancies in the opportunities and challenges farmers encounter in the different farm locations. However, results proved that the spatial differences in the utilization of shallow well water is accounted for by size of land holding in Alapere (r=.155) and Tejuoso (r=.231), level of education in Barracks (r=.228) and Vegetable types in Ikeja (r=.155).
- Shallow well water is a major source of water for vegetable production. Conveyance and application is 90% manual without any strict conservation methods, increased water supply is done by deepening the depth of shallow wells. At critical times, farmers concentrate more on wells located near drains, rivers and canals. Farmers' perception about the negative impact of modern irrigation infrastructure, high cost of procurement together with land insecurity discourage long-term investment in modern irrigation infrastructure.
- Shallow well water salinity was found to be high in Alapere with chloride content reaching 97.5 mg/l (ppm). Other farm sites have 16.05 mg/l (ppm), 20.5 mg/l (ppm) and 38.0 mg/l(ppm) in Barracks, Ikeja and Tejuoso respectively. The high contents of chloride could be linked with seepage from other natural and sewage sources together with evaporation activities.

- Average nitrate content was found to be 11.2 mg/l (ppm), 6.39 mg/l (ppm) for phosphorous and 5.20 mg/l (ppm) for potassium in sampled shallow well water. The presence of these nutrients in shallow wells can possibly be related to fertilizer and chemical runoffs from farm activities within the environs. The result also depicts that shallow well water is highly contaminated with faecal coliforms reaching $1.8\text{x } 10^7$, $1.21\text{x } 10^5$, $1.1\text{x}10^7$, and $1.72\text{x}10^8$ in Alapere Barracks, Ikeja and Tejuoso respectively. These figures exceed WHO acceptable standard limit of $1\text{x}10^3$ for irrigation crops.

9.1.3. Distribution of Poultry Waste Utilization and Management Pattern

- There is relatively equal distribution of the utilization of poultry waste in the study area. The reason being that poultry waste is a relevant resource for urban agriculture and its alternative sources are difficult to access. A statistical analysis shows different reasons for the observed pattern of distribution. It shows that the utilization is influenced by the number of farms a farmer owns (r=.339) in Alapere, by educational level (r=.248) in Barracks, farmers experience (r=.085) in Ikeja and seasonal variation (r=.383) in Tejuoso.
- Application of poultry waste is highly manual and without the use of any protective gadgets because of convenience and ease of application. Storage is by heaping and burying. Poultry waste is inadequately treated because of lack of skill (64%), insufficient space and time (15%) and paucity of capital (9%). Other reasons are the burdensomeness of the long

composting processes required for its treatment (8%), and inadequate access to other needed materials such as ash (4%).

- Nitrate content of poultry waste was found to be lower in three study sites. This means that poultry waste might not offer better source of nitrate for food production in the study area. However, phosphorous (P) and Potassium (K) contents of sampled poultry waste were relatively adequate. The study further revealed that poultry waste is highly contaminated with average *faecal Coliform* ranging between $1.7x10^{5}$ to $1.81x10^{6}$ and which exceeds WHO acceptable standard limit of $1.0x10^{3}$ for crops that are likely to be eaten raw.

9.1.4 *Farmers' socio-cultural Influence on management practices*

- There are significant association between age and poultry waste treatment method ($P< 0.201$), application ($P< 0.523$) and storage ($P< 0.126$); income and treatment ($P< 0.504$), application ($P< 0.638$) and storage ($P< 0.554$); religion and treatment ($P< 0.177$), application ($P< 0.623$) and storage ($P< 0.485$. On the other hand, the result also shows significant association between religion and shallow well treatment ($P< 0.230$), application ($P< 0.223$) and storage ($P< 0.182$).

9.1.5 *Implications on Health and Productivity*

- The result shows that there is a corresponding increase in crop yield and the increased quantity of shallow well water used and hence high revenue. Exotic vegetables require more shallow well water than local vegetables in the study area.

- There is significant variation between the quantity of poultry waste ($P > 0.05$) used and crop yield ($P>0.05$) in the study area. That is high input of poultry waste does not necessarily mean high output. This is due to the differences in soil quality which influences the quantity of poultry waste utilization and crop yield. The study also shows that application of higher quantity of poultry waste gave lesser yield whereas a low quantity produces a higher crop output. Local vegetables require less poultry waste than exotic vegetables.

- There are a high number of reported cases of malaria infection among resident urban farmers but clinical analyses for malaria parasite revealed that resident non-farmers are more infected with malaria parasite than farmers in all the four study locations.

- Less than 25% of the respondent complained of regular stomach problems. However, stool analyses revealed that more farmers (65%) are infected with Escherichia coli of Salmonella and shigella species than non-farmers (30%).

9.1.6. Role of Government Agencies in Poultry Waste and Shallow Well Utilization

- There is virtually no solid policy support system for urban agriculture and poultry waste and shallow well water utilization in the study area due to the general apathy towards the activity. As a result, most urban farmers individual or collectively strive to cultivate their crops within their capacity.

- There is haphazard utilization of poultry waste and shallow well water management such that the beneficial components and nutrients are lost during storage, transportation and application.

- There is bad poultry waste and shallow well water management practices and poor personal and community hygiene due to lack of sanitary facilities, skill and risk education. This is also due to absence of monitoring and evaluation activities of the urban farmers.

9.2 Implications of Findings

The implications of this study are numerous some of which are:

- Majority of poultry waste and shallow well water users are heads of household who cultivate to fully or partially support their household to make a living within the city area. This means that poultry waste utilization support more, if not all-urban farmers and alleviate them from food insecurity, unemployment and poverty. Through the availability of vegetables urban households are able to meet their nutrient requirements.

- With more women having less access to land and other agricultural input like water and manure, more children and household may be prone to hunger and may lack other basic necessities of life. This is because women are caregivers and deprivation of opportunities often has multiplier effects (on children, youth and the aged). It further inflicts negatively on the socio-economic and environmental development of the nation since both male and female have been recognized by the international community as partners and contributors to sustainable agricultural development.

- Difference in the factors affecting shallow well water utilization implies a geographic perspective to the water need and problems of the urban farmers. Promoting land security in Alapere and Tejuoso farms would be more solution driven than supporting investment in irrigation infrastructure in those farm communities.

- More shallow well water produces more output and more income. Knowledge on water requirement for the crop types promotes water planning and management in urban agricultural practices.

- Management and utilization pattern of poultry waste and shallow well water exposes not only urban farmers to health and environmental risk, but the entire municipal population. Long term effect of the situation could increase demand and cost of health facilities, the bulk of which falls on the government. Poor personal and community management could also accentuate bad health problems at the long run. All these associated effects could limit the productivity of farmers, increase individual and state budget on health and could further have multipliers effect on the farmers household.

- Lack of technical knowledge and adequate monitoring has led to haphazard utilization and poor management of poultry waste and shallow well water for urban food production. It could also lead to circulation of nutrient within the agro-ecosystem such that there could be excesses of certain minerals in the crops via the soil.

9. 3. Contribution to Knowledge

This study:

- brings to fore the salient attributes of poultry waste and shallow well water utilization for urban food production in Lagos metropolis. It clearly shows the importance and constraints of poultry waste and shallow well water utilization as well as their impacts on vegetable production and health of users
- exposes the extent to which socio-cultural attributes of Lagos community conform to the traditional models of agricultural production.
- relationship between geography, agriculture, economic, sociology, health and environmental resources management that can lead to sustainable development in Nigeria.
- bridges the information and data gap in the utilization of poultry waste and shallow well water for urban agriculture.

