



**Assessment of the Implementation of Quality  
Management Systems in Elshahafa Modern  
Slaughterhouse (EMS)**

**قياس تطبيق أنظمة ادارة الجودة في مسلخ الصحافة الحديث**

**A Dissertation Submitted in Partial Fulfillment of the  
Requirements for the Degree of Master of Economics of  
Animal Resources Development**

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**May /2018**

## ***Dedication***

*In the name of God, The most compassionate and Merciful.*

*This work is dedicated with mercy and love, to .....*

*To my parents, for their prayers and encouragement me. To my lovely great family my brothers and sisters, for their support. My gratitude and love to my small family my husband, my sons and daughter Awab, Ahmed, Eyaad and Aseel, for their endless support and patience all period of my study.*

*Noha*

بِسْمِ اللَّهِ الرَّحْمَنِ الرَّحِيمِ

(انما قولنا لشيء اذا اردناه ان نقول له كن فيكون)

سورة النحل (40)

# Acknowledgement

Great thanks for Allah for giving me the strength and patience to complete this work. I want to express my sincere gratitude to my supervisor prof. Tamador Angara who has provided support and every step of my work, sharing her great ideas and giving me invaluable experiences.

It would not have been possible to do this work without help and support of the kind people around me, to only some of whom it is possible to give particular mention here.

I wish to express my warm and sincere thanks to Mr. Abdu elazeez Abdu Elmageed the chairman of Elshahafa modern slaughterhouse for his never lasting support.

Special thanks are due to Mr. Majdi Hasan the manager of Elshahafa modern slaughterhouse for his help in the field work and for sharing data.

I also would like to acknowledge the engineers of Pinar Company Slaughter and Meat Processing for providing me engineering information.

Also great thanks to Dr. Ammar El sheikh Edres the chairman of the planning, investments and training affair, federal ministry of animal resource and fishery for his help and sharing data of this work. I would like to thank my father for his personal support and great patience at all times. My special thanks are due to my mother, brother and sisters for their deep love and encouragement in accomplishing my goals in life. I also feel greatly indebted to my husband and children who patiently accepted and afforded to have me away, for my studies, even at times when they needed me the most.

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# ABBREVIATIONS

<b>Symbols</b>	<b>Abbreviations</b>
BCR	Benefit Cost Ratio
CBA	Cost- Benefit Analysis
CCPs	Critical Control Points
EU	European Union
FAO	Food & Agriculture Organization
FSIS	Food Safety And Inspection Services
FSMS	Food Safety Management System
GCC	Gulf Cooperation Council
GDP	The Gross Domestic Product
GHP	Good Hygienic Practices
GMP	Good Manufacturing Practices
GSO	Gulf Standard Organization
HACCP	Hazard Analysis and Critical Control Point
IFS	International Food Standard
IPPC	International Plant Protection Convention
IRR	Internal Rate of Return
ISO	International Standardization Organization
NCF	Net Cash Flow
NPV	Net Present Value
OIE	Office International des Epizooties
PP	Payback Period
QA	Quality Assurance

SOPs	Standard Operating Procedures System
SPS	Sanitary Photo Sanitary
SRR	Simple Rate of Return
TBT	Technical Barriers of Trade
TCs	Technical Committees
TQA	Total Quality Assurance
USAL	United States Army Laboratory

# Abstract

Although Sudan is among the top producers of livestock and has several export oriented slaughterhouses yet, the country failed to become a major player in the international meat market. This is attributed to the fact that all of these slaughterhouses do not satisfy the quality standards required, particularly in the Middle East where the demand has been changing towards assurance of food quality and safety measures and regulations. Elshahafa Modern Slaughterhouse (EMSH) is not an exception. It is unqualified to meet the requirements of the ISO certification, yet it can comply with the Gulf standard organization (GSO) if the current situation is improved.

The aim of this study was to assess the profitability of the implementation of quality management system in Elshahafa modern slaughterhouse to comply with the Gulf standard organization (GSO). The cost/benefit analysis was used to examine the profitability of the improvement. The life span of the (EMSH) was set to 25 years and a rate of (15%) cost of capital was used to discount the cash flow. Sensitivity analysis was carried out to assess the effect of the change in the prizes by 10% and 50%.

The study revealed that the improvement is feasible since the evaluation criteria (both discounted and undiscounted) are show positive results. The payback period is 1.01 year, and the simple rate of return is found to be (100 %), undiscounted benefit cost ratio is (25) with a net cash flow (\$ 453.5 million). On the other hand the discounted criteria are as follows: the net present value is (\$ 89.8 million), and internal rate of return (100 %) and discount benefit cost ratio is (25).The sensitivity analysis shows no risk, since changing the prizes by 50% has no negative effect on the profitability.

The study concluded that improvement of the quality standard to Sudan slaughterhouses has a positive impact on the profitability of the investor as well as the economy as a whole and recommended that all meat producing sector should comply with the international requirements of quality management and obtain the ISO certification for the benefit of all.

## المستخلص

بالرغم من ان السودان يعد من اكبر الدول انتاجا للثروة الحيوانية ويمتلك عدد ا مقدر من مسالخ الصادر الا انه فشل في ان يلعب دورا مهما في اسواق اللحوم العالمية.

يعزى ذلك الى ان جميع هذه المسالخ لا تستوفي معايير الجودة المطلوبة خاصة في الشرق الاوسط حيث تغيير الطلب الى تطبيق معايير واجراءات توكيد جودة وسلامة الغذاء . ومسلخ الصحافة كغيره من مسالخ السودان غير مؤهل للايفاء بمتطلبات الايزو الا انه يمكن ان يفي بمتطلبات المنظمة الخليجية للمقاييس الا تم تحسين الوضع الراهن للمسلخ..

الهدف من اجراء هذه الدراسة هو تقييم ربحية تطبيق نظم الجودة بمسلخ الصحافة الحديث؛ حيث استخدم تحليل المنافع والتكاليف لاختبار مدى ربحية التحسينات التي تضمن جودته باعتماد المقاييس الخليجية للجودة . افترض ان العمر الزمني للمسلخ 25 عاما واستخدم معدل خصم % 15 كتكلفة لرأس المال في خصم التدفق النقدي . كما اجري تحليل اختبار الحساسية لمعرفة اثر تغيير الاسعار بمعدل 10% و 50%.

توصلت الدراسة الي ان التحسينات مجدبة طالما ان مقاييس الربحية كانت موجبة في حالة المعايير المخصومة وغير المخصومة . فقد بلغت فترة الاسترداد 1.01 سنة، والعائد البسيط % 100 ، ودليل الربحية غير المخصوم 25 ، وصافي التدفقات النقدية 453.5 مليون دولار. ومن ناحية اخري فقد كانت المعايير المخصومة كالاتي :صافي القيمة الحالية 89.8 مليون دولار، ومعدل العائد الداخلي % 100 ، ودليل الربحية المخصومة 25 . كما اوضح تحليل اختبار الحساسية عدم وجود خطر طالما انه لا يوجد اثر سالب بتغيرات الاسعار ب % 50 .

خلصت الدراسة الي ان تحسين معايير الجودة بالمسالخ السودانية له اثار ايجابية علي ربحية المستثمر والاقتصاد ككل. واوصت بان يلتزم قطاع انتاج اللحوم بتطبيق المعايير العالمية للجودة و الحصول على شهادة الايزو لفائدة الجميع.

# CHAPTER ONE

## 1. INTRODUCTION

### 1.1. Background

Sudan has a large livestock population, estimated at 104.6 million head in 2016. Out of which 28.4 million head of cattle, 40.2 million head of sheep, 31.2 million head of goats and 4.8 million head of camels (Elzubir. 2016).

Livestock plays an important role in the economy of the country the Livestock sector contributed approximately 53.2% of the agriculture sector and its contribution to the national economy accounting for 25% of the gross domestic product (GDP) and employing 40% of the country's population (El Dirani *et al.* 2009).

Of the total livestock population of the Arab world Sudan livestock accounts for about 70% of cattle, 31% of sheep, 49% of goats and 25% of camels (El Dirani ,*et al.* 2009), while accounts for circa 43% of the Arab world's red meat production.

Middle East and Gulf markets are the main markets for exports Sudanese meat. The major importers of Sudan meat are; Kingdom of Saudi Arabia, United Arab Emirates, Egypt, Kingdom of Bahrain, Qatar State and Jordan (El Dirani ,*et al.* 2009). Although demand for meat in the Middle East—especially in the Saudi market—has rapidly increased, propelled by the high income levels, population growth as well as urbanization and growth of the food service sector as due to increased investments in tourism. However quantities of meat exports from Sudan to these countries are low compare to demand. This is attributable to non-compliance to the international standards as due to lack of expertise in meat processing, handling and packing. The future growth of the meat industry in Sudan depends largely on improvement in meat processing technology and adherence to quality standards (Ibrahim, 2004).

Slaughterhouses are key in the meat production and distribution chain. Therefore, slaughterhouses and meat establishments must fulfil the requirements for protection of products from external contamination by following the high-hygienic standards, and further facilitate of the slaughtering and butchering of animals to be economically and efficiently produced for the market (Havas, 1995).

There are several export slaughterhouses in Sudan with production capacity of 11,000 head/day for sheep and 1,700 head/day for cattle. Sudan government allocated about SDG 1 million for developing like tool export, and SDG 1.5 million for quality control of export slaughterhouses (Elzubir. 2016).

To improve competitiveness and increase livestock share in the global market, better understanding of quality requirements, supporting value chain actors to meet these standards and increasing countries' capacity to supply the market with high-quality and eligible livestock and meat products is required. For Sudan to improve the competitiveness of livestock production and meat trade in global market, it is necessary to apply a total quality assurance system, such as food safety management, HACCP system and certification. Therefore, the adoption of the national and local capacity building initiatives is the right step in the right direction in order to improve Sudan's food safety systems and strengthening the country's livestock and meat value chains .To enable Sudan to meet the demand for high quality livestock and meat on global market. Lack of clear and detailed knowledge on food safety and quality requirements demanded by importing countries, is the key challenge facing primary and secondary livestock traders in Sudan (FAO, 2016).

## **1.2. The Statement of the Research Problem**

Although Sudan is among the top producers of livestock, the country failed to become a major player in the international meat trade. Middle East countries had been the major market Sudan for meat. In recent years the pattern of



demand in the Middle East has been changing towards assurance of food quality and safety measures and through implementation of food safety regulations. As a result new suppliers (like Australia, Brazil and New Zealand) that are able to comply with new Gulf standards have entered in the market on the exports Sudanese livestock meat (El Dirani, *et al.* 2009).

Sudan's declining and fluctuating market share is mainly due to problems within the supply chains for meat as a result of poor implementation of the quality and safety regulations and tests. Slaughterhouses are important components of the meat value chain; and application of the quality standards is a determining factor in meat market competitiveness. Unfortunately, no single slaughterhouse in Sudan is certified to meet these international requirements, Elshahafa Modern Slaughterhouse (EMSH) is not an exception. (EMSH) within the vicinity of Khartoum causes it unqualified to meet the requirements of the ISO certification, yet it can comply with the Gulf standard organization (GSO).

### **1.3. Research Objectives**

#### **1.3.1. Main objective**

The overall objective of the study is to conduct assessment of implementation of quality management system in Elshahafa Modern Slaughterhouse (EMS) to meet the requirement of the Gulf Standard Organization.

#### **1.3.2. Specific objectives**

- To investigate and assess current quality situation of Elshahafa modern slaughterhouse, whether they comply with the requirements of quality assurance of Gulf Standard Organization or not.
- To identify the gaps of the safety and quality assurance according to (GSO) and propose mitigations.
- To estimate the quality cost to achieve quality assurance.
- To estimate the quality benefit achieved by compliance with Gulf Standard Organization (GSO).

-To assess how sensitive Sudan's market share to changes in prices as a result of additional costs incurred by quality standard.

## **1.4. Research Hypothesis**

- ❖ There are many short falls current quality situation of the Elshahafa slaughterhouse shows compared to the requirements of Gulf quality assurance and standards.
- ❖ The cost required to achieve the GSO exceeds more than SDG 1.5 million.
- ❖ The benefits of improving the quality Elshahafa slaughterhouse according Gulf standard exceeds more than SDG 50 million annually.
- ❖ The investment has positive profitability due to improvement of Elshahafa slaughterhouse.
- ❖ The improvement of Elshahafa slaughterhouse is not sensitive to 50% increase cost and reduced benefit to 50%.

## **1.5. Scope, Time and Place of the Research**

The study was conducted in Elshahafa modern slaughterhouse in Khartoum state during the period (2016-2018). Primary data were collected from October 2016 to May 2017.

