بسم الله الرحمن الرحيم

Sudan University of Science and Technology

College of Graduate Studies

Assessment of Biosecurity Measures in Poultry Farms in Khartoum North Locality - Khartoum State – Sudan

تقييم إجراءات الأمن الحيوي في مزارع الدواجن في محلية الخرطوم بحري ـ ولاية الخرطوم ـ السودان

A Thesis submitted for Partial fulfillment of the Requirement for the degree of Master in Animal Production in Tropics

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الإستهلال

بسم الله الرحمن الرحيم

قَالَ تَعَالَىٰ:

﴿ وَلَحْمِ طَيْرٍ مِّمَّا يَشْتَهُونَ ﴿٢١﴾ ﴾

صدق الله العظيم

سورة الواقعة:الاية ٢١

DEDICATION

I dedicate this research to

My father and mother

My brothers

My sisters

My friends and colleagues

And

Everyone who facilitated this work

Acknowledgment

First of all I thank Allah for Almighty for helping me to complete this work.

I would like to express my gratitude and appreciation to my supervisors

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Abstract

This study was conducted by field survey to study the application of biosecurity in Khartoum Bahri locality during the period 3/ September 2018 to 27/ December 2018. A number of farms were selected randomly 44 farms (17 layers, 27 broiler farms) using the Ministry of Animal Resources and Fisheries records. Data was analysed by simple percentages and using SPSS version number (16). The findings showed that the majority of farmers raise broilers for the quick turn – over and easiness of management. Most farms (79.5%) were of closed system with wire fencing. Most replacement chicks were from local commercial sources at (86.4%). The distance from main road was less than 50m for (25%), Less than 1 km for (29.5%) between the farms and between houses less than 20m for (29.5%). More than (50%) of the farms raised more than 50000 birds. Most farms (75%) used wood sawdust for litter and (27.3%) do not change litter for the whole cycle. $\chi 2$ showed positive relationship between housing system and house numbers. Also between housing system and number of birds and between housing system and total number of birds per farm. For the experience period a total of (43.2%) were more than 10 years. A total of (63.3%) do not use protective clothing for visitors. Some (52.3%) were not committed to workers uniform and (34.1%) do not perform staff health check. Farm ownership was (18.2%) veterinarians, (15.9%) agricultural engineers and (9.1%) animal production specialist. The main water source was wells at (43.2%). The main feed source at (54.5%) was farm preparation and (25%) do not clean the feed stores and also (54.5%) do not examine water pollution. Most visitors allowed were marketing agents and (25%) of the farms do not have rules for interring visitors and most farm staff were not committed to biosecurity measures when entering. A total of (90.9%) practiced sick bird's isolation. Most diseases encountered were bacterial and a majority of (95.9%) followed fixed vaccination programme and the majority disposed of dead birds by incineration. A majority protects the units from the wild birds and do not keep other animals. Most farms dispose of manure by selling and at the cycle end.

The study concluded that many of the biosecurity measures were not addressed in Khartoum Bahri locality.

المستخلص

هذه الدراسة أجريت عن طريق المسح الميداني لدراسة تطبيق الأمن الحيوي في محلية الخرطوم بحري في الفترة 3 سبتمبر 2018 وحتي 27 ديسمبر2018 . تم الإختيار العشوائي لعدد 44 مزرعة دواجن منها 17 للدجاج البياض و27 لفروج اللحم من سجلات وزارة الثروة الحيوانية والسمكية وتم تحليل المعلومات عن طريق النسب المئوية البسيطة ومربع كاي باستخدام برنامج (الحزمة الإحصائية للعلوم الإجتماعية) رقم 16. أبرزت النتائج أن معظم المزارع كانت لتربية اللاحم لسرعة دورة الإنتاج وسهولة الإدارة. من مجموع المزارع 79.5% كانت بالنظام المغلق وسياج من السلك. مصدر كتاكيت الإستبدال كانت وحدات تجارية بنسبة 86.4%. كانت المسافة والبعد من الطريق الرئيسي أقل من 50 مترا بنسبة 25% من المزارع، والمسافة بين المزارع أقل من 1 كيلومتر بنسبة 29.5% ، وبين المساكن أقل من 20 مترا لعدد 29.5% من المزارع، وأكثر من 50% من المزارع كان يضم أكثر من 50000 طائر ونسبة 75% استعملو نشارة الخشب للفرشة و 27.3% لا يغيرون الفرشة إلا بعد نهاية فترة الدورة الإنتاجية. مربع كاي أورد علاقة موجبة بين نظام الإسكان وعدد المساكن. وأيضا بين نظام الإسكان وعدد الطيور في المسكن وبين نظام الإسكان وعدد الطيور في المزرعة. وطول فترة الخبرة كانت بنسبة 43.2% أكثر من 10 سنوات. أوردت الدراسة أن 63.3% لا يستعملون ملابس واقية للزوار. وأن 52.3% لا يلتزمون بزي محدد للعاملين. وأن 34.1% لا يقومون بالفحص الصحي للعاملين. ولملكية المزرعة، أوردت الدراسة 18.2% أطباء بيطرين، و15.9% مهندسين زراعين و9.1% أخصائي إنتاج حيواني. وأهم مصدر للمياه الأبار بنسبة 43.2%. وأهم مصدر للعلف التصنيع الذاتي بنسبة 54.5% و 25% من أصحاب المزارع لا يقومون بتنظيف مخزن العلف و54.5% لا يقومون بفحص المياه للتلوث. ومعظم الزوار المسموح لهم كانوا من الوكلاء التجار و 25% من المزارع ليست لديهم نظم ولوائح لدخول الزوار كما ان معظم العاملين لا يلتزمون بمعايير الأمن الحيوي عند الدخول. ومن المزارع 90.9% يقومون بعزل الطيور المريضة. ومعظم الأمراض التي وجدت كانت بكتيرية بنسبة عالية واشارت الدراسة الي ان 95.5% يتبعون نظام تحصين ثابت. والغالبية يتخلصون من الدجاج النافق عن طريق المحرقات. ومعظم المزارع تحمي الوحدات من الطيور البرية ولا يقومون بتربية حيوانات أخري. ومعظم المزارع تتخلص من الزرق عن طريق البيع في نهاية الدورة الإنتاجية. خلصت الدراسة الي أن معظم معايير الأمن الحيوي لم تجد التطبيق في محلية الخرطوم بحري.

List of contents

List of Tables

List of figures

Introduction

Biosecurity aims to prevent disease causing agents entering in to a poultry project or to prevent pollution by transacting intersecting acting and interacting agents by direct or indirect ways including body fluids, excreta, feed, water, equipment, air movement, transportation, environmental changes, animal and human movements and activities.

Many factors affect biosecurity including visitors, control of animal and human movement, staff knowledge and application of biosecurity measures, staff training and commitment to the business, flock management, feed composition and storage and handling, disinfectants and antibiotics uses, dead birds and manure disposal, project building design and material and units distribution inside the project plus others.

The main pillars of biosecurity include site selection (irreversible), distances between farm units and between project components, project management and biosecurity knowledge capacity and when and how to take the prompt and correct decision and the comprehensive biosecurity strategy and the degree of cooperation and coordination between the involved government institutions, agencies and organisations to maintain the comprehensive biosecurity strategy for the poultry industry including laws, regulations, extension and quality control standards.

Biosecurity is gaining more importance and attention regionally and internationally, yet in Sudan it is still lagging behind and few scientific studies have been conducted to assess, evaluate and improve biosecurity measures in the poultry industry in the Sudan and its impact on the economics of production and on human and animal health.

This study was conducted to survey and assess the knowledge on and application of biosecurity measures in Khartoum North locality being the most densely populated by the small and medium size poultry farms in Khartoum State and being a totally rural area.

Biosecurity in the cheapest way of disease control and the most effective as prevention is less expensive than treatment.

1.1 Study Problem:-

-There is no complete implementation of the biosecurity measures in Kh. North locality, thus increasing the spread of diseases in poultry farms, in addition to the economic losses that result from disease spread.

1.2 Study Objectives:-

- To assess the situation of poultry farms in Bahri locality and to evaluate application of biosecurity in the poultry farms.

- To survey the introduction of infectious disease agents to the poultry farm in the locality.

Chapter Two

2. Literature review

Poultry production has become one of the most popular and visible enterprises. Profitable poultry industry is always characterized by quick body gain and high egg production with less utilization of feed (Paul et al., 2004).

Poultry refer to number of domesticated avian species which include the chicken (reared for laying eggs"-layer or meat production - broiler)-turkey-duck and other water fowls –game bird which have different type of production (Aboubakr,2016). Biosecurity can be defined as the exclusion, eradication and effective management of risks posed by pests and diseases to the economy, environment and human health (Siekkinen et al., 2012).

Poor or absent disease control strategies and in adequate management practices result in high levels of baseline mortality due to predators (e.g. Rodents – snakes- small carnivores) or infections disease (e.g. New castle Disease (ND), Salmonellosis, Gambaro disease, fowl typhoid). (Abdalla, 2016).

A biosecurity plan should therefore be a part of any poultry production system. The plan consists of a set of practices and measures taken to form physical and conceptual barriers that prevent or control the introduction and spread of infectious agents to a flock by keeping potentially infected animals and objects away from healthy birds. (Segal, 2011).

While good biosecurity implementation can support animal welfare, farm productivity, environmental sustainability, product quality, trade and ultimately profitability, lack of biosecurity rises the likelihood of dissemination of pathogens and pests between farms and from farms to wild populations. Researchers strongly recommend that biosecurity best management practices should be clear, science-based, cost-effective and appropriate to their context. (Mohan et al., 2008).

Adequate biosecurity measure can improve overall flock health, cut the cost of treatment reduced the losses and improve farm profitability (Aboubakr, 2016).

With the increasing population and standard of living, the consumption of poultry products and the high demand for chicken meat and table eggs is becoming increasingly important in Khartoum state. However, the lack of adoption of biosecurity measures in the small commercial and backyard sector will certainly jeopardize biosecurity level in the modern poultry industry in Sudan (Mustafa, 2013).

The term (poultry) covers a wide variety of birds of several species. The term is relevant whether the birds arc alive or dressed .It includes chickens, turkeys, ducks, geese, swans, guineas, pigeons, peafowl, ostriches, pheasants, and other game birds. Poultry farming means raising various types of domestic birds commercially for the purpose of meat, eggs and feather production, the most common and widely raised poultry birds are chicken. (Flanders, and Gillespie, 2015).

2.1 Occurrence of poultry diseases:-

Infectious diseases seriously affect village poultry production in Africa and therefore constitute one of its major threats.

Newcastle disease is the most widespread infectious disease in the continent and its symptoms are generally clearly described by village poultry keepers.

Severe rearing losses resulting partly from the high incidence of diseases are experienced. For example, it has been estimated that diseases account for 56% of the annual losses suffered in Nigeria, and other mortality causes reported were parasites (17%), cats (15%), snakes (4%), accidents (4%) and bees (4%), (Guèye, 1999).

Diseases seriously affect growing birds because they are particularly vulnerable to infection. The mortality of indigenous fowl up to four weeks of age under traditional management systems in sub-Saharan Africa has been estimated at 53%. When indigenous guinea fowl are reared under free-range conditions in Nigeria, the mortality of keets before eight weeks of age can be as high as 60% (Guèye, 1999).