9.4 Gaps for Further Research

The finding from this study shows that there is high risk of nutrient loss and health problems associated with the present state of poultry waste and shallow well water utilization for urban agriculture. Therefore further research is required to investigate:

1. Stakeholders perception about shallow well water and poultry waste enterprise
2. Impact of poultry waste and shallow well water on household welfare.
3. Tracing toxic element of and pesticides in crop production system
4. Poultry waste nutrient preservation from production to utilization.
5. Forward and backward linkages in poultry waste and shallow well water utilization for urban agriculture
6. Gender analysis on health implications of poultry waste and shallow well water management for urban agriculture.
7. Cost-benefit analysis of poultry waste and shallow well activities in urban agriculture.
8. Accessing the ethnic composition and roles of stakeholders in urban agricultural activities
9. Investigating the health condition of different vegetables crop

9.5 Recommendations

The study has obviously proven that poultry waste and shallow well water are important resources for urban agriculture but are poorly managed and utilized due to a combination of factors which can be traced to many actors. This shows that broad appreciation of the potential benefits of urban agriculture is needed to overcome the obstacles for its development. This of course require policies and programmes and research to promote and regulate urban agriculture and its associated activities. Based on this, the underlisted recommendations are made in respect of the state of urban agriculture in Lagos generally, and specifically for poultry waste and shallow well water utilization:

- Increase in Peoples Knowledge and Support for Urban Agriculture- Public information aimed at potential benefits is an effective tool for transforming urban agricultural practices from its present status into a more developed instrument against hunger and poverty, environmental deterioration and unemployment. More balanced and objectively analytical reports are needed to broadly understand how urban agriculture could improve livelihood. This could be done through articles in the Newspapers and network, newsletter, workshops and conference as well as the electric media (Television and documentaries programmes). Primary urban agriculture education in schools, vocational training and in secondary school curriculum would be essential component of any action plan to increase the peoples' knowledge and support for urban agriculture.

- Increase Interest of Policy Makers: Legislator and government administrators should be sensitized on urban agricultural activities so as to increase their political wills needed for urban agriculture to achieve its potentials. This could be in form of one or two day leadership forum where policy narrative on urban agriculture is presented. Such forum could be facilitated by experts in urban agriculture and related topics to ensure full consideration of all critical areas such as the utilization of poultry waste and shallow well water.

- Inclusion of Urban Farmers in National Farmers Organisation: Effort to educate the public and government administrators should include farmers. This is because the general lack of organisation among farmers especially lower income farmers is due to their physical exclusion from each other. Farmers could also be assisted to organize themselves into cooperatives and associations and to facilitate their development. Good and effective communication among the farmers should be encouraged to facilitate information dissemination, knowledge and experience sharing. Improved organisation among farmers would have benefits for production as well as improve access to pre-production and post- production facilities.
- Access to Land: Urban agriculture should be included into urban city land use policy. This would trigger a more balanced ecological and sustainable urban development pattern that conserve natural resources and biodiversity and towards a more productive landscape. Polluted and idle lands could be transformed, thus providing leverage as land that are unsuitable for buildings would have value.

- Access to Agricultural Resources and Inputs: Special line of credit should be provided for urban farming entrepreneurs and existing agricultural credit quota should be preserved for them. Urban farmers should be provided with access to market and market information. Market place could be created for small farmers and helping farmers to form cooperative marketers. The backward and forward linkages between urban farmers and other associated entrepreneur should be strengthened especially processors and marketers.

- Exploiting Opportunity: The activities of poultry waste should be monitored and regulated for urban agriculture. This could be adopted through small scale, simple, easy to manage and maintain technology at household, community and state levels. According to Redwood (2004) the benefit of using cured organic waste as poultry waste is ratio five to one meaning that every dollar spent on treatment system is five dollar made from agricultural yield. For example simple household anaerobic treatment systems in Palestine have achieved a recovery of 55% waste implications on food production. Engaging in the treatment system at the local and state levels would create more livelihood opportunities to the increasing urban unemployed and under employed and also improve the urban local economic development through backward and forward linkages. This should be linked with land accessibility because waste treatment and composting is land driven. Making land available and accessible through less stringent measures would reduce the threat the present state exhibits.

- Integrated Nutrient Management Practices: Aquatic plants can be used to treat shallow wells with high nutrient contaminants. Knowledge and education of the linkages between the human activities should be shared with farmers so that they can appreciate how some of their problems emanate. Knowledge on useful plant such as duckweed, water lettuce, water hyacinth, typha and bulrush effective in reducing and absorbing nutrient from water to balance water contents should be spread.

- Risk Education: Education on risk management should be an important requirement for urban farmers so that promptness, regularity and consistency in waste and water information can be gained for urban agricultural practices. This would help farmers to make sound decisions about proper poultry waste and shallow well management and also have a reliable way to monitor their quality. This could either be through information, awareness creation, training on treatment systems (safe transportation of poultry waste and shallow well water, storage, packaging, application, safe irrigation, protection etc. This would preserve poultry waste nutrients and further reduce health risk associated with its uses.

- Balance Synergy Among Stakeholders: People that shared interest and take decisions that influence urban agricultural activities should be encouraged to come together to have common understanding on important issues in urban agricultural activities in Lagos. These could be achieved through partnership with farm community associations, government actors and non-state actors (non-governmental organization, local and international agencies). This will promote constant exchange of management information, the end result being to develop synergies and coordinate interventions based on shared interests. It would further enhance better regulation and monitoring of the activities within the urban agriculture system to ensure safe practices and proper use of resources. The synergy among stakeholders could ensure formulation and adopting policies for land security and the provision of transport facility.

- Gender Balance in Access and Distribution of Resources: The study has shown that there is need for poultry waste and shallow well water users particularly women to move from the present disadvantaged positions relative to men in urban agricultural practices in Lagos. First, the access to agricultural resources gap needs to be closed to provide level playing ground for both male and female urban farmers, in order to minimize the extent young children who are supposed to be at school are used as labourers . This could be achieved by reducing work burden, production cost and time. And by making needed agricultural tools, training, resources and income related to poultry waste and shallow well water utilization and management activities available and accessible to women. This would raise women's status and contribute adequately to sustainable poultry waste and shallow well water utilization for urban agriculture.

- Institutional Arrangement: An effective institutional arrangement devoid of stiff bureaucratic process, corrupt practices, incompetent and unskilled personnel should be enforced and ensured. Capacity of the extension agents should be built to enhance their expertise and enable them attend to problems that need urgent solutions. They should further be provided with necessary resources that would enhance the performance of their duties.

9.6 Conclusion

The research highlights that poultry waste and shallow well water utilization for urban agriculture are indeed integral part of the urban economy. It is one activity that has multiple means of addressing some core challenges of urbanisation in Lagos. Its potentials synchronize into the objectives and programmes of international, regional and national organisations (FAO, IDRC, WORLD BANK). The use of poultry waste and shallow well water for urban food production reduce government burden to sufficiently provide inorganic and quality water for the growing urban farmers. With steadily increasing number of people and a growth rate of 5% per annum in Lagos coupled with large number of people actively venturing into urban agriculture focusing on perishable vegetable crops with short shelf life to sustain their livelihoods, in spite of inadequate access to inorganic manure, the potential capacity of urban agriculture seems to be very promising. Some of its prospects include:

a. Attaining a balanced local food supply apart from increasing food and nutritional security through direct and indirect household food supply.
b. Creating increased employment for unemployed women, men, youth and the underemployed. As well as increased income generation which in turn will enable people to have access or purchase non-food needs to improve their general livelihood.
c. Contributing to urban waste reduction amid huge waste management problems with large biodegradable contents.
d. Maintaining green spaces that decongest atmospheric elements that enhance ozone layer depletion adding more to the aesthetic of the urban environment.
e. Allowing good land economy by maximizing the use of idle, fragile and waste land that would have been hide out for miscreants.
f. Proving entrepreneurial abilities for small and medium enterprises through backward and forward linkages thereby promoting urban local economic development.

These prospects of urban agriculture through the use of poultry waste and shallow well water, as laudable and capable to minimize the common urban challenges seems unachievable in Lagos due to the following problems:

- Unavailability and accessibility of knowledge regarding benefits and proper use of poultry waste especially in respect of composting procedures, handling and storage. This also include knowledge and accessibility on science and Technology of composting and recycling operations that enable safe utilization of the resources
- Financial and time constraints in carrying out proper composting of poultry waste. This limitation is also applicable to the utilization of shallow well water. Because the most farmers are poor but desperate to survive little or no time is created to examine the potency and adequacy of any agricultural inputs.
- Absence of affordable and better alternatives of poultry waste and shallow well water.
- There is the problem of regulations and monitoring guidelines on how best to utilize poultry waste and shallow well water for sustainable environmental development. The urban farmers also lack needed institutional support.
- There is also the problem of land availability and accessibility within the urban enclave. Every piece of land is often subjected to cultivation rather than composting of some of the input for safe production.