## **1.6. Organization of the Research**

Chapter one give an introduction and background to the study, highlight the research problem, represent objective, hypotheses and the research layout, While literature reviewing and canceled framework of study is given in Chapter two, Chapter three displays the research methodology, and Chapter four presents the research results and their discussion, finally the research conclusion and the recommendations set.

# CHAPTER TWO

## LITERATURE REVIEW

### 2.1. Quality Assurance Systems

To be competitive at the international levels requires building competitive advantages linking quality and origin and/or food safety and quality assurance management as key drivers of agribusiness (Jatib, 2003). To achieve the quality management for food Industry, Food safety is the main pathway, both food safety and quality management is essential strategy for small and middle food industry to cope with globalization process and pervade of new markets ( Jatib, 2003).

Implementation of total quality assurance (TQA)rule such as ISO (9001-22000) is superior to implementation of food safety such as Good manufacturing practices (GMP), Standard operating procedures (SOPs), Hazard Analysis and Critical Control point (HACCP).Total quality management satisfier the consumers implicit and explicit.

Developed countries currently pay more attention to the production of safe and high quality food, sold for their final customers. Similarly, EU companies working in food industry have become much more demanding for safety requirement on food products from developing countries. The exporting countries must include therefore, all food safety procedures and assure implementation of the HACCP system in their processes to satisfy the need of the final consumers in the international markets (Bandini *et al.*, 2002)

In the Food Chain, the development of Food Safety is mandatory while the quality assurance is voluntary. The establishment and functioning of slaughterhouses is governed by implementation, quality assurance (QA) systems and legislation. Thus, a food safety management system (FSMS)

implemented in a slaughterhouse should be based on good hygienic practices (GHP) and hazard analysis critical control point (HACCP) principles and should address both food safety control and assurance activities in order to guarantee food safety (Luning and Marcelis, 2007; Jacxsens *et al.*, 2009).

Nowadays, several QA standards are available, like the ISO 22000, the international food standard (IFS), and the global standard for food safety (BRC), which were specifically developed for food processing industries. However, one of the emerging challenges in many slaughterhouse are the translation and implementation of the QA and legislative requirements into a slaughterhouse FSMS and to assess the performance of a present FSMS as well (Jacxsens *et al.*, 2009).

### **2.1.1. Good manufacturing practices (GMPs)**

Ioannis *et al.*, (2009) defined the good manufacturing practices (GMPs), which are sometimes referred to as ‘control points’, as the correct processes and procedures to be followed to prevent food from contamination (microbial, chemical and physical). GMPs define what has to be done to prevent contamination, when it has to be done and by whom. They do not address specific hazards, and loss of control would not necessarily result in an acceptable health hazard to the consumer. Areas covered by the GMP program include: personnel, premises, equipment, raw materials, product traceability and documentation. The personnel including task and hygiene training, job description and organizational structure. The premises include the location and structure while the equipments include the design, maintenance and calibration services, including sanitary services, disposal of waste materials, and the provision of electricity, water, refrigeration and steam. However, raw materials include live animals, packaging, food ingredients and chemicals.

### **2.1.2. General hygiene practices (GHP)**

The general hygiene practices (GHP) has been defined by (Ioannis *et al.*, 2009) as those operations involved in providing a clean sanitary environment for the preparation, handling and storage of fresh food. Areas covered by the GHP program include: The cleaning of plant and equipment, the staff working in health food handling, staff cleanliness and raw materials cleanliness including live animals and ensuring that all detergents, sanitizers and other nonfood chemicals are properly packaged and labeled, complying with their specializations and are stored correctly.

### **2.1.3. The standard operating procedures (SOPs)**

Ioannis *et al.*, (2009) defined (SOPs) as the procedures for used in each step during routine slaughtering, which tell how each (GMP) and (GHP) is to be carried out, and procedures to be followed at each critical control point (CCP).

The efficient meat hygiene practices begin in the farm; if should be maintained in the animal collection centres, markets, during transportation of animals for slaughter, in abattoirs, during transportation of animals to butcheries and even at the consumer home (Thornton, 1968).

The slaughterhouse is the initial point at which micro-organisms translocate from the environment to the product and also the point at which food-borne pathogens would be introduced into the carcasses (Gregory, 1996; NACMCF, 1992). According to Gill, (1998) and Abdalla *et al.*,(2009), the microbiological contamination of carcasses occurs at slaughterhouses and retail establishments therefore all slaughter processes must be done in good environmental and hygiene condition.

The competent authority of each member slaughterhouse is responsible for the official control of the slaughter establishments, the operational procedures and the level of hygiene practice in compliance with the relevant legislation

.The official controls are performed with impartiality, quality and in accordance with documented procedures. The staff performing official controls must receive appropriate training enabling them to undertake their duties competently and in a consistent manner (Ioannis *et al.*, 2009).

## **2.2. Hazard Analysis and Critical Control Point**

Hazard analysis and critical control point (HACCP) has been defined by Surak (2007) as a food safety system designed to prevent biological, chemical and physical hazards in food. The process starts with identifying the food safety hazards most likely to occur in a specific food product manufactured by a specific process. Next, the food safety team determines the likelihood of occurrence of the hazard and its severity .However, hazard analysis has the same roots as failure mode effects analysis.

According to Herrera (2004) the hazard analysis and critical control point system (HACCP) has a proven track record for identifying and preventing contamination. Both common sense and science are combined to ensure the production of safe food. HACCP was first developed in USA as a joint effort of the Pillsbury Corporation and the United State Army Laboratories as a system that ensures food is free from pathogens and toxins (Crosland, 1997). The Codex standard, which was included under the agreement of Sanitary and phytosanitary reference for international food safety and baseline of consumer protection is based on HACCP system principles (Slatter, 2003).

Small and mediums companies in the food industry are faced with many critical point in developing their competitive abilities, one of these critical points are implementation of HACCP to costumer care and the market demand for healthy and safe food, ecological standard and some of the requirements facing the food procedures. As well, this imply implementation of HACCP which is the standard of (ISO 22000:2005) (Dejan *et al.*, 2010).

Puckett and Schneider (1997) summarized the strategy developed to prevent the occurrence of the food hazards by controlling the environment and processes that keep food safe in the HACCP plan. They mentioned an implementation a proper of HACCP program by having management commitment to food safety and the HACCP approach. The food producers benefits considerably by implementing HACCP standard especially with regard to customer protection that the standard protect the safe food in production and sale (Surak, 2007).

Surak (2007) described five preliminary steps and seven principles of (HACC). The preliminary steps of (HACCP) are: assemble the HACCP team, describe the product, identify intended use of the product, construct a flow diagram and conduct an on-site verification of the flow diagram. While the seven principles of HACCP are; conduct a hazard analysis, determine critical control points (CCPs), establish critical limits for CCPs, establish a monitoring system for CCPs, establish corrective actions, establish verification procedures and establish documentation and record keeping.

### **Application of a HACCP system in the slaughterhouse**

For Mortimore and Wallace (1998) the ante and post-mortem veterinary inspection cannot completely eliminate or reduce effectively contamination hazards for the production of safe meat. Therefore, the implementation of a (HACCP) system is an essential management tool, and the procedures of these principals guarantee that each animal is properly identified by its information from, does not come from prohibition or restrictions area, the veterinary medicinal products rules have been complied and there is nothing which might adversely affect human or animal health. The information about the animals should be available at least 24 hours before the arrival of the animals to the slaughterhouse. These information must include; the health status and the veterinary medicinal products or other treatments administered to the animals, in addition to the occurrence of diseases that may affect the safety of meat and

the results of any laboratory analysis to diagnose diseases and any other report submitted by the official veterinarian. Slaughtering the animals must take place after approval of official veterinarians who base their decision after the evaluation of food chain information.

## **2.3. International Standardization Organizations (ISO)**

### **2.3.1 International standardization organization (ISO)**

The international standardization organization (ISO) is one of requirements for any organization in the food chain is used by the international organizations for standardization. It is concerned with issuing conditions that a certain process, product, service, material or raw material must satisfy. Standardization also assumes defining and issuing continuous requirements that a product, service, process or management system must fulfill within a certain period of time (Surak, 2007). Recognized worldwide, this universal standard harmonizes key requirements and overcomes the difficulties of various food safety standards by region, country, activity, organization and food-type (Varzaka, 2015).

These international standards allow an organization to implement an externally developed combination of control measures. The aim of this international standard is to harmonize on a global level the requirements for food safety management for businesses within the food chain. It requires an organization to meet any applicable food safety related statutory and regulatory requirements through its food safety management system (ISO / ISO 2204). The standard can be applied on its own, or in combination with other management system standards such as ISO 9001:2000, with or without independent (third party) certification of conformity (Frost, 2005).

(Holt and Henson, 2000) Claim that, ISO standards are applicable to the slaughterhouse industry; ISO (9001-2000), HACCP and (ISO 22d000: 2005).In this regard, the ISO 22000 and ISO 9001 are two standards have been aligned



together to enhance the compatibility (Huss, 2003). Especially in the fresh meat (low processing), in which microbial hazards can be eliminated. Thus, only hygiene concepts using the basic HACCP methodology can be developed (Upmann and Jacob, 2004). HACCP principles with food safety and inspection services (FSIS) can maintain or even improve food safety and other consumer protection conditions relative to traditional inspection methods (Cates *et al.*, 2001).

ISO 22000 is the new international common standard systems for food safety management systems (FSMS). The Food Safety Management System should cover organizational and technical issues and address the needs of the consumer based on the concept of continuous assessment and participation of all employees working in the slaughterhouse as well (Jouv, 2000).

Ioannis (2009) adopting the ISO 22000 standard provides the company with competitive efficiencies worldwide. That company can plan better and less post-process verification and can take their decisions. The first, benefits of (ISO) incorporate the legal and regulatory requirements relating to food safety including HACCP systems and provides a framework for third-party certification. Secondly, benefit grantee continuous improvement and improved internal and external communications and facilitates traceability and clear communication across the supply chain. Thirdly, the HACCP speeds and simplifies processes, increases efficiency and reduces costs without compromising existing or other quality or management systems. Finally, ISO 22000 ensures safety of food products by greater health protection and reduces risk of product/service liability claims that increase international acceptance of food products.

### **2.3.2 Gulf standard organization (GSO)**

Gulf Standard Organization (GSO) is a regional standardization organization established under the umbrella of the Gulf Cooperation Council for the Arab States in the Gulf area (GCC), and it includes members as: United Arab

Emirates, Kingdom of Bahrain, Kingdom of Saudi Arabia, Sultanate of Oman, State of Qatar and the State of Kuwait. GSO Members are member bodies in; Codex Alimentarius Commission (Codex), Office International des Epizooties (OIE), and International Plant Protection Convention (IPPC). They are also signatory on Technical Barriers of Trade (TBT) Agreement; Code of Good Practice for preparation, adoption and application of standards GSO.

Main Functions of GSO include: Formulation, preparation and publication of GCC Standards and Technical Regulations. In addition to further Formulation of GCC conformity, assessment procedures, legal and industrial metrology and quality and other standardization activities on the GCC level. Further function of the GSO include facilitation of the intra GCC trade as well as international trade through elimination of technical barriers to trade, protection of the consumer, health and environment. The GCC Standards and Technical Regulations are to be formulated to meet many requirements such as; health, safety, public procurement and international trade, the GCC Committee for Food and TBT&SPS Agreements ([www.GSO.org.sa](http://www.GSO.org.sa)).

The Gulf Cooperation Council set the countries standards for the foreign slaughterhouses exporting meat to gulf countries which based on the prerequisite program including good manufacture practices (GMP) and general hygienic practices (GHP) according to GS (21/1984) standards.

### **2.3.3. The GS (21/1984) standard**

#### **2.3.3.1 Hygienic Regulation for Food Plant**

The GS (21/1984) standard include design, materials, services, maintenance and controlling authority and management responsibility of slaughterhouses.

##### **a) The design of the slaughterhouses**

The slaughterhouses should be located in an area approved by the concerned controlling authorities. Its building should not be located in an area subject to floating source and it should be far away from any objectionable contaminant

such as, smoke, odors or dust. Size-wise, the slaughterhouse area should be wide enough to include sufficient space for storing both raw and finished products.

Regarding the slaughterhouse buildings and facilities, they should be sound, provided with enough lightening, adequately ventilated and easily cleaned and should have secured entrance harboring, environment contaminants and apply hygienic operations in a regulated flow in the process lines. The intensity of light should not be less than: 5x at all inspection points; 220 lux in work rooms; 110 lux in other areas.

The ceilings and walls should be light coloured, easy to clean and sanitize; all joints tightly should be coving to facilitate cleaning, and prevent accumulation of dirt and condensation. The floors should be durable, water-proof, nonabsorbent, nontoxic and easy to clean materials. The surface should be non-slip, even and free from crevices to facilitate draining. The stairs, lifts and additional installations should be constructed to avoid contamination of food and to facilitate the process of frequent cleaning. Doors should be: hard, smooth, impervious, washable surfaces and tight fitting and automatically closed. Windows are to be constructed in a way to avoid accumulation of dirty, and facilitate easy cleaning and maintenance, provided with suitable net screens and can tightly self-closed.

