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DEPARTMENT OF ADULT EDUCATION

Research topic: An investigation into the suitability of Guano fertilizer on farming in Gokwe North District Chireya Ward 5 West Circuit in Midlands Zimbabwe.

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Dedication

I dedicate this project to my beloved ones, Lylian, Briggetta and family members who kept on praying for this to succeed. Lastly, I dedicate this to Janjasi Chandifira, Innocent Chigamba and Ncube Sylvester who encouraged me to carry out studies at Midlands State University.

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Declaration

I, Zaroni Ezekiel, hereby declare that this project is my original work and affirm that it has not been submitted to this or any other University in support of an application for a Degree.

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Abstract

The study entitled ‘ An investigation into the suitability of guano fertilizer on farming in Gokwe North District- Chireya Ward 5 in Midlands Province in Zimbabwe’, was carried out to find out the solution to the problems caused by chemical fertilizers like health hazards, pollutions on water, air, soil only to mention but a few. The study employed an explanatory research design and a qualitative research paradigm. Farmers, agricultural officers, agricultural teachers, local authorities (village heads, rural council and the government), and the researcher were the key beneficiaries of the study. The study concluded that guano fertilizer was suitable on farming in Chireya and all participants participated in the study believed that chemical fertilizers had devastating health hazards. Therefore, they wanted to venture into eco-friendly methods of farming that suited the contemporary world. The researcher suggested that demonstration and experiments on the use of guano fertilizer had to be done in order to increase guano utilisation in Chireya. Recommendations made were that: the government should introduce communal bat funded projects, and the local authority-Gokwe North Rural Council should encourage their people to make use of locally acquired resources to make money.

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Chapter One: The Research Problem

1.0 Introduction

This chapter focused on the background to the study, statement of the study, research questions, significant of the study, delimitation of the study, and, limitations of the study. The chapter ended with a summary. The topic dealt with was ‘An investigation into the suitability of guano fertilizer on farming in Gokwe North District Chireya Ward 5 West circuit in Zimbabwe.’ I chose this topic because of poor yields harvested by people in my area due to bad farming methods they had embarked on since 2000 to date. I was also decided to carry out this research because of the devastating health effects of chemical fertilizers which were rampantly used in my area. Although, many people thought that chemical farming was the best way of doing farming in Zimbabwe, I noted that the same method had severe problems to human life, animal life, water, air and soil. Hence, there was a need for people to make a sudden turn to traditional methods of farming which involved use of organic fertilizers. In fact, besides the effects of the chemical method, the whole world was turning organic, so the same must happen to Zimbabwe particularly in Gokwe North Chireya Ward 5.

1.1 Background to the study

As person who grew up in communal areas doing farming with my parents I was tempted to show-case my flair towards improving farming in my area of Gokwe. When I was a little boy my parents were doing organic farming and use of chemical fertilizers was very limited. Organic farming proved to be the most effective way of farming because my parents could produce in abundance. They could also sell their proceeds to Grain Marketing Board (GMB). They were able to send us to school, buying us clothes and feeding us sufficiently through organic farming.

In addition, organic farming included the use of cow dung manure, organic matter from fallen tree leaves, and chicken waste. These fertilizers had zero negative effects on either, human beings, animals, water or soil. Crops were doing well. Farmers were earning well because they had little costs to incur in order to purchase farming inputs.

In 2000 there was a sudden turnaround of things on farming in Gokwe North Chireya. There was a huge utilization of chemical fertilizers. Some farmers were saying they were effective than organic fertilizers. Others said most soils were infertile due to exhaustion of nutrients. Livestock manure was longer available because most animals had perished by tsetse flies, anthrax, blackleg and many other deadly diseases. Therefore, the usage of chemical fertilizers burst like the veld fire and spread all over the district due to the mentioned shortages.

However, it was hell on earth when the country's economy hit rock bottom in 2002 to 2008. There was skyrocketing inflation in Zimbabwe. Subsistence farmers were no longer able to purchase synthetic fertilizers to aid their lands nutritiously and pesticides to control pests. Farming life became tough and horrible in my area of Gokwe. Hunger struck the whole nation and later on companies which were producing fertilizers such as Sables Chemicals closed. As result farming life became impossible to everyone in Zimbabwe.

Therefore, as an academia I started to look back to our past farming life where chemical fertilizers were not taken to a greater extent. I started to read books on agriculture and I discovered that the Zimbabwean agriculture begun by Hunters and Gatherers Makuve and Mdewa (2013). Hunters and gatherers followed by Nomads who practiced shifting cultivation. Organic matter was their fertilizer. As time went by, the former and latter were followed by subsistence farmers who did organic farming. Subsistence farming was usually done by communal farmers and in Gokwe North-Chireya Ward 5 was the order of the day.

Moreover, I observed organic farming and I found that it was free from health hazards. I also noticed that some deadly diseases like anthrax seemed to be some of the negative effects of chemical farming. In addition, pests were no longer controlled by traditional methods and they were also immune to some pesticides and this was making farming life more difficult to people. I tried to find out the differences between chemical fertilizers and organic ones. I discovered that chemical fertilizers had devastating effects on human beings. Savci (2012) says that chemical fertilizers affect the water environment, soil, air and animals.

Therefore, I decided to carry out a research that sought to find out the suitability of guano fertilizer on farming in Gokwe North District Chireya Ward 5 in Zimbabwe

as a solution to the problem. My intention was to find the impact of organic farming in the contemporary farming world. Guano was organic hence it would fit well onto Zimbabwean farming since organic farming was practiced during the early phases of farming life and proceeded to the late 20th century. I also had the feeling that guano would minimise the country's burden of diseases caused by chemical farming. I thought that since Zimbabwe was once the bread basket in the Southern Region, use of guano would restore its popularity. Moreover, one of the advantages that the researcher felt important was that guano was locally obtained and this was going hand in glove with the statements found in the Zimbabwe's economic blue print-the Zimbabwe's Agenda for Sustainable Socio-Economic Transformation (ZIMASSERT). Finally, the world in general is turning organic in terms of farming, so the same should happen to Zimbabwe as well Bhebhe (2016).

1.2 Statement of the problem

The current state of the economy, harmful effects of chemical fertilizers and their costs as well as poor yields from agriculture had set the tone for me to carry out a study on the suitability of guano fertilizer on farming projects in Gokwe North District in Chireya Ward 5. Precisely, guano is organic for organic farming, so I aimed at bringing eco-friendly farming methods to the country.

1.3 Significant of the study

This study was aimed at benefitting the government, farmers, teachers and the researcher.

1.3.0 Government

The government would benefit from exporting guano to other countries. Exports would bring forex that would improve the country's ailing economy. Moreover, the government would create employment for its citizens through the extraction of guano. Most importantly, the government would have foreign investors who would want to establish their factories using guano to manufacture various products like explosives, gun powder and many others.

1.3.1 Farmers

Both commercial and subsistence farmers would benefit from this study. They would get cheap, harmless and pollution free type of fertilizer to use on their farms. Literature available showed that guano, like any other organic fertilizers improves soil texture and its water holding capacity. Lastly, consumption of locally acquired resource would cut costs on the part of farmers in Gokwe Chireya Ward 5.

1.3.2 Agriculture teachers

Teaching children is the best way of conserving knowledge for future use. Therefore, teachers would have another board of knowledge to teach their students. This would help the knowledge of using guano to be transmitted from one generation to another.

1.3.3 Agricultural workers

These would increase their board of knowledge. They would be using the results of the study to educate their farmers. This, therefore, would encourage farmers to use cost effective fertilizers to farm.

1.3.4 Researcher

This study would benefit the researcher. The researcher as the student had to write this study as a requirement in the department of adult education in order for him to get a Bachelor's degree.

1.4 Limitations

The study faced a lot of limitations which went a long way disturbing the researcher from carrying out the research effectively.

1.4.0 Time

Time constraints were a serious challenge because I was a teacher, student and a family man. I had to teach my students adequately. I had also to provide food on the table for my family as well as attention. Lastly, I had to do my research project as was wanted by the University. Therefore, time constraints made my studying life difficult to cope with.

1.4.1 Financial constraints

The other limitation faced was finance. I wanted money to travel from the work place to school to see the supervisor. I also wanted money to travel from one place to another during data collection phase. Lastly, I wanted money to buy printing papers and to photocopy my papers.

1.4.2 Polarised society

This study was carried out towards election time. Therefore, people were not prepared to disclose information to me since I was a stranger to them. Most people hesitated to participate in the study because they feared to be victimised by their political leaders. Therefore, I had to take more time expressing myself to them through village heads. Although I followed all channels, people remained suspicious about me and only a few people had faith in me.

1.4.3 Language

Generally, questionnaires prepared by university students are in English. However, the targeted population of this study was mixed up with literate and illiterate people. Therefore, I had to prepare questionnaires for those who could understand the jargon of English and of those who could not in order to avoid bias.