With the afore-mentioned constraints to achieve a desirable development in urban agricultural practices in Lagos, the adoption of an integrated approach is imperative to minimizing the problems if not eradicating them. This task could be realized if all stakeholders particularly Government, Non- Governmental Organisations and poultry waste and shallow well users play their different roles, paying more attention to issues that could enrich the fulfilled lives of the citizenry especially the marginalized majority of whom are women, youth and children.

Be that as it may a critical analysis of the situation shows a robust opportunity that could be explored upon the numerous challenges. This is in terms of developing low-cost technology for poultry waste treatment and policy options. This is because several things are clear from the study.

It is therefore hoped that a multi-stakeholders process that will ensure solution and ensure responsible decision making to develop appropriate urban agriculture management including poultry waste and shallow well water would alleviate the problems experienced as a result of poultry waste and shallow well water utilization for urban agriculture in Lagos. These roles are:

i. Non Governmental Organisations should create public awareness about the importance of urban agriculture and urban agricultural activities to development programmes and project. They could prioritize the needs of farmers for efficient urban farming. Such priorities could attract external and internal funding and also collaborate with other relevant agencies. Centres through which farmers can identify the quality of available poultry waste and water should be established.

ii. Federal and State government could promulgate an acceptable guideline for the quality of poultry waste and water use for food production. This is because the international acceptable standard seems difficult for the farmers to meet. Complete restriction and adherence to the WHO standard would affect the livelihood of hundreds of peoples negatively. Government could also promulgate laws and regulations to allow access to land as well as user right for both private and public vacant lands.

iii. Farmers could act as check on themselves to ensure safe use of any agricultural input.

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Appendix I

Implications of Poultry Waste and Shallow well water Utilization for Urban Agriculture in Metropolitan Lagos

This questionnaire is designed to obtain information on farmers' activities on poultry waste and shallow well water management in Lagos and it is strictly for academic research. It will therefore be appreciated if you respond to the questions truthfully. The responses from this question shall be treated confidentially. Thank you for your cooperation.

Location: ....

Section A: Socio-cultural Identity of farmers

INSTRUCTION: Please circle or fill the blank spaces appropriately

How old are you? Below 20years =1; 21-30 years =2; 31 - 40 years =3 ; above 40 years=4

2. Sex: Male=1; Female=2

Marital Status: Married=1; Single=2; Divorced=3; Widowed=4

4. Ethnic group: Hausa=1 ; Igbo=2; Yoruba=3; others=4

5. Religion: Christianity=1; Islam=2; Traditional=3; Others Specify=4

6. Family size: 1 to 4=1; 5 to 8=2; others=3 Level of Education: none=1; Primary=2; Secondary=3; Tertiary=4 ; Adult Education=5 ; Quranic=6

8. □□w long have you been living in Lagos: Under one year=1; 2-4 years=2 ; 5-7 years=3; 8 years or more=4

9How long have you been farming here? Under one year=1;-4 years=2 5-7 years=3; 8 year or more=4

10. What is the source of your finance? 1. personal savings2. bank loan 3=cooperative 4. associations

10. Number of workers: none=1; 1—5= 2; 6-10=3

11. Type of farmer: Full time=1 Part time=2

12. Secondary work: Trading=1 Night guard=2 Civil Servant=3 others Specify=4

13. What are the numbers of your workers by gender? Male............ female........................

14 Why do you engage in this type of farming? Lack of employment=1; supplement insufficient income=2; recreation=3; profession=4 others........=5

15 How many farms do you have? 1-3=1; 4-6=2; 7-9=3; 10 and above=4

16, What is your average monthly income? ....

17. How many hours do you work in a day? ....

18. How many farm beds do you have? < 110=1; 111-220=2; 221- 440=3;.> 2plots=4;

19. How do you acquire your land holding: Purchase=1; Inheritance=2; Rented=3; guard=4; Allocated by Government=5 ; others (Specify)................... =6

20 If rented, how much do you pay per month/ year: ....

21. What type of vegetable crops do you cultivate? Local vegetable=1; European Vegetable=2; Please list them...

....

SECTION B: Poultry Waste Management

22. What type of waste do you use to improve the soil? Please rank Use 1 for the most frequently used one and 5 for the least

Waste Type	Rank
Poultry waste	
Cattle dung	
compost	
Sheep dung	

23 where do you get you poultry waste form?

Government=1; NGO=2; community effort=3; personal effort=4; Brokers=5.

24. Why do you use Poultry waste? ....

....

25. How much do you purchase a bag of Poultry waste?

....

26 On how many farm beds do you apply a bag of poultry waste for Lectus........; Tete.......;Spring onions........; bitter leave................

27 how much do you sell a bed of Lectus........; Tete.......;Spring onions........; bitter leave................

28. How do you treat your poultry waste before application?...

....

29. How do you store your poultry waste before application? ....

....

b30. How do you apply your poultry waste on farm beds? ....

....

31. Do you use any of the following? Please tick and give reason for using your choice

Other source of Manure	Reason for usage
NPK	
Urea	
Waste compost	
Black soil	
others	

32. At what stage of cultivation do you apply Poultry waste and other manure?

....

....

....

33. How do you cope during scarcity of poultry waste?

....

....

....

34. What health problems do you think have as a result of poultry waste usage?

....

....

35. What advice do you have for government about poultry waste usage for vegetable production in Lagos ....

....

SECTION C: Shallow well Water Management

36. What are sources of water used in your farm Tap water=1 ; Shallow well=2l; Borehole=3; Drainage=4; River=5; others(specify).............................=6

37. How do you have access to your choice of water NGO=2; community effort=3; personal effort=4; Brokers=5.

38. Why do you use shallow well water for irrigation?...

....

....

39. How much do you it cost you to have access to shallow well.............................. ...

40 On how many beds do you apply bucket of water for Lettus.........; Tete........;Spring onions.........; bitter leave................

41. How do you treat your shallow well before application?...

....

42. How do you store your water from shallow well?

....

43. How do you apply your water on farm beds?

....

44. Do you use any of the following? Please tick and give reason for using your choice

Other source of water	Reason for usage
Wash bore	
River	
Canal	
piped	
others	

45. At what stage of cultivation do you apply shallow well and other types of water?

....

....

....

46. How do you cope during scarcity of dry season?

....

....

....

47. What health problems do you think have as a result of poultry waste usage?

....

....

48. What advice do you have for government about shallow well water usage for vegetable production in Lagos...

....

....

SECTION D: Other Information

49. Where do you acquire the knowledge you apply to your waste and water management from? Home town =1; government=2; Experience=3 ; NGOs=4; farmer association=5 others(specify).................= 6

50. What are the roles peculiar to men, women and children in this aspect of farming?

Men..

Women..

Children...

Aged...

51. Why are these roles peculiar to these individuals? ....

....

....

52 Who takes decision on the use and management of poultry waste and shallow well water types used in your farm? ....

....

Section E: Health Risk and Personal hygiene

53. Where do you pass stool while on the farm? Pit latrine=1; farm environment=2; others (please specify)...

54. Where do you dump your domestic and farm refuse? Farm surrounding=1; others..............=2

55. Do you wash your hand before eating and after working on the farm? Yes=1 ; No=2

56. Where are the sources of water for:

Use	Source
drinking	
Washing vegetables before sales	
Washing plates	
Washing clothes	
bathing	
cooking	

57.What protective measures do you take while applying poultry waste and shallow well water on your farm

Measures	Waste	Water
Wearing of boots		
Wearing of protective cloths		
Wearing gloves		
Cream application		
Others pls specify		

58. What kind of ill health do you usually suffer? Pls tick as appropriate.

Illness	Experience
Malaria	
Skin irritation	
Respiratory infection	
Stomach/intestinal disorder	
dysentry	
Diarrhea	
Others pls specify	

59. Where do you seek medication? Self- medication=1; herbalist=2; health centre=3; others (please specify) ....=4

60. What do you think is the usual cause of the illness?

....

....

61. Do you associate your ill health with possible contamination from the use of water and waste in your farm? Yes=1; No=2

62. Please give reason for your answer in question 60

....

....

63. In what ways can someone avoid the health problems related to waste and water contamination?

Wearing protective covers= 1; growing certain crops=2; acquiring more skill about means of contamination=3; washing adequately=4 others (pls. specify).......................................=5

64. What environmental problems do you know have been associated any with farm practices in your neighbourhood? Flooding=1; erosion=2; offensive odour=3; stealing=4

65. What kind of problem do you experience from your neighbourhood? Stealing=1; harassment=2; dumping of refuse on farm site=3; fear of ejection=4; Others...........=5

66. Do your customers patronize you because of the type of manure you use? Yes=1; No=2

67. Please explain your answer in question 65

....