The inspectorial staff should be provided with a separate staff amenities with adequate number of washable walls, ceilings and floors changing rooms. The bath rooms should open far out a way from food handling places, and there should be two bathrooms for every 10 persons. The bath rooms should be provided with sufficient hot and cold water, and approved soap and hand towels, self-closing doors, well lighted and ventilated. And also provided with wash basins, showers and flush lavatories.

In addition, the slaughterhouse should encompasses specific requirements, namely lairage, Slaughter room and Holding-rails. The lairage should be

strongly constructed and adequate ventilation and good lighting, smooth floor and have a cover. Area of each pen should limit on the base of 3.3 m<sup>2</sup>/cow and 0.7 m<sup>2</sup>/sheep or goat. Furthermore, each pen should have an adequate water supply and a feeding trough. Round corner posts should be used and avoided protruding bolts, nuts and wires. A lairage for inspection of animals should be provided an adequate space and, clearly separated area for the isolation of suspect or diseased stock. Covered restraining facilities should be provided to allow for close examination of animals when necessary.

The Slaughter room or slaughterhouse Hall: The way from the lairage to the slaughter room should enclose and be designed to allow a single line of animals to quietly progress to slaughter. The layout of slaughter room should conform to Islamic requirements, for satisfaction, and reflect the manner of the work carried out in. The equipment should be designed as to minimize animal stress; to automatically restrain the animals in the defined attitude for slaughter, then to have them positioned immediately after the slaughter cut and ensure blood discharge does not contaminate the carcass and pelt. The layout of slaughter room and equipment should facilitate continuous process or physical separation between animals to meet full and proper slaughter rites, and to minimize cross contamination. Carcass dressing room should be provided with effective physical separation of edible and inedible material. Slaughter room equipment should minimize the opportunity of contaminating carcass surface. A room should be provided with space to allow cleaning of digestive organs, together with a separate room for the further processing of the organs. Separate individual rooms should be provided for storage of hides, horns and hooves if the holding period extends beyond one day. Slaughter and dressing rooms, refrigerated rooms and transfer corridors should have carcass holding rails of sufficient height and positioned away from walls.

The refrigeration systems should have adequate capacity with control systems for each department or storage area and supply clean air. Condensation

from refrigeration units should be pipe directly the processing or storage rooms. The equipment used for disposal of refused meat and inedible parts should be well designed. The optimal refrigeration temperature degree should be  $(- 0.5 \pm 1)$  and the humidity degree in the range (90% - 95%). Finally, the Slaughterhouse should contain a laboratory for veterinary tests to take periodically samples from production lines for analysis.

#### **b) Materials and equipment of slaughterhouses**

All surfaces in contact with food should be non-toxic, smooth, no odour or taste, corrosion-resistant, free from pits and non-absorbent. Galvanized iron should be not used in the food processing equipment. Plastics or glass used in manufacturing equipment should be abrasion resistant and should be not contain phenols or free formaldehyde. Steam boilers and packing materials should be non-porous and non-absorbent. Canvass belts used should be made of suitable material, easy to be cleaned and non-absorbent to food juices.

Sanitary design (Equipment and utensils) should be designed and fix, easily cleaned and sterilized. Industrial safety and protection should be provided for sharp ended equipment and utensils.

#### **c) Services of slaughterhouse**

The Potable water should be provided in sufficient amounts and be suitably protected against contamination. It should be conformed to the Gulf standard to be approved by Standardization and Metrology Organization for GS 149/1993 “Bottled and Un bottled Drinking Water”. In addition to cold water, the potable hot water apply should be in 82°C temperature, and an effective water temperature control and monitoring system should be installed and maintained. The potable water system should be completely separated from any other water or liquid transfer systems. Non-potable water should be conformed to hygiene regulations approved by official hygienic authorities, and be free from microbiological contaminants and should contain no more than 4 per 100 mi of coliform bacteria.

Effluent and waste disposal systems should be approved by the concerned controlling authorities and should be efficient and well maintained, identifiably separated from the potable water supply, to ensure no cross contamination to it. All effluent lines should be large, adequately trapped and vented. Effluent pumps and collection points should be kept outside the area of meat processing or store.

The drainage system should connect with an adequate sewerage system and should meet local regulatory requirements. Lines from toilets should not be connected with any other drainage system within the facility. Floor inlets to the drainage system should be covered with a grill or similar barrier. A general refuse and waste collection and disposal system should be provided. The system should be ensured that the waste materials are separated from edible products. Collection and temporary waste storage areas should be situated away from edible processing and storage areas and be designed to prevent cross contamination and environmental nuisance.

The equipment, containers and methods used for handling and transportation of the waste products and inedible materials should be designed and maintained to isolate such materials from edible products. All enclosed buildings should be proofed against the entry and harbor of pests and rodents in order to prevent the spread of contamination and disease.

**d) Maintenance:** All site facilities, buildings and equipment should be well maintained at all times.

**e) Controlling authority and management responsibilities**

An official qualified veterinarian, appointed by the controlling authority should be applied all conditions of this standard. In particular, at least one official veterinarian should be appointed for the supervision of hygiene, including meat inspection in slaughterhouse.

Management responsibilities include: implementation and maintenance the hygiene standards. However, the manager should designate a single

individual as a “Hygiene Officer” directly. The hygiene officer should have the authority to halt production in operating conditions if are not to required standards. The maintenance of hygiene standards should, be the duty of all production staff. The manager should also establish and maintain regular cleaning and sanitation program schedules, this programs should keep site in processing areas and equipment clean.

The controlling authority should be designed and commissioning approval all facilities, services and operating system. And also, establishing documentation, verification and traceability system. Staff should be well informed about the significance of contamination and hazards, and should be trained on cleaning methods, and meat processing and transportation to fulfill their designated functions.

### **2.3.3.2 Hygienic regulations for their personnel**

#### **a) Hygiene of personal**

All personnel in contact with meat should be subject to medical examination to prior employment and every 6 months thereafter. The medical examination should pay attention to; wounds and infectious sores, enteric disease and respiratory diseases. Every person on duty should wear suitable protective clothing, wash his hands with water and approved soap before commencing work and must have a high standard of personal cleanliness. Special equipment should be from impervious material and sharpening steels and belts and easy to clean. All kinds of behavior which can contaminate meat should be prohibit, and the manager of the slaughterhouse should ensure the adherence to Gulf standard and the personnel hygiene.

#### **b) Hygienic operating conditions**

**1.** Cleaning and sanitation during operation; All equipment in contact with meat at slaughterhouses should be washed and sanitize during processing. The

contaminated equipment should immediately and thoroughly be cleaned and sanitize. Sanitization should be carried out by water at (82C°/ 30 seconds) or with water containing 50 ppm chlorine for 2 minutes. Equipment and utensils used for slaughtering and processing should not be used to cut and dress meat. The floors of processing rooms should be free from discarded materials be during processing. The carcasses which did not pass postmortem inspection should be washed after handling .The daily clean-up procedures; at the end of processing, all equipment land the processing rooms should be cleaned and sanitized as well as.

**2.** Hygienic slaughtering and dressing; every animal intended for slaughtering must undergo ante and postmortem inspection. No animal should be slaughtered without an inspector's approval.

For hygienic slaughtering the animals should be slaughtered without delay, and the slaughter rate should not exceed the permissible limit level. Before carcasses are hoisted into a hanging position, the esophagus should clip. On the other hand, the skinning should be carried out animals in the hanging position to assure hygienic dressing. The carcass should be completely skinned before evisceration commences, the head must also be skinned. Pumping air is prohibited unless by a hygienic method. Evisceration should be carried out in a manner that prevents contamination of the carcass with the content of abdominal organs and to avoid of carcass to contamination with the secretions.

#### **2.3.4. GS (815/1997) standard**

The *GS (815/1997)* standard is concerned with the operating requirements for slaughterhouses (The Slaughtering Process) these include:

**a)** Transportation of animals for slaughter; Vehicles used for the transportation of slaughter animals should be durable of construction, non-slip, with suitable ramps, and have tying points or partitions and Screening.

**b)** Pre-slaughter holding and slaughter the requirement concerned in this:



- i. The identification system of the Animals should permit what to be maintained after dressing. Different species of animals, should be kept in separate pens.
- ii. Cleaning; Lairages should be cleaned daily to remove animal faeces, urine and other materials.
- iii. Ante and post mortem inspection; the animals should be subjected to ante mortem inspection by a veterinarian not more than 24 hours before slaughter. Animals suspected of being diseased should be identified and separated accordingly, they should be slaughtered in special area and their carcasses should have particular attention in inspection. The inspection point of the post-mortem should have adequate size, have appropriate lighting and adequate facilities for the meat inspection services.
- iv. Animals handling; animals should be treated quietly and gently, and should not be used heavy wooden sticks or metal bars and electric prodders should be set at 50 V.

**C) Slaughtering;** Slaughtering should be carried out according to the GS (993/1998) standard requirement of the animal to be slaughter; it should not be unlawful animals for Muslims to eat, it should meet the slaughter rules to Muslim or *Kitabi*. The slaughterer has to know well the rules of “*Dakah*”. The slaughtering tool should be of made from material, but clean and sharp and electrical stunning is allowed. The stamp of the Islamic center or organization should tamper proof and the branding ink should stable and un-harmful to health.

## 2.4. The Certifications

Meuwissen *et al.*, (2003) defined certification as the voluntary assessment and approval by an accredited party according to neutral accredited standard and independent third-party audits by a certifying party with the aim of assessing the compliance of a certifiable party with a standard typically laid down in a systems. Hand-books are at the heart of certification procedures. Luning *et al.*, (2002) added that a firm receives a certificate after successfully passing the audit procedure then the certificate can be used as a quality signal in the market. This reduces the quality uncertainty of buyers and thereby, lower transaction costs. Meuwissen *et al.*, (2003) mentioned that certification has to be distinguished from the activities of public surveillance and control authorities that control fulfillment of legal requirements and also be distinguished from second-party audits by customers checking compliance with their own standards. Jahn *et al.*, (2003) roughly distinguished between private and public standards. For them the public standards can be laid down by national or regional governments while the private standards can be laid down by customer. The objectives of certification schemes can have very diverse objectives as Porter (1989) conceived, he roughly described them as the improvement of food safety by guaranteeing compliance with minimum standards and differentiating food products. For him the minimum standard schemes reduce quality uncertainties such as freedom from microbiological risks.

One current controversy in agricultural economics revolves around the question whether higher food quality and safety standards can be met in traditionally organized food supply chains (Windhorst, 2004; Schulze *et al.*, 2006). In this respect Den Ouden *et al.* (1996) identified the growing requirements of the customers' for quality as a major impetus behind contracts and vertical integration. Product differentiation, in particular, emerges in order to meet the ever changing consumer demands such as animal welfare, food safety and

environmental issues; which are considered as important drivers of closer ties in the meat supply chain. International schemes have been broadly implemented in two or more countries. Examples are the International Food Standard (France and Germany), ISO (9001 and 22000) and Gulf Standard Organization (GSO). GSO through the technical program of committee has updated the GSO standard (GSO.1931) Halal Food certification.

## **2.5. Gulf Standards Organization (GSO) Certification**

The Gulf standards organization (GSO) certification was issued after the competent authorities responsible for food control in the GCC countries recognized the effective and efficient inspection and certification systems as fundamental components in food trade. The common goal of competent authorities is an integrated and harmonized import inspection and certification system without prejudice and in the obligations of the relevant World Trade Organization agreements. This system will be fit for purpose and will ensure consumer protection while facilitating trade. The responsibility of GCC is to ensure all food arriving in the GCC countries complies with the relevant GCC requirements, the assurance provided by documentation and certification. These Guide documents are a commitment to science-based import control systems and clearance procedures that are applied in proportion to potential risks to consumers from imported food responsive to new or emerging risks that may arise in the global food supply. They also address non-food safety (i.e. food suitability) requirements in a transparent and objective manner. (Agriculture and fisheries resources directorate, 2015)

The GSO Certificate (paper or electronic) issued by the competent authority in the country of origin or the country of exportation, attesting that the safety and suitability of the consignment of food is in accordance with the relevant technical regulations of the GCC increasing registration numbers of food establishments, or approved alternative equivalent measures. The authenticity

and accuracy of official certification and certification by officially recognized bodies will be periodically verified and audited by the countries of the GCC. The certificates required are:

1) Health certificate for export of meat and meat products; this is the assurance certificate which issued by concerned competent authority and the template format of health certificate was approved by GCC which based on principles stated on codex (codex *CAC/IGL* 38-2001). The requirements of the health certificate include and assure that:

- i. The meat/meat product is in conformity with the existing GCC requirements.
- ii. b. The source of meat shall meet OIE criteria, which relate to fitness for human consumption.
- iii. c. Animals have been slaughtered in a slaughterhouse that is approved by the GCC authorities and is under the supervision of the Competent Authority of exporting country.
- iv. d. The meat is produced from animals that have been subjected to ante-mortem and post-mortem inspection by the Competent Authority, in accordance with GCC requirements.
- v. e. The meat and/or meat product was handled in accordance with the GCC requirements, at an establishment that has been subjected to inspections by the Competent Authority and implements a food safety management system based on HACCP principles or an equivalent system.
- vi. f. Good veterinary practice has been applied use of veterinary medicines (including growth hormones) and agriculture chemicals in live animals, and any residues in meat comply with GCC requirements.
- vii. g. The meat/meat product originates from animals that have not been slaughtered for the purpose of disease eradication /control.