1.5 Research Questions

1. What is guano fertilizer?
2. What are the advantages of using guano fertilizer?
3. What crops need guano fertilizer?
4. Where does guano fertilizer originate from?
5. How do people process guano and apply it?
6. Can guano be of commercial value to the country?
7. Is guano fertilizer effective on farming?
8. Can people only rely guano and ignore chemical fertilizers?

1.6 Delimitation of the study

This study was carried out in Gokwe North District Chireya Ward 5 West Circuit in the Midland Province in Zimbabwe. The study dealt with subsistence farmers in communal areas, agricultural officers, agricultural teachers, village heads, Environment Management Authorities (EMA), caves and disused buildings.

1.7 Summary

This chapter focused on the background to the study, statement of the problem, research questions, significance of the study, delimitation of the study, and, limitations of the study. The next chapter focuses on literature review.

Chapter Two

2.0 Literature Review

2.1.1 Introduction

This chapter reviewed related literature on the effects of chemical fertilizer usage on farming and the advantages of guano fertilizer. Effects of chemical fertilizers were looked at on water, soil, air, humans and animals. The researcher, therefore, looked at the advantages of guano fertilizer on soil and its richness in nutrient content as an alternative way of farming that could be done by contemporary farmers in Zimbabwe and the whole world in general. Lastly, the chapter ended with a summary.

2.1.2 Effects of chemical fertilizers on water sources

Researches on the effects of chemical fertilizers on water sources were carried out in various places in the world. The major thrust was to identify solutions to the severe and devastating problems that were caused by the use of synthetic fertilizers.

Savci (2012) carried out a research in her country, Turkey, and discovered that synthetic chemical fertilizers had massive environmental damages that were beyond control if no immediate remedy was taken. In her findings, she discovered that chemical fertilizers affected the accumulation of heavy metals in the soil and plant systems. Moreover, chemical fertilizers especially nitrogenous ones were causing a lot of pollution in water bodies.

Furthermore, Orman (2004) who also carried out a research on the effects of chemical fertilizers on water in Turkey found that chemical fertilizers had devastating effects on water bodies since they had a lot of pollution on them. Orman (ibid) condemned excessive application of chemical fertilizers and says that this was affecting shallow wells which most people used for water. For example, Orman (ibid) alludes that too much application of inorganic fertilizers promoted the increment of nitrates in drinking water and rivers as a result of high levels of nitrogen in fertilizer use. Both Orman (2004) and Savci (2012) agreed on the notion that nitrogen reaches the water environment by three ways which are:

drainage, leaching and flow. However, this caused rampant damages to humans, animals and water species.

Since it was not enough, Food and Agriculture Organisation FAO (2009) carried out researches in a number of Sub-Saharan Countries found more similar results to those of Orman (ibid) and Savci (ibid) who carried out their studies in Turkey. FAO (2009) established that serious effects of chemical fertilizers were endured by most of the people who had massive stream bank cultivation and irrigation. Water sources were found with a high rate of synthetic chemical fertilizer residues in most drinking water sources.

Meanwhile, Korkmaz (2007) and Sonmez et al (2008) carried out their studies in Europe on the same topic and discovered that chemical fertilizers had negative effects to the water environment. For instance, they suggested that the majority of nitrogenous fertilizers were not absorbed products and they interfered with both underground and surface water. They also said that underground water problems were considerable in Europe with about 22% of cultivated areas with nitrate contaminated water bodies. Precisely, for the researches made by Kormaz (ibid) and Sonmez et al (ibid) reflections were that most of the water wells close to areas where farming activities were done there were rampant adverse effects to human beings. This was shown through health examinations done to some adults and infants. Adults were found with problems in their digestive and urinary systems. High nitrate concentrations in drinking water caused diseases in infant called methamoglobinemia Tayyar et al (2011)

Moreover, not only humans had been found with critical problems due to inorganic fertilizers, even water living species were found experiencing massive challenges. Fish, frogs and many other water species died due to chemical fertilizers entered their habitats. As a result of this, water bodies developed some odors that polluted the air that people inhaled. Therefore, having observed these calamities of synthetic chemical fertilizers, the researcher found it very apt to carry out a research on the suitability of guano fertilizer on farming activities in Zimbabwe.

2.1.3 Effects of chemical fertilizers on soils

Although, fertilizing the soil increases and improves production on farming, application of chemical fertilizers on soil has devastating side effects. Researches

carried out by Savci (2012) in Turkey indicated that high levels of sodium and potassium containing fertilizers make a negative impact on soil. Furthermore Savci (ibid) proposes that continued use of acid- forming nitrogen fertilizers causes a decrease in soil ph, liming, if not carried to prevent the declining efficiency of field crops. On another note Topbas et al (1998) say that the other serious negative impact of chemical fertilizers is that of destroying important organisms that live in soil. These organisms play a critical part on soil drainage, moisture preservation and good flows underground.

In addition, Michael et al (2012) also made research on the effects of chemical fertilizers in India and discovered that use of chemical fertilizers in that country were used more than organic manure. The defects were that they caused loss of soil fertility rigorously and demanded larger quantities of fertilizer to be used and pests became immune requiring farmers to use stronger pesticides. Thus in turn was posing a great threat to the health of the younger generation.

2.1.4 Effects of chemical fertilizers on air

Nothing can be minimized as far as the effects of chemical fertilizers are concerned. As they do to both water and soil, chemical fertilizers have tremendous effects on air pollution. Atilgan et al (2007) say that application of inorganic fertilizers causes air pollution by nitrogen oxides emissions. The researchers suggest that there are some gases in the atmosphere such as water vapour, carbon dioxide, methane, nitrogen sulfide with chloro-fluoro hydro carbons such as halon gases associated with these compounds. Atilgan et al (ibid) go on to state that there are some gases on lower layers of tropospheric ozone. They suggest that excessive use of nitrogenous fertilizers, especially nitrate content of levels of the plant would threaten human health level reaches the leaf- vegetables eaten. On a more note, Shaviv (2003) who did his research on the effects of inorganic fertilizers on air discovered that ammonia emission from fertilized, adjacent to result in depositing on ecosystems and vegetation damage. NH_3 may be oxidized and turn into nitric acid and sulfuric acid from industrial sources, create acid rain after the chemical transformations. This acid rain can damage vegetation and organism that live in both lakes and reservoirs.

2.1.5 Effects of chemical fertilizers on humans and the environment

Tomkins and Bird (2002) cited in Anitha et al (2014) who carried out research on the adverse effects of chemical fertilizers and pesticides on human health and environment in USA, UK, Canada, Europe, India and Germany suggest that use of synthetic chemical fertilizers had caused tremendous harm to the environment as well as human beings indirectly. They say that continued use of chemical fertilizers results in developing resistances of the pests, which become difficult to control by other means. In addition, Talukdar et al (2003) who also carried out research on the same topic in Australia discovered that use of inorganic fertilizers led to imperfectly synthesized protein in leaves, which was responsible for poor crops and in turn for pathological conditions in humans and animals fed with such deficient food.

In addition, Anitha et al (2014) postulate that foods grown with chemical fertilizers caused various deteriorating health hazards in animals as well as human beings. They listed a number of diseases caused by chemical fertilizers and some of them include: asthma, TB, lung cancer and many other devastating ones. These diseases were said to have claimed a bigger number of deaths in many countries. Some of the diseases could not be cured easily and needed a lot of money to be treated by medical practitioners. Hence, in order to curb such a danger to humans and animals, farming systems should be eco-friendly.

However, after having gone through this literature I decided to carry out a research on the suitability of guano fertilizer on farming in Zimbabwe in general and Gokwe South District Ward 13 in particular. I believed that all the adverse effects of chemical fertilizers experienced in other African countries and beyond were also common to Zimbabwe since it was among countries practiced chemical farming to a greater extent.

2.1.6 Guano fertilizer

Guano appeared to be a term that made no sense to a lot of people in Zimbabwe because there was little literature about its use and impact on farming activities. According to Russell (2012) guano consists of the droppings of pelicans and other seabirds mixed with feathers, corpses of dead birds, remains of food etc. Along the same lines, Purists refer to guano as seabird dung. In this research guano refers to

bat manure which is so familiar to people between Zhombe and Gokwe around Chief Samambwa's area.

2.1.7 History of guano.

Russell (2012) notes that bat guano started to be well-known in Europe around mid 19th century. The researcher confirms that guano was found in Peru around mid 19th century again. During the same period other supplies of guano were drawn from numerous Islands of the South Pacific. Russell further states that some deposits of guano occurred on some of the Coasts of South Africa (Inchaboe). In the same vein, Schwarz (2006) says that the word 'guano' came from the native people of South America. It specifically, derived from the word 'wanu' which was an ancient Quechuan word meaning bird or bat droppings.

According to Schwarz (2006) guano was crucial in the agricultural history of Incan Government to the extent that bat bearing Islands were put under strong control. Killing or disrupting of the nesting birds that produced guano was punishable by death. Therefore, this explains the importance of guano on agriculture and it also spells out the effectiveness or richness on farming production.