....

68. What problems do you have in respect of waste and water management in your farming activities? Land insecurity=1; market access=2; lack of skill for adequate management=3; water problems during scarcity time=4; others pls specify=5

69. What service would you like to get as farmer? ....

....

71. What comment do you have on this research?

....

....

Appendix II

Questionnaire of the Economics of Vegetable in Lagos Metropolis

Please answer and tick the questions as appropriate

1. Gender Male (1) Female (2)
2. Occupation
3. Age

4. What do you use vegetables for? processing for other use ( ), home food ( ) for selling ( ) for health reason ( )

5. Where do you buy your vegetables? From Urban farms ( ), from the Market ( ) hawkers ( ) from vegetable stores ( ) from rural farms
6. What type of vegetables do you usually buy? Indigenous {Efo, Ugu, Ewedu, Tete, Bitter leave, Water-leave etc} ( ); exotic vegetables { lettuce, India spinage, spring-onions, Dheal etc} ( ); Herbal (aloe-vera)
7. How many bunches of vegetables do you use in a week during dry season?

....

8. How much do you spend on vegetables in a week during this period?

....

9. How many bunches of vegetables do you use in a week during wet season?

....

10. How much do you spend on vegetables in a week during this period?

....

11. What factors influence the quantity of vegetable that you buy?

....

12. Do you actually meet your demand for vegetables? Yes ( ), No ( )

13. How many vegetables would you need ordinarily in a week?

....

14. What is the difference in the quantity of vegetables you need and what you buy often?...

15. What factors are influence the quantity of vegetables that you use at a time? Price ( ), taste ( ), income ( ) season ( ) health reason ( ) others pls. be specific____________________ ( ).

APPENDIX III: REGRESSION ANALYSIS OF SHALLOW WELL WATER

Alapere Farm

Descriptive Statistics

	Mean	Std. Deviation	N
Source of Water	2.14	.35	73
Gender	1.08	.28	73
Level of Education	4.44	1.52	73
Years of farming	3.01	.84	73
Number of Farm at site	1.48	.75	73
Monthly income	1.70	.95	73
Size of land holdings	1.81	1.10	73
Types of vegetabless produce	2.79	.47	73

Correlations

		Source of Water	Gender	Level of Education	Years of farming	Number of Farm at site	Monthly income	Size of land holdings	Types of vegetabless produce
Pearson Correlation	Source of Water	1.000	-.119	.043	.136	-.150	-.126	-.112	-.081
	Gender	-.119	1.000	-.219	-.065	.008	-.063	-.221	.025
	Level of Education	.043	-.219	1.000	.071	.033	.121	-.173	-.028
	Years of farming	.136	-.065	.071	1.000	.011	-.012	-.207	-.028
	Number of Farm at site	-.150	.008	.033	.011	1.000	.011	-.039	-.032
	Monthly income	-.126	-.063	.121	-.012	.011	1.000	-.056	.077
	Size of land holdings	-.112	-.221	-.173	-.207	-.039	-.056	1.000	.003
	Types of vegetabless produce	-.081	.025	-.028	-.028	-.032	.077	.003	1.000
Sig. (1-tailed)	Source of Water	.	.158	.360	.125	.103	.145	.172	.249
	Gender	.158	.	.031	.294	.472	.299	.030	.417
	Level of Education	.360	.031	.	.274	.392	.153	.071	.408
	Years of farming	.125	.294	.274	.	.462	.460	.039	.407
	Number of Farm at site	.103	.472	.392	.462	.	.464	.373	.394
	Monthly income	.145	.299	.153	.460	.464	.	.319	.259
	Size of land holdings	.172	.030	.071	.039	.373	.319	.	.489
	Types of vegetabless produce	.249	.417	.408	.407	.394	.259	.489	.
N	Source of Water	73	73	73	73	73	73	73	73
	Gender	73	73	73	73	73	73	73	73
	Level of Education	73	73	73	73	73	73	73	73
	Years of farming	73	73	73	73	73	73	73	73
	Number of Farm at site	73	73	73	73	73	73	73	73
	Monthly income	73	73	73	73	73	73	73	73
	Size of land holdings	73	73	73	73	73	73	73	73
	Types of vegetabless produce	73	73	73	73	73	73	73	73

Variables Entered/Removed[b]

Model	Variables Entered	Variables Removed	Method
1	Types of vegetabless produce, Size of land holdings, Number of Farm at site, Monthly income, Years of farming, Level of Education, Gender[a]	.	Enter

a. All requested variables entered.

b. Dependent Variable: Source of Water

Model Summary[b]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.304[a]	.092	-.005	.35

a. Predictors: (Constant), Types of vegetabless produce, Size of land holdings, Number of Farm at site, Monthly income, Years of farming, Level of Education, Gender

b. Dependent Variable: Source of Water

ANOVA[b]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	.797	7	.114	.945	.479[a]
	Residual	7.833	65	.121		
	Total	8.630	72			

a. Predictors: (Constant), Types of vegetabless produce, Size of land holdings, Number of Farm at site, Monthly income, Years of farming, Level of Education, Gender

b. Dependent Variable: Source of Water

Coefficients[a]

Model		Unstandardized Coefficients B	Unstandardized Coefficients Std. Error	Standardized Coefficients Beta	t	Sig.
1	(Constant)	2.631	.424		6.206	.000
	Gender	-.187	.159	-.150	-1.180	.242
	Level of Education	-3.49E-04	.029	-.002	-.012	.990
	Years of farming	3.967E-02	.050	.096	.792	.431
	Number of Farm at site	-7.22E-02	.055	-.156	-1.317	.192
	Monthly income	-4.89E-02	.044	-.135	-1.124	.265
	Size of land holdings	-4.37E-02	.040	-.139	-1.086	.282
	Types of vegetabless produce	-5.04E-02	.087	-.068	-.577	.566

a. Dependent Variable: Source of Water

Residuals Statistics[a]

	Minimum	Maximum	Mean	Std. Deviation	N
Predicted Value	1.87	2.34	2.14	.11	73
Residual	-.34	.88	-5.11E-16	.33	73
Std. Predicted Value	-2.521	1.883	.000	1.000	73
Std. Residual	-.965	2.538	.000	.950	73

a. Dependent Variable: Source of Water

Barracks Farm

Descriptive Statistics

	Mean	Std. Deviation	N
Source of Water	2.69	.57	75
Gender	1.81	.39	75
Level of Education	2.80	1.00	75
Years of farming	2.77	.85	75
Number of Farm at site	1.77	.73	75
Monthly income	2.13	.81	75
Number of beds	2.85	1.22	75
Types of vegetabless produce	1.32	.74	75

Correlations

		Source of Water	Gender	Level of Education	Years of farming	Number of Farm at site	Monthly Income	Number of beds	Types of vegetabless produce
Pearson Correlation	Source of Water	1.000	.043	.200	-.006	.058	.090	.032	-.085
	Gender	.043	1.000	.248	-.048	-.150	-.176	-.058	.116
	Level of Education	.200	.248	1.000	-.086	-.175	.017	.176	-.022
	Years of farming	-.006	-.048	-.086	1.000	-.041	.064	-.033	-.055
	Number of Farm at site	.058	-.150	-.175	-.041	1.000	-.040	.176	-.115
	Monthly income	.090	-.176	.017	.064	-.040	1.000	.294	.063
	Number of beds	.032	-.058	.176	-.033	.176	.294	1.000	-.158
	Types of vegetabless produce	-.085	.116	-.022	-.055	-.115	.063	-.158	1.000
Sig. (1-tailed)	Source of Water	.	.358	.043	.480	.309	.222	.393	.234
	Gender	.358	.	.016	.342	.099	.066	.310	.161
	Level of Education	.043	.016	.	.231	.067	.444	.066	.426
	Years of farming	.480	.342	.231	.	.365	.292	.390	.319
	Number of Farm at site	.309	.099	.067	.365	.	.368	.066	.163
	Monthly income	.222	.066	.444	.292	.368	.	.005	.295
	Number of beds	.393	.310	.066	.390	.066	.005	.	.088
	Types of vegetabless produce	.234	.161	.426	.319	.163	.295	.088	.
N	Source of Water	75	75	75	75	75	75	75	75
	Gender	75	75	75	75	75	75	75	75
	Level of Education	75	75	75	75	75	75	75	75
	Years of farming	75	75	75	75	75	75	75	75
	Number of Farm at site	75	75	75	75	75	75	75	75
	Monthly income	75	75	75	75	75	75	75	75
	Number of beds	75	75	75	75	75	75	75	75
	Types of vegetabless produce	75	75	75	75	75	75	75	75