- viii. h. The meat/meat product has not been derived from animals fed with processed animal protein, excluding fish meal, according to the GCC requirements.

## 2. Health Attestations

Health attestations declared by the competent authority in an exporting country of dispatch, this certification assure that the food meets the requirements of system compliance and product safety of the importing country.

## 2.6. Economics of Quality

(Keogh *et al.*, 1989) the terms "economics of quality" and "quality costs" are often considered to be synonymous. The economics of quality is economic analysis applied to Quality Control while the quality costs are the specific cost items attributable to quality improvement activities. In general there are two main approaches to deal with the economics of quality. Firstly, there are models which are supposed to reflect the 'economic cost of quality'. Secondly, emerging developments have a basis in systems approaches to quality costs.

The practical measurement of quality costs involves dealing with the attitudes and approaches by management to exactly analyze what constitutes a quality cost. Many components of quality costs can only be estimated and this adds to the difficulty in applying the economic models of analysis in an organization.

### 2.6.1. Economic cost of quality

The cost of quality defined as the conformance which the price needed to ensure things turn out right and nonconformance which shows expense incurred in doing things wrong (Crosby, 1979). This concept is more readily understood by the manufacturing sector because of the need to comply with specifications and standards set by the company or customers. In large companies the cost of quality is important to justify the considerable investment incurred in a process of continuous quality improvement (Dale *et al.*, 1989).

The increase of the prevention cost is actually result of the decrease failure's costs (Campanella and Corcoran, 1983). However, this decrease should be larger than the cost of failure then the cost of prevention and total quality costs would be overall reduced.

### **2.6.2. Quality costs (Prevention/Appraisal/Failure)**

Feigenbaur (1961) proposed a model to analyze quality cost that is almost universally accepted (Plunkett and Dale, 1987). This model assumes that production costs relevant to quality changes can be divided in three categories: prevention costs, appraisal costs and failure costs.

The Prevention Costs are the costs of activities aimed at preventing defects occurring during the development, production, storage and transport of a product. They relate to quality before a single unit of product is made. They became an essential component of the quality cost scheme after the introduction of HACCP and quality assurance (QA) concepts.

The Appraisal costs are the costs of inspecting and testing to ensure that the products were conformed to quality requirements.

The Failure costs are the highest type of quality cost in virtually any operation. It includes the internal failure costs (Scrap; Reprocessing and Other costs) and the external failure costs related to international food trade and external failure costs related to domestic markets.

## **2.7. Cost- Benefit Analysis**

Cost- Benefit Analysis (CBA) is a technique used to evaluate individual projects, or compare alternative projects, which involve costs and generate revenues over a number of years. Cost-benefit analysis has become a widely used technique in public policy-making due to the widespread interest in observing the tangible economic benefits of a given strategy (Levenstein and Dunn, 2005).

### **2.7.1 Financial benefit-cost analysis**

The Asian Developing Bank (ADB) (1999) used the financial benefit-cost analysis to assess the financial viability of the proposed project. This analysis is done for the chosen least-cost alternative which is identified. In the financial benefit-cost analysis, the project is the unit of analysis and not the entire economy. Therefore, maintained is the additional financial benefits and costs which are attributable to the project.

Financial analysis is the subject of the ADB Guidelines on the financial analysis of projects. The financial benefit-cost analysis includes the following: determine annual project revenues and project costs, calculate annual project net benefits, determine the appropriate discount rate. (i.e., weighted average cost of capital serving as proxy for the financial opportunity cost of capital), calculate the financial net present value; calculate the financial internal rate of return and Sensitivity analysis.

### **2.7.2. Sensitivity analysis**

Sensitivity analysis is a technique used for investigating the impact of changes in project variables on the base-case. Only adverse changes are typically considered in sensitivity analysis. The purpose of using the sensitivity analysis is to:

- Help identify the key variables which influence the project cost and benefit streams. The key variables to be normally included in sensitivity analysis include investment cost; O&M cost, financial revenues.
- Investigate the consequences of likely adverse changes in these key variables.
- Assess whether project decisions are likely to be affected by such changes
- Identify actions that could mitigate possible adverse effects on the project.

# CHAPTER THREE

## 3. METHODOLOGY

### 3.1. The Study Area

Elsahafa slaughterhouse is located south to Khartoum local market, Khartoum locality, Khartoum state, between 9°31'N and 15°N and 32°S and 33'1°S, about one kilometer from Khartoum airport. The slaughterhouse occupies an area of 5400 square meter and connected to Khartoum local market and airport by Asphalt roads. It was established in the mid (70's) of the last century, and rehabilitated and modernized by Pinar slaughtering and meat processing company as modern slaughterhouse in 2012. The main objectives are to keep meat hygiene, organize the slaughtering processes and limit illegal slaughtering practice, increase meat supply in local markets and contribute to meat exports.

The slaughterhouse was originally owned and operated by Khartoum locality and continued to be administered by the locality until 2013, when it became a joint venture between Khartoum locality and Pinar Company and meat processing. However, the slaughterhouse is technically under the supervision of the Department veterinary and public health, ministry of agriculture and animal resource, Khartoum State.

### 3.2. The Standard Quality Model Adopted

The major market for Sudanese meat is the Gulf countries, which require adoption of a high quality assurance system that satisfies the Gulf standards organization (GSO) requirements. These include the following major standards:

- Standard GS (21/1984) “Hygienic Regulations for Food Plants and Their Personnel”. This Standard was used to assure and satisfy the requirements



of slaughterhouse design, materials, services, maintenance and controlling authority and management responsibility.

- Standard GS (593/1995) “Meat and Meat Products - Physical Tests”. This standard was used to identify the requirements of physical tests during the post-mortem inspection of meat.
- Standard GS (149/1993) “Un bottled Drinking Water”. The standard was used to satisfy the need of sufficient amount of water and suitably protected against contamination.
- Standard GS (815/1997) “Code of hygienic practice for preparation, transportation, handling and storing of fresh Meat’. Also the standard was used to assure the slaughterhouse operating requirements or and the slaughterhouse process.
- Standard GS 993/1998 “Animal Slaughtering Requirements According to Islamic Law”. This Standard to meet the requirements of slaughtering methods according to Islamic Law.
- Standard GS 714/1997 “Transportation Regulations of Livestock by Rail, Road and Ships - Part 1: Transport of Sheep and Goat”-Part 2: Transport of Cows and Buffalos. This standard used to identification the quality requirements of transportation of the animal to the slaughterhouse and the requirements of the vehicales.

### **3.3. The Costs Components of Improving the Quality of the Slaughterhouse**

#### **3.3.1 Investments costs**

a) The fixed costs

Are include; the rent of the slaughterhouse land, establishment costs of the slaughterhouse building and equipments and administration cost.

b) The fixed costs of improvements of EMSH

These include; design and layout improvement, equipments costs, the required training courses, Gulf Cooperation Council (GCC) certifications and feasibility study fees (5% of investment cost) and improvement of the administration.

### **3.3.2 Variable costs**

The variable costs are include; annual license fees, annual training programme costs, annual maintenance costs, costs of utilities (electricity, telephone, *et)c* and fuel.

## **3.4 The Benefits Components of Improving the Quality of the Slaughterhouse**

### **3.4 .1. The benefits components without improving the quality**

These include; Sales of meat, the inspection, testing and slaughtering fees, sales of by-products and sales of hide and skin.

### **3.4 .2.The benefits components with improving the quality**

Are include; annual exported meat sales, annual administration fees, annual health certifications fees and annual revenue of the by-products and sales of hide and skin.

## **3.5. Sources of Data**

### **3.5.1. Sources of the secondary data**

The study relied on the slaughterhouse records as sources of the secondary data. These include establishment, location, capacity and financial statements. Also slaughterhouse records were used to identify the components and estimate the quality cost, labor and equipment required to carry out quality system requirements. The records also provide all data needed to describe the current situation of slaughterhouse. Moreover, some data are collected from records of Ministry of Animal Resources and credible web-sits. All data related to quality programs such as, food safety management system, prerequisite program, standards operating procedures system, HACCP system were obtained from

peer reviewed papers. In addition, data related to costs items require collected from market services.

### **3.5.2. Sources of the primary data**

The study was based on in-depth interviews with managers and staff members of slaughterhouse involved in the compliance to international standards of quality and implementation Quality assurance systems. Moreover, some personal observations of researchers on the currant quality situation of the slaughterhouse were documented using a camera.

## **3.6 The Prices Used in Calculation and their Sources**

**Appendix 1:** The prices of the investment items including administration and GCC certifications.

**Appendix 2:** The prices of the investment items of design and layout.

**Appendix 3:** The prices of the investment items of materials, equipment and services provided.

**Appendix 4:** The cost of the investment items of the required training courses.

**Appendix 5:** The prices of the variable items of (salaries -wages-incentive) of slaughterhouse employee.

**Appendix 6:** The prices of the operating items of the administration of the slaughterhouse

**Appendix 7:** The price of the benefits items

The average Sudan's currency exchange during the time of this study (2016-2017), was (\$1=SDG 27) in parallel market (central of Sudan bank ,2017) The Sudan's currency exchange in 2006 was \$1=2.17 SDG ( central of Sudan bank ,2006).

### **3.7 Data Analysis**

The cost –benefit model was used to analyze the data using Microsoft excel programme (Appendix 9). The study used the evaluation criteria include:

a) The investment profitability criteria:

1. The discounted criteria; Net cash flow (NCF), Net present value (NPV), internal rate of return (IRR) and Benefit cost ratio (BCR)
2. The undiscounted criteria; Payback period (pp), Simple rate of return (SRR) and Benefit cost ratio (BCR).

b) The sensitivity test analysis criteria; the study used various scenarios of changes in prices and costs ranging between 10% - 50%:

1. Increase the total costs by 10% and by 50%.
2. Decrease the total benefits by 10% and by 50%.

# CHAPTER FOUR

## 4. RESULTS AND DISCUSSION

### 4.1. The Current Quality Situation of Elshahafa Modern Slaughterhouse (EMSH)

#### 4.1.1. The hygiene of the slaughterhouse

The Situation analysis with regard to hygienic of the (EMSH) includes: Controlling authority and management responsibility, Design, Materials, Services and maintenance of slaughterhouse.

##### a) Management responsibility and controlling authority of slaughterhouses

The slaughterhouse management structure is not based on modern methods of management techniques. There is no organized pattern managing the slaughterhouse with little consideration to the technical issues needed to efficiently running the slaughterhouse. The controlling authority of the slaughterhouse do comply with animal health regulations, but they not comply or apply the food safety legislation, quality assurance (QA) systems and hazard analysis of critical control point system. Moreover, the concerned administration does not plan to certify the slaughterhouse or adopt training programs to the skills and abilities of the employees and increase awareness of workers. The management of the slaughterhouse do not keep proper records and relied documentation systems to keep information of the slaughterhouse, for marking and evaluate (EMSH).in addition to, there is no effective maintenance systems to meet the requirement of good scheme and efficient procedures.