2.1.8 Composition and character of guano

Russell (2012) says that composition and character of guano depended on the conditions under which it had accumulated. In rainless areas it rapidly dries and remains discomposed. In wet areas it suffers considerable decomposition and loses much of its nitrogen and organic matter, becoming more phosphate. Guano can be put into two grades which are: nitrogenous obtained from rainless districts and phosphatic obtained from moister regions.

According to Cynthia (2016) guano is an organic fertilizer rich in nitrogen which promotes rapid green growth. It improves plant growth and soil structure. Cynthia points out that guano has nitrogen content of 10%, 3% phosphorous and 1% potassium. Phosphorous is good for root growth and supports flowering and potassium for stems. From an agricultural point of view, guano seems to be the most productive fertilizer good for all kinds of farming activities.

2.1.9 Soil improvement

Guano fertilizer benefits the texture of the soil. It also helps loose soils to hold and makes dense soils lighter. Guano cannot be easily leached out of soil so it benefits the plants and soil much longer than some inorganic fertilizers which are more readily displaced. Bat guano contains microbes which benefit the soil and plants (Cynthia 2016).

2.1.10 Microbes Action

Cynthia (2016) suggests that microbes in bat guano have been reported to have bioremediation capabilities. This means that guano can aid in cleansing toxic soils. In addition, the researcher says microbes can increase the water-holding capacity and air space by loosening the soil. On a more advantageous note, Cynthia points out that bat guano microbes are efficient decomposers and help control the incidence of soil diseases and dangerous nematodes. Last but not least, guano can be added to a compost pile to speed up the decomposition processes.

2.2.0 Application of guano

According to Russell (2012) high grade guanos are used in horticulture, the ordinary grades in market gardens and occasionally for potatoes. Phosphatic guanos are used in both market gardens and on farms. In addition to that, Cynthia (2016) says that guano can be applied to vegetables, herbs, ornamentals, fruits and nut trees. It can be put directly into the soil or turned into liquid to foliage or dispersed through an irrigation system.

2.2.1. Guano usage in Zimbabwe

Very little information was found about the use of guano in Zimbabwe. Oral tradition claims that guano started to be known in Zimbabwe in 1964. Information taken from the Sunday Mail of May 31 2015 indicated that residents of Zhombe area in Kwekwe district had knowledge about the use of guano fertilizer on farming by the time the paper was published. According to Sunday Mail Reporter residents of the area said that they used guano as an alternative to compound D fertilizer. The Reporter claimed that there were huge deposits of guano which was rich in nitrogen and phosphorous. According to the paper, this precious mineral

was mined from Mabura Caves near Somapani Primary School in the North-Western end of Zhombe under Chief Samambwa area.

Furthermore, traditional leaders who talked to the Reporter said that guano was mined since the 1950s in this area by some white owned companies and sold it to South Africa. They also said some foreign investors were coming to the place to take some samples to test them in South Africa. Some information obtained by the Reporter showed that Scientists at the University of Guelph in Canada confirmed that by 1991 there were over two million guano deposits at Mabura Caves. Moreover, on the part of nutrients most farmers claimed that guano had more nitrogen content as compared to any other fertilizers. They said that they mined this fertilizer from the caves where bats dwell their millions. Farmers used guano fertilizer as an alternative of compound D fertilizer which was by then more expensive for peasant farmers to purchase. On an advantageous note, Scientists said that guano could be used to manufacture gunpowder.

Therefore, it was the belief of the researcher that when guano fertilizer was put to public notice and also tried and tested to a larger extent on farming it could be the most effective and cheaper fertilizer to be exploited by indigenous farmers. Considering its advantages and adverse effects of chemical fertilizers, guano will be more useful.

2.2.2 Summary

In short, this chapter reviewed related literature on the effects of chemical fertilizers and advantages of guano fertilizer on farming. The researcher reviewed effects of chemical fertilizers on water, soil, air, humans, animals and the environment. Definitions and history of guano were given. Advantages, its nutrients richness were also shown. Lastly, usage of guano in Zimbabwe was discussed. The next chapter focuses on research methodology.

Chapter Three

Research Methodology

3.0 Introduction

This chapter discussed research methodology employed to conduct this study. It focused on research design, population and sample, instrumentation, ethical considerations, data collection procedures and data analysis plan. A summary was given at the end of the chapter.

3.1.0 Research Design

Describing research design, Rukuni (2005) says it is a set of plans or structure of an investigation. Happener (1992) says a research design is a set of plans including procedures that reduce errors and simultaneously help the researcher obtain evidence about variables. Along the same lines, Bless and Higson-Smith (1995: p 63) say a research design is “a programme that guides a researcher in collecting, analyzing and interpreting observed facts. It is a detailed plan that indicates steps on how the scientific inquiry into the research problem was conducted.” Therefore, from the above definitions, a research design is the roadmap that directs the researcher toward achieving the objectives of the research problem. It draws lines of operation under which a researcher gathers information.

In this study the researcher employed an explanatory research design. According to Chiromo (2006) an explanatory design is a design that answers ‘why’ questions and explains the data collected. Dooley (1998) says that an explanatory design is used to explain the findings and conclusions drawn from a research project. It can be used to explain, for instance, reasons why certain human behaviours are very popular in one area and not in another. In this study this design was used to explain different ideas put forward by respondents during interviews. The researcher employed an explanatory design also to explain findings obtained through observations. It was also used to justify the facts that were obtained during the data collection phase with those achieved during literature review. Lastly, this design was employed because it was concurring with the qualitative research paradigm which was the researcher’s choice.

3.2 Population and Sample

3.2.1 Population

According to Dooley (1990) population is a group of people in which some specific information is required during a research project. On another note, Chiromo (2006) describes population as all individuals, units, or events that will be considered in a research project. Therefore, in this study, population is defined as all variables, items or people purposely involved in a study in order to provide required information about the research problem. Hence, in this research population was made up of 500 variables which were grouped into the following: 118 peasant farmers (60 males and 58 females of ages between 25 and 45), 110 agricultural officers (12 males and 8 females of age between 30 and 45), 120 agriculture teachers, 20 caves (bat deposits) and 112 members of Environmental Management Authority (EMA), and 20 disused buildings (bat deposits). All variables were selected purposively because they were the most affected by the problem under study.

Table 1. Target population

Human variables	Males	females	age	Total	Non-human variables	Total	Total
1. Teachers	60	60	25-45	120	1. caves	20	20
2. Agric officers	55	55	30-45	110	2. disused buildings	20	20
3. EMA members	50	62	30-45	112		Grand total	40
4. Peasant farmers	60	58	25-45	118			
			Grand total	460			

The above table shows the total population dealt with. Human variables complemented 92% of the total population while non-human variables complemented 8% of the total population.

3.2.1 Sample

Robson (2002) defines sampling as the procedure of selecting a given percentage of the population as a representative of the whole population. Sample by Leedy (1993) is a subset of the overall population that one wishes to study. Hence, sample is a smaller representative of the whole population under study or part of the population which would be used to make informed decisions about the entire population. In this study the researcher used a purposive sampling technique to make the sample. The researcher used 10% of the total population which was composed of 12 peasant farmers, 11 ARREX Officers, 12 Agriculture Teachers, 11 members from EMA, 2 caves and 2 disused buildings. Human variables were chosen respecting gender equity to promote equal participation between males and females.

Table 2 Sample used

Human variables	Males	Females	Age	Total	Non-human variables	No.	Total
1.Agric Teachers	6	6	25-45	12	Caves	2	2
2.Peasant Farmers	6	6	30-40	12	Disused buildings	2	2
3.Agric Officers	8	3	30-45	11			
4. EMA members	6	5	30-45	11			
5. Grand total	26	20	-	46	Grand total		4

3.3 Instrumentation

Sue and Sue (2002) define instrumentation as the application of research instruments. Defining instrumentation, Miles and Huberman (1984) say that it is a kit of data collecting devices that are essential to both conceptual framework and research development. This research define instrumentation as research tools used to acquire data from the respondents which include: interviews, observation, questionnaires, surveys and many others. In this study the researcher employed questionnaires, observations, interviews, documentations, and focus group discussion (FGDs).

3.3.0 Observations

Observations were made during the tours made by the researcher to various bat deposits between Gokwe and Zhombe districts. The major reason was to observe how bat guano was being extracted and applied into farming. Observations helped the researcher to interpret respondents' feelings, attitudes and their behaviours as they were responding to oral questions. However, nothing was being written during the process as the principle of observation says Meara and Schmith (1991).

3.3.1 Interviews

Haralambos (1995) says that interviews can be put into two categories which are structured and non-structured. In this study the researcher used unstructured interviews. These allowed him to restate or alter questions when they were found vague to respondents since they were open-ended. The researcher interviewed teachers, ARREX officers and peasant farmers. However the researcher had to use both observation and interviews concurrently because sometimes he had to observe behaviour as he posed questions to the respondents.