Current control strategies for reducing Campylobacter in poultry production on farms propose either the use of biosecurity measures to exclude the organisms from the flock and/or complementary, non-biosecurity-based approaches, such as antibacterial treatments, probiotics or vaccination, to prevent establishment, or reduce levels, of colonization. (Newell et al., 2011).

2.2 Major routes for disease and pathogen transmission:-

Poultry transfer of birds from production area to production area and dead bird disposal. And the other animals like wild birds, insects, feral and domestic animals, including other livestock and pets, rodents – rats / mice and domestic birds. Also the people like farm personnel and family members living on site, contractors, maintenance personnel, neighbours, serviceperson, visitors, disease can be transmitted by, for example, hands, boots, clothing, dirty hair. Also the equipment vehicles air by transmission as an aerosol or dust.

And the water supplies may become contaminated with faeces from contact with avian or other animal species. Also the feed may be contaminated by the raw materials used, post-production and during transport, or by exposure to rodents and birds on the property. Bacteria and mould in poor quality or damaged feed may also be a concern. Also the Litter by transport of litter material on and off the farm site as well as storage of used litter on site may be a biosecurity risk. (Federation, 2010).

2.3 Controlling Disease Outbreaks:-

It is better to prevent a disease outbreak than to try to control it once it has occurred. Following the sanitation, management, and vaccination will help the poultry producer prevent disease outbreaks from occurring.

The poultry flock should be checked daily for signs of disease. A sudden drop in feed and water consumption is oft en a sign of health problems.

Death rate is another sign of disease. During the first 3 weeks, the normal death rate for chicks is about 2 percent. After 3 weeks of age, the death rate should not be more than 1 percent per month. A sudden increase in the death rate is an indication of disease. (Flanders, and Gillespie, 2015).

2.4 Biosecurity in the poultry farms:-

Biosecurity is the implementation of measures that reduce the risk of introduction and spread of disease agents. Biosecurity requires the adoption of a set of attitudes and behaviors by people to reduce risk in all activities involving domestic, captive exotic and wild birds and their products. Farm's performance is directly linked to good biosecurity measures (Rushton et al., 2005).

Biosecurity also defined as the integral parts of any successful poultry production system. Biosecurity refers to those measures taken to prevent or control the introduction and spread of infectious agents to a flock. Such infectious agents, whether they cause clinical or subclinical disease, significantly reduce the productivity, profitability and long term financial viability of a poultry operation (Federation., 2010).

Biosecurity practices designed to minimize the transmission of infectious diseases between and within farms are an important component of modern flock health programs (Dorea et al., 2010).

Biosecurity is simply described to consist of three fundamental principles: Segregation Cleaning and Disinfection (Rushton et al., 2011).

Biosecurity is a term created out of a need to protect poultry from an intentional or unintentional threat of a biological agent. In other words, it means keeping the germs away from poultry and keeping the poultry away from germs (Alsaffar, 2015). In addition, Cardona and Kuney (2001) defined biosecurity as a set of practices designed to prevent disease causing organisms from coming in contact with resident birds on the farm. These practices, when followed correctly, will reduce the potential for the introduction and spread of disease causing organisms in the sites.

And (Segal, 2011). Defined biosecurity as a set of practices designed to prevent the entry and spread of infectious diseases into and from a poultry farm.

Numerous studies were conducted in the USA during the (1980s and 1990s) repeatedly which confirmed that biosecurity's the most economical and effective method of disease prevention and control. The studies demonstrated how a relatively small investment in the improvement of housing and equipment, and the development of a farm's biosecurity procedures in conjunction with staff education and trainings, can yield better results, specifically: healthier birds and a more profitable farm. In comparison, there were high costs associated with disease outbreaks due to bird mortality and low performance. Low performance is characterised by slow growth, a drop in egg production and hatchability, high Feed Conversion Rate (FCR henceforth), medication and a need for farm cleaning and disinfection. (Segal, 2011).

Biosecurity refers to all the management practices aimed at excluding or reducing the potential for the transmission and spread of diseases to animals, humans or an area initially free from the diseases causing agents and it is a term coined from two words: Bio – life, and Security – protection, with the two main objectives of biosecurity being bio-exclusion and bio-containment (Halifa, 2008).

Biosecurity is of much importance in poultry production in so much that the FAO based the classification of poultry production systems on the levels of biosecurity (Ameji et al., 2012).

Strict biosecurity measures in addition to vaccinations, are strategic prevention and control policies adopted to control some contagious poultry diseases as vaccinations alone are not enough to control them under field conditions and the good husbandry practices such as adequate feeding, housing and stocking to avoid overcrowding, good ventilation, proper disposal of wastes, cleaning and disinfection of poultry premises help to keep out infections and their spread (Ameji et al., 2012).

Casal et al., (2007) classify biosecurity measures into three groups: those related to replacement animals, those related to husbandry and facilities, and those related to the geographical location of the farm.

Farmers are usually aware that biosecurity measures are of paramount importance in preventing diseases, but they either forget to take them or take the wrong ones. Some factors associated with the non-compliance with the measures are: poor training of farm personnel, lack of communication among the personnel, lack of motivation for following the rules, poor record keeping, and no audit of biosecurity-related activities (Casal et al., 2007)

2.5 Biosecurity components:-

2.5.1 Isolation: The principle of isolation refers to the confinement of animals within a controlled environment. A fence keeps your birds in, but it also keeps other animals out. Isolation also applies to the practice of separating birds by age group. In large poultry operations, all-in/all-out management styles allow simultaneous depopulation of facilities between flocks and allow time for periodic clean-up and disinfection to break the cycle of disease.

2.5.2 Traffic Control: This includes both the traffic onto your farm and the traffic patterns within the farm.

2.5.3 Sanitation: Addresses the disinfection of materials, people and equipment entering the farm and the cleanliness of the personnel on the farm. (OIE, 2016).

2.6 Biosecurity Bodies:

Biosecurity involves many different of stakeholder at national level. Government agencies have primary interest but industry, scientific research institutes, specialist interest group and the nongovernmental organizations and general public all have role to play (Hawkes and Ruel, 2006).

Biosecurity measures involves all stakeholders in developing sustain, There should be participatory field work involving all stakeholders to develop methods that can be sustained using available resources. It is necessary to define the limitations of what people can and will afford and what fits in with their normal routine in order to develop practical and sustainable solutions (Domenech et al., 2009).

Biosecurity requires the adoption of asset of attitude and behavior by people to reduce risk in activities involving poultry production and marketing for that it must be clear that even comprehensive biosecurity plan can not completely eliminate the possibility of disease, but it can significant reduce the possibility of disease entering farm (Segal, 2O11).

2.7 Needs of Biosecurity:-

Before developing the plan it is necessary to investigate which diseases are present in the farm's area. This can be gleaned from historical data, from past experience at the farm, or updated information that can be obtained from neighbouring farms, or most reliably from the veterinarian or local veterinary services.

It is important to understand how various disease agents can infect chickens; this is known as the mode of transmission. Chickens can get infected through direct or indirect transmissions. Direct transmission is a direct contact between animals. Examples of this are: one infected chicken to another chicken, duck to chicken, cattle/goat/pig to chicken, rat/mouse to chicken, wild bird to chicken, dog/cat to chicken, or flies/mites/beetles to chicken. Under indirect transmission infections occur through carriers, otherwise known as vectors. Examples of this type of contamination are: droppings, nasal discharge, blood and feathers of clothes and footwear, vehicle wheels, farm equipment, feed or the bags in which the feed is kept, water, air, or litter material.

Awareness of how diseases may enter a farm is vital. Potential entry points of disease agents should be identified and their risk level quantified. This assessment process should be repeated for different diseases present in the farm's area. For example: if NDV is an issue, one would assess what is the level of risk of transmission presented by drinking water.

If a flock consumes water from a deep well, the risk of infection is very low, but if they drink untreated, surface water from a dam or pond, the risk of infection rises due to potential contamination with faecal material of wild birds that carry the virus. Similar assessments should be performed for: feed, litter, hatchery, stock from another source (for example introducing young males from another farm into an older breeding flock, a practice known as spiking), vehicles, housing, workers and visitors, equipment, rodents, insects and wild birds. (Bleich et al., 2009).

2.8 Biosecurity Measurement:-

Protect your birds with basic tips to prevent animal disease outbreaks:

1. Keep Your Distance - Restrict access to your property and poultry, or post a biosecurity sign. Have a specific area where visitors can enter. Visitors should not be allowed near poultry unless absolutely necessary, and then visitors should be wearing clean footwear (disposable boots work well) and clothes (supply for them). An area should be available for visitors to change clothes and provide shower-in, shower-out facilities if possible. Require and teach

biosecurity to family, employees, and all visitors coming into, or involved with your poultry production area.

2. Keep It Clean - You, your staff and family should always follow biosecurity procedures for cleanliness. Wear clean clothes, scrub boots/shoes with disinfectant and wash hands thoroughly. Equipment and vehicles should be kept clean and insist all equipment and vehicles should be cleaned before entering property. Maintain programs to control birds and rodents who can carry and spread disease.

3. Don't Haul Disease Home - If you, your employees or family have been on other farms, or other places where there is livestock and/or poultry, clean and disinfect your vehicle tires and equipment before returning home. Always change clothes and wash hands before returning to your flock.

4. Don't Borrow Disease from Your Neighbor - Do Not share equipment, tools, or other supplies with your neighbors of other livestock or poultry owners. If sharing equipment, be sure to clean and disinfect before returning to your property.

5. Look for Signs of Infectious Diseases - Know what diseases are of concern for your flock and be on the lookout for unusual signs of behavior, severe illness and/or sudden deaths. Assess the health of your flock daily. Early detection is important to prevent the spread of disease.

6. Report Sick Animals - Don't wait. Report serious or unusual animal health problems to your veterinarian, local extension office, or State Animal Health officials. (East, 2007).

2.9 Levels of Biosecurity:-

2.9.1 Level 1—Routine biosecurity procedures:

These procedures should be implemented and followed on a daily basis.

They give a high degree of assurance that diseases and pathogens will not be carried into poultry production areas and will reduce the risk of transmission between production areas. These should be seen as a minimum requirement.

2.9.1.1 Documentation and training:

- Each production facility must keep a copy of the National Farm Biosecurity Manual (the manual), or a more detailed document that encompasses the National Farm Biosecurity Manual, that is readily accessible to staff.

- Staff must be provided with training in the relevant parts of the manual and such training is to be recorded.

2.9.1.2 Facility standards:

-The production area must have a perimeter fence or otherwise well-defined boundary (e.g. creek, vegetation) establishing a clearly defined biosecurity zone. - If livestock graze the property then the production area must have a stock proof fence.

-A sketch or map of the layout of the property, showing the production area, sheds, ranges, access roads and gates must be created and kept up-to-date.

-The main entrance to the production area must be capable of being closed to vehicle traffic, and must display appropriate signage including biosecurity area no entry unless authorised or similar wording.

In addition, signage must direct visitors to contact the producer before proceeding i.e. telephone number and/or enquire at house.