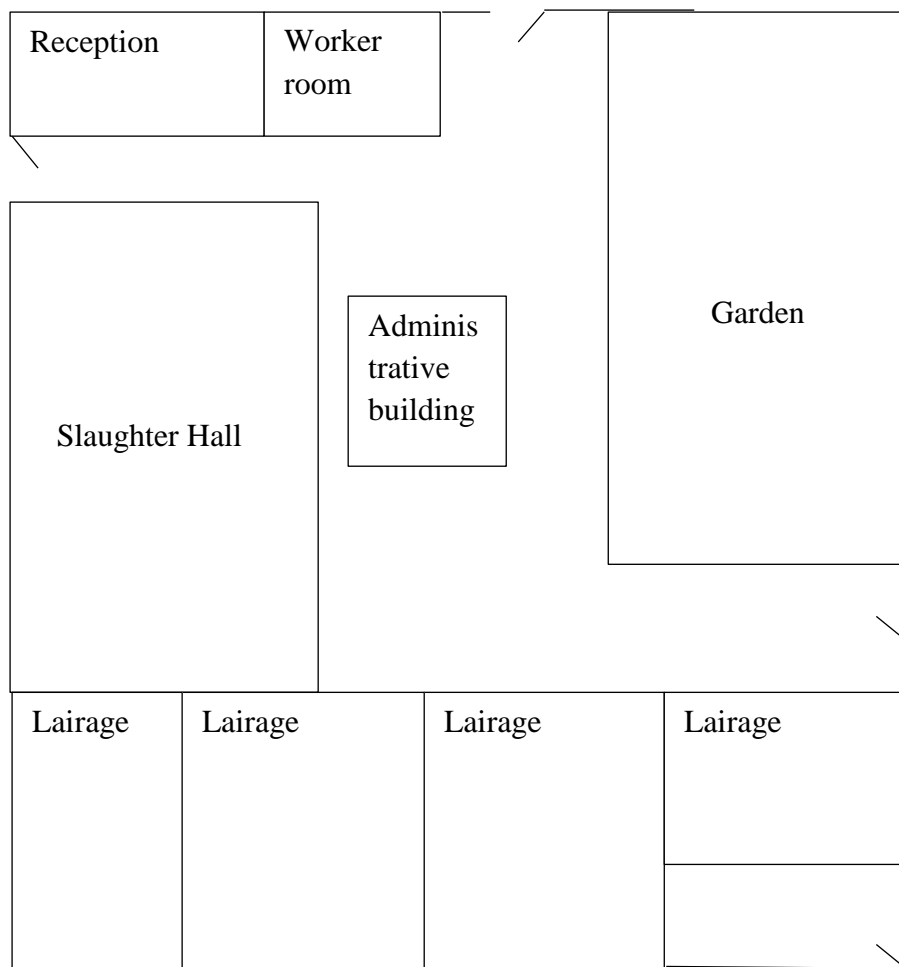
The organization structure of the slaughterhouse consists of: slaughterhouse-manager, deputy manager, courier, driver, laborers, technical-troubleshooter, technical-cooling, veterinary doctors, vet-technician, Hall-monitor, health-observer, slaughterers, Shearers. (Table 4.1) shows the member and distribution of workers in (EMSH).

**Table (4.1): The Labor Forces in Elshafa Modern Slaughterhouse**

Occupation	Number	Education level	Grade
1-The manager	1	University grade	Grade 2th
2- Deputy manager,	1	Secondary school	Grade 4 <sup>th</sup>
3- Veterinary doctor	4	High educate (MSC)	Grade 3th
4- Vet -technician	1	University grade	Grade 8 <sup>th</sup>
5- Hall-monitor	1	Secondary school	Grade 3th
- Health- observer	1	University grade	Grade 5 <sup>th</sup>
7- Technical-cooling	1	Secondary school	Grade 14th
8- Driver	1	Secondary school	Grade 14th
9- Laborers	8	Primary school	Grade 15th
10-Technical troubleshooter	1	Secondary school	Grade 17th
11- Courier	1	Primary school	Grade 17th
12- Slaughterers& shearers	14	Illiterate	Grade 15th
<b>Total labuor-forces</b>	<b>35</b>		

**b) Design and layout**

The slaughterhouse is surrounded by stonewalls. All the buildings are designed in fixed materials metal, cement and stones. There are four accesses; the first is beside Lairages to enter the animals, the second for meat transmission cars, the third is the exit of waste and products, the fourth for personal entrance. The logic behind the several accesses is to reduce hazards and potential contamination although there is no serious obligation to comply with this logic. The yard areas are designed in flagstone and it joins a small garden. Electric light and power connection to public electricity supply is available beside stand-by generator. The capacity of the incinerator is about 120 kg/ hour of animal carcasses but currently not working (Personal observation, 2017).



**Figure (4.1): Design and layout of SMSH**

Design of slaughterhouse includes:

**The staff amenities;** the administrative building consists of three offices (for director, doctors and employee) beside the toilet and the kitchen. Another building consists of security room, workers changing room, storeroom, and toilets and selling room. There is no canteen and doctor rest.

**The lairage;** is designed to receive and store the animals before the ante-mortem inspection where the stock is kept overnight, also the ante mortem inspection is performed in these lairages. There is large lairage of about 1500 square meters divided to several pens, four pens for large animals (cows

camels), three for small animals (sheep & goats), one pen for animals that are waiting to be slaughtered after inspection and checking and there is especial Quarantine pen for sick animals. It is equipped with feed and water troughs in each pen. The capacity of lairages is 300 head for sheep and 200 head for cows. The floor and passageways are of sandy surface and there is no shelter to protect animals from the direct sunlight. The slaughterhouse depends mainly on the natural lighting and the available artificial lightings are insufficient.

**The slaughter hall;** It occupies about 600 square meter and designs in two flats the lower is for large animals and upper for small animals, large animals line is full automatic but the small animals line (in the upper flat) is not completely automatic, the carcasses are carried to chiller after being washed manually (by workers hands). The floor is sloped to drain for liquids to grated-trapped outlets. The walls are painted in light colour and they are not coving at the bottom. The doors are smooth and easy clean but no close fitting screen to protect from insects. There are no windows, the stairs are designed with materials do not allow contamination. The light fixtures are not adequate for inspection and it concentrated only at the wall sides, the ventilation system is based only for conditioning, although it is satisfactory yet, it needs to be checked and repaired.

The slaughter hall is divided in to two parts: Dirty area contains slaughtering, skinning and eviscerating processes and clean area contains washing and chillers. No partition between clean and dirty areas. All slaughter processes are done in traditional way disregarding to meat hygiene and food safety management system norms.

### **c) Materials and equipment**

All equipment (hook and saws) used in the slaughter processes are easy to decontaminate (it constructed of corrosion resistant material), whereas the knives are not of the required quality. Contact surfaces are constructed from non- absorbent, non –toxic and smooth material. There are no washbasins inside



to wash hands. It is worth mentioning that the equipment of the slaughterhouse except the knives were brought from CEMSAN Company, which was awarded the ISO 9001 certificate in 2008.

#### **d) Services provision to the slaughterhouse**

**The quality of water supply;** the potable water is provided in sufficient amounts supply from public water supply. But not protected against contamination for slaughter processes (not adequately clean). There is a supplement tank provide to drinking water. Although there is boiler but hot water system is it not operative. Thus, the knives and saws are not sterilized. However, non-potable water conforms to hygienic regulations.

**Effluent disposal, pests and rodents control;** the sewage system is designed in such to avoid cross-connection of effluent toilet waste will any other effluent waste and separated from the potable water supply. Effluent pumps and collection points were located near the slaughter hall. All effluent lines are large, adequate trapped and vented. The drainage system connected on adequate sewerage system. Floor of drainage system is covered by a grill. The waste materials are separated from edible products.

The equipment of the storage and processing facilities for animal waste products and inedible materials is found in separate areas.

**The solid waste;** were scraped by automatic press and carried by car. Blood disposal must be collected in drum tank but inoperative (workers do not slaughter in bleeding area).

**The pests control and rodents;** buildings are proofed against the entry and harbor of pests. Hide and skin processing; skins do not collected in hide room, but it was taken for the tanneries.

**The hygiene of the Personnel;** All workers and labors who contact meat during preparation, handling and transportation are not subject to medical examination and do not have certificate, do not wear protective clothes and gloves, there is no sanitation procedure for preventing contamination of carcasses or meat. All

kinds of passive behavior (tobacco, eating..etc) are evident contrary to standards requirement.

#### **e) Maintenance of slaughterhouse**

The slaughtering and dressing systems are maintained annually, whereas the receiving and lairage system do not, there are no schedules and documentation systems with adequate record.

#### **4.1.2. The slaughtering process**

**a) Satisfaction of the animal slaughtering requirements according to Islamic law”;** all slaughtering processes are satisfactory and confirm to the Islamic law of slaughtering methods.

#### **b) The hygienic practice for preparation and handling of meat**

This process occurs in two areas: The processing in dirty area and the processing in clean area. In the dirty area the following operations take place:

- i. Slaughtering: slaughtering of animals is performed without medical certifications and definitional records (only ante mortem inspection). Usually some animals are subjected to injury or fracture during loading. Stunning is done on the floor and there is no special bleeding area, the bleeding take place anywhere, some slaughtered animals are not sling for complete bleeding. There are no separate lines for small and large animals.
- ii. Skinning; although there are automatic systems for the hid, the skinning process is done manually in the traditional way without wearing gloves; they are not use the especial skinning knives. After skinning the hides are left on the floor and do not collected in hide-room resulting in hide being perishable and tarnish- able.
- iii. Eviscerating; all handling is done manually, the workers carry the red organs (Heart, Lung, Kidney and Liver) and the green offal (Rumen and intestine) to the offal rooms (additional rooms inside hall) for inspection. These rooms have insufficient ventilation (no windows and any other

ventilation sources) and lighting, the tables of inspection are fixed and not movable and that don't allow blood drainage.

In the clean area the following operations take place:

- i. Washing: workers wash carcasses manually (the automatic washing system out of work and needs maintenance).
- ii. Chilling: after washing carcasses are entered to the chiller.

**c. The hygienic practice for storing of fresh meat;** there are three chillers to store and froze in 4C & 18C, the overall capacity is 20 ton .The lighting need checking and there is no hygrometer and sewage system.

**d. The hygienic practice for transportation of meat:** vehicles that used for meat transmission do not comply with the standard.

**e. The physical tests of meat and meat products:** The meat is physically tested in postmortem inspection using knives but there is no equipped laboratory for quality assuring tests.

## **4.2. The Proposed Quality Situation for Elshafa Modern Slaughterhouse**

The study adopted the Gulf standardization organization (GSO) for Gulf cooperation council (GCC) model for quality assurance. Accordingly the Gulf Technical (GT) regulation and the technical program of committee TC No (5) “Gulf technical committee for sector Standard” shall be in the analysis and following features and practices will be followed.

### **4.2.1. The hygiene of the slaughterhouse**

The proposed hygiene of the slaughterhouse include; Controlling authority and management responsibility, Design, Materials, Services and maintenance of slaughterhouse.

#### **a) Management responsibility of slaughterhouse**

To improve and develop the capacity of slaughterhouse administration to apply modern management systems and techniques, the administration should follow

appropriate organizational and technical rules and regulations that meet requirement of GCC by adopting the concept of continuous assessment and participation of all employers in the slaughterhouse by:

- i. Adherence to animal health regulations and food safety legislation, and also apply quality assurance (QA) systems and plan for certification schemes.
- ii. Establishing and implementing the Food safety management system (FSMS), which make good environment to implement the Prerequisite Programs, which help to fulfil Hazard Analysis and Critical Control Point (HACCP) plans, in order to have the GSO certification.
- iii. Establishing and implementing the standard operating procedures system (SOPs) which defined take of all individual in the slaughterhouse.
- iv. Adopting training programs covering all employees to upgrade skills and abilities and increase awareness. The training programmes should be documented, updated annually and kept in special records that enable in identifying which are courses needed. The main or essential training courses should consist HACCP Implementation, Food Hygiene & Safety, prerequisites, and SOPs programmes. The training courses should be made for each particular level of slaughterhouse job as following:

The manager, deputy manager and veterinary doctors should have Risk assessment and Risk analysis in food safety, Food Hygiene & Safety Consultants Tools for safe food, Quality Assurance and HACCP requirements. However, the vet-technicians, Hall-monitor and health- observer should have courses on food hygiene - Quality Assurance and HACCP requirements. And the slaughterers & shearers should have training will enable them to acquire the necessary skills related to the slaughtering of animals, their dressing as well as cutting and skinning. The training should be at animal welfare “Animal welfare officer training”.

- v. Establishing records and documentation system to keep all information related to the slaughterhouse.
- vi. Establishing and adopting effective maintenance systems to cope with the good schemes, efficient procedures and keeping especial maintenance records.

## **b) Design and layout**

The staff amenities; the administrative building should include canteen, doctor rest and labors changing room.

The lairages; It should be suitably covered to provide protection against adverse weather conditions for animals waiting for slaughter. The floors of lairage and passageways should be properly sloped to satisfactorily drain and the surfaces should be safe to foothold animals. Also it should be provided by feed and water troughs, and there should be natural and artificial lighting, the lairage should have adequate equipped lockable exclusive. The lairage should be constructed of impervious materials to easy facilities and clean. There are particular place for ante mortem and detention facilities for animals need more inspection and/or evaluation.