Variables Entered/Removed[b]

Model	Variables Entered	Variables Removed	Method
1	Types of vegetables s produce, Level of Education, Monthly income, Years of farming, Number of Farm at site, Gender, Number of beds[a]	.	Enter

a. All requested variables entered.

b. Dependent Variable: Source of Water

Model Summary[b]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.261[a]	.068	-.029	.58

a. Predictors: (Constant), Types of vegetabless produce, Level of Education, Monthly income, Years of farming, Number of Farm at site, Gender, Number of beds

b. Dependent Variable: Source of Water

ANOVA[b]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	1.631	7	.233	.700	.672[a]
	Residual	22.316	67	.333		
	Total	23.947	74			

a. Predictors: (Constant), Types of vegetabless produce, Level of Education, Monthly income, Years of farming, Number of Farm at site, Gender, Number of beds

b. Dependent Variable: Source of Water

Coefficients [a]

Model		Unstandardized Coefficients B	Unstandardized Coefficients Std. Error	Standardized Coefficients Beta	t	Sig.
1	(Constant)	2.105	.550		3.825	.000
	Gender	4.751E-02	.183	.033	.260	.795
	Level of Education	.125	.072	.220	1.734	.087
	Years of farming	2.383E-03	.080	.004	.030	.976
	Number of Farm at site	8.563E-02	.097	.109	.879	.382
	Monthly income	8.683E-02	.089	.124	.971	.335
	Number of beds	-3.50E-02	.061	-.075	-.572	.569
	Types of vegetabless produce	-7.00E-02	.094	-.091	-.745	.459

a. Dependent Variable: Source of Water

Casewise Diagnostics[a]

Case Number	Std. Residual	Source of Water	Predicted Value	Residual
10	3.612	5	2.92	2.08

a. Dependent Variable: Source of Water

Residuals Statistics [a]

	Minimum	Maximum	Mean	Std. Deviation	N
Predicted Value	2.37	3.12	2.69	.15	75
Residual	-1.09	2.08	-7.82E-16	.55	75
Std. Predicted Value	-2.189	2.907	.000	1.000	75
Std. Residual	-1.884	3.612	.000	.952	75

a. Dependent Variable: Source of Water

Ikeja Farm

Descriptive Statistics

	Mean	Std. Deviation	N
Source of Water	2.53	.71	73
Gender	1.33	.47	73
Level of Education	3.37	1.58	73
Years of farming	3.33	4.82	73
Number of Farm at site	2.51	1.02	73
Monthly income	2.82	1.13	73
Number of beds	4.47	1.57	73
Types of vegetabless produce	2.21	.78	73

Correlations

		Source of Water	Gender	Level of Education	Years of farming	Number of Farm at site	Monthly income	Number of beds	Types of vegetabless produce
Pearson Correlation	Source of Water	1.000	.173	-.217	.082	.101	-.139	.135	.125
	Gender	.173	1.000	-.109	-.060	.198	.007	-.078	.153
	Level of Education	-.217	-.109	1.000	-.106	-.362	.037	-.087	.061
	Years of farming	.082	-.060	-.106	1.000	.221	.115	.005	.026
	Number of Farm at sit	.101	.198	-.362	.221	1.000	-.162	.137	.130
	Monthly income	-.139	.007	.037	.115	-.162	1.000	-.264	-.021
	Number of beds	.135	-.078	-.087	.005	.137	-.264	1.000	-.124
	Types of vegetabless produce	.125	.153	.061	.026	.130	-.021	-.124	1.000
Sig. (1-tailed)	Source of Water	.	.072	.033	.245	.198	.120	.127	.146
	Gender	.072	.	.178	.306	.047	.476	.256	.098
	Level of Education	.033	.178	.	.186	.001	.377	.232	.303
	Years of farming	.245	.306	.186	.	.030	.166	.483	.413
	Number of Farm at sit	.198	.047	.001	.030	.	.086	.124	.137
	Monthly income	.120	.476	.377	.166	.086	.	.012	.431
	Number of beds	.127	.256	.232	.483	.124	.012	.	.148
	Types of vegetabless produce	.146	.098	.303	.413	.137	.431	.148	.
N	Source of Water	73	73	73	73	73	73	73	73
	Gender	73	73	73	73	73	73	73	73
	Level of Education	73	73	73	73	73	73	73	73
	Years of farming	73	73	73	73	73	73	73	73
	Number of Farm at sit	73	73	73	73	73	73	73	73
	Monthly income	73	73	73	73	73	73	73	73
	Number of beds	73	73	73	73	73	73	73	73
	Types of vegetabless produce	73	73	73	73	73	73	73	73

Variables Entered/Removed[b]

Model	Variables Entered	Variables Removed	Method
1	Types of vegetables s produce, Monthly income, Level of Education, Years of farming, Gender, Number of beds, Number of Farm at site[a]	.	Enter

a. All requested variables entered.

b. Dependent Variable: Source of Water

ANOVA[b]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	4.486	7	.641	1.315	.258[a]
	Residual	31.678	65	.487		
	Total	36.164	72			

a. Predictors: (Constant), Types of vegetabless produce, Monthly income, Level of Education, Years of farming, Gender, Number of beds, Number of Farm at site

b. Dependent Variable: Source of Water

Coefficients[a]

Model		Unstandardized Coefficients B	Unstandardized Coefficients Std. Error	Standardized Coefficients Beta	t	Sig.
1	(Constant)	2.323	.595		3.906	.000
	Gender	.243	.181	.162	1.341	.185
	Level of Education	-9.50E-02	.057	-.211	-1.681	.098
	Years of farming	1.438E-02	.018	.098	.805	.424
	Number of Farm at site	-5.81E-02	.093	-.083	-.623	.536
	Monthly income	-7.58E-02	.077	-.121	-.986	.328
	Number of beds	5.622E-02	.055	.125	1.016	.313
	Types of vegetabless produce	.122	.109	.134	1.120	.267

a. Dependent Variable: Source of Water

Residuals Statistics [a]

	Minimum	Maximum	Mean	Std. Deviation	N
Predicted Value	1.99	3.17	2.53	.25	73
Residual	-.89	1.85	-5.48E-17	.66	73
Std. Predicted Value	-2.171	2.542	.000	1.000	73
Std. Residual	-1.280	2.648	.000	.950	73

a. Dependent Variable: Source of Water

Tejuoso Farm

Variables Entered/Removed[b]

Model	Variables Entered	Variables Removed	Method
1	Types of vegetabless produce, Number of Farm at site, Number of beds, Level of Education, Years of farming, Gender, Monthly income[a]	.	Enter

a. All requested variables entered.

b. Dependent Variable: Source of water for domestic use

Descriptive Statistics

	Mean	Std. Deviation	N
Source of water for domestic use	1.40	.49	75
Gender	1.13	.34	75
Level of Education	3.29	2.09	75
Years of farming	2.99	.89	75
Number of Farm at site	1.12	.33	75
Monthly income	1.71	.94	75
Number of beds	5.08	1.15	75
Types of vegetabless produce	1.68	.47	75