3.3.2 Questionnaires

According to Chiromo (2006) a questionnaire is a form of inquiry which contains a systematically compiled and organized series of questions that are sent to the population sample. Questionnaires were distributed to teachers who did not have enough time to sit and answer questions orally. Therefore, they had to respond to them during their spare time. Conversely, to other respondents, questionnaires were not given, the researcher simply asked them and jotted down responses. This

was so because it was believed that some of the respondents could not understand the English jargon so it was better for them to respond orally to questions asked in their vernacular language. This became more productive to the researcher because dependable and useful information was achieved through questionnaires.

3.3.3 Documentation

Mongella (200) says that documentation refers to all information that is reserved in libraries, journals, magazines and newspapers. Thus, documentation is all literature that is stored in form of books, magazines and journals as well as other research projects done by other students that researchers can use to support their work. In this study the researcher used literature read to cement the findings and compared and contrasted them.

3.3.4 Focus Group Discussions

Other instruments used were focus group discussions (FGDs). Lee (1993) defines FGDs as groups of people who are asked to share their perceptions, opinions, beliefs, thoughts and attitudes towards the problem under study. In the study, FGDs are defined as group discussions held by people chosen with one thing in common in order for them to unveil their feelings, thoughts and opinions. In this study, FGDs were held at Chireya Business Centre. Farmers, agricultural officers, and teachers were asked to discuss together the problem under study. Focus group discussions helped the researcher to a greater extent in soliciting in depth thoughts of people towards the study and their perceptions about chemical fertilizers and organic fertilizers.

3.4 Ethical Considerations/ Research Ethics

According to Chiromo (2006) research ethics are the principles of right and wrong that guide the researcher when conducting a research. Therefore, ethical considerations refer to the art of seeking consent from respondents, respecting their personality and their way of thinking towards the problem under study. In this study the researcher discussed informed consent, anonymity, confidentiality, protection from harm and honesty.

3.4.0 Informed Consent

Informed consent entails that subjects must be informed about the research before they decide to participate in the study. At this juncture, researcher must introduce himself or herself to the respondents. Reasons for the research must be exhaustively spelt out for the subjects understand and make their best choices. Benefits, if any should be made known at this point. In this study, subjects were informed prior to maximum participation about the reasons and why they were chosen. Moreover, subjects were told that they were free to decline or withdraw from the study as soon as they noticed something bad. All minors who wanted to contribute towards the research project consent was sought from their guardians or parents.

3.4.1 Anonymity

The researcher assured the participants that their names were not by any means disclosed to anyone. In consolidating the researcher made use of pseudonyms. Their residential addresses were not given and no registers were used to record people who were involved in the study. No spaces for names on the questionnaires.

3.4.2 Confidentiality

In this research the researcher respected respondents' rights and managed to treat them in the strictest of confidence. The researcher assured all participants that data collected were not to be exposed. Their names were not demanded and they were told that data were for the researcher and some few research assistants only. Furthermore, respondents were assured that data collecting devices were to be kept under lock and key. However, confidence assured to participants helped the researcher to achieve information needed since they were vitalised by the kind of confidentiality put on place. This also helped participation to be vivid and energetic.

3.4.3 Protection from harm

The above outlined measures left participants free from any kind of physical, social, emotional, spiritual or any potential harm of any nature. Having their names kept unknown, and their residential places unstated, subjects involved in the study were highly protected from harm. Lastly, the researcher sought consent from the

leaders of the communities in which he was operating to avoid any kind of suspicion by assembling people in their area of jurisdictions without their knowledge.

3.4.4 Honesty

The researcher made maximum effort to become as honest as possible. No practices contradicted with issues about informed consent were done. The researcher upheld all issues about research ethics that were outlined to participants before maximum involvement in the study. No one was injured as a result of taking part in the study. Therefore, this only explains how far the researcher managed to be as honest as possible.

3.5 Data collection procedures

An introductory letter was obtained from Midlands State University and was first presented to the chief as the local governance personnel to get the consent to carry out the research in his area of jurisdiction. The Chief gave the researcher a stamped letter of approval to that effect and both the University and chief's letter were presented to the subjects included in the collection of data. All subjects involved in the research project during data collection phase opened up their minds and shared their ideas freely and fairly. The researcher obtained data through observations, interviews, focus group discussions and from documentary evidence. Observations were at times used concurrently with interviews. They were also used during the tours made by the researcher to various places (bat deposits).

Furthermore, the researcher interviewed two agriculture teachers, two agricultural officers and one member of EMA who were chosen purposively and respecting gender balance. They were all given questionnaires to fill in. Peasant farmers were interviewed face to face because there was a belief that some of them would not be able to understand the English jargon. Most importantly, interviews were conducted respecting respondents' autonomy and their personalities.

Focus group discussions were also engaged and were made up of two peasant farmers, two teachers, and two agricultural officers and all were chosen purposively because they were the most affected subjects by the study.

After the interviews the researcher visited one cave and two disused buildings to observe bat droppings to see how they live and produce guano. The researcher observed whether guano could be extracted in large quantities and become a precious mineral for commercialization.

However, as with any other researches, this research had some challenges. The first one was the issue of money to travel from one place to another. This affected progress of the study to larger extent since it caused the researcher to delay embarking on the business. Secondly, time constraints became a greater hindrance. The researcher was a teacher, a parent and a student at the same time. This made the researcher break ties with his family at times and also faced accusations at work since he had to leave work doing his research. Therefore, this to some extent caused the researcher to have insufficient time to carry out the research as he wanted because of these other commitments.

3.6 Data Analysis Plan

A qualitative method of data analysis was used in this study. Explained tables were used to analyse data clearly and precisely. Much credit was given to information supported by most respondents during data collection phase. The researcher linked data collected with literature reviewed in order to draw comprehensive conclusions about the problem under study.

3.7 Summary

In a nutshell, this chapter discussed the research design, population and sample, instrumentation, ethical considerations, data collection procedures, and data analysis plan. Findings of the research follow in the next chapter.

Chapter Four: Data Presentation, Analysis and Discussion

4.0 Introduction

This chapter concentrated on the presentation, analysis, and discussion of data collected using the methods discussed in the preceding chapter. The methods adopted by the researcher to collect data included the focus group discussion (FGDs), interviews, questionnaires, documentations, and observations. Data were presented and analysed using tables and research questions formed the framework of data presentation, analysis and discussion against the responses given by the participants participated in the study. The chapter ended with a summary.

4.1 Presentation and Analysis of the Findings

Data were obtained from human variables and non-human variables. Human variables complemented 92% of the total sample dealt with and non-human variables complemented 8%.

4.1.0 Demographic data

Target population

Table 3

Human variables	Males	females	total	Non-human variables	No	Total
Teachers	60	60	120	Caves	20	20
Agric Officers	55	55	110	Disused buildings	20	20
EMA members	50	62	112			
Farmers	60	58	118			
Total	225	235	460	Total		40
Grand Total						500

The above shows the population dealt with by the researcher. Human variables were 460 while non-human variables were 40.

Table 4

Sample used

Human variables	Males	Females	Total	Non-human variables	Total
Teachers	6	6	12	Caves	2
Farmers	6	6	12	Disused buildings	2
Agric Officers	8	3	11	Total	4
EMA	6	5	11		
Total	26	20	46		
Grand total	Of	Sample	used		50

The above table shows the sample from which the researcher obtained data. Teachers complemented 24% and farmers also complemented 24% of the total sample used. Agricultural workers complemented 22% and EMA members constituted 22% again. Non-human variables complemented 8% of the total sample used. In short, grand total of sample used was 50 (100%) and in that, human variables complemented 92% while non-human complemented 8%.

4.1.1 Teachers

Teachers participated in the study were 12 (24% of the sample). They came from both primary and secondary schools. These variables were given questionnaires to complete. They also took part in structured interviews conducted at their schools by the researcher. 8 (67%) teachers said that they had used guano in their past life and they knew more about this fertilizer. 4 (33%) teachers said that they just heard about guano and they theoretically knew that it was very nutritious.

4.1.2 Farmers

Farmers participated in the study were 12 (24% of the sample). They were six males and six females. 10 (83%) farmers were O' level graduates and 2(17%) were grade seven graduates. All farmers said that they knew guano. However, 7(58%)had used guano on their farming projects and the remaining 5 (42%) had heard about guano but did not use it on their farming projects.

4.1.3 Agricultural workers

Agricultural officers participated in the study complemented 22% of the total sample used. They were 8 (73%) males and 3 (27%) females. All of them said that they knew guano. 6 (55%) of them were using guano on their farming projects and 5 (45%) of them said that they were about to start using guano in the next farming season. However, the officers agreed on one thing that guano was very nutritious with an estimated nitrogen content of 47%. They also accepted that it was suitable on farming in the area of Chireya Ward 5 where the research was being carried out. They all said that they were on the way to educate their farmers about the use of guano fertilizer.