The slaughter hall; all floors, walls, coving, doors, ceiling/ head fixtures and stairs in the production areas, should be constructed of durable, easy to clean and drain. The floors should be sloped to drain sufficiently. The doors and windows should be equipped with close fitting screens and smooth, non-absorbent surface .In addition to, stairs should be installed to prevent meat. The light fixtures should be protected in shatterproof diffuser, and should also be adequately lighted. The ventilation system should be eliminated and remove contaminated air. The sewage system should be with no cross-connection between toilet waste and any other waste.

## **c) Materials and equipments**

Materials and equipment should be designed in a manner that facilitates hygienic operation of the slaughterhouse and minimizes contamination. The

equipment use to hand- held tool (knives, hook and saw) should be sterilized (82c) during production process. The sterilizers used should be located near operative's workstations.

#### **d) Services on slaughterhouse**

The quality of water (water supply); the potable water should be provided by well-constructed filter and provided with particular tanker to pledge sufficient amounts and protected against contamination for slaughter processes. Hot water should be provided by boiling. And non-potable water should be treated-unit conforming with hygienic regulation,

The Effluent disposal should transmission through sluice drag to other area. The solid waste and blood disposal should conform to hygienic regulations. Hide and skin processing; the skins and hides will be collected in hide room and taken for the tanneries.

The hygiene of the Personnel; All workers and labors in contact with meat during preparation, handling and transportation should have medical examination and get medical certificate every 6 months, and they must comply with the sanitation procedure; wearing protective clothes and gloves for prevention from contaminated carcasses or meat and change all kinds of passive behavior (tobacco, eating).

### **4.2.2. Operating requirements in the slaughtering process**

#### **a) The hygienic practice for preparation and handling of meat**

All the slaughter process should be carried out under suitable conditions, health and hygiene rules which must be respected particularly during the slaughtering operations and handling of the carcass. Workers slaughterhouse must follow the hygiene procedures for those parts of the carcass, which must be removed, or need special handling in order to avoid contamination of the meat. Slaughtering of animals should be performed post medical certifications and definitional records before ante mortem inspection and the slaughter process start.

The stunning; must be done in the particular area for stunning and with special knives. Automatic chain drive in main hall slaughter, animal should be led into the bleeding area where it will restrain by a tether through the floor ring prior to stunning (using a captive bolt pistol). After stunning the animal will be shackled by one leg and hoisted, with a rope pulley block. The animal will stuck and allowed to bleed in this position and the blood collected in a drum for disposal. Cleaning and sterilization of hands and knives must be used in slaughterhouses so as to reduce the contamination.

The skinning must be done using machines to remove hides to reduce contact of exposed tissue with external surfaces of the skin. Once bleeding is complete the head can be removed , then the skin opened up along the breast bone and the hide partially flayed. Leg hooks will then be attached and the carcass will be raised to ‘half-hoist’ position on the spreader. Flaying can then be completed and hide removed and should be kept in skinning room.

In the eviscerating animal should be lowered onto the cradle for dressing. The feet should be removed, the paunch could then be removed to the inspection buggy and the red offal (including lungs if treated as edible) should be placed on hooks or the inspection table for inspection.

Washing after post-mortem inspection the carcass should be washed with potable water in sufficient amounts, protected against contamination in suitable temperature. Then sent immediately to chilling. The chilling temperature must also be maintained during transport. These temperature provisions may be unnecessary when the competent authority allows meat to leave the slaughterhouse immediately to be supplied as fresh meat at outlets within two hours travelling time.

**c) The hygienic practice for storing of fresh meat;** the chiller must satisfy GSO standard.

**d) The hygienic practice for transportation of meat;** vehicles that transmission meat should comply with standard.

e) **The physical tests of meat and meat products;** establishing equipped laboratory for assure inspection tests.

For professional qualifications of inspectors the veterinarian should have knowledge on relevant aspects of good farming, manufacturing and hygiene practices; quality management; principles, and methods of HACCP, auditing and regulatory assessment of food safety management systems, aspects of zoonosis and food borne diseases. This may acquire the necessary knowledge as part of their basic veterinary training, or through specialized training courses, or professional experience acquired, after qualifying as veterinarians. Inside physical tests of meat on postmortem inspection, an equipped laboratory should be available to assure these tests were done.

### 4.3. Identification of the Cost Items Required Improving the Quality of the Slaughterhouse.

**Table (4.2): The Investment Items Required Improving the Quality of the Slaughterhouse**

Areas	Shortfalls	Improvement needed
The slaughterhouse administration	-decrease in vet -technicians and drivers numbers	-Increasing vet -technicians to seven and drivers to two.
	- No transmission vehicles	-Buying two additional vehicles
	-No training programme	-Executing training programme in (TQM)
	- No (GCC) certifications.	- Acquiring GCC certifications
	- No Feasibility study	- Conducting feasibility study-
Designs and layout	<b>a-Lairage</b> -no roofing	<b>a-Lairage</b> - Build a roof (shelters)
	-sandy floors & passageways	Improving the floors & passageways
	-poor lighting	-Adding additional applicate lighting
	<b>b- Slaughter Hall</b> -incomplete automatic line	<b>b- Slaughter Hall</b> -installation of a full the automatic



		line& repair and space parts
	-no partition between big and small slaughter	-make of a partition between big and small slaughter
	- poor ventilation system	- Installation of exhaust fan, air-condition
	-changing rooms not adequate	-Building of additional changing rooms (two)and extra new toilets(6)
	-no workstation wash and provision in the toilets of (paper towels-bins-toilet paper )	-Repairing workstation and provision in toilets
	-no canteen and doctor rest room	-Establishing canteen and doctor rest room to doctors and after stroll
	-chiller: no lighting and no sewage system	- Adding lighting and sewage system
	-no thermographs	Adding a thermographs and other meteorological equipment
	-Incinerator ( no gas container)	-Adding gas container
	- no equipped Laboratory	-Establishing an equipped Laboratory
	- Electric power (generator).	Repairing of the generator
Materials and equipment	-no special knives	Providing special knives
Maintenance	- no programs for maintenance of slaughterhouse	-Establishing of a maintenance system
Services	Un clean potable water	-Providing filtration unit - Providing tanker with pipeline

### **4.3.1 The investment items**

#### **a) The investment item needed to improve the slaughterhouse administration**

Are include; training courses (On job and line) in quality assurance system for all workers and employees, employing seven vet -technicians and two drivers, (GCC) certifications and feasibility study.

#### **b) The investment items needed to improve the hygiene of the slaughterhouse**

These improvements include; adding shelter to the Lairage, additional lighting and maintenance of the floors and passageways. In slaughter hall introduction of a partition between clean and dirty areas, adding extra lighting, completing automatic line and repairing the old one and introduction of exhaust fan and air-condition. Also additional gas container for incinerator is needed, maintenance of the generator, changing the location of sluice drag and providing additional 30 pieces of special knives for processing and inspection.

#### **c) The investment items needed to improve the hygiene of the Personnel**

These include; maintenance of the workstation and provision of toilets, establishing a canteen and a doctor rest room and establishing changing rooms and toilets and washing basin.

#### **d) The investment items needed to improve the physical tests of meat and meat production**

Establishing a well-equipped quality control Laboratory (oven, Autoclave, Incubator, microscopes and Fridge).

#### **e) The investment items needed to improve the quality of water**

These include; constructing an ultra-filtration unit and providing a tanker with pipelines.

#### **f) The investment items needed to improve the hygienic practice for preparation of meat;**

Special knives for stunning, skinning and cutting.

**g) The investment items needed to improve the hygienic practice for transportation of meat;**

These include; protecting clothes for labors that transport meat and providing two extra transport vehicles.

**h) The investment items needed to improve the hygienic practice for handling of meat;**

No improvement required (all handling equipment are satisfying the standard requirements).

**j) The investment items needed to improve the hygienic practice for storing of fresh meat**

These include; equipping the chiller with thermographs temperature probes, increasing the number of lighting lamps by fourfold and constructing sewage system.

**i) The investment items needed to meet the requirement of slaughtering animal according to Islamic Law**

Animal slaughtering is satisfactory to the Islamic slaughtering law “Shariaa”.

### **4.3.2 The operating items**

**A. The operating items of the slaughterhouse administration expenses**

Include; fuel cost of vehicles and transmission and electricity and telephone expenses, annual maintenance cost (cars), annual license, depreciations rate, the salaries, wages and incentives.

**B. The operating items of the hygiene of the slaughterhouse**

Cleaning materials.

**C. The operating items of the hygiene of the Personnel**

Protective clothing, soaps and gloves & masks.

**D. The operating items of the quality tests of meat and meat Products;**  
materials of lab testing.

**E. The operating items of the quality of water;** filter maintenance

**F. The operating items of the hygienic practice for preparation of meat; no costs needed.**

**G. The operating items of the hygienic practice for transportation of meat; cleaning materials.**

**H. The operating items of the hygienic practice for handling of meat; cleaning materials.**

**I. The operating e items of the hygienic practice for storing of fresh meat  
Cleaning materials.**

## **4.4. The Cost Estimate of Improving the Quality of the Slaughterhouse**

### **4.4.1 The investment costs**

Table (4.3) represents the investment costs of the items mentioned in table (4.2). The total investment costs account about (\$ **3.96** million), the lowest cost item is design and layout improving costs which account to (about \$ **34.8** thousand) and the fixed costs are highest one.

**Table (4.3): The investment costs**

<b>Description</b>		<b>Items</b>	<b>Costs estimate</b>		<b>% of total</b>
			<b>SDG</b>	<b>\$</b>	
<b>The fixed</b>		The costs of slaughterhouse land	<b>54,000,000</b>	<b>2,000,000</b>	
		The costs of establishing the slaughterhouse	<b>3,639,040</b>	<b>1,676,977</b>	
		<b>Sub-total</b>	<b>57,639,040</b>	<b>3,676,977</b>	<b>92.8</b>
<b>Improvement Area</b>	The administration expenses	Employing six vet-technicians and tow driver.	<b>154,800</b>	<b>5,733.33</b>	
		The training courses costs	<b>137,700</b>	<b>5,100</b>	
		GCC certifications.	<b>0</b>	<b>0</b>	
		Feasibility study	<b>3,111,662.6</b>	<b>115,246.76</b>	
		<b>Sub-total</b>	<b>3,404,162.60</b>	<b>126,080.09</b>	<b>3.2%</b>

Design and layout improving costs	Build roofing(shelters)	200,000	7,407.41	
	repairing floors and passageways	55,000	2,037.04	
	Make partition between big and small slaughter	55,000	2,037.04	
	workstation and provision in toilets	15,000	555.56	
	- changing rooms and toilets	88,000	3,259.26	
	- lighting and sewage system in chiller	36,480	1,351.11	
	-Canteen and doctor rest	210,000	7,777.78	
	-Change the place of sluice drag	280,000	10,370.37	
	<b>Sub-total</b>	<b>939,480</b>	<b>34,795.56</b>	<b>0.9%</b>
Improving costs of materials, equipment	-automatic line (Sheep) and repairing old	900,000	33,333.33	
	The ventilation system exhaust fan, air-condition. etc....	25,000	925.93	
	-thermographs	1,323	49	
	-extend with gas burners	35,000	1,296.30	
	- Equipped laboratory	320,000	11,851.85	
	<b>Sub-total</b>	<b>1,281,323</b>	<b>47,456.41</b>	<b>1.2%</b>
Improving costs of services.	-adds extra lighting	10,600	392.59	
	- repairing the generator	300	11.11	
	- Buying vehicles	1,900,000	70,370.37	
	-Providing filter and tanker	170,000	6,296.30	
	<b>Sub-total</b>	<b>2,080,900</b>	<b>77,070.37</b>	<b>1.9%</b>
<b>Total</b>		<b>65,344,905.6</b>	<b>3,962,379.16</b>	<b>100</b>

#### 4.4.2 The annual variable costs

The annual variable costs accounted to (about \$99.1 thousand), the maintenance costs are the highest cost (about \$54.9 thousand) whereas the costs of License of slaughterhouse are the lowest cost (about \$ 185.2). Table (4.4).