Model Summary[b]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.334[a]	.111	.019	.49

a. Predictors: (Constant), Types of vegetabless produce, Number of Farm at site, Number of beds, Level of Education, Years of farming, Gender, Monthly income

b. Dependent Variable: Source of water for domestic use

Correlations

		Source of water for domestic use	Gender	Level of Education	Years of farming	Number of Farm at site	Monthly income	Number of beds	Types of vegetabless produce
Pearson Correlation	Source of water for domestic use	1.000	.080	-.273	-.080	.034	-.122	-.057	-.082
	Gender	.080	1.000	.152	.094	-.145	-.003	.007	.101
	Level of Education	-.273	.152	1.000	.125	-.052	.106	.075	.138
	Years of farming	-.080	.094	.125	1.000	-.133	-.117	.107	.022
	Number of Farm at site	.034	-.145	-.052	-.133	1.000	.160	.010	-.011
	Monthly income	-.122	-.003	.106	-.117	.160	1.000	-.003	-.154
	Number of beds	-.057	.007	.075	.107	.010	-.003	1.000	-.027
	Types of vegetabless produce	-.082	.101	.138	.022	-.011	-.154	-.027	1.000
Sig. (1-tailed)	Source of water for domestic use	.	.247	.009	.248	.388	.148	.313	.243
	Gender	.247	.	.096	.210	.108	.490	.477	.195
	Level of Education	.009	.096	.	.142	.328	.182	.263	.119
	Years of farming	.248	.210	.142	.	.127	.158	.181	.426
	Number of Farm at site	.388	.108	.328	.127	.	.085	.466	.464
	Monthly income	.148	.490	.182	.158	.085	.	.490	.093
	Number of beds	.313	.477	.263	.181	.466	.490	.	.409
	Types of vegetabless produce	.243	.195	.119	.426	.464	.093	.409	.
N	Source of water for domestic use	75	75	75	75	75	75	75	75
	Gender	75	75	75	75	75	75	75	75
	Level of Education	75	75	75	75	75	75	75	75
	Years of farming	75	75	75	75	75	75	75	75
	Number of Farm at site	75	75	75	75	75	75	75	75
	Monthly income	75	75	75	75	75	75	75	75
	Number of beds	75	75	75	75	75	75	75	75
	Types of vegetabless produce	75	75	75	75	75	75	75	75

ANOVA[b]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	2.005	7	.286	1.200	.315[a]
	Residual	15.995	67	.239		
	Total	18.000	74			

a. Predictors: (Constant), Types of vegetabless produce, Number of Farm at site, Number of beds, Level of Education, Years of farming, Gender, Monthly income

b. Dependent Variable: Source of water for domestic use

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	1.713	.480		3.566	.001
	Gender	.202	.171	.140	1.186	.240
	Level of Education	-6.06E-02	.028	-.257	-2.145	.036
	Years of farming	-3.48E-02	.066	-.063	-.530	.598
	Number of Farm at site	7.706E-02	.179	.051	.430	.668
	Monthly income	-6.41E-02	.063	-.122	-1.019	.312
	Number of beds	-1.52E-02	.050	-.035	-.305	.762
	Types of vegetabless produce	-8.22E-02	.125	-.078	-.660	.512

a. Dependent Variable: Source of water for domestic use

Residuals Statistics[a]

	Minimum	Maximum	Mean	Std. Deviation	N
Predicted Value	1.08	1.79	1.40	.16	75
Residual	-.79	.83	5.42E-16	.46	75
Std. Predicted Value	-1.968	2.387	.000	1.000	75
Std. Residual	-1.623	1.701	.000	.952	75

a. Dependent Variable: Source of water for domestic use

APPENDIX IV: REGRESSION ANALYSIS ON POULTRY WASTE

ALAPERE FARM

Descriptive Statistics

	Mean	Std. Deviation	N
Quanntity of Poultry per week	1.99	.893	75
Level of Education	2.80	1.000	75
Years of farming	2.77	.847	75
Number of Farm at site	1.77	.727	75
Monthly income	2.13	.811	75
Number of beds	2.85	1.216	75
Types of vegetabless produce	1.32	.738	75
Type of manure use	1.21	.444	75
typpe of inorganic Manure	1.91	.808	75
Seasonal variation	1.79	.412	75

Correlations

		Quanntity of Poultry per week	Level of Education	Years of farming	Number of Farm at site	Monthly income	Number of beds	Types of vegetabless produce	Type of manure use	typpe of inorganic Manure	Seasonal variation
Pearson Correlation	Quanntity of Poultry per week	1.000	.194	.014	-.028	-.072	-.052	.007	.075	.186	-.118
	Level of Education	.194	1.000	-.086	-.175	.017	.178	-.022	.310	.010	.157
	Years of farming	.014	-.086	1.000	-.041	.084	-.033	-.055	-.049	.048	.208
	Number of Farm at site	-.028	-.175	-.041	1.000	-.040	.176	-.115	-.099	.101	-.028
	Monthly income	-.072	.017	.084	-.040	1.000	.294	.063	-.043	-.187	.086
	Number of beds	-.052	.178	-.033	.176	.294	1.000	-.158	-.091	-.234	-.090
	Types of vegetabless produce	.007	-.022	-.055	-.115	.063	-.158	1.000	-.046	-.130	.050
	Type of manure use	.075	.310	-.049	-.099	-.043	-.091	-.046	1.000	.094	-.043
	typpe of inorganic Manure	.186	.010	.048	.101	-.187	-.234	-.130	.094	1.000	.021
	Seasonal variation	-.118	.157	.208	-.028	.098	-.090	.050	-.043	.021	1.000
Sig. (1-tailed)	Quanntity of Poultry per week	.	.048	.453	.414	.269	.330	.478	.260	.056	.157
	Level of Education	.048	.	.231	.087	.444	.066	.426	.003	.466	.089
	Years of farming	.453	.231	.	.365	.292	.390	.319	.337	.343	.037
	Number of Farm at site	.414	.087	.365	.	.368	.066	.163	.199	.193	.405
	Monthly income	.269	.444	.292	.368	.	.005	.295	.359	.054	.231
	Number of beds	.330	.066	.390	.066	.005	.	.088	.218	.022	.221
	Types of vegetabless produce	.478	.426	.319	.163	.295	.088	.	.347	.132	.336
	Type of manure use	.260	.003	.337	.198	.359	.218	.347	.	.212	.356
	typpe of inorganic Manure	.056	.466	.343	.193	.054	.022	.132	.212	.	.431
	Seasonal variation	.157	.089	.037	.405	.231	.221	.336	.356	.431	.
N	Quanntity of Poultry per week	75	75	75	75	75	75	75	75	75	75
	Level of Education	75	75	75	75	75	75	75	75	75	75
	Years of farming	75	75	75	75	75	75	75	75	75	75
	Number of Farm at site	75	75	75	75	75	75	75	75	75	75
	Monthly income	75	75	75	75	75	75	75	75	75	75
	Number of beds	75	75	75	75	75	75	75	75	75	75
	Types of vegetabless produce	75	75	75	75	75	75	75	75	75	75
	Type of manure use	75	75	75	75	75	75	75	75	75	75
	typpe of inorganic Manure	75	75	75	75	75	75	75	75	75	75
	Seasonal variation	75	75	75	75	75	75	75	75	75	75

Model Summary[b]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.324[a]	.105	-.019	.901

a. Predictors: (Constant), Seasonal variation, typpe of inorganic Manure, Type of manure use, Types of vegetabless produce, Number of Farm at site, Monthly income, Years of farming, Level of Education, Number of beds

b. Dependent Variable: Quanntity of Poultry per week

ANOVA[b]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	6.175	9	.686	.844	.578[a]
	Residual	52.812	65	.812		
	Total	58.987	74			

a. Predictors: (Constant), Seasonal variation, typpe of inorganic Manure, Type c manure use, Types of vegetabless produce, Number of Farm at site, Monthly income, Years of farming, Level of Education, Number of beds

b. Dependent Variable: Quanntity of Poultry per week

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients		
		B	Std. Error	Beta	t	Sig.
1	(Constant)	1.666	.875		1.904	.061
	Level of Education	.221	.119	.248	1.857	.068
	Years of farming	6.831E-02	.128	.065	.532	.596
	Number of Farm at site	1.202E-02	.153	.010	.078	.938
	Monthly income	-1.94E-02	.139	-.018	-.140	.889
	Number of beds	-4.54E-02	.101	-.062	-.450	.654
	Types of vegetabless produce	4.637E-02	.148	.038	.314	.754
	Type of manure use	-5.22E-02	.254	-.026	-.205	.838
	typpe of inorganic Manure	.190	.138	.172	1.377	.173
	Seasonal variation	-.391	.270	-.181	-1.449	.152

a. Dependent Variable: Quanntity of Poultry per week

Residuals Statistics[a]