- There must be a parking area for vehicles not entering the production area. There must be a change area away from sheds with clean protective clothing and boots provided.

- Entry to sheds must only be made through entrances with a footbath containing a suitable disinfectant used in accordance with company or manufacturer's instructions and changed on a regular basis.

- Dead bird disposal method must conform to applicable environmental compliance requirements.

- All poultry housing must be designed and maintained so as to prevent the entry of wild birds and limit the access of vermin as far as is practical.

- Landscape, trees and shrubs should be selected to minimise wild bird attraction, particularly in free-range operations. The area around sheds must be kept free from debris and vegetation should be mown regularly.

- Drainage, the production area should be adequately drained to prevent accumulation and stagnation of water likely to attract water fowl, especially in the areas around sheds and range areas.

- An appropriate vermin control plan must be developed and implemented, including rodents, foxes, and wild dogs and cats.

- A baiting program for rodents must be implemented where a risk assessment deems this necessary (e.g. live rodents, droppings, nests).

- Drinking water for poultry, as well as cooling water used in poultry sheds, must meet appropriate water standards. Treated water supply must be kept in a closed system from the point of treatment to the drinker.

- Sheep and other domestic stock must not have access to the production area at any time except under the specific condition stipulated in 2.2 above, dogs and cats must not enter sheds unless dogs are part of the flock security strategy.

- Only commercially produced avian species are to be kept in the production area and no other avian species.

- If more than one commercially produced avian species is kept in the production area, the species should be housed and managed separately, with suitable biosecurity arrangements for each species. Shared equipment should be cleaned and disinfected between uses.

Despite this general requirement, emus and ostriches may be farmed together.

- Feeding systems must wherever possible be closed to ensure that feed in silos and feed delivery systems are protected from access and contamination by wild birds and rodents. Feed spills should be cleaned up without delay to prevent the congregation of wild birds.

- Where bird weighing is practised, it must be carried out using the production area's own weighing frames and scales. Company service personnel can use their own scales provided they are cleaned and disinfected when moved between production areas.

2.9.1.3. Personnel standards and procedures:

2.9.1.3.1 Production personnel:

Production area personnel or any person residing on the property must not have contact with any other poultry. Production area personnel must wear laundered clean clothes each day at the commencement of their work.

2.9.1.3.2 Company service personnel: company service personnel by necessity make multiple production visits on a single day. Protective clothing and food wear could be worn in the production area. Visitors should always be made from clean areas.

2.9.1.3.3 Repair and maintenance: repair and maintenance contractors have had contact with poultry or other birds that day or keep birds at their home must not enter sheds. Routine maintenance should be conducted where possible between batches prior to final disinfection where batch system is practiced.

Tools taken into the production area must be cleaned before entry into sheds and must be free of dust and organic matter.

2.9.1.3.4 Contractors suppliers: other service personnel and visitors the visits must be approved by the manager before visitors may enter sheds and rang. This requirement also applies to vaccination crews. Visitor logs — are cord must be kept of all visitors to the poultry sheds and poultry ranges including company personnel .any authorized visitor must not enter the sheds unless they have had a shower and changes clothes and boots and wearing clean cloth, all visitors should park their vehicles outside the production area.

2.9.1.3.5 Requirements for specified movements:

Pick up of poultry should work from youngest to oldest-or all the young birds or all the olds on shift basis. Day old chick delivery trucks and to rries must be cleaned and disinfected each day. litter delivery and collection of used litter trucks carrying must be cleaned and disinfected between production area .Other deliveries (e.g. gas and feed drives) must not enter sheds .There must be system for tracing movements of delivery personnel.

2.9.1.3.6 Entry procedures for bird sheds and rages:

Any person interfering sheds must sanities hands and use foot baths before entering each shed. Soles of boots must be scraped before disinfecting in the foot baths .Ahmad sanitizer must be available at all shed entrances and must be used before entering.

2.9.1.4 Operational standards:

2.9.1.4.1 Water supply:

The use of a suitable treated water supply is critical to achieving good biosecurity; for chlorinated water supply the treatment must achieve a level of 1.0 — 2.0 parts per million (PPM) free available chlorine (FAC) when chlorinated water .there must be a minimum of 2hours contact time between chlorine and water prior, testing must be conducted and recorded daily. The effectiveness of water treatment systems including alternative system (e.g. ultraviolet) drinking water quality must be maintained at standard suitable for use in livestock.

2.9.1.4.2 Cleaning and ground maintenance:

Feed spills must be cleaned up as soon as practicable. Grass on and around the production area must be kept cut .foot bathe must be inspected daily — (e.g for excessive organic matter) .on free rang production sites. • Manure deposits outside the hatch opening must be removed after each batch. Ramps to free rang area must be scraped and cleaned after each batch. The production area must be adequately drained to prevent accumulation and stagnation of water.

2.9.1.4.3 Record keeping:

Bird mortality must be recorded on regular basis to assist monitoring for any annual animal health problems .a record of bird movements must be maintained to facilitate tracing in case of an animal health or food safety concern.

2.9.1.5 In- off batch procedure:

After the final pick up, the shed must be kept closed except during litter removal after washing and disinfecting. Shed doors must be kept closed .litter and manure must not be stock piled in the production area.

2.9.1.6 Species specific additional bio-security requirements: additional requirement that must be followed by all those producing a particular species of poultry should be added.

2.9.2 Level 2 high risk biosecurity procedures:-

In the event of an outbreak of an emergency disease or serious endemic disease, high risk biosecurity procedures will be implemented.

2.9.2.1 Action plan for suspected emergency animal disease:

Each owner must establish and document clear guidelines regarding the circumstances when an emergency animal disease alert should be raised (e.g. an unusual increase in mortality or drop in production), and who must be informed.

2.9.2.2 Facilities:

Gates must be kept locked and shed doors must be locked at night. Facilities for the cleaning and disinfection of equipment coming in and off the production area must be in place.

2.9.2.3 Personnel:

No visitors are to enter the production area unless absolutely essential, Company personnel will discontinue routine visits except on suspicion of problems.

The repairs and maintenance not routine work, only emergency work to be carried out.

2.9.2.4 Operational:

- Essential visits head to-toe shower before and after visit. A complete change of clothes, footwear, hair covering and breathing protection is required. Used clothing and all used personal protection equipment must remain on the property.

- Any vehicle which must enter the property must be washed and disinfected at the wash pad before and after going onto the property (e.g. feed trucks, gas). Vehicle driver cabins must also be sanitised inside.

- No birds or litter to be moved on or off properties until disease status is clarified. - If a major outbreak should occur, further measures will be stipulated by the processor and/or the state's Chief Veterinary Officer.

2.9.2.5 Standard operating procedures (SOPs):

Standard operating procedures will be available for any specific outbreak of an emergency animal disease from animal health. (Department of Agriculture, Fisheries and Forestry, (DAFF), 2009).

Chapter Three

3. Material and Method

3.1 Study Area:

The locality was selected for the study was Bahri locality which includes (Alkadaro –Shambat – Alhalfaya - Nile east (algerife - alaelafon – omdawanban)).

It is located within the urban triangle of the Sudanese capital Khartoum along with the southern city of Khartoum and the western city of Omdurman, they are smaller in terms of area and population and historically, but are not less important.

Temperature; temperature may exceed 48 degrees Celsius (118.4degrees Fahrenheit), in mid-summer, but the average annual temperature is about 37.1 degrees Celsius (98.78 Fahrenheit), with six months a year that exceeds a monthly average temperature of 38 degrees Celsius (100.4 F), the state weather schedule does not have a monthly temperature of less than 30 d. C (86.5 d. F), in all cases, temperature in Khartoum Bahri dropps at high rates overnight, below 15 d. C (59 d. F) in January and may reach 6 d. C (42.8 d. F) when a cold air front passes.

Bahri area was selected as a study area because it was found in a previous study that 45% 0f the total farms in Khartoum state are found in a Bahri area.

3.2 Data Collection:

This study started from 3/ September 2018 to 27/ December 2018 and involved 44 poultry farm, 17 layers- 27 Broilers farms.

A sample was selected and a pre-tested, questionnaire was used to collect information farms bio- security. The questionnaire contained 51 questions to obtain information on: General information on farm, management and Bio-security measures related to water and feed, herd management and biosecurity procedures.

3.3 Statistical analysis:

The collected information was analyzed by using the SPSS (16), (the statistical package for social sciences) computer practices, and the data was divided to five axis.

Questionnaire results were analyzed by simple percentages and Chi-square test was used.

Chapter Four

4. Results

The following tables carry the study results and findings.

4.1 General information to farm:

Table 1. Types of production

Types of production	Frequency	percent
Broilers	27	61.4
Layers	17	38.6
Total	44	100

Table (1) shows that the majority were broiler farms.

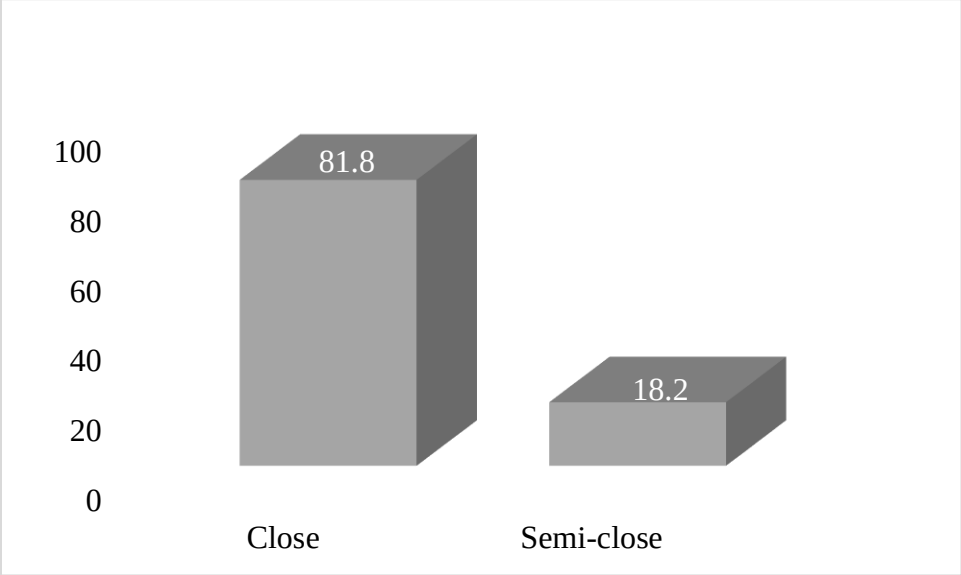

Figure 1. Type of production system

Figure (1) shows that most of farms were closed design.

Table 2.The distance of farm from the main road

Distance (m)	Frequency	Percent
More than100m	23	52.3
Less than 50m	11	25.0
Between 50-100m	10	22.7
Total	44	100

This results show, (25%) of total farms had distance from main road, less than 50m. (Biosecurity hazard).

Table 3. Distance to the nearest farm

Distance (Km)	Frequency	Percent
Between 1-3 km	21	47.7
Less than 1km	13	29.5
More than 3km	10	22.7
Total	44	100

This results show, for (29.5%) distance was less than 1 km. (Biosecurity hazard).