**Table (4.4): The variable Cost**

Description	Costs estimate/year		25 year/\$
	SDG	\$	
The administration expenses	801,600	29,688.89	742,222.3
License of slaughterhouse	5,000	185.19	4,629.75
Annual maintenance costs	1,481,323	54,863.82	1,371,596
filter maintenance costs	30,000	1,111.11	27,777.75

Training programme costs	<b>26,460</b>	<b>980</b>	<b>24,500</b>
The services costs (water, electricity, etc...)	<b>91,200</b>	<b>3,377.78</b>	<b>84,444.5</b>
Materials of lab testing costs	<b>96,000</b>	<b>3,555.56</b>	<b>88,889</b>
Clean materials-gloves-masks-Protective clothing)	<b>37,100</b>	<b>1,374.07</b>	<b>34,351.75</b>
Transport cots	<b>107,040</b>	<b>3,964.44</b>	<b>99,111</b>
<b>Total</b>	<b>2,675,723</b>	<b>99,100.86</b>	<b>2,477,522</b>

## **4.5. The Annual Benefits of the Slaughterhouse**

### **4.5.1 The annual benefits before the improvement**

The annual benefits of Elshahafa slaughterhouse without improving its quality for the production to domestic markets. The average daily number of cattle and sheep slaughtered is 65 and 78 head /day respectively. The annual benefits are (about \$ 14.9 million) mostly of meat revenue (about \$ 14.2 million) and lesser extend the skin revenue (about \$ 64.7 thousand). (Table 4.5)

**Table (4.5): The Annual Sales without Improvement of the Quality**

<b>Description</b>	<b>Total benefits SDG</b>	
	<b>/year</b>	<b>\$</b>
Meat sales	<b>384,696,000</b>	<b>14,248,000</b>
The inspection, testing and slaughtering fees	<b>2,199,600</b>	<b>81,466.67</b>
by-products sales	<b>12,589,200</b>	<b>466,266.67</b>
hide and skin sales	<b>1,746,000</b>	<b>64,666.67</b>
<b>Total</b>	<b>401,230,800</b>	<b>14,860,400</b>

### **4.5.2 The annual sales with improvement**

The work in the slaughterhouse will be suspended for one year in order to carry out the rehabilitation necessary to improve the quality of the slaughterhouse, so the annual revenues of slaughterhouse in this year is considered as a cost. After the improvement the slaughterhouse will work at its full capacity (200 head of cattle and 300 head of sheep daily). The

slaughterhouse will operate twelve day per month to allow meat freezing. The annual benefits with the improvements accounted to(\$ 18.9 million), the meat revenue are the main benefit item (about \$ 18 million) whereas the administration fees consists a lowest item (about \$ 15.4 thousand) (Table 4.8).

**Table (4.6): The Annual sales with the Improvement**

Description	Total benefits /year	
	SDG	\$
meat sales	<b>484,416,000</b>	<b>17,941,333.33</b>
Administration fees	<b>417,600</b>	<b>15,466.67</b>
Medical certifications fees	<b>7,200,000</b>	<b>266,666.67</b>
by-products sales	<b>16,272,000</b>	<b>602,666.67</b>
hide and skin sales	<b>4,536,000</b>	<b>168,000</b>
<b>Total</b>	<b>512,841,600</b>	<b>18,994,133.33</b>

## 4.6 The Cost/Benefit Analysis

### 4.6.1. The cash flow of the improved (EMSH)

Table (4.7) and appendix (4.10) represented the total costs and the total benefits that will be incurred in the improvements of quality assurance of the Elsehafa slaughterhouse and the expected net cash flow. The live span of the slaughterhouse is assumed to be 25 year which is the hypothetical age of the slaughterhouse building (Ab elazeez, 2018) (interview).

**Table (4.7): The cash flow of the improved (EMSH)**

Description \ Years	Base year 0	Year 1-25	Total /\$
Investment cost \$	<b>3,962,379.16</b>	<b>00</b>	<b>3,962,379.16</b>
Benefit foregone in year 0	<b>14,860,400</b>	<b>0</b>	<b>14,860,400</b>
The annual variable costs	<b>0</b>	<b>99,100.86</b>	<b>371,510,000</b>
Total benefits	<b>00</b>	<b>18,994,133.33</b>	<b>474,853,333.25</b>
Net cash flow(NCF )	<b>-18,822,779.16</b>	<b>18,895,032.5</b>	<b>453,453,931.73</b>

#### 4.6.2. The profitability with improvement of (EMSH)

a) The profitability according to the undiscounted criteria includes; Net Cash Flow (NCF), Payback period (pp), Simple Rate of Return (SRR) and Benefit cost ratio (BCR). The study revealed that the Net Cash Flow (NCF) is a positive value, the Payback period (pp) is one year, the Simple Rate of Return (SRR) is more than the cost of capital used in the analysis (15%) and Benefit cost ratio (BCR) is more than one (table 4.10). All of which indicates that the improvement of the improvement of Elshahafa slaughterhouse is feasible.

b) The profitability according to discounted criteria including; Net present value (NPV), Internal Rate of Return (IRR) and Benefit cost ratio (BCR).

On discounting the cash flow at 15% discount rate, the study revealed that the Net Present Value (NPV) is positive value, Internal Rate of Return (IRR) is greater than the cost of capital used in the analysis (15%) and the discounted Benefit cost ratio (BCR) is greater than one (table 4.10).

Both discounted and undiscounted investment criteria indicate that the improvement of Elshahafa Slaughterhouse is feasible and can be acceptable for implementation.

**Table (4.8): The Values of the Investment Criteria**

<b>Investment criteria</b>		<b>Value of criteria</b>
Undiscounted criteria	Net Cash Flow (NCF)	<b>\$ 453.5 million</b>
	Payback period (pp)	<b>1</b>
	Simple rate of return (SRR)	<b>100%</b>
	Benefit cost ratio (BCR)	<b>25</b>
Discounted criteria	Net Present Value (NPV)	<b>\$ 89.8 million</b>
	Internal Rate of Return (IRR)	<b>100%</b>
	Benefit cost ratio (BCR)	<b>25</b>



### 4.6.3. Sensitivity test analysis

The study used the sensitivity test analysis to test the profitability in case of expected increase in the cost and the reduction of benefit by (10% and 50%).

1. The investment criteria when the total cost increase by 10%. (Table 4.9)
2. The investment criteria when the total cost increase by 50%. (Table 4.10)
3. The investment criteria when the total benefits decrease by 10 %. (Table 4.11)
4. The investment criteria when the total benefits decrease by 50%. (Table 4.12)
5. The investment criteria when the total cost increase by 10% and the total benefits decrease by 10 %.( Table 4.13)
6. The investment criteria when the total cost increase by 50% and the total benefits decrease by 50 %.( Table 4.14)

**Table (4.9) The Investment Criteria in case of 10% Increase in the Total Cost**

Investment criteria		Value of criteria
Undiscounted criteria	Net Cash Flow (NCF)	<b>\$451.3 million</b>
	Payback period (pp)	<b>1.1</b>
	Simple rate of return (SRR)	<b>91%</b>
	Benefit cost ratio (BCR)	<b>22</b>
Discounted criteria	Net Present Value (NPV)	<b>\$ 88 million</b>
	Internal Rate of Return (IRR)	<b>91%</b>
	Benefit cost ratio (BCR)	<b>22</b>

Table (4.9) indicates that the increase in the total cost by 10% resulted in reducing the net present value but it is still a positive value, this is also true in case of Net cash flow, the payback period is one year, the internal rate of return

is greater the cost of capital and benefit cost ratio is ( $>1$ ). So the improvement of the slaughterhouse is not sensitive to increase the total cost by 10%.

**(4.10): The Investment Criteria in Case of 50% Increase in the Total Cost**

Investment criteria		Value of criteria
Undiscounted criteria	Net Cash Flow ( \$ )	<b>\$ 442.8 million</b>
	Payback period (pp)	<b>1.5</b>
	Simple rate of return	<b>66%</b>
	Benefit cost ratio	<b>16</b>
Discounted criteria	Net Present Value ( \$ )	<b>\$ 81.2 million</b>
	Internal Rate of Return	<b>66%</b>
	Benefit cost ratio	<b>16</b>

According to table (4.10) the effect of the expected increase in the total cost by 50% is that the Net present value is positive, the Net cash flow is also positive, the payback period is less than two years, the Internal rate of return is greater than the cost of capital and benefit cost ratio ( $>1$ ). So the improvement of the slaughterhouse is not sensitive to the increase the total cost by 50%.

**Table (4.11): The Investment Criteria in case of 10% Decrease in the Total Benefits**

Investment criteria		Value of criteria
Undiscounted criteria	Net Cash Flow ( \$ )	<b>\$ 408.4 million</b>
	Payback period (year)	<b>1.1</b>
	Simple rate of return	<b>90%</b>
	Benefit cost ratio	<b>22</b>
Discounted criteria	Net Present Value ( SDG )	<b>\$79,6 million</b>
	Internal Rate of Return (IRR)	<b>90%</b>
	Benefit cost ratio (BCR)	<b>22</b>

From the table (4.11) it is clear that the net present value is positive, the net cash flow is positive, the payback period is less than two years, the internal rate of return is greater than the discount rate used (cost of capital) and benefit cost ratio (>1). In conclusion, the improvement of the slaughterhouse to meet GCC standard is not sensitive to the reduction to total benefits by 10%.

**Table (4.12): The Investment Criteria in case of 50% Decrease in the Total Benefits**

Investment criteria		Value of criteria
Undiscounted criteria	Net Cash Flow ( \$)	<b>\$ 218.5 million</b>
	Payback period	<b>2</b>
	Simple rate of return	<b>50%</b>
	Benefit cost ratio	<b>12</b>
Discounted criteria	Net Present Value (\$)	<b>\$36.9 million</b>
	Internal Rate of Return	<b>50%</b>
	Benefit cost ratio	<b>12</b>

From the table (4.12) it is clear that the net positive, the payback period is two years, acceptable Internal rate of return which is higher than the discount rate used ( cost of capital) and benefit cost ratio (>1). Therefore, improvement of the slaughterhouse is not sensitive to the reduction the total benefit by 50%.

**Table (4.13): The Investment Criteria in case of 10% Increase in the Total Cost by 10% Decrease in the Total Benefit**

Investment criteria		Value of criteria
Undiscounted criteria	Net Cash Flow (\$)	<b>\$ 403.8 million</b>
	Payback period	<b>1.2</b>
	Simple rate of return	<b>82%</b>
	Benefit cost ratio	<b>20</b>
	Net Present Value (SDG)	<b>\$77.4 million</b>

Discounted criteria	Internal Rate of Return (IRR)	<b>82%</b>
	Benefit cost ratio (BCR)	<b>20</b>

From the table (4.13) presents the simultaneous 10% increase in the total cost and 10% decrease in the total benefit. the Net present value is positive value, the Net cash flow is also positive, short payback period less than two years, acceptable internal rate of return which is less than the discount rate used and benefit cost ratio ( $>1$ ). Therefore, the improvement of the slaughterhouse is not sensitive to the simultaneous reduction the total benefit by 10% and increase total cost by 10%.

**Table (4.14): The Investment Criteria in case of 50% Increase in the Total Cost by 50% Decrease in the Total Benefit**

Investment criteria		Values
Undiscounted criteria	Net Cash Flow (\$)	<b>\$ 205.3 million</b>
	Payback period	<b>3</b>
	Simple rate of return	<b>33%</b>
	Benefit cost ratio	<b>8</b>
Discounted criteria	Net Present Value (\$)	<b>\$8.1 million</b>
	Internal Rate of Return	<b>33%</b>
	Benefit cost ratio	<b>8</b>

From the table (4.14); Net present value is positive, Net cash flow is positive, short payback period is three years , internal rate of return less than the discount rate used return (the cost of capital), and benefit cost ratio ( $<1$ ). So the improvement of the slaughterhouse is not sensitive to the reduction the total benefit by 50% and increase the total cost by 50%.

# **CONCLUSION & RECOMMENDATION**

## **The Conclusion**

There are many short falls in the safety and quality assurance requirements of current situation of the EMSH compared to the requirements of Gulf standards organization. There are many short falls that need improvements in the design and layout, materials and equipments, services and administration. The operational objective of EMSH been achieved, in terms of increase the productivity and capacity utilization. The quality cost required to improve the quality standard of EMSH to meet the requirement of the Gulf standard organization is less than the benefits. The benefits achieved are very high that encourage the adoption of the quality improvements. The cost/benefit analysis showed high profitability based on investment criteria even after conducting the sensitivity test.

## **The Recommendations**

- The slaughterhouse administration must comply with the required quality criteria of the Gulf Standard Organization to take the attestation certificate of GCCs for establishments of meat and meat production.
- The administration must establish an impervious management system that organizes the required quality needs, grantee the continuous need of improvements with the participation of all employees in the system.
- All meat producing sector should comply with the international requirements of quality management and obtain the ISO certification for the benefit of all.
- Building the capacity of the personal involved in meat processing plants through training programs will generate fruitful results in improving the quality standards of meat products.