	Minimum	Maximum	Mean	Std. Deviation	N
Predicted Value	1.35	2.75	1.99	.289	75
Residual	-1.50	1.30	.00	.845	75
Std. Predicted Value	-2.187	2.627	.000	1.000	75
Std. Residual	-1.667	1.438	.000	.937	75

a. Dependent Variable: Quanntity of Poultry per week

Barracks Farm

Descriptive Statistics

	Mean	Std. Deviation	N
Quanntity of Poultry per week	1.64	.844	72
Level of Education	3.72	1.973	72
Years of farming	3.47	4.809	72
Number of Farm at site	1.76	1.000	72
Monthly income	2.10	1.103	72
Number of beds	3.42	2.061	72
Types of vegetabless produce	2.24	.778	72
Type of manure use	1.22	.562	72
typpe of inorganic Manure	1.64	.737	72
Seasonal variation	1.60	.494	72

Correlations

		Quanntity of Poultry per week	Level of Education	Years of farming	Number of Farm at site	Monthly income	Number of beds	Types of vegetabless produce	Type of manure use	typpe of inorganic Manure	Seasonal variation
Pearson Correlation	Quanntity of Poultry per week	1.000	-.112	.164	.298	.023	.080	-.083	.201	.150	-.186
	Level of Education	-.112	1.000	-.079	-.027	-.065	-.605	.548	-.045	-.138	.380
	Years of farming	.164	-.078	1.000	.248	.159	.082	-.026	-.019	-.090	-.091
	Number of Farm at site	.298	-.027	.248	1.000	.277	.130	.073	-.131	-.003	-.053
	Monthly income	.023	-.068	.159	.277	1.000	.180	.153	-.058	-.026	-.056
	Number of beds	.080	-.605	.082	.130	.180	1.000	-.431	.126	.119	-.414
	Types of vegetabless produce	-.083	.548	-.026	.073	.153	-.431	1.000	-.028	-.168	.251
	Type of manure use	.201	-.045	-.019	-.131	-.058	.126	-.025	1.000	.264	.175
	typpe of inorganic Manure	.150	-.138	-.090	-.003	-.026	.119	-.168	.264	1.000	-.096
	Seasonal variation	-.186	.380	-.091	-.053	-.056	-.414	.251	.175	-.096	1.000
Sig. (1-tailed)	Quanntity of Poultry per week	.	.175	.084	.006	.424	.253	.245	.045	.105	.069
	Level of Education	.175	.	.257	.412	.293	.000	.000	.353	.124	.001
	Years of farming	.084	.257	.	.019	.092	.246	.413	.439	.225	.224
	Number of Farm at site	.006	.412	.019	.	.009	.137	.272	.137	.491	.330
	Monthly income	.424	.293	.092	.009	.	.065	.099	.314	.416	.319
	Number of beds	.253	.000	.244	.137	.066	.	.000	.147	.160	.000
	Types of vegetabless produce	.246	.000	.413	.272	.099	.000	.	.417	.079	.017
	Type of manure use	.046	.353	.439	.137	.314	.147	.417	.	.012	.071
	typpe of inorganic Manure	.105	.124	.225	.491	.416	.160	.079	.012	.	.212
	Seasonal variation	.060	.001	.224	.330	.319	.000	.017	.071	.212	.
N	Quanntity of Poultry per week	72	72	72	72	72	72	72	72	72	72
	Level of Education	72	72	72	72	72	72	72	72	72	72
	Years of farming	72	72	72	72	72	72	72	72	72	72
	Number of Farm at site	72	72	72	72	72	72	72	72	72	72
	Monthly income	72	72	72	72	72	72	72	72	72	72
	Number of beds	72	72	72	72	72	72	72	72	72	72
	Types of vegetabless produce	72	72	72	72	72	72	72	72	72	72
	Type of manure use	72	72	72	72	72	72	72	72	72	72
	typpe of inorganic Manure	72	72	72	72	72	72	72	72	72	72
	Seasonal variation	72	72	72	72	72	72	72	72	72	72

Model Summary[b]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.472[a]	.223	.110	.796

a. Predictors: (Constant), Seasonal variation, Number of Farm at site, typpe of inorganic Manure, Years of farming, Monthly income, Types of vegetabless produce, Type of manure use, Level of Education, Number of beds

b. Dependent Variable: Quanntity of Poultry per week

ANOVA[b]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	11.295	9	1.255	1.979	.057[a]
	Residual	39.316	62	.634		
	Total	50.611	71			

a. Predictors: (Constant), Seasonal variation, Number of Farm at site, typpe of inorganic Manure, Years of farming, Monthly income, Types of vegetabless produce, Type of manure use, Level of Education, Number of beds

b. Dependent Variable: Quanntity of Poultry per week

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	1.646	.657		2.504	.015
	Level of Education	-2.58E-02	.066	-.060	-.389	.699
	Years of farming	1.473E-02	.021	.084	.714	.478
	Number of Farm at site	.287	.103	.339	2.789	.007
	Monthly income	-3.33E-02	.094	-.043	-.356	.723
	Number of beds	-6.91E-02	.064	-.169	-1.086	.282
	Types of vegetabless produce	-6.62E-02	.154	-.061	-.430	.668
	Type of manure use	.432	.186	.288	2.327	.023
	typpe of inorganic Manure	6.822E-02	.137	.060	.498	.620
	Seasonal variation	-.409	.222	-.239	-1.843	.070

a. Dependent Variable: Quanntity of Poultry per week

Residuals Statistics[a]

	Minimum	Maximum	Mean	Std. Deviation	N
Predicted Value	.97	2.85	1.64	.399	72
Residual	-1.22	2.16	.00	.744	72
Std. Predicted Value	-1.687	3.046	.000	1.000	72
Std. Residual	-1.538	2.709	.000	.934	72

a. Dependent Variable: Quanntity of Poultry per week

Ikeja Farm

Descriptive Statistics

	Mean	Std. Deviation	N
Quanntity of Poultry per week	2.24	1.041	72
Level of Education	3.38	1.587	72
Years of farming	3.32	4.849	72
Number of Farm at site	2.49	1.007	72
Monthly income	2.83	1.138	72
Number of beds	4.47	1.583	72
Types of vegetabless produce	2.19	.781	72
Type of manure use	1.14	.348	72
typpe of inorganic Manure	1.83	.751	72
Seasonal variation	1.63	.488	72

Correlations

		Quanntity of Poultry per week	Level of Education	Years of farming	Number of Farm at site	Monthly income	Number of beds	Types of vegetabless produce	Type of manure use	typpe of inorganic Manure	Seasonal variation
Pearson Correlation	Quanntity of Poultry per week	1.000	.039	.102	.050	.046	-.052	-.023	-.014	.033	-.073
	Level of Education	.039	1.000	-.105	-.362	.035	-.088	.065	.057	-.041	.057
	Years of farming	.102	-.105	1.000	.222	.117	.006	.024	-.018	-.128	-.115
	Number of Farm at site	.050	-.362	.222	1.000	-.150	.148	.111	-.035	.034	-.082
	Monthly income	.046	.035	.117	-.150	1.000	-.268	-.011	-.012	-.082	.165
	Number of beds	-.052	-.088	.006	.148	-.268	1.000	-.121	.058	-.099	-.242
	Types of vegetabless produce	-.023	.065	.024	.111	-.011	-.121	1.000	.262	-.160	-.139
	Type of manure use	-.014	.057	-.018	-.035	-.012	.058	.262	1.000	.198	.145
	typpe of inorganic Manure	.033	-.041	-.128	.034	-.082	-.099	-.160	.198	1.000	.135
	Seasonal variation	-.073	.057	-.115	-.082	.165	-.242	-.139	.145	.135	1.000
Sig. (1-tailed)	Quanntity of Poultry per week	.	.371	.197	.338	.352	.334	.425	.453	.391	.272
	Level of Education	.371	.	.169	.001	.385	.230	.293	.316	.365	.318
	Years of farming	.197	.169	.	.031	.164	.481	.420	.439	.141	.167
	Number of Farm at site	.338	.001	.031	.	.105	.111	.177	.387	.388	.245
	Monthly income	.352	.385	.164	.105	.	.011	.465	.461	.246	.083
	Number of beds	.334	.230	.481	.111	.011	.	.156	.314	.205	.020
	Types of vegetabless produce	.425	.293	.420	.177	.465	.156	.	.013	.069	.123
	Type of manure use	.453	.316	.439	.387	.461	.314	.013	.	.048	.112
	typpe of inorganic Manure	.391	.365	.141	.388	.246	.205	.069	.048	.	.130
	Seasonal variation	.272	.318	.167	.245	.083	.020	.123	.112	.130	.
N	Quanntity of Poultry per week	72	72	72	72	72	72	72	72	72	72
	Level of Education	72	72	72	72	72	72	72	72	72	72
	Years of farming	72	72	72	72	72	72	72	72	72	72
	Number of Farm at site	72	72	72	72	72	72	72	72	72	72
	Monthly income	72	72	72	72	72	72	72	72	72	72
	Number of beds	72	72	72	72	72	72	72	72	72	72
	Types of vegetabless produce	72	72	72	72	72	72	72	72	72	72
	Type of manure use	72	72	72	72	72	72	72	72	72	72
	typpe of inorganic Manure	72	72	72	72	72	72	72	72	72	72
	Seasonal variation	72	72	72	72	72	72	72	72	72	72