Table 4. Number of houses

Number	Frequency	Percent
Less than 3 houses	13	29.5
Between 3-5 houses	19	43.2
More than 5 houses	12	27.3
Total	44	100

Table (4) shows, that the number of houses in most farm was between 3-5 houses.

Table 5. Distance between houses

Distance (m)	Frequency	Percent
Less than 20m	13	29.5
Between 20-50m	22	50.0
More than 50m	5	11.4
Less than 20m in layer + between 20-50m in broiler	1	2.3
Total	41	93.2

This results show, (29.5%) of total farm the distance was less than 20m. (Biosecurity hazard).

Table 6. Number of birds in One house

Number	Frequency	Percent
Less than10000	7	15.9
10000 -20000	12	27.3
More than20000	25	56.8
Total	44	100

This results show, that (43.2%) of the total have number of chickens in one houses of less than 20000, while (56.8%) of total had more than 20000.

Table 7. Number of birds in the farm

Number	Frequency	percent
Less than20000	3	6.8
Between 20000-50000	19	43.2
More than50000	22	50.0
Total	44	100

Table (7) shows that the number of chickens in farms, (50.0%) carry more than 50000 birds in one farm.

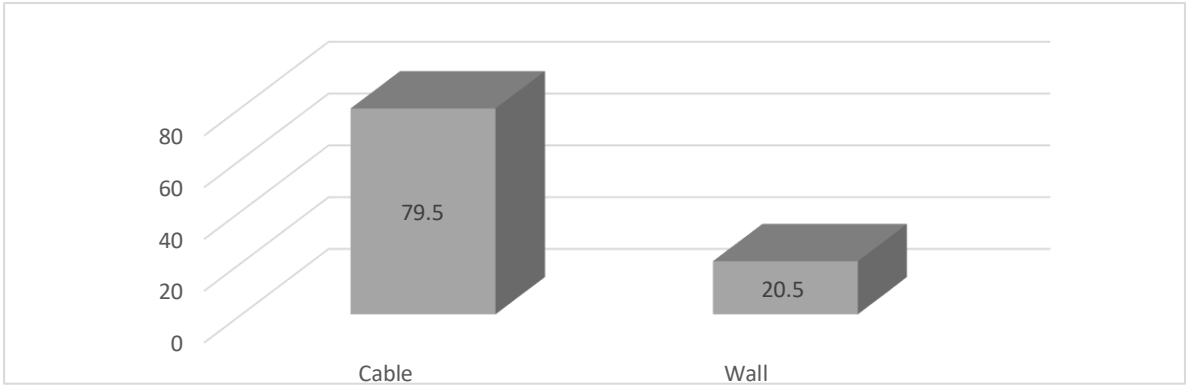

Figure 2. Farm fence

Figure (2) shows that most of the total farms were fenced by wire.

Table 8. Source of birds

Source	Frequency	percent
local	38	86.4
Imported	3	6.8
Hatching in farm	2	4.5
Hatching in farm + Imported	1	2.3
Total	44	100

Table (8) shows that the most replacement chicks produced locally.

Table 9. Type of litter in the houses

Litter type	Frequency	percent
Sawdust	33	75.0
Other	7	15.9
Sawdust + other	4	9.1
Total	44	100

This results show that (75.0%) from the total farms the type of litter in houses was sawdust.

Table 10. Period of changing litter

Period (month)	Frequency	Percent
From 1-2 month	23	52.3
No change	12	27.3
Less than1 month	9	20.5
Total	44	100

Table (10) shows that (27.3%) of total farms do not change litter. (Biosecurity hazard).

Table 11. Relationship between housing system type and number of houses

Number of houses	Type of housing system				Total	
	Closed		Semi-closed			
No. of houses	n	%	n	%	n	%
Less than 3	7	53.8	6	46.2	13	29.5
Between 3-5	17	89.5	2	10.5	19	43.2
More than 5	12	100.0	0	0.00	12	27.3
Total	36	81.8	8	18.2	44	100.0

χ^2 value= 10.253, P. value =0.006

Table (11) shows the relationship between housing system type and houses number, (positive relationship), (100.0%) from closed system had number of house more than 5, and less than 5 houses in semi-close system, The chi-square test was found to be significant (χ2 value= 10.253, P. value < 0.01).

Table 12. Relationship between housing system type and No. of birds in one house

Number of birds	Type of housing system				Total	
	Closed		Semi-Closed			
No. of chicken in one house	n	%	n	%	n	%
Less than10000	4	57.1	3	42.9	7	15.9
10000 - 20000	8	66.7	4	33.3	12	27.3
More than 20000	24	96.0	1	4.0	25	56.8
Total	36	81.8	8	18.2	44	100.0

χ^2 value= 8.097 , P. value =0.017

This results show positive relationship between housing system and number of birds in one houses, (96.0%) of total house in the closed system had number of chickens in one house of more than 20000, while just (4.0%) in semi-closed system, the chi-square test was found to be significant (χ2 value= 8.097, P. value < 0.05).

Table 13. Relationship between housing system type and No. of birds in the farm

Number of birds	Type of housing system				Total	
	Closed		Semi - closed			
No. Of chicken in farm	n	%	n	%	n	%
Less than 20000	1	33.3	2	66.7	3	6.8
Between 20000 – 50000	13	68.4	6	31.6	19	43.2
More than 50000	22	100.0	0	0.00	22	50.0
Total	36	81.8	8	18.2	44	100.0

χ^2 value= 11.922 , P. value=0.003

This results showed positive relationship between housing system and number of birds in the farm, (χ2 value= 11.922, P. value < 0.01).

4.2 Farm management:

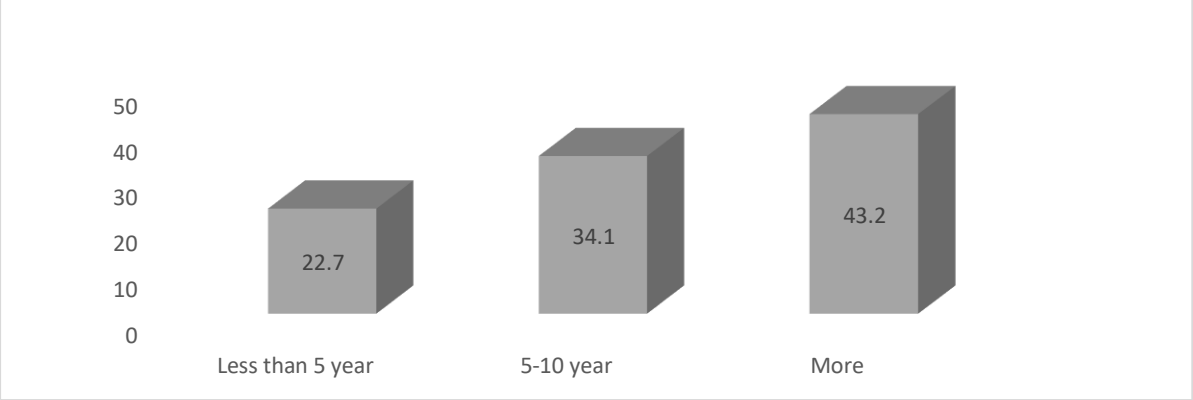

Figure 3. Experience period

This figure show that about (22.7%) of total farms had experience period of less than 5 years, while (43.2%) of total farms more than10 year.

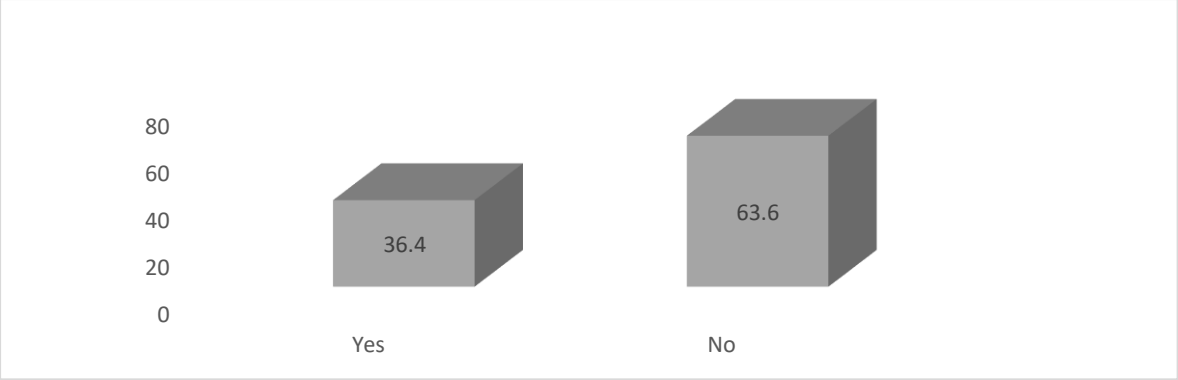

Figure 4. Protective clothing and boots for visitors

This results show most of the farms do not use protective clothing and boots to visitors, (63.6%) from total.

Table 14. Workers uniform

Uniformed	Frequency	percent
Committed farms	21	47.7
Not committed	15	34.1
Sometimes	8	18.2
Total	44	100

This results show, (47.7%) of the farms did commit to special workers uniform.

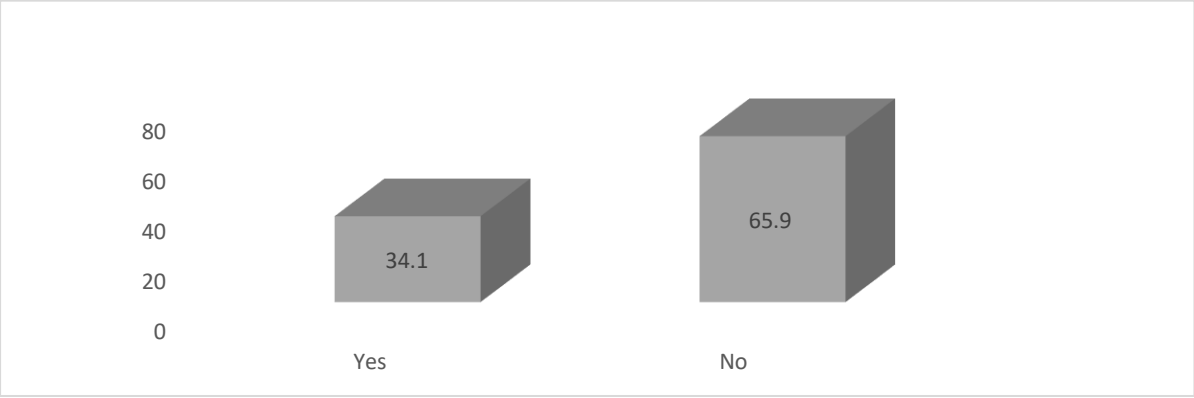

Figure 5. Staff health check

Figure (5) showed most of the farms do not practice staff health check, (65.9%) of total.

Table 15. Farm owner

Owners	Frequency	percent
Veterinary	8	18.2
Agricultural Engineer	7	15.9
Animal production specialist	4	9.1
Other	25	56.8
Total	44	100

This results show, the most of the farm owners were not specialized.