4.1.4 EMA members

Members from EMA were 11 (22% of the total sample). They were given questionnaires to complete. They all completed the questionnaires and returned them to the researcher. They suggested that extraction of guano had no effects to the environment but killing of the bats would be the major issue of concern. They also said that chemical fertilizers had devastating effects to the environment, water, air, and soil. Therefore, they supported the use of organic fertilizers on farming.

4.1.5 Caves

The researcher visited two caves (bats deposits) to observe how bats survive and produce guano. From the two deposits visited, the researcher concluded that bats were many and were producing guano that could be utilized on farming.

4.1.6 Disused buildings

The researcher visited two buildings which were lying idle. In the buildings bat pallets were scattered all over the floors. From the observation made, it was

concluded that bat guano could be collected in huge quantities if some more buildings were spared to rear bats.

4.2 Discussion

Research Questions

4.2.0 What are the effects of chemical fertilizers?

To justify the suitability of guano fertilizer on farming in Gokwe North Chireya Ward 5, the researcher started by asking the effects of chemical fertilizers on farming activities. Questionnaires distributed to farmers, agricultural officers, and, teachers together with the interviews made to the same respondents revealed that chemical fertilizers had negative effects on water, soil and environment.

Effects on water

According to 11(22%) agricultural officers completed the questionnaires leaching was the serious effect of chemical fertilizers. The officers said that leaching caused plants to lose nutrients. One of the officers said that leaching was caused by excessive rains which often fell in the area of Gokwe North Chireya. The respondents said that although excessive rains came for a short time, they caused a greater harm on the part of farmers. This, however, indicated that chemical fertilizers played an insignificant role in providing necessary nutrients to crops because of leaching. Furthermore, another effect shown on the questionnaires was that chemical fertilizers were easily washed away by rainfall thereby entering water sources such as rivers, dams and shallow wells. This affected human life, livestock and other water species such as fish.

In addition, some questionnaires completed by teachers indicated that inorganic fertilizers were made up of chemicals which were poisonous. Therefore, when leached or washed away by excessive rains and enter the water environment they could destroy water living species. By so doing the water become unsafe for human consumption and sometimes the water produces some odor smell which polluted the air that people inhale.

Moreover, Mapako one of the agricultural officers interviewed one on one, said that most farmers in Chireya Ward 5 practised stream bank cultivation. Mr Mapako

said that stream bank cultivation increased chances of chemical fertilizers residues which leach and flow underground into the rivers. He went on to say that chemical fertilizer residues which enter water sources affected fish which were said to be the most consumable food by the local people. The respondent said that fish fed on the residues indirectly as they fed on mud. However, people would therefore feed on the same residues when they feed on fish. As a result of this, most people would suffer from deadly diseases like cancer.

Furthermore, Mr Mapako's sentiments concurred with Savci (2012) who carried research in Turkey on the effects of chemical fertilizers. She found that inorganic fertilizers affected water bodies and this also affected the water living species, human beings and livestock. On the same note, Orman (2004) also carried a research on the effects of chemical fertilizers on water in Turkey. The researcher discovered that chemical fertilizers polluted water sources thereby causing them to become unsafe for human consumption. Orman (ibid) pointed out that too much application of chemical fertilizers promoted increment of nitrates in drinking water and rivers as a result of high levels of nitrogen fertilizers use.

Meanwhile, Korkmaz (2007) and Sonmez et al (2008) carried out their studies in Europe on the effects of inorganic fertilizers and discovered synonymous results to those of Orman and Savci (ibid). For example, they found that the majority of nitrogenous fertilizers were not absorbed products they interfere with both underground and surface water. They also said that ground water problems were considerable in Europe with about 22% Of cultivated areas with nitrate contaminated water bodies. Therefore, the findings of this research were not unique in nature since there were other researcher who discovered same results. In this study the researcher concluded that effects of synthetic fertilizers on water were devastating in many parts of the world. However, the researcher did not tested the water from surrounding sources, but the suggestion put forward by respondents explained that water problems were there. The reason being that utilization of chemical fertilizers was considerable. Hence, the only solution suggested by many respondents was to return to the use of organic fertilizers which were less harmful.

Effects on soil

According to Machedze (pseudonym) a teacher at Chireya who taught agriculture interviewed one on one, chemical fertilizers affected soil ph (potential of hydrogen). The teacher said that most soils in Gokwe North Chireya Ward 5 were acidic due to cropping. This meant that they had low ph. Hence, application of inorganic fertilizers was not recommended especially when soil sampling or analysis was not done. Mr Machedze went on to say that most crops need soil ph that ranges from 5,5 to 7 which is neutral. Hence, the interviewee suggested that chemical fertilizers had to be replaced by animal manure which he said have good conditions for crop production.

Furthermore, questionnaires completed by agricultural officers indicated that inorganic fertilizers decreased soil ph system thereby causing crops to fail. The respondents said that crops in Chireya failed because of soil ph disturbances. However, when such things happened farmers had to find soil conditioners like lime, but due to poverty not all farmers afforded that and as a result they failed to harvest.

In addition, Savci (2012) made a research in Turkey on the effects of chemical fertilizers and discovered that fertilizers with high levels of sodium and potassium had negative impact on soil. She concluded that utilization of fertilizers if done often times led to soil pollution, deterioration of fertility, soil degradation, reactions occurring in the soil led to degradation of the balance of the current element. Tapbas et al (1998) say that inorganic fertilizers destroyed important organisms which play a critical role in making soil conducive for cropping. They improve soil drainage system, moisture conservation and good flow underground. This however, implied that the effects of chemical fertilizers discovered by the researcher in Chireya concurred with those discovered by Savci and Tapbas (ibid). A clear indication which explains that chemical fertilizers were not significant to a greater extent. Therefore, the above mentioned effects caused soil to perform pathetically and crops grown fail dismally. Farmers who participated in the focus group discussions said that the effects of chemical fertilizers were that in the event that they had failed to acquire them their farms did not do well and to some extent they were harvesting nothing. Thus, they were voting for organic fertilizers because they were saying these held soil fertility and promoted moisture

conservation. This meant that farmers responses concurred with Tapbas et al (ibid) who found that chemical fertilizers destroy soil capacity to fertilize crops for long time.

Moreover, one agricultural officer who was interviewed one on one, said that 90% of farmers in Chireya were using ammonium nitrate, urea, and compound D to aid their soil fertility. These types of fertilizers were said to have poisons which kill microbes which decompose organic matter. Hence, this meant that soils in Chireya had problems due to utilization of synthetic chemical fertilizers.

Continuous usage

Another effect cited by most of the participants participated in the FGDs was continuous usage. There were 15 participants from farming, teaching and ARREX who were at Chireya Business Centre where the FGDs conducted. 6 farmers said that inorganic fertilizers did not last as compared to organic ones. These farmers said that continuous usage of chemical fertilizers sometimes made them fail to make a good yield when they did not have money to purchase them. Hence, they said that naturally they love organic ones which could last for two to three years. They also said that inorganic fertilizers caused them to incur huge expenses in order to purchase them while organic ones were from their locality. In addition to that, agricultural workers who were present said that inorganic fertilizers were bad to a greater extent. They said that they deteriorate faster due to leaching and high dissolving rate when mixed with water. Therefore, they advised farmers to apply them seasonally for them to harvest a good yield. However, this suggestion was not good for incapacitated farmers in Chireya who sometimes survived with below \$ a day. Bondayi and Kanyoka (2004) carried out their research in Zimbabwe on the factors affecting fertilizer use and discovered that expenses incurred by farmers to purchase one 50kg bag of fertilizer were huge and that caused most farmers to fail. In addition, from the observation made by the researcher, farmers in Chireya had no sufficient money to purchase basic needs to use on daily bases. So they could not buy chemical fertilizers time and again to improve their soil fertility. They, however, needed to practice low cost farming projects which involved the use of guano and other animal manure in order to realize profits from their farming business.

Time of application

One of the agricultural officers who wanted to be named Johna interviewed by the researcher, said that time of application of chemical fertilizers was determined by climatic conditions. Sometimes farmers would want to apply them, but failed because it would be excessively raining or hot. As a result crops would go a long way without additional nutrients. In addition to that, Mr Johna said that technical knowledge would be needed for proper use to avoid burning effects. Contrary to organic fertilizers, chemical fertilizers had one season effect because no residuals remained in the soil. Thus, they needed to be eliminated if guano deposits were to be found in huge quantities.

4.2.1 What is guano fertilizer?

Since people participated in the study were selected purposively, they all knew guano to some extent. Some farmers defined guano as bird pullets that can be collected from caves. Some agriculturalists defined guano as bat droppings which were an organic fertilizer. Teachers completed questionnaires described guano as highly nutritive form of fertilizer with the highest content of nitrogen than any other forms of fertilizers. All participants agreed that guano could be collected from disused buildings, caves and from functioning buildings which would lay idle for long time like classrooms, halls and churches. Therefore, all the definitions given concurred with that of Cynthia Domenghini (2016) who said that guano was from bats or seabird and rich in nitrogen.