Model Summary[b]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.176[a]	.031	-.110	1.097

a. Predictors: (Constant), Seasonal variation, Level of Education, typpe of inorganic Manure, Years of farming, Types of vegetabless produce, Monthly income, Number of beds, Type of manure use, Number of Farm at site

b. Dependent Variable: Quanntity of Poultry per week

ANOVA[b]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	2.388	9	.265	.221	.990[a]
	Residual	74.598	62	1.203		
	Total	76.986	71			

a. Predictors: (Constant), Seasonal variation, Level of Education, typpe of inorganic Manure, Years of farming, Types of vegetabless produce, Monthly income, Number of beds, Type of manure use, Number of Farm at site

b. Dependent Variable: Quanntity of Poultry per week

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients		
		B	Std. Error	Beta	t	Sig.
1	(Constant)	2.277	1.137		2.003	.050
	Level of Education	5.095E-02	.089	.078	.574	.568
	Years of farming	1.817E-02	.028	.085	.641	.524
	Number of Farm at site	7.590E-02	.147	.073	.516	.608
	Monthly income	4.079E-02	.123	.045	.333	.741
	Number of beds	-4.70E-02	.092	-.071	-.513	.610
	Types of vegetabless produce	-7.47E-02	.188	-.056	-.397	.693
	Type of manure use	3.299E-02	.416	.011	.079	.937
	typpe of inorganic Manure	6.065E-02	.188	.044	.323	.748
	Seasonal variation	-.216	.291	-.101	-.744	.460

a. Dependent Variable: Quanntity of Poultry per week

Residuals Statistics[a]

	Minimum	Maximum	Mean	Std. Deviation	N
Predicted Value	1.88	3.12	2.24	.183	72
Residual	-1.46	1.97	.00	1.025	72
Std. Predicted Value	-1.963	4.815	.000	1.000	72
Std. Residual	-1.329	1.792	.000	.934	72

a. Dependent Variable: Quanntity of Poultry per week

Tejuoso Farm

Descriptive Statistics

	Mean	Std. Deviation	N
Quanntity of Poultry per week	1.53	.704	75
Level of Education	3.29	2.091	75
Years of farming	2.99	.893	75
Number of Farm at site	1.12	.327	75
Monthly income	1.71	.941	75
Number of beds	5.08	1.148	75
Types of vegetabless produce	1.68	.470	75
Type of manure use	1.20	.593	75
typpe of inorganic Manu	1.73	.741	75
Seasonal variation	1.44	.500	75

Correlations

		Quanntity of Poultry per week	Level of Education	Years of farming	Number of Farm at site	Monthly income	Number of beds	Types of vegetabless produce	Type of manure use	typpe of inorganic Manure	Seasonal variation
Pearson Correlation	Quanntity of Poultry per week	1.000	.021	-.075	-.106	.036	-.104	-.090	.162	-.035	.323
	Level of Education	.021	1.000	.125	-.052	.106	.075	.136	-.113	-.080	-.177
	Years of farming	-.075	.125	1.000	-.133	-.117	.107	.022	.260	.158	.195
	Number of Farm at site	-.106	-.052	-.133	1.000	.160	.010	-.011	-.125	-.033	.086
	Monthly income	.036	.106	-.117	.160	1.000	-.003	-.164	.010	.003	-.067
	Number of beds	-.104	.075	.107	.010	-.003	1.000	-.027	-.024	.089	.056
	Types of vegetabless produce	-.090	.136	.022	-.011	-.164	-.027	1.000	-.155	-.132	-.025
	Type of manure use	.162	-.113	.260	-.125	.010	-.024	-.155	1.000	.246	.155
	typpe of inorganic Manure	-.035	-.080	.158	-.033	.003	.089	-.132	.246	1.000	-.044
	Seasonal variation	.323	-.177	.195	.086	-.067	.056	-.025	.155	-.044	1.000
Sig. (1-tailed)	Quanntity of Poultry per week	.	.430	.263	.184	.382	.188	.221	.083	.384	.002
	Level of Education	.430	.	.142	.328	.182	.263	.119	.166	.249	.064
	Years of farming	.263	.142	.	.127	.158	.181	.426	.012	.088	.047
	Number of Farm at site	.184	.328	.127	.	.085	.466	.464	.142	.388	.232
	Monthly income	.382	.182	.158	.085	.	.490	.093	.467	.491	.285
	Number of beds	.188	.263	.181	.466	.490	.	.409	.420	.224	.318
	Types of vegetabless produce	.221	.119	.426	.464	.093	.409	.	.092	.130	.415
	Type of manure use	.083	.166	.012	.142	.467	.420	.092	.	.017	.092
	typpe of inorganic Manure	.384	.249	.088	.388	.491	.224	.130	.017	.	.355
	Seasonal variation	.002	.064	.047	.232	.285	.318	.415	.092	.355	.
N	Quanntity of Poultry per week	75	75	75	75	75	75	75	75	75	75
	Level of Education	75	75	75	75	75	75	75	75	75	75
	Years of farming	75	75	75	75	75	75	75	75	75	75
	Number of Farm at site	75	75	75	75	75	75	75	75	75	75
	Monthly income	75	75	75	75	75	75	75	75	75	75
	Number of beds	75	75	75	75	75	75	75	75	75	75
	Types of vegetabless produce	75	75	75	75	75	75	75	75	75	75
	Type of manure use	75	75	75	75	75	75	75	75	75	75
	typpe of inorganic Manure	75	75	75	75	75	75	75	75	75	75
	Seasonal variation	75	75	75	75	75	75	75	75	75	75

Model Summary[b]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.447[a]	.200	.089	.672

a. Predictors: (Constant), Seasonal variation, Types of vegetabless produce, Number of beds, Number of Farm at site, typpe of inorganic Manure, Monthly income, Level of Education, Type of manure use, Years of farming

b. Dependent Variable: Quanntity of Poultry per week

ANOVA[b]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	7.316	9	.813	1.800	.085[a]
	Residual	29.351	65	.452		
	Total	36.667	74			

a. Predictors: (Constant), Seasonal variation, Types of vegetabless produce, Number of beds, Number of Farm at site, typpe of inorganic Manure, Monthly income, Level of Education, Type of manure use, Years of farming

b. Dependent Variable: Quanntity of Poultry per week

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	1.743	.675		2.582	.012
	Level of Education	4.582E-02	.040	.136	1.152	.254
	Years of farming	-.160	.096	-.203	-1.666	.101
	Number of Farm at site	-.314	.247	-.146	-1.271	.208
	Monthly income	2.459E-02	.087	.033	.284	.778
	Number of beds	-6.70E-02	.069	-.109	-.969	.336
	Types of vegetabless produce	-.111	.173	-.074	-.640	.524
	Type of manure use	.168	.145	.142	1.166	.248
	typpe of inorganic Manure	-1.40E-02	.111	-.015	-.126	.900
	Seasonal variation	.539	.166	.383	3.241	.002

a. Dependent Variable: Quanntity of Poultry per week

Residuals Statistics[a]

	Minimum	Maximum	Mean	Std. Deviation	N
Predicted Value	.99	2.13	1.53	.314	75
Residual	-1.11	1.53	.00	.630	75
Std. Predicted Value	-1.721	1.891	.000	1.000	75
Std. Residual	-1.656	2.275	.000	.937	75

a. Dependent Variable: Quanntity of Poultry per week