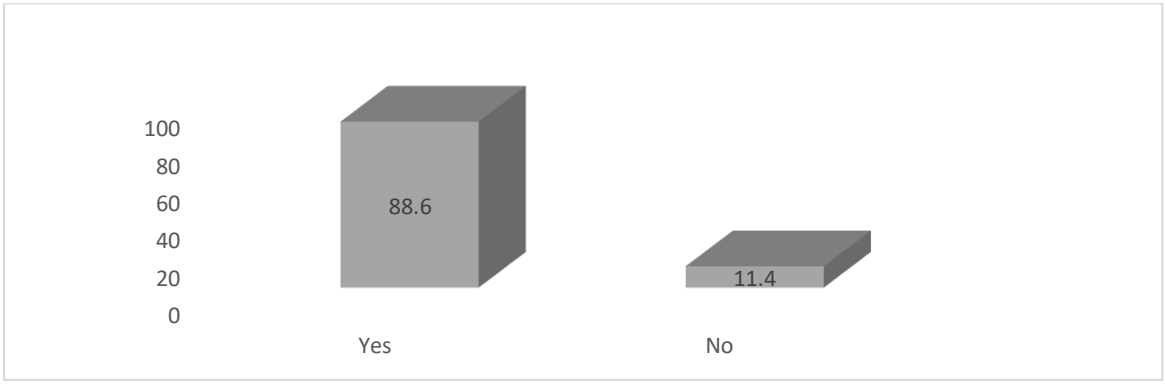

Figure 6. Veterinary supervisor

This results show that the most of the farms had found veterinary supervisor in his farms.

4.3 Source of water and feed in poultry farm:

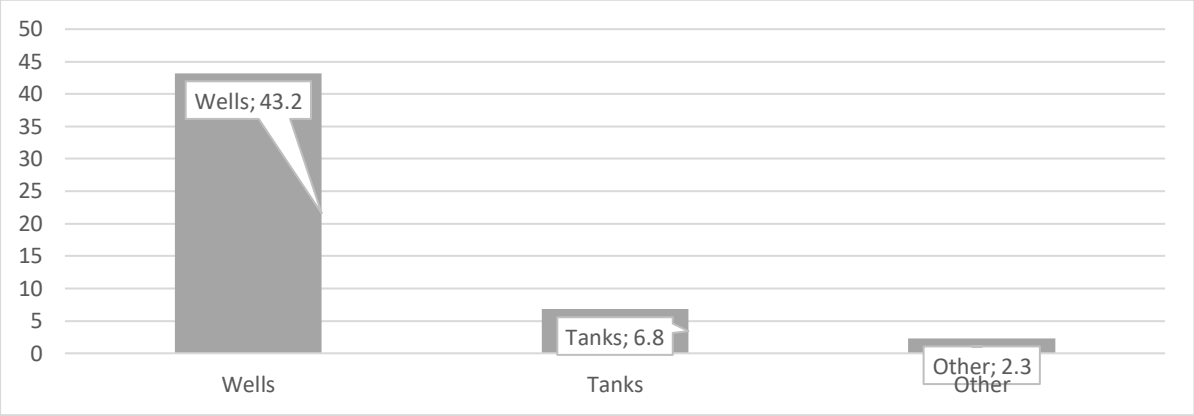

Figure 7. Source of water

This results show, the main source of water was well water.

Table 16. Source of feed

Feed source	Frequency	percent
Manufacturing in the farm	24	54.5
Buy from companies	18	40.9
From the market	1	2.3
Manufacturing intra the farm + Buy from companies	1	2.3
Total	44	100

This table show, the majority of total farms manufacture and process feed in the farm.

Table 17. Period of water samples examination

Period	Frequency	percent
Not done	24	54.5
Start of project	5	11.4
End of cycle	4	9.1
More than them	11	25.0
Total	44	100

This results show, (54.5%) of total farms do not send water samples for examination.

Table 18. Period of water system cleaning

Period	Frequency	Percent
No practiced	8	18.2
Less than 1 month	13	29.5
From 1 -2 month	16	36.4
More than 2 months	7	15.9
Total	44	100

Table (18) shows, (18.2%) from total farms do not practice water system cleaning.

Table 19. Period of fodder store cleaning

Period	Frequency	Percent
No practiced	11	25.0
Less than 1 month	6	13.6
From 1 -2 month	25	56.8
More than 2 month	2	4.5
Total	44	100

Table (19) shows, (25.0%) from total farms do not clean the food stores.

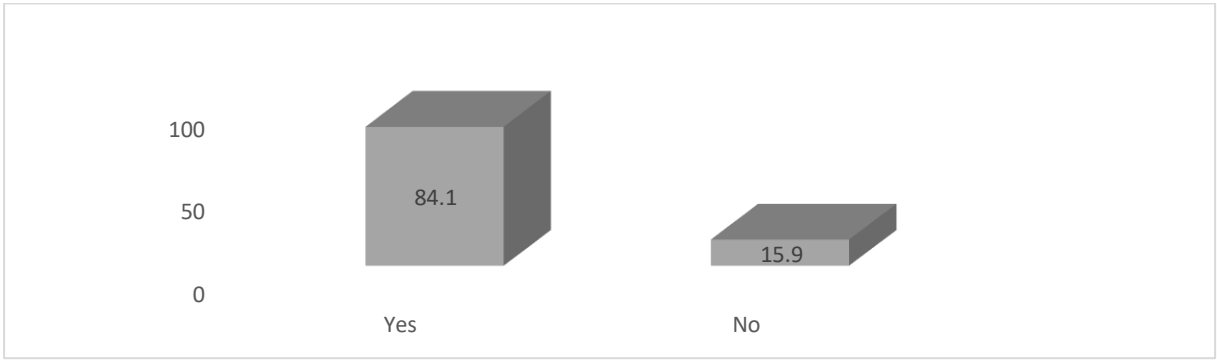

Figure 8. Protection of feed from wild birds and rodents

This results show, about (84.1%) from total farms have found protection fodder from wild bird and rodents.

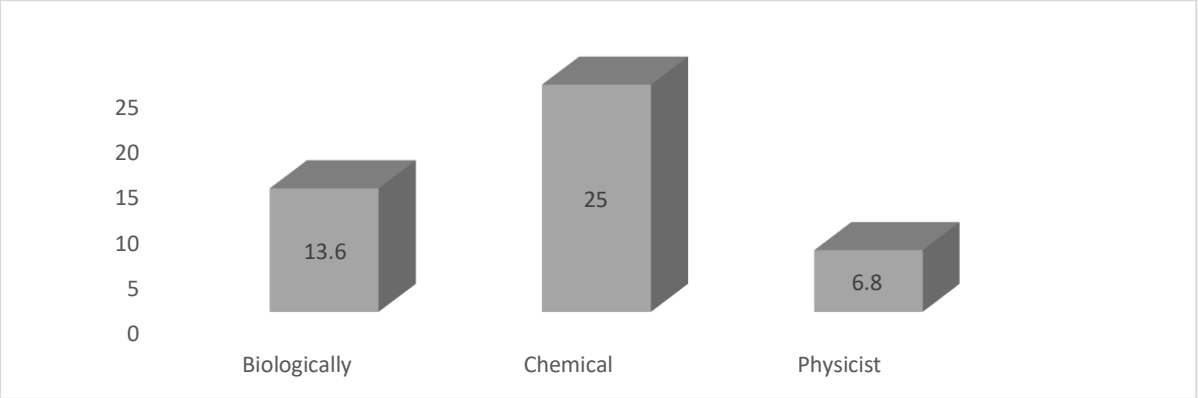

Figure 9. Pollution type

Figure (9) shows that the most pollution comes from chemicals.

4.4 Flock management and biosecurity procedures:

Table 20. Use of the dipping vat

Biosecurity procedure	Frequency	Percent
Used regularly	30	68.2
Do not use regularly	9	20.5
Do not use	5	11.4
Total	44	100

Table (20) shows, (31.9%) either do not use the dipping vat.

Table 21. Entry procedures

Procedure	Frequency	percent
Allowed when necessary	29	65.9
Not allowed	11	25.0
Allowed	4	9.1
Total	44	100

This results show (9.1%) allowed visitors entrance (Biosecurity hazard).

Table 22. Visitors type

Visitor type	Frequency	Percent
Feed supplier	6	13.6
Workers	6	13.6
Customer producer	2	4.5
Marketing representative	11	25.0
Feed supplier + Workers + Marketing representative	2	4.5
Feed supplier + Workers +Customer producer + Marketing representative	3	6.8
Feed supplier +Customer producer	1	2.3
Feed supplier +Marketing representative	2	4.5
Workers + Marketing representative	2	4.5
Feed supplier +Workers	3	6.8
Workers + Customer producer + Marketing representative	1	2.3
Feed supplier + Workers + Customer producer	1	2.3
Feed supplier +Customer producer + Marketing representative	2	4.5
Total	42	95.5

Table (22) show mixed visitor but mostly marketing representative.

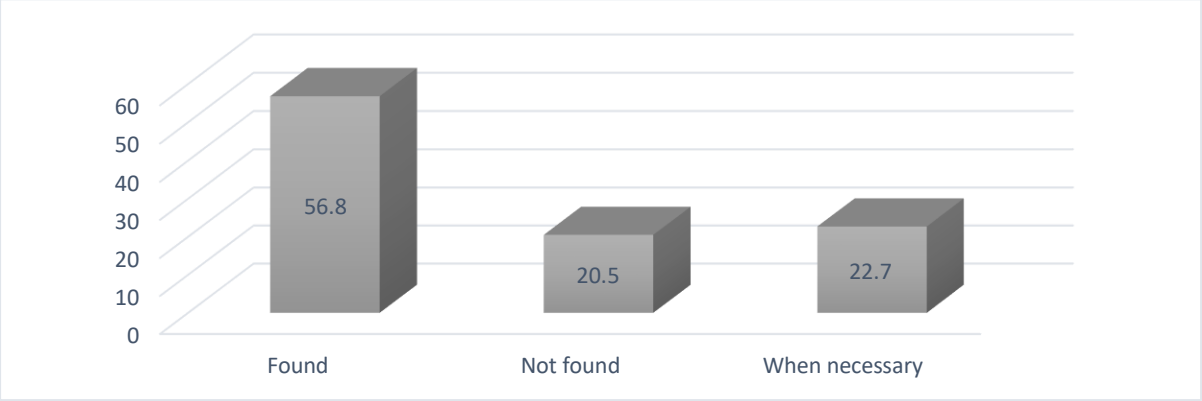

Figure 10. Following for chick source

This results show follow-up by chick source was at (56.6%).

Table 23. Rules for visitors entering

Rules	Frequency	percent
Not found	11	25.0
Disinfectant for feet	22	50.0
Other	1	2.3
Protective clothing +Disinfectant for feet+ Other	5	11.4
Protective clothing +Disinfectant for feet	3	6.8
Disinfectant for feet+ Other	2	4.5
Total	44	100

This results show, (25.0%) from total farms do not have fixed rules for visitors entrance.

Table 24. Worker biosecurity procedures

Procedures	Frequency	percent
Showering	5	11.4
Dipping boot in disinfectant	16	36.4
Protective clothing +Dipping boot in disinfectant	8	18.2
Showering +Protective clothing +Dipping boot in disinfectant	9	20.5
Showering +Dipping boot in disinfectant	4	9.1
Total	42	95.6

Table (24) shows only 20.5% practise showering, Protective clothing +dipping boot in disinfectants.