Furthermore, Mr Muzuva an agricultural worker who was interviewed said that guano promoted vegetative growth on crops. He said that guano suited all crops and he had experience of using guano on vegetables and horticultural plants. Mr Muzuva alluded that guano did very well on all the crops he had applied it. Therefore, this meant that guano was effective and suitable for farming.

Application of guano

All farmers interviewed on individual capacities said that guano was applied once in a farming season or once for two farming seasons. They also said that guano worked as both basal and topdressing fertilizer. Moreover, guano was put in lines

made by oxen drawn ploughs. It was put before seeds and seeds would be put on top of it and then lines were closed to enhance germination of the seeds.

Effectiveness of guano

Questionnaires completed by 8 teachers (16% of the total sample used) indicated that guano was very effective as compared to other forms of fertilizers. The teachers said that it promoted vegetative growth thereby increasing the final yield especially on vegetable crops. Another agriculture teacher interviewed one on one, who claimed to be named Hove, said that guano was highly effective because it improved soil pH system. He further stated that soil pH was good for soil water holding capacity thereby leading to moisture conservation. Along the same lines, agricultural officers interviewed at Chireya business centre said that guano was effective on farming in their area. They also said that guano could change clay soils to become loam soils which were said to be the best for cropping. The officers claimed that if guano was brought to the attention of all farmers it would provide a good remedy to the challenges faced by farmers due to usage of inorganic fertilizers. One farmer claimed to be Chigova interviewed one on one, said that most soils in Chireya were clay soils and they were causing high rate of waterlogging leading to plant wilt due to failure to respire. Hence, guano as organic was thought to be a soil conditioner that could sort out the problems.

Meanwhile, one agricultural officer, Mr Johnson (pseudonym) interviewed by the researcher at Chireya Business Centre, testified that he had used guano fertilizer on crops like sesame, cotton, maize and groundnuts. He said that the results were good and all crops did very well. However, one agricultural officer interviewed agreed that guano was effective but, he said that it was good on fodder crops meant for livestock feed. He suggested that guano at most promoted growth of stems and leaves with a greenish colour required for food manufacturing process. But needed proceeds such as tomatoes, maize cobs or balls on cotton crops would not be satisfactory. However, this suggestion was clashed by some farmers who also took part in FGDs. The farmers said that guano enhanced production of needed proceeds such as health cobs or cotton balls.

Moreover, observations I made reflected that guano was effective. I visited Mr Masango who was a renowned farmer in Chireya. The farmer had used guano for

several years. From the observations made by the researcher, Mr Masango had applied guano on crops like groundnuts, sesame, maize, vegetables and cotton. All plants seen were health and promising. Mr Masango said that he collected guano from nearby caves and some from disused buildings. The farmer postulated that he had used guano since 2007 and it was working very well. He said guano needed to be applied consciously because if farmers apply a lot of it on a small acreage it causes burning effects.

Therefore, the researcher after receiving such a comprehensive data about the effectiveness of guano, he concluded that guano was very effective and hence, suitable in Chireya Ward 5.

4.2.2 What are the advantages of using guano fertilizer over chemical fertilizers?

In order to justify the suitability of guano fertilizer on farming, the researcher crafted questionnaires which sought to reveal the minds of the people.

Teacher's questionnaires

12 teachers completed questionnaires and they suggested the following points as some of the advantages of using guano.

Guano was cheaper

The teachers suggested that financially farmers in Chireya were incapacitated. Hence, purchasing of chemical fertilizers was a huge blow to them. However, guano was very productive and useful because it was cheaper to gather. No funds were needed to buy guano since it was found from within the community. Guano was applied without any other scientific processes involved. Therefore, the cost effectiveness of guano made it more advantageous than chemical fertilizers.

Moisture conservation

Another advantage cited by teachers was that of preserving moisture. Like any other animal manure, guano held moisture for long time. This was good for all crops since lack of moisture led to crop wilting. Unlike chemical fertilizers, guano could help crops to survive for long even if there were erratic rainfalls. Hence,

guano was thought to be the most important fertilizer to use because many farmers in Chireya relied on natural rainfalls.

Guano was free from diseases

According to one of the teachers interviewed by the researcher, guano was free from diseases which could lead to toxic soils or poisons. Whereas inorganic fertilizers caused soil ph to decrease, guano improved soil ph. As the teacher put it across, most soils in Chireya were acidic due to cropping. Therefore, chemical fertilizers were no longer suitable especially when no soil analyses were taken to check whether the nutrient put fitted the soil nutrient demand.

Hence, after obtaining the information put above the researcher realised that Cynthia (2016) acknowledged that guano fertilizer was more of a soil conditioner. It was used to improve soil texture and water holding capacity. Therefore, soils in Chireya were clay and did not suit well on farming projects. Most of them had high rate of waterlogging which was a danger for crop progress. People in Chireya were supposed to use guano fertilizer which had microbes and elements that could change clay soils to loam ones. Moreover, since the farmers in Chireya had used chemical fertilizers for quite long their soils were already polluted. Hence, they had to use guano that could cleanse toxics and poisons that were left by inorganic fertilizers. If the farmers followed the use of guano, it would help them improve their yields thereby leading to self-sufficiency.

Accessibility

Seven (7) agricultural officers who completed questionnaires said that guano was accessible by all interested farmers. 10 farmers participated in FGDs said that in Chireya Ward 5 guano was found from disused buildings, houses, classrooms and from halls and churches where people did not stay in them daily. Therefore, it was accessible to any farmer who was willing to apply it. Furthermore, observations made by the researcher showed that guano was accessible. For example, in schools bats were found in huge quantities and their droppings could be collected in packs of 10kg to 15kg daily. Farmers interested were using guano in gardening projects. In addition to that literature reviewed indicated that in Zhombe in chief Samambwa's area guano was plenty and accessible. All farmers interested in guano were collecting it in large quantities from the Mabura caves. Thus, the

researcher concluded that guano if most farmers wanted to apply it they could access it easily.

4.2.3 What do you think can be done by the country to benefit from guano?

Farmers' questionnaires

Six (6) out of 12 farmers wrote that the government could benefit from guano to a larger extent. The following were the suggestions put forward by farmers.

Experiments

Six farmers suggested that the government could benefit from guano through making experiments with people so that they would learn how to use it or how effective it was. They said that there should be plots taken to farm different crops using guano fertilizer. The farmers also said that when experiments were made by the government this would make people knew guano fertilizer. However, other four farmers said that government could not really benefit from guano because most people did not know it. Therefore, they had to be taught first about it. Two farmers did not reveal their minds concerning the question. Hence, from the contribution made by farmers, I concluded that government could benefit from guano through making experiments. This was not a difficult thing to administer because most cotton companies were well known for carrying out experiments with farmers and succeeded. Experiments could help most people learn and identify strengths and weaknesses of guano.

Teachers' questionnaires

Responses obtained from teachers' questionnaires went hand in glove with farmers'. However, five (5) teachers suggested that the government through its Ministry of Agriculture visit areas in search of guano fertilizer, especially in rural schools where buildings would be idle for holidays. Six (6) teachers suggested that the local authority should exploit natural resources found locally to make money than to think of other resources. They alluded that the rural council of Gokwe North should make demonstrations using guano on farming projects. When they had lured many people they would sell it and benefit financially. One teacher said that agricultural officers had to be staff developed on how to use guano so that they would educate their farmers. Hence, from these suggestions, the researcher

concluded that the country could benefit from guano if it had to follow the brilliant ideas brought forward by the local people.

Agricultural officers' questionnaires

Views given by agricultural workers were promising. Two(2) officers suggested that the government should initiate communal funded bat projects. The officers highlighted that when bats were kept and their droppings collected intensively, it could be used to a greater extent. They said that most of the people in communal areas needed to get money, so when they could start funded projects they could do them effectively. Seven (7) agricultural officers wrote that the government should encourage both communal and commercial farmers to form co-operatives involved in bat fertilizer use. They said that farmers in Chireya Ward 5 were already in some cooperatives funded by cotton companies, therefore, if the government came to them through those companies it would succeed and this would cut costs on the part of the government which was pumping a lot of money to supply chemical fertilizers to Chireya residents. Furthermore, the officers said that the government was by then importing chemical fertilizers at huge charges and that was causing a negative impact on the economy. Therefore, to initiate guano co-operatives was a noble idea that would help the government to cut costs.

However, three (3) officers disagreed with others. The trio said that guano was limited to some specific areas such as Madzivazvido, Jahane, CM- Nemangwe and Mabura Zhombe where very few people could access if they wanted to collect it in huge quantities. Conversely, the researcher's observations proved that guano fertilizer could be used by any farmer who was interested to use it. Hence, the opinions given by the three officers were not watertight because guano could be collected in packs of 5kg to 10kg per day from nearby bat deposits. This meant that one farmer could get 25kg to 50kg per week. The quantity was good enough for farmers to rely on guano thereby benefiting from it.