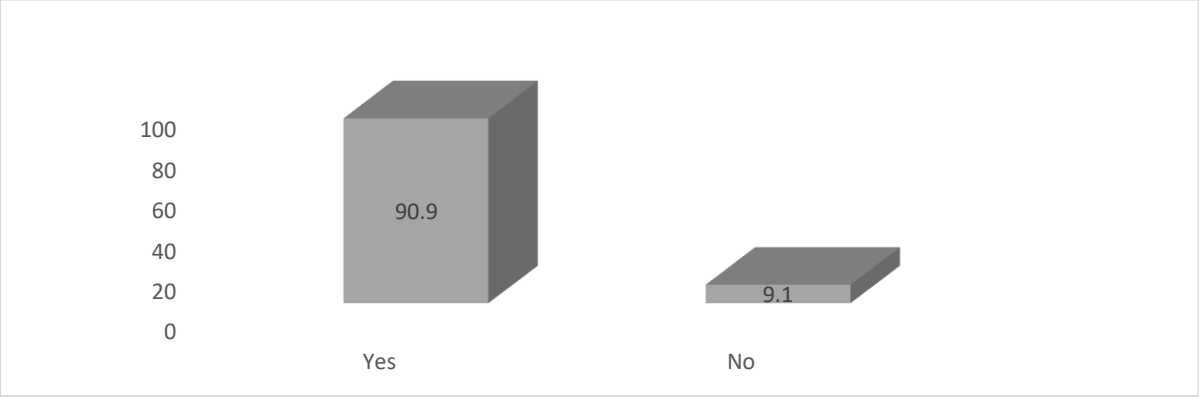

Figure 11. The Sick bird isolation

This results showed that most of total farms isolated the sick birds.

Table 25. Diagnosing procedure

Diagnosing procedure	Frequency	percent
Dissecting inside the farm	16	36.4
Dissecting inside the farm +Send samples to the laboratory	16	36.4
Send samples to the laboratory	12	27.3
Total	44	100

This results show, only (27.3%) from send samples for laboratory diagnosis.

Table 26. Most common diseases encountered

Common diseases	Frequency	percent
Bacterial	29	65.9
Viral	7	15.9
Parasitic	4	9.1
Bacterial+ Parasitic	3	6.8
Bacterial + Viral	1	2.3
Total	44	100

Table (26) show, most diseases encountered were bacterial (65.9%).

Table 27. Fixed vaccine program

Fixed program	Frequency	percent
Found	42	95.5
Not found	1	2.3
Irregular	1	2.3
Total	44	100

This results show, a majority of 95.5% follow fixed vaccination program.

Table 28. Disposal of dead birds

Disposal method	Frequency	percent
Incinerator	26	59.1
Burying	14	31.8
Throwing out the farm	2	4.5
Other	2	4.5
Total	44	100

Table (28) shows that the most farm dispose of dead birds by incineration.

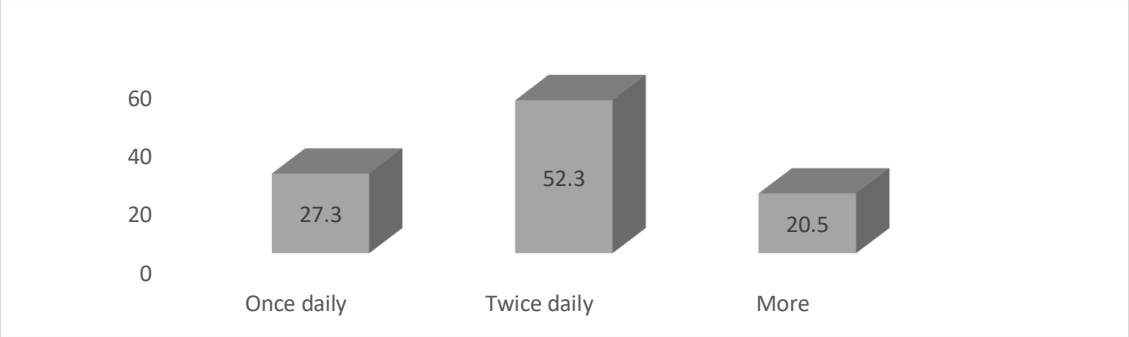

Figure 12. Collection periods of dead birds

This results show that most of total farms collect dead bird twice daily.

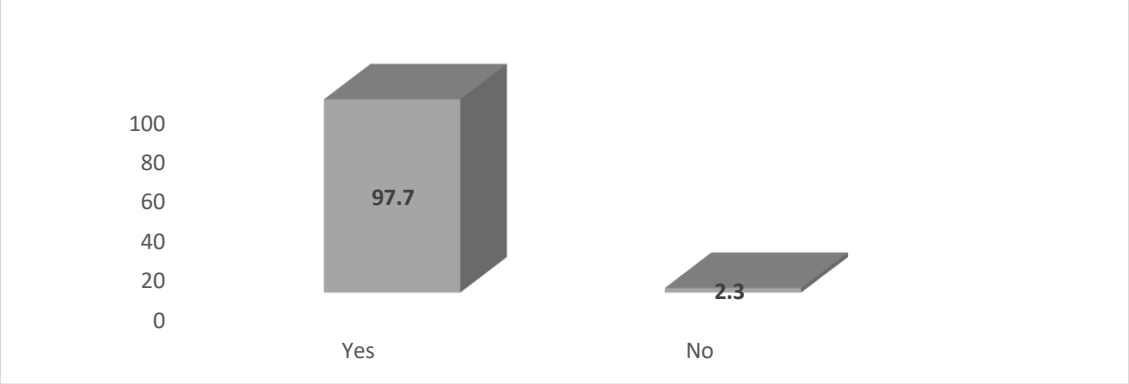

Figure 13. Vaccination done on time

Figure (13) shows that about (2.3%) do not vaccinate on time.

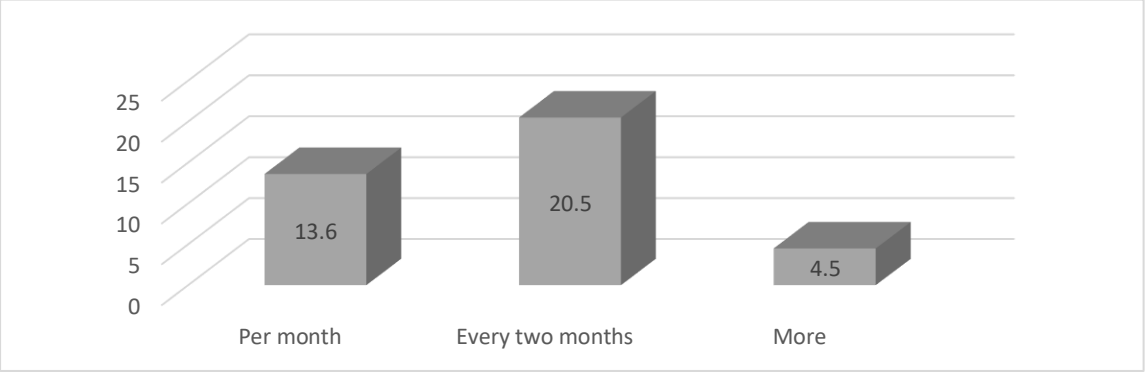

Figure 14. Timing of booster dose

Figure 14 shows that, (4.5%) from total farms give the poster dose more than two months.

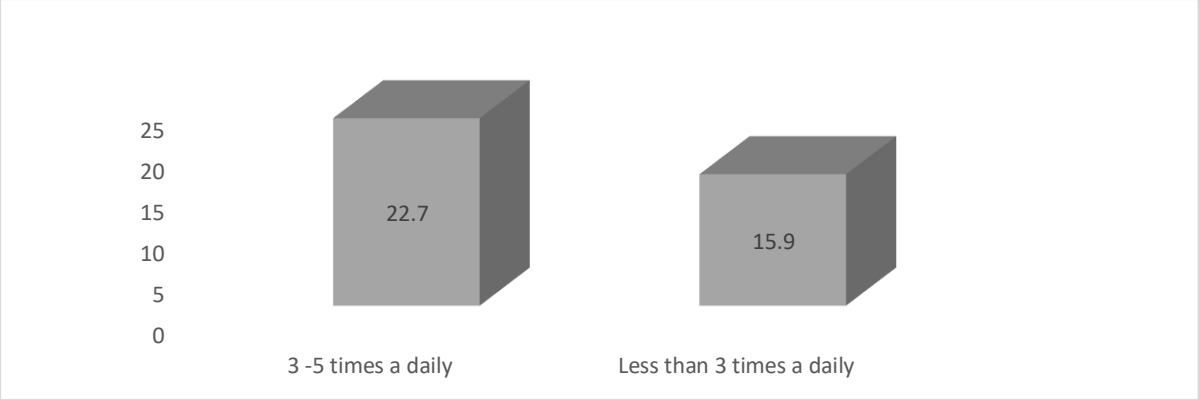

Figure 15. Number of times of eggs collection

Figure (15) shows (15.9%) of the total farms collect eggs less than 3 time daily.

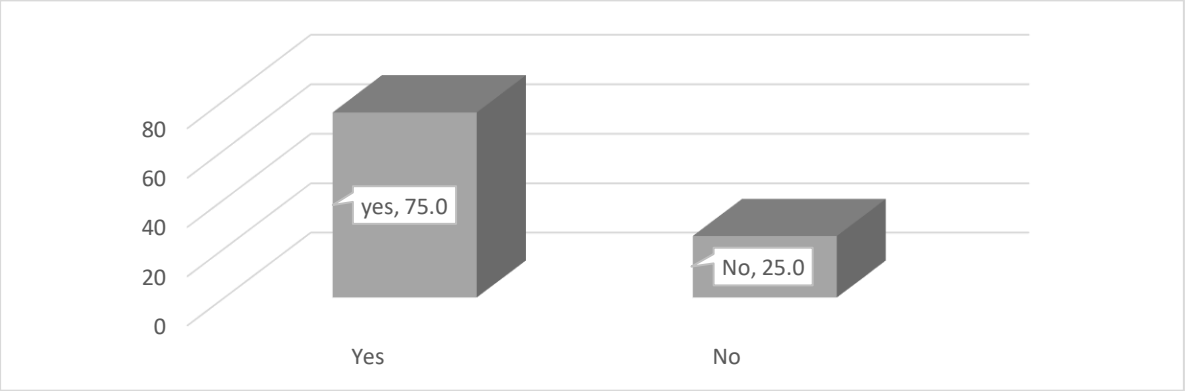

Figure 16. Security entry of wild birds

This results show, (25.0%) from total farms do not secure entry of wild birds.

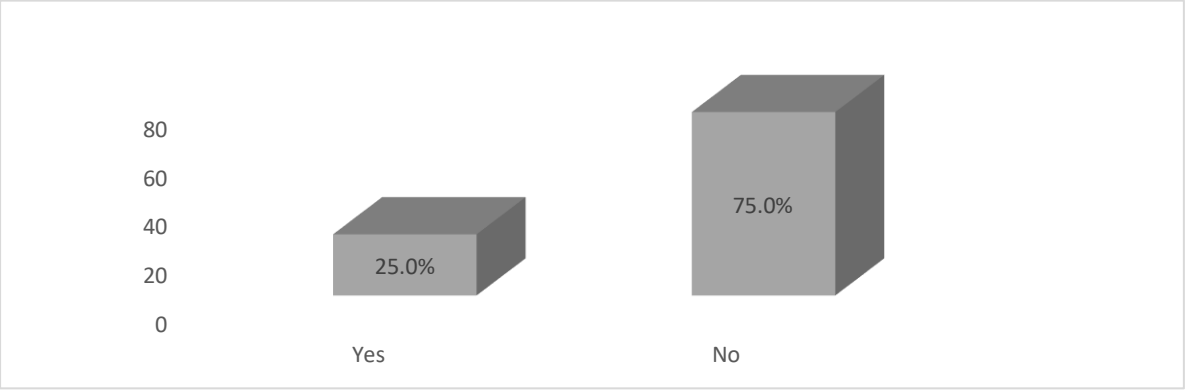

Figure 17. Household animals

Figure (17) shows, (25.0%) from total farm household keep animals in his household.

Table 29. Disposal of poultry manure

Disposal method	Frequency	Percent
By selling	37	84.1
Use as manure	6	13.6
By selling + Use as manure	1	2.3
Total	44	100

This results show, majority of farm dispose manure by selling.

Table 30. Disposal time of manure

Disposal time	Frequency	percent
Immediately after the end of the cycle	29	65.9
Daily	8	18.2
More than that	4	9.1
After a week or two	2	4.5
Daily + Immediately after the end of the cycle	1	2.3
Total	44	100

Table (30) shows that most farms dispose of manure immediately after the end of the production cycle.

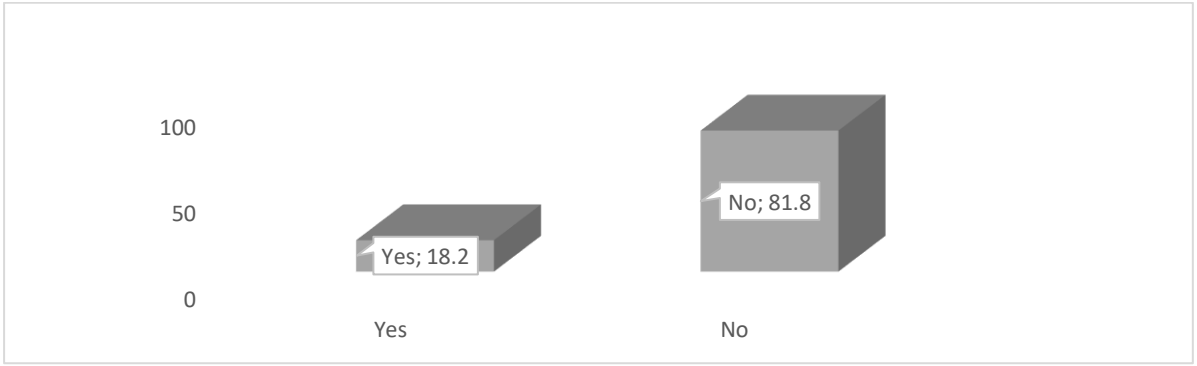

Figure 18. Exchange of equipment between other farms

Results show that, (18.2%) from the total farms exchange equipment with other farms.

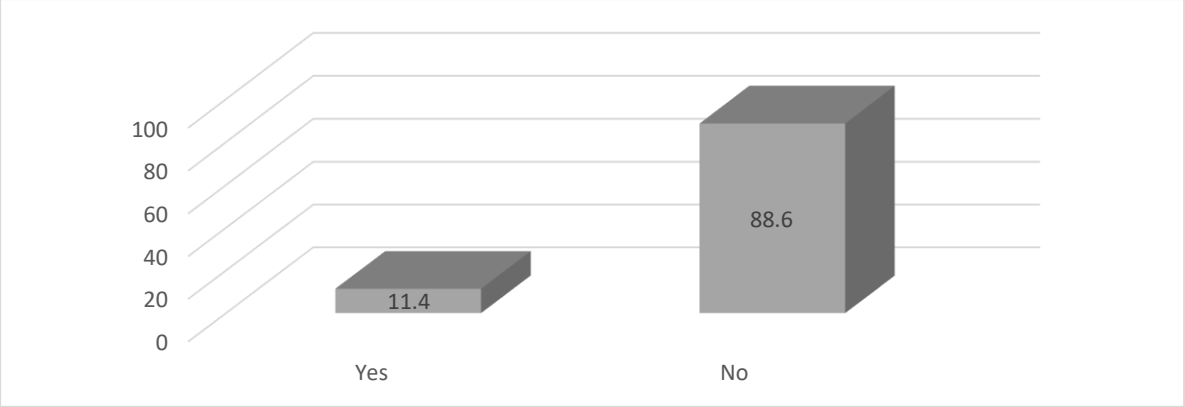

Figure 19. Movement of workers between farms

Figure (19) shows that, (11.4%) from total farm the workers move between farms.

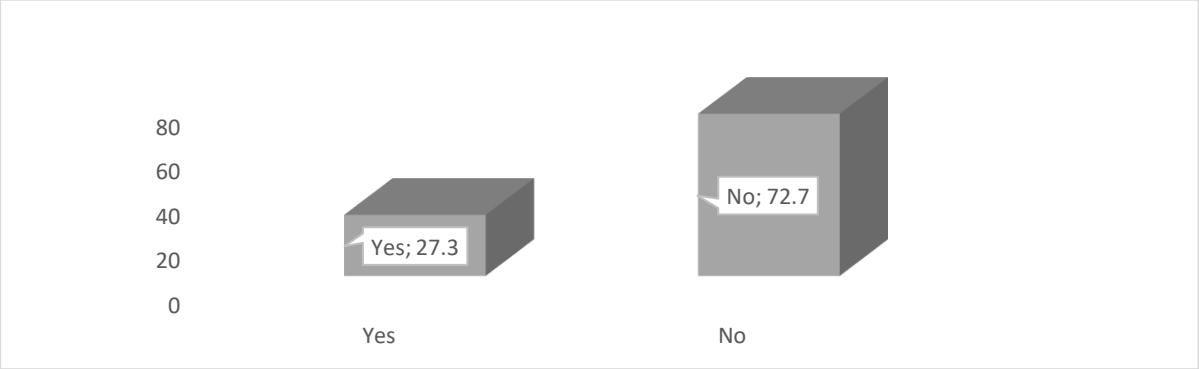

Figure 20. Taking samples to measure the effect cleaning

This results show, (72.7%) from total farms do not take samples to measure the effect cleaning.

Table 31. Relationship between visitors type and most ages infected

Total		%	57.1	16.6	11.9	4.8	2.4	7.2	100.0
		n	24	7	5	2	1	3	42
Visitors Type	Feed supplier +Customer producer+ Marketing representative	%	8.3	0.00	0.00	0.00	0.00	0.00	4.8
		n	2	0	0	0	0	0	2
	Feed supplier +Workers+ Customer producer	%	0.00	0.00	0.00	0.00	0.00	33.3	2.4
		n	0	0	0	0	0	1	1
	Workers + Customer producer+ Marketing representative	%	0.00	14.3	0.00	0.00	0.00	0.00	2.4
		n	0	1	0	0	0	0	1
	Feed supplier +Workers	%	8.3	0.00	0.00	50.0	0.00	0.00	7.1
		n	2	0	0	1	0	0	3
	Workers+ Marketing representative	%	4.2	14.3	0.00	0.00	0.00	0.00	4.8
		n	1	1	0	0	0	0	2
	Feed supplier +Marketing representative	%	0.00	0.00	20.0	0.00	100.0	0.00	4.8
		n	0	0	1	0	1	0	2
	Feed supplier +Customer producer	%	4.2	0.00	0.00	0.00	0.00	0.00	2.4
		n	1	0	0	0	0	0	1
	Feed supplier +Workers+ Customer producer +Marketing representative	%	12.5	0.00	0.00	0.00	0.00	0.00	7.1
		n	3	0	0	0	0	0	3
	Feed supplier + Workers+ Marketing representative	%	8.3	0.00	0.00	0.00	0.00	0.00	4.8
		n	2	0	0	0	0	0	2
	Marketing representative	%	29.2	57.1	0.00	0.00	0.00	0.00	26.2
		n	7	4	0	0	0	0	11
	Customer producer	%	4.2	0.00	0.00	50.0	0.00	0.00	4.8
		n	1	0	0	1	0	0	2
	Worker	%	12.5	14.3	20.0	0.00	0.00	33.3	14.3
		n	3	1	1	0	0	1	6
	Feed supplier	%	8.3	0.00	60.0	0.00	0.00	33.3	14.3
		n	2	0	3	0	0	1	6
	Most ages infected		Small	Medium	Great old	Small + medium	Medium + great old	Small +great old	Total

$\chi 2$ value = 81.764 , P. value = 0.032

-Table 31 show, the relationship between visitors type and most ages infected, the chi-square test was found to be significant ($\chi 2$ value= 81.764, P. value < 0.05).

4.5 Problems facing farm owners:

Table 32. Financial problems

Problem	Frequency	percent
Disability to cover project costs	2	4.5
Difficulty marketing	4	9.1
Financial losses due to diseases and death	9	36.4
Not specific	16	20.5
Disability to cover project costs +Difficulty marketing	1	2.3
Difficulty marketing +Financial losses due to diseases and death	2	4.5
Difficulty customer + Not specific	5	11.4
Total	39	88.6

This results show that for most farms the financial problem was the losses due to diseases and death.

Table 33. Administrative problems

Problem	Frequency	percent
Do not follow workers staff biosecurity procedures	9	29.5
Lack of employment	11	20.5
Not specific	13	25.0
Lack of medicines or difficulty in obtaining them in case of disease + Lack of employment	1	2.3
Do not follow staff biosecurity procedures + Not specific	5	11.4
Total	39	88.7

Table (33) shows that in most farms the administrative problems was not following biosecurity procedures by the staff.

Table 34. Health problems

Problem	Frequency	percent
Diseases	11	25.0
Height temperatures	9	20.5
Not specific	9	20.5
Rains	5	11.4
Rains + Not specific	3	6.8
Diseases + Rains	1	2.3
Diseases + Height temperatures	1	2.3
Diseases + Height temperatures + Rains	1	2.3
Diseases + Height temperatures + Not specific	1	2.3
Height temperatures + Not specific	1	2.3
Total	43	97.7

This results shows that in most farms the health problems were diseases.

Table 35. Problems in the project

Problems	Frequency	percent
Yes	22	50.0
No	22	50.0
Total	44	100

Table (35) shows that (50.0%) from total farms have problems in their projects.