Interviews

Interviews were conducted to get the points of people concerning the role that could be played by the government to benefit from guano fertilizer. During the interviews, the researcher met a farmer who was called Binga (psuednyme). Binga said that the government should make guano known nationwide as with other

minerals like gold and diamond. Mr Binga said that he used guano very much on farming projects when he was living in Zhombe before he came to Chireya. He also said that guano had been used on farming in the 1960s and was mined by the White companies from South Africa. However, Mr Binga said that the government had to advertise guano through its platforms to make it known by many people. The interviewee continued to say that if the government wanted to exploit guano it had to visit areas like Zhombe West to observe whether guano could be used as the basic fertilizer of the country. In conclusion, Binga said that the country through its municipalities or rural councils could benefit from guano if they coordinate people to exploit this precious resource.

Meanwhile, literature reviewed by the researcher showed that guano could be a commercial fertilizer which could be exported. Given the chance that the government played its role to make guano known and utilized, a lot could be achieved. For example, there were other products cited like gunpowder and biogases made from guano. In addition, Russell (2012) said that guano was an exporting resource in South Africa, Peru and Europe. Therefore, the researcher concluded that guano could be exported and helped the government to get forex thereby improving its coffers. It could also cut costs of importing fertilizers which were very expensive.

4.2.4 How suitable is guano fertilizer on farming projects in Gokwe North District Chireya Ward 5?

In order to answer the question, the researcher put the respondents into their groups which were teachers, farmers and agricultural officers.

4.2.4.0 Teachers' responses concerning guano suitability on farming.

Table 5

Respondents	Suitable	%	Not suitable	%	Total
Teachers					
Males	5	83	1	17	6
Females	6	100	-	0	6
Total	11	92	1	8	12

The table shows 5(83%) out of 6 males accepted that guano was suitable in Gokwe Chireya on farming projects. 6 (100%) females said that guano was very suitable. Therefore, 11(92%) teachers out of 12 participated in the study believed that guano could be used on farming in Gokwe Chireya and produce good results. Only 1(8%) participant disagreed with others citing reasons like people would not manage to acquire guano from their localities in huge quantities.

4.2.4.1 Agricultural officers' responses

Table 6

Respondents	Suitable	%	Not suit	%	Total
Agric officers					
Females	2	67	1	33	3
Males	8	100	-	0	8
Total	10	90	1	10	11

The above table shows responses given by agricultural officers concerning the suitability of guano fertilizer on farming in Chireya. 2 (67%) females accepted that guano was suitable. 1 (33%) female said that guano could not be suitable. 8 males (100%) said guano was suitable on farming in Chireya. All in all, 10 (90%) out of 11 (100%) officers participated in the study confirmed that guano was suitable in Chireya Ward 5 on farming projects. However, one (10%) officers doubted the suitability of guano fertilizer citing that it could not be accessed by all people.

4.2.4.2 Farmers responses

Table 7

Respondents	Suitable	%	Not suit	%	Total
Farmers					
Males	4	67	2	33	6
Females	6	100	-	0	6
Total	10	83	2	17	12

Data presented on the above table reflects farmers' responses on the suitability of guano fertilizer in Chireya. 4 (67%) males said that guano was suitable while 2 (33%) said the opposite. The table also shows 6 (100%) females who accepted that guano was effective and suitable on farming.

Table 5 given below shows the total number of participants took part in the study and their views concerning the suitability of guano fertilizer on farming in Gokwe North Chireya Ward 5. However, EMA members were not involved.

Table 8

Respondents	Suitable	%	Not suit	%	Total
Females	14	93	1	7	15
Males	17	85	3	15	20
Total	31	89	4	11	35

The table above illustrates the figures of the respondents who were asked about the suitability of guano fertilizer on farming in Chireya Ward5. 35 (100%) respondents were dealt with. 15(43%) were females and 20 (57%) were males. The respondents included teachers, farmers and agricultural officers. 14 (93% of the total number of females)females said that guano was suitable on farming projects in Chireya. One (7%) female respondent disagreed with the views of others. 17 (85%)male respondents alluded that guano was suitable on farming projects in Chireya while three (15%) males suggested that guano was not suitable.

However, all in all, 31 of the respondents dealt with said that guano was suitable on farming. Despite the tiny figure of four respondents discouraged the suitability of guano, the researcher was therefore, took the stance that guano was suitable on farming. As it was stated in chapter three on analysis that much credit would be given to information given by many respondents, thus, the researcher concluded that guano was suitable on farming in Chireya Ward 5.

4.2.4.3 Experiences

The researcher learnt a number of things during his studying time. The following were some of the things encountered.

Interesting things

The researcher was excited by the way most working mates took his topic. Almost everyone at the work place was surprised by the kind of a research problem I was dealing with. Some teachers thought that I was embarking on a witchcraft project sought to find how effective bat droppings were they. Moreover, some farmers could not believe that chemical fertilizers had side effects. However, after learning from the researcher some of them promised to stop applying them in the next farming season. In addition, the researcher was welcomed by people as soon as they knew that he was doing something that could better their farming life. For example, Mr Masango (pseudonym), a well renowned farmer applauded the researcher by carrying out a researcher that educated people about health hazards caused by chemical fertilizers.

Furthermore, some agricultural officers were impressed by the way the researcher did his study and the type of questionnaires which were very comprehensive. For example, Mr Johnson (pseudonym) said that he would want to get the copy of the document when the researcher finished.

The researcher was also interested with tours he made during data collection phase. This exposed him to different people with diverse ideas which he used to complete his project. The study enhanced the researcher to visit EMA members which was a remarkable thing to his life because had not been the study the researcher would not have time to visit them. Last but not least, the researcher was glad to possess a

special knowledge from agriculture while he was just a mere teacher who had never trained in that area of agriculture.

Challenges

The English people say no sweet comes without sweat. Therefore, it was supposed to be a time of challenges since they were the ones strengthened the researcher.

Finances

I was cut short by financial constraints. My research wanted a lot of money to travel, buy stationery and to visit the supervisor. Although, I strove to make ends meet, financial constraints hindered me to a greater extent.

Floods

I carried out my research during a heavy rain season. Rivers were flooded and I could not cross them. Therefore, this caused me to delay to finish my research because I could not access the respondents to gather data.

Time

I faced time constraints due to several commitments. I was a teacher, student and a family man. However, at work I was needed to do my teaching work. At school, the supervisor wanted me and the family also wanted me to bring food on the table as well as my attention to them. Sometimes I had to spend sleepless nights focusing on my project and this caused my professional records not be attended to. I also ended up fighting cold war with school leaders because he did not want me to leave work doing my study.

However, I was happy that I managed to complete my study despite the thickest situation I went through.

4.2.4.4 Strategies to increase utilization of guano fertilizer on farming

From the observations, interviews, and literature reviewed the researcher came up with some strategies to be used in order to increase utilization of guano fertilizer on farming projects. Discussed below are some of the strategies suggested.

Making co-operatives on guano projects

Guano fertilizer was found to be the most nutritious form of fertilizer with highest nitrogen content of about 46% to 47% though more researches were still underway to find the exact content. Therefore, the country through its Ministry of Agriculture had to introduce co-operatives which involved the use of guano fertilizer. This could be done through local agricultural officers and even through some cotton companies which were already working in Chireya. Co-operatives were thought to be the most effective way because most participants suggested that the government could introduce funded guano projects to make it familiar with many farmers. In addition to that co-operatives could help people to come up with divergence ideas and by so doing a synergy would be formed. When people work as a team they mostly succeed.

The researcher discovered that initiation of guano projects would cut costs on farmers to buy chemical fertilizers which were very expensive. The government would also reduce its expenditures which were very high due to importation of chemical fertilizers that were donated to farmers in Chireya.

Demonstrations

The researcher also suggested that demonstrations had to be done by the government in order to increase utilization of guano fertilizer in Chireya Ward 5. Like what was done by the maize-seeds producing company- Pioneer, government through its structures in agriculture had to demonstrate on the use of guano fertilizer on a chosen piece of area. The idea of demonstrations was also seconded by some esteemed farmers in Chireya. The farmers said that the local responsible authority -rural council had to select few farmers whom they had demonstrations done to education others on the use of guano. This was thought that it would help many farmers to observe the effectiveness of guano.

Moreover, from the evidence shown by a minority number of farmers who had used guano, the researcher concluded that guano could be a nation's another cheap form of fertilizer that could improve farming in the country. Therefore, demonstrations would help disseminate the knowledge about guano to many people.

Introduce funded bat projects

Bats were said to be little birds that could be trapped and domesticated, though, some respondents disagreed with this idea. However, the researcher using own experience obtained through observations, suggested that communal bats rearing projects could be done in Chireya Ward 5. Bats were found in classrooms, church buildings which lay idle for some days in a week and in some houses though to a lesser extent. Therefore, if they were to be kept at home like any other birds, they could stay. Bats rearing projects were thought to be the cheapest way of obtaining guano fertilizer.