Table 36. Relationship between problems in the project and administrative problems

	problems in the project				Total	
	Yes		No			
Administrative problems	n	%	n	%	n	%
Do not follow workers to biosecurity procedures	8	88.9	1	11.1	9	23.1
Lack of employment	1	9.1	10	90.9	11	28.2
Not specific	8	61.5	5	38.5	13	33.3
Lack of medicines or difficulty in accessing them in case of disease +Lack of employment	0	0.00	1	100.0	1	2.6
Do not follow workers to biosecurity procedures + Not specific	4	80.0	1	20.0	5	12.8
Total	21	53.8	18	46.2	39	100.0

$\chi 2$ value= 16.165 , P. value =0.003

Table (36) shows that, (88.9%) from total farms do not follow staff biosecurity procedures, while (11.1%) do not have problems in their projects, and (90.9%) had administrative problems as lack of employment, the chi-square test was found to be significant ($\chi 2$ value=16.165, P. value < 0.01).

Chapter Five

5.1 Discussion:

The results of questionnaire of assessment of biosecurity in poultry farms in Bahri locality showed that the majority of types of production was broiler production, (63.6%) for the quick turn – over and easiness of management, this result agreed with Tabidi et al., (2014). The study showed the majority of farms were closed system, (81.8%) from total, as the closed system gives better results and contains greater numerical number of bird but investment is great. The study showed the distances of farm to the other nearest farm was mostly between 1-3Km at (47.7%). this result agreed with Abdalla, (2016), and dis agree with Ali et al., (2014), and the distances between the houses in one farm was mostly between 20-50m (50.0%). This can allow the transmuting of disease between the farm and also between the houses specially if present in deference ages. This result agreed with Abdalla, (2016). The study showed that the majority of the number of chickens in one house were more than20000, (56.8%) and the number of chicken in one farm mostly was more than50000, (50.0%), due to that the closed system capacity is greater.

About (79.5%) of total farms were fenced by wire, while (20.5%) were wall fenced. The fence could be used to stop people and animals of entering the farm as control diseases and the mostly fence is wire due to that farm areas are large and the wire is easier and less expensive. The results showed the origin of chicken was mostly commercial (86.4%), because most of farms adopt commercial breeding. This result agreed with Abdalla, (2016), and also agreed with Ali et al., (2014). The study showed the majority of type of litter in houses was sawdust because the sawdust is the best type of litter and absorbs moisture quickly. Results from the survey showed only (36.4%) of farms provided visitors with protective clothing and boots. This is a harmful process because it helps to transmit disease. This result agrees with Ali et al., (2014), and also agreed with Abdalla, (2016). About (47.7%) of total farm his workers it committed to uniform, while (34.1%) of total farm not committed to uniform, the uniform reduces the risk of disease transfer and for protecting.

For the question about health check for the staff (65.9%) stated No, this result agreed with Abdalla, (2016). and Aboubakr, (2016). The study showed the majority of farm had veterinary supervisor, which agreed with Abdalla, (2016), and Ali et al., (2014). Results show, (54.5%) of total farm take water samples for examination. (15.5%) from total farm do not protect fodder from wild bird and rodent and about (25.0%) not cleaned the fodder store. All these factors can

allow the entering and spreading of diseases in poultry farm in kh. North locality.

The questionnaire showed the biosecurity procedures which include the dipping vat, the entry procedures, rules for entering visitors, and staff procedures, all the above help in diseases transmission. The study showed, (90.9%) from total farm isolated the sick birds. This result agreed with Ali et al., (2014). The study also showed, the majority of farm used a fixed vaccine program, for (95.5%) from total, which agrees with Ali et al., (2014), who observed a total of 91.1% of the respondents had a vaccination program.

The study showed, (59.1%) from total farm disposed of dead birds by incinerators and (31.8%) disposed of dead birds by burying. This result dis agreed with Aboubakr, (2016), how found about (30.0%) of the farms disposal of dead birds was by use of incinerator and (60.0%) disposed of the dead birds by burning. The study showed, the majority of farms collect dead bird twice daily. This result dis agreed with Ali et al., (2014), who found (88.9%) of the farm collect dead bird once daily. The study showed the farmers have a good understanding about the risk of enterence of wild birds and the presence household animals in farms. For exchange of equipment between farms (81.8%) stated No, due to the high careful attention in closed systems. About mixing between worker from different farms (88.6%) stated No. This result agrees with Aboubakr, (2016).

For the question about after cleaning and disinfecting samples were taken to measure the effectiveness of the process, (72.7%) stated No. This result agrees with Aboubakr, (2016).

The study showed, (50.0%) from total farms have problems in their projects, due to health, financial or administrative reasons.

5.2 Conclusions:

- Most farm units do not stick to or abide by biosecurity rules and regulations and most lack the information on biosecurity measures and importance.

5.3 Recommendations:

The study recommended to:-

1-Raise awareness and guides to implementation of biosecurity and follow-up of the implementation of biosecurity measures in a comprehensive manner, without fragmentation for better results.

2- Educating the poultry farmers on the importance of biosecurity application and its impact on the overall health of the flock, national economy and human health.

3- Government policy specially extension needs to facilitate the improvement of biosecurity adoption among poultry farmers.

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Appendix

Sudan University of science and technology

Collage of Graduate studies

Questionnaire about the evaluation of Biosecurity measures in poultry farm in Bahri city – Sudan:

A-The First Axis:-

Farm:

(1)The Type of production (specialization):

a- Layers production ( ) b- broilers production ( )

c- Layers and broilers production ( )

(2)The farm design:

a- Close ( ) b-semi close ( ) c-open ( )

(3) The distance of farm from the main road:

a- Less than 50m ( ) b-between 50-100m ( ) c-more than100m ( )

(4) Distance to the nearest farm:

a- ≤ 1km ( ) b-between 1-3 km ( ) c-more than 3km ( )

(5) The number of houses on farm:

a-Less than 3 houses ( ) b-between 3-5 houses ( ) c-more than 5 houses ( )

(6) The distance between the houses:

a- Less than 20m ( ) b- between 20-50m ( ) c- more than 50m ( )

(7) The number of birds in one houses:

a- Less than 10000 ( ) b- 10000 -20000 ( ) c-more than20000 ( )

(8) The number of birds in the farm:

a- Less than 20000 ( ) b- between 20000-50000 ( ) c-more than50000 ( )

(9) The fence of the farm:

a- Wire ( ) b- wall ( ) c- other ( )

(10) Is there found Present parking area:

a- Yes ( ) b-no ( )

(11) The source of birds:

a- Local ( ) b- hatching in farm ( ) c- Imported ( )

(12) Type of litters in houses:

a- Sawdust ( ) b-other ( )

(13) Is there changing the litters?

a- Yes ( ) b- no ( )

What is the time period? .....

B- The 2nd Axis:-

Management:

(1) Experience period:

a- Less than 5 year ( ) b- 5-10 year ( ) c-more ( )

(2) Specific protective clothing and boots are used for visitor?

a- Yes ( ) b- no ( )

(3) Records are saved:

a- Yes ( ) b- no ( )

(4) Production personnel (workers):

a- Are committed to uniform ( ) b- not committed ( ) c- sometimes ( )

(5) Are health check periodically for staff?

a- Yes ( ) b- no ( )

(6) Is there a veterinary supervisor in the project?

a- Yes ( ) b- no ( )

(7) Farm owner:

a- Veterinary ( ) b- agricultural ( ) c- animal production ( ) d- other ( )

C- The 3rd Axis:-

Water and feeder:

(1) Source of drinking water:

a- Wells ( ) b- tanks ( ) c-centrality ( )

(2) Source of feed:

a- Manufacturing intra the farm ( ) b- buy from companies ( )
c- from the market ( )

(3) Are water samples taken for examination?

a- Yes ( ) b- no ( )

If yes what is the time period? .....

(4) Is the water system cleaned?

a- Yes ( ) b- no ( )

If yes what is the time period? .....

(5) The feed store is cleaned?

a- Yes ( ) b- no ( )

If yes what is the time period? .....

(6) Is there protection for feed from wild birds and rodents?

a- Yes ( ) b- no ( )

(7) When checking the water, type of pollution:

a- Biologically ( ) b- chemical ( ) c- physicist ( )

D- The 4th Axis:-

Flock management and biosecurity procedures:

(1) Dipping vat:

a- Used regularly ( ) b- do not use ( ) c- do not use regularly ( )

(2) Entry procedures:

a- Not allowed ( ) b- allow ( ) c- allowed when necessary ( )

(3) Type of visitors:

a- Feed supplier ( ) b- workers ( ) c-customer producer ( )
d- Marketing representative ( )

(4) Technical following of owners of chicks:

a- Found ( ) b- not found ( ) c- when necessary ( )

(5) Are there a rules to enter visitors?

a- Yes ( ) b- no ( )

If are found what are that?

a- Protective clothing ( ) b- disinfectant for feet (doused) ( ) c- other ( )

(6) What are the procedures for worker when entering the farm?

a- Showering ( ) b-Protective clothing ( ) c-Dipping boot in disinfectant ( )

(7) Is the sick birds isolated?

a- Yes ( ) b- no ( )

(8) In the event of satisfactory symptoms how to diagnose:

a- Dissecting inside the farm ( ) b- send samples to the laboratory ( )
c- other ( )

(9) Most ages are infected:

a- Small ( ) b- medium ( ) c- great old ( )

(10) The most common diseases:

a- Bacterial ( ) b- viral ( ) c- parasitic ( )

(11) Is there existent vaccine program?

a- Found ( ) b- not found ( ) c-irregularly ( )

(12) -how to get rid of the dead birds disposal?

a- Throwing out the farm ( ) b- use a hole ( )

c- Crematory according to the certain specifications ( ) d- other ( )

(13) Number of times the collection of dead bird:

a- Once daily ( ) b- Twice daily ( ) c- more ( )

(14) Is there a record for the mortality?

a- Yes ( ) b- No ( )

(14) IS vaccination done in time?

a- Yes ( ) b- No ( )

(15) Timing of poster dose for (I + ND) in layers:

a-Per month ( ) b- every two months ( ) c- more ( )

(16) In the case of layers, number of time eggs are collected:

a- Less than 3 times a daily ( ) b- 3 -5 times a daily ( ) c- more ( )

(17) Is there security against the entry of wild birds?

a- Yes ( ) b- no ( )

(18) Are there other household animals in the farm?

a- Yes ( ) b- no ( )

(19) Method of disposal of manure:

a- By selling ( ) b- use as manure ( ) c- burning and burial ( )
d- other ( )

(17) And it is disposed of: a- Immediately after the end of the cycle ( )
b-after a week for two ( ) c- more than that ( )

(18) Is there an exchange of tools and equipment between farms?

a- Yes ( ) b- no ( )

(19) Is there any mixing between workers from different farm?

a- Yes ( ) b- no ( )

(20) After cleaning and disinfecting farm are samples are taken to measure the effectiveness of the process?

a- Yes ( ) b- no ( )

E- The 5th Axis:-

Problems:

(1) Financial problems:

a- Disability to cover project costs ( ) b- difficulty marketing ( )
c- financial losses due to diseases and death ( ) c-Not specific ( )

(2) Administrative problems:

a- Do not follow staff biosecurity procedures ( )
b- lack of medicines or difficulty in accessing them in case of disease ( )
c- Lack of employment ( ) d- Not specific ( )

(3) Health problems:

a- Diseases ( ) b- height temperatures ( ) c- rains ( )
d-Not specific ( )

(4) Are there problems with the project?

a- Yes ( ) b- no ( )