Summary

This chapter concentrated on the presentation, analysis and discussion of the findings. The data were presented on tables. The chapter indicated the demographic data, and population and sample dealt within in the study. Effects of chemical fertilizers were written to justify the suitability of guano fertilizer. Definition of guano fertilizer was given and its application and effectiveness were also highlighted. Advantages of guano fertilizer over chemical fertilizers were written. Least, but not last, statistics of the respondents agreed on the suitability of guano was presented on tables and they were fairly discussed. Lastly, the researcher highlighted the experiences he experienced during the study, and some strategies to increase the utilization of guano fertilizer in Chireya were given. Summary, conclusions and recommendations of the whole project were given in chapter 5.

Chapter Five: Summary, Conclusions and Recommendations.

5.0 Introduction

This chapter focused on the summary, conclusions and recommendations of the whole research derived from the topic entitled “An investigation into the suitability of guano fertilizer on farming in Gokwe North District Chireya War 5.”

5.1 Summary

Chapter one

My chapter one had background to the study, statement of the problem, significance of the study only to mention but a few. I was prompted by the health hazards caused by chemical fertilizers on human beings, animals and the environment to embark on this study. Poor yields that were being realised by farmers in Chireya even though they received chemical fertilizers were some of the pushing factors to me to carry out this study.

The then current state of the economy, harmful effects of chemical fertilizers and their costs as well as poor yields from agriculture had set the tone for me to carry out this study in order to bring about eco-friendly farming methods.

Beneficiaries of the study were: government, farmers, teachers, agricultural workers and the researcher. The limitations faced by the researcher included finances, time, polarization and language. Financially, I wanted a lot of funds to use during the study. On the part of time, I was committed to number of duties at the same time when I had to carry out the study. Therefore, these and others were causing me not to do the research as I wanted.

Chapter two

In chapter two the researcher reviewed related literature. Effects of chemical fertilizers were highlighted and they were found on water, air and soil. Guano was defined in this chapter and its advantages and effectiveness were highlighted.

Chapter three

My chapter three concentrated on research design, paradigm and instruments employed to gather data from the respondents. The researcher used an explanatory research design and it was accompanied by a qualitative research paradigm. Population was made up of human variables and non-human variables. Human variables complemented 460 and non-human 40. 10% of the population became the sample of the study. Instruments used included observations, interviews, questionnaires and FGDs

Chapter four

This chapter concentrated on presentation, analysis and discussion of data. Teachers, farmers, agricultural officers and EMA members were the respondents in this study. The researcher analysed data using tables. From the contributions given by the respondents participated in the study, guano was suitable on farming in Chireya.

5.2 Conclusions

The researcher was pushed by the then current state of the economy, poor yields obtained by farmers in Chireya and health hazards caused by chemical fertilizers to carry out this study. The study strove to find the suitability of guano fertilizer on farming in Chireya. Government, farmers, teachers and the researcher were the key beneficiaries of the research.

In chapter two, the researcher found that chemical fertilizers had devastating health effects that were haunting the whole world. It was also established that the world was turning organic in order to curb the disaster caused by the use of chemical fertilizers. Moreover, guano fertilizer was found to be the most nutritious form of fertilizer that had an estimated nitrogen content of about 46% to 47%. Effectiveness of guano fertilizer made it a dependable form of fertilizer in Chireya. The soils in Chireya were clay and needed some kind of fertilizer that changed clay soils to become loam soils which were good for farming.

In addition, research design, paradigm and instruments employed were productive in as much as the presentation, analysis and discussion of data were concerned. The researcher discovered that respecting issues to do with ethical considerations

was important. Due to the correct procedures followed by the researcher before maximum participation of participants in the study, the researching life became easier.

The findings revealed that most people supported the use guano fertilizer. The researcher used the information provided by participants on questionnaires and the information obtained during structured interviews as well as FGDs. Statistically, 31(89%) out of 35(100%) respondents said that guano was suitable on farming in their area. 4 (11%) respondents disagreed with others. But, from the assessment made by researcher, the disagreed respondents were a beat short academically with three (3) of them ended schooling at grade seven and one (1)at form one. Therefore, critical thinking was limited.

Moreover, carrying out this study was also educative to the researcher. The researcher learnt that not all respondents complete questionnaires within the given time. For example, some agricultural officers and farmers did not complete the questionnaires and they did not return them to the researcher. Others completed just after seeing the researcher coming to collect them. Some of the things learned were that chemical fertilizers had serious effects that caused long term health problems in human beings such asthma, lung cancer and many other deadly diseases.

Furthermore, the researcher faced some challenges. Financially, he had limited funds to buy stationery, to travel and to print. This caused the researcher not to do the research as he wanted. He also faced time constraints. The researcher was a family man, teacher and a student at the same time. Hence, all areas needed him to do some duties, so this again hindered the progress of the research. Last but not least, the researcher found limited literature that dealt with guano utilization in Zimbabwe. This made his researching life tough to some extent.

5.3 Recommendations

The following recommendations were made after noting that people in Chireya Ward 5 West Circuit had acknowledged that guano was suitable on farming activities in their area.

The government should:

- Establish communal funded bat projects
- Initiate farming co-operatives that make use of guano fertilizer with the help of agricultural extension workers
- Encourage more people to carry out researches on the effects of inorganic fertilizers in order to make people aware of their side effects so that they apply them with caution.

The local authority- Gokwe North District Rural Council (GNDRC) should:

- Insist more people to carry out researches on the use of guano fertilizer
- Carry out experiments on the use of guano fertilizer to insist confidence in farmers.
- Through cotton companies already operating, should demonstrate to people how to use guano fertilizer.

5.3.0 Recommendations for further study

The researcher had recommendations for further study and the proposed recommendations were as follow:

- Conducting a research on how bats can be domesticated in their thousands.
- Conducting a research on the effects of using inorganic fertilizers on horticultural crops like leaf vegetables and cabbages.

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Appendix 1

Chemhondoro Primary School

P. O. Box 20

Chireya

Gokwe

13 March 2017

Dear Sir

Ref: Application for permission to carry out my research in your area from your subjects.

I Zaroni Ezekiel a teacher at Chemhondoro Primary School in Chirya am writing this letter seeking permission to carry out my research in your area from your subjects.

I am a student at the Midlands State University and I am doing studies in Bachelor of Adult Education Degree (BAED). I am doing this in partial fulfillment of the degree programme.

I wish to visit your subjects from the to the of March 2017. May you allow your subjects to participate in this study in a free manner.

Yours faithfully

Zaroni Ezekiel

Appendix 2

Informed consent

This letter serves to inform you that you are free to participate or decline to participate in this study. The study entitled “An investigation into the suitability of guano fertilizer (bat droppings) on farming in Gokwe North District Chireya Ward 5”. The study is only for academic purposes. In order to preserve privacy, no names, physical addresses or any other information pertaining yourselves shall be put or shown on the instruments. Moreover, it is important to know that there shall be no incentives given to participants or any kind of benefits shall be achieved as a result of participating in this study. Lastly, this study is not based on political affiliations, gender or race. Therefore, every one interested has the right to participate fairly and freely.

Appendix 3

Farmers' Questionnaire

Please fill the information in the gaps provided

Male

Female

2. Education Level: Primary....

Secondary.....

Tertiary....

3. Have you ever heard about guano fertilizer (bat droppings)?

4. What do you know about guano fertilizer?

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5. Are you using guano fertilizer on farm?

Yes.....

NO.....

6. What crops do best when you use that fertilizer? List them.

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.....

7. Where do you get guano in your area?

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8. Is guano fertilizer obtained easily?

Yes.....

No.....

9. What are the advantages of using guano?

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10. How often do you use guano fertilizer and why?

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...

11. Do you think the country can export guano fertilizer? No Yes

Give reasons for answer.

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12. What do you think can be done by the country to benefit from guano?

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Appendix 4

Questionnaire for Agriculture Officers

1. Sex : Male Female
2. Education level: Primary Secondary Tertiary

3. What is guano fertilizer?

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4. Where does guano fertilizer originate from?

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5. Do you encourage your farmers to use guano fertilizer? Yes No

Give reasons for your answer.

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6. What crops do well when you use guano fertilizer?

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7. What are the advantages of using guano fertilizer over chemical fertilizers?

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8. What processes are applied before guano fertilizer can be applied on farms?

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9. Can the country benefit from the extraction of guano? Explain your answer.

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10. Are there other products made from guano? List them.

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11. Can the country make guano fertilizer a commercial resource? Explain your answer.

Appendix 6

Interview questions

1. Are there any effects of using chemical fertilizers? Explain them.

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2. Explain the differences between guano fertilizer and chemical fertilizers?

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3. Given the chance that guano deposits are found in huge quantities, do you think people would rely only on it? Explain your reasons why?

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4. Are there any bats in disused buildings in your area? If they are do people use their droppings in farming activities?

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