## References

- Abdalla, M; Suliman, S. and Alian, Y. (2009).** Microbial Contamination of Sheep carcasses at Slaughterhouse in Khartoum State. Sudan. *Journal of Veterinary Science Animal Husbandry*. Husb, 48 (1&2), pp. 51-56.
- Agriculture and fisheries resources directorate. (2015).** GCC guide for control imported foods in the Cooperation Council for the Arab States of the Gulf .secretariat general. g.c.c Printting Press.
- Asian Development Bank (ADB). (1999).** Handbook and Manuals for the Economic Analysis of Water Supply Projects. Manila. Economics and Development Resource Center, ISBN: 971-561-220-2, p. 361.
- Bandini, S; Dall, E and Tagni, R. (2002).** Safer Food stuff in Europe through HACCP. A guide for Trainers .CO-ordinated by centro Ricerche Ambientali Montecatini Spa.
- Campanella, J. and Corcoran, F. J. (1983),** *Quality Progress*, 16 (4), pp16-21.
- Cates, S., Anderson, D., Karns, S. and Brown, P. (2001).** Traditional versus Hazard analysis and critical control point based inspection. Results from poultry slaughter projects. *Journal of Food Protection*, 64 (6), pp. 826- 32.
- Central of Sudan bank** (2006) annual report [www.cbos.gov.sd/node/6243/](http://www.cbos.gov.sd/node/6243/) (accesses 5/5/2017 at 9:15 am).
- Central of Sudan bank** (2017) <http://Cbos.Gov.Sd> > exchange rates (accesses 25/10/2017 at 11:30 am).
- **Crosby, P. (1979)** -*Quality is free*-New York: McGraw-Hill.
- Crosland, W. (1997).** HACCP and factory auditing. In: Chesworth, E. (Ed) *Food Hygiene Auditing*. London-New York. Blackie Academic Chapman and Hall.

- Dale, B. and Eldridge, S. (1989)** .Quality costing: the lessons learnt from a study carried out in two phases.’ *Engineering Costs and Production Economics* 18, pp.33-44.
- Dejan, D., Dragan, C. and Srdjan, B. (2010)**. An analysis of the HACCP system implementation- The factor of improving competitiveness in Serbian companies. *African Journal of Agricultural Research*, 6(3), pp. 515-520  
<<http://www.academicjournals.org/AJARDOI:10.5897/AJAR10.889>>
- Den, O., Dijkhuizen, A., Huirne, R. and Zuurbier, P. (1996)**. Vertical cooperation in agricultural production-marketing chains- with special reference to product differentiation in pork, *Agribusiness*, 12, pp. 277-290.
- El Diran , O., Jabbar, M. and Babiker , I. (2009)**. Constraints in the market chains for export of Sudanese sheep and sheep meat to the Middle East- Research, Addis Ababa, Ethiopia. ILRI Publications Unit, report 16, pp .3-8.
- FAO (Food and Agriculture Organization of the United Nations, (2016)**. Improving Sudan's livestock and meat export trade through food safety be practice. Khartoum, Sudan .16-17 May 2016 FAO workshop, viewed 18 May2016. <<http://www.fao.org/sudan/fao-in-sudan/en/>>
- Feigenbaum, A. (1961)** -Total quality control- New York: McGraw-Hill.
- Frost, R. (2005)**. ISO 22000 standard for safe food supply chains. *ISO Management Systems*, **July–August**, 28.  
<[http://www.nsai.ie/IR/index.cfm/area/page/information/ISO 22000](http://www.nsai.ie/IR/index.cfm/area/page/information/ISO%202000)>.
- Gill, G. (1998)**. Microbial contamination of meat during slaughter and butchering of cattle, sheep and pigs- In: Davies, A; Board, R. (Eds). London, The Microbiology of meat and poultry, pp. 118-157.
- Gregory, N. (1996)**. Welfare and hygiene during pre-slaughter handling, *Meat Science*, 43, suppl. S35-S46.

- Havas, F. (1995).** Wirkung and Desinfektion; Kontrolle mit mikrobiologischen Verfahren, *Fleischwirtsch*, 75(3), pp. 272–274.
- Herrera, A. (2004).** The hazard analysis and critical control points system in food safety, *Methods Mol Biol*, 268:235-80.
- Holt, G .and Henson, S. (2000).** Quality assurance Management in small business, *British Food Journal*, vol. 102 (4), pp. 320 – 337.
- Huss, H. (2003).** Assessment and Management of Sea Food safety and Quality, Rome. FAO Fisheries technical paper, No 444.
- Ibrahim, A. (2004).** Sudanese livestock export marketing and competitiveness, unpublished report submitted to the Ministry of Agriculture and Forestry for FAO and WTO.
- Ioannis, S.,Theodoros , H. and Varzakasand, P. (2009).** HACCP and ISO 22000 Application to Foods of Animal Origin, University of Thessaly, Greece: Department of Agriculture, Ichthyology Aquatic Environment, School of Agricultural Sciences.
- Jacxsens, L., Devlieghere, F. and Uyttendaele, M. (2009).** Quality management systems in the food industry, Sofia. St Kliment Ohridski University Press.
- Jahn, G and Peupert M. (2003) -** Spiller Auf dem Weg in eine Zertifizierungsgesellschaft -Proceedings of 24th GIL Annual Conference-Goettingen, pp. 61-64.
- Jatib, M. (2003).** Food Safety and food security food safety and quality assurance key drivers of competitiveness. Buenos Aires, Argentina. Buenos Aires University.
- Jouve, J. (2000).** HACCP in the Meat Industry Moving on from HACCP- Ed: Brown M. Cambridge, England .Wood Head Publisher Ltd, pp. 293-317.
- Keogh, W., Martin, H. and John, F. (1989).** Dalrymple Aberdeen Business School. Aberdeen, Scotland. The Robert Gordon University.



- Krishnamoorthi, K. (1989).** Predict quality cost changes using regression, *Quality Progress*, 22 (12), pp. 52-55.
- Levenstein, C. and Dunn, M. (2005).** Show me the money cost-benefit analysis the work environment. *New Solutions*, vol 15, p.261-276.
- Luning, P., Marcelis, W. and Jongen, W. (2002).** Food Quality Management: A Techno-Managerial Approach, Wageninge. Wageningen Academic Publishers.
- Luning, P. and Marcelis, W. (2007).** A food quality management functions model from a techno-managerial perspective, *Trends in Food Science and Technology* 18, pp. 159–166.  
<<http://dx.doi.org/10.1016/j.tifs.2006.10.021>>
- Meuwissen, M., Velthuis , A., Hogeven, H. and Irne, R. (2003).**Traceability and Certification in Meat Supply Chains, *J. Agrib. (21)*, pp.167-181.
- Mortimore, S. and Wallace, C. (1998).** HACCP: A Practical Approach, 2 nd edn. Gaithersburg. Aspen Publishers.
- NACMCF (1992).** Hazard Analysis and Critical Control Point system, *International Journal of Food Microbiology*, vol.(16), pp. 1–23.
- Pfeifer, T. (2002).** Quality Management: Strategies, Methods, Techniques, Hanse, Munich and Vienna.
- Plunkett, J. and Dale, B. (1987).** A review of the literature on quality-related costs, *International Journal of Quality and Reliability Management*, 4(1), pp. 40-52.
- Puckett, R. and Schneider, G. (1997).** Keeping it clean, playing it safe: What the HACCP program is all about . . . the Hazard Analysis and Critical Control Point (HACCP) system, *Journal of the American Dietetic Association*, vol. (97), pp. 125.
- Porter, M. (1989).** Competitive Strategy; Techniques for Analyzing Industries and Competitors. New York. Free Press.

- Schulze, B., Spiller, A. and Theuvsen, L. (2006).** Is More Vertical Integration the Future of Food Supply Chains? *in: J. Bijman et al. (editors). International Agri-food Chains and Networks. Wageningen. Wageningen Academic Publishers. pp. 49-63.*
- Slatter, J. (2003).** Hazard Analysis Critical Control Point -*Encyclopedia of Food sciences and Nutrition.* pp. 3023 –3028.
- Surak, J. (2007).** HACCP and ISO Development of a Food Safety- Department of Food Science and Human Nutrition. Clemson University.
- Surak, J. (2007).** A recipe for Safe Food ISO 22000 and HACCP, *Quality Progress*, pp. 21-27 <[www.asq.org](http://www.asq.org)>.
- Thornton, H. (1968).** Text book of Meat Inspection. 5th.ed.Bailliere. London. Tindal and Cass ell.
- Upmann, M. and Jacob, P. (2004).** HACCP and self-regulation, Encyclopedia of Food Sciences and Nutrition.pp.548–557.
- Varzakas ,T. (2015).** *Handbook of Food Processing Food Safety, Quality, and Manufacturing Processes* . In ISO 22000, HACCP, and Other Management Tools for Implementation of Food Safety-Traceability Case Studies. ISBN. Available at ([http://www.foodsafety.uk.sgs.com/westbury\\_dairies\\_case\\_study-4.pdf](http://www.foodsafety.uk.sgs.com/westbury_dairies_case_study-4.pdf)).
- Windhorst, H. (2004).** Qualitaetssicherung in der Lebensmittelkette: Wo liegen die Herausforderungen? *in: Dachverband Agrarforschung (editor)-Lebensmittel qualitaet und Qualitaet tssicherungs systeme. DLG-Verlag, Frankfurt/M. pp. 21-33.*

## Sources

- Abdu elazeez Abdu Elmageed. (2017).** the head of Elshahafa slaughterhouse and Pinar company slaughter & meat processing, Khartoum.
- Ammar Elshikh Edres. (2018),** Ministry of animal recourse and fishery. Khartoum, Sudan.

- **Gulf Standard (1997).** Hygienic practice for preparation, transportation, handling and storing of fresh meat, AS 815-1997, Publication in the Official Gazette ICS: <[www.gso.org.sa](http://www.gso.org.sa)>
- **Gulf Standard (1998).**Animal slaughtering requirements According to Islamic law, AS 993-1998, amended 4 June 1999, the Official Gazette ICS <[www.gso.org.sa](http://www.gso.org.sa)>.
- **Gulf Standard (1984).** Hygienic regulations for food plants and their personnel, AS 21-1984, amended 4 April 1986, the Official Gazette ICS: <[www.gso.org.sa](http://www.gso.org.sa)>.
- **Gulf Standard (1995).** Meat and Meat Products - Physical Tests, AS 593-1995, the Official Gazette :<[www.gso.org.sa](http://www.gso.org.sa)>.
- **Gulf Standard (1993).** UN bottled Drinking Water, AS 14-1993, the Official Gazette :< [www.gso.org.sa](http://www.gso.org.sa)>.
- **Gulf Standard (1997).** Transportation Regulations of Livestock by Rail, Road and Ships - Part 1: Transport of Sheep and Goat-Part 2: Transport of Cows and B, AS 714-1997, the Official Gazette :< [www.gso.org.sa](http://www.gso.org.sa)>
- Elzubir, M. (2016)** .statistic bulletin for animal resourced, issues no 25, pp. 12. Available at [inf@mar.gov.sd](mailto:inf@mar.gov.sd)
- **Market services (2017),** Mohamed khadar (2017), perfective company for ultra-filtration unites, Khartoum-Sudan.
- **Pinar company slaughter & meat processing (2017),** Khartoum, Sudan.
- **Personal observation, (2017).**Elsahafa slaughterhouse. Khartoum, Sudan
- **Tarig Abdu AL Khaliq (2017).** Geemco slaughterhouse manager. Khartoum, Sudan.
- Teagasc . (2017),** Food industry training Centre, (Online) available at [courseadministrator@teagasc.ie](mailto:courseadministrator@teagasc.ie) . [Accessed September. 2017]
- Trade Ministry point (2016),** (Online) available at [www.tpsudan.gov.sd](http://www.tpsudan.gov.sd) - [Accessed September. 2017]

## Appendices

### Appendix (3.1): The prices of the investment items of administration and GCC certifications

Description	Prices /unit		Sources
	SDG	\$	
GCC certifications cost and fees	000	00	Ammar (2018)
Feasibility study(5%) total costs	3,111,662.6	115,246.76	
Vet –technicians expenses (one)	1,500	55.55	Slaughterhouse record (2017)
Drivers expenses (one)	1,200	44.44	Slaughterhouse record (2017)
Vehicle prices(3 ton) (one)	9,500,000	351,851.85	Market services (2017)
<b>Total</b>	12,614,362.6	467,198.6	

### Appendix (3.2): The Prices of the Investment Items of Design And Layout

Description	Prices/unit		Sources
	SDG	\$	
Construction roofing(shelters for Lairage )	200,000	7,407.41	Pinar company (2017)
Repairing floors and passageways(for Lairage )	55,000	2,031.03	Pinar company (2017)
Adding lighting	10,500	388.88	Pinar company (2017)
Make partition between clean and dirty area	55,000	2,031.03	Pinar company (2017)
-Workstation and provisions of toilets	15,000	555.56	Pinar company (2017)
Changing rooms and toilets	88,000	3,259.25	Pinar company (2017)
Improving the chiller	36,480	1,351.11	Pinar company (2017)
Gas burners	35,000	1,296.29	Pinar company (2017)
-Repair electric power (generator)	300	11.11	Pinar company (2017)
Establish canteen and doctor rest	210,000	7,777.77	Pinar company (2017)
<b>Total</b>	705,280	26,121.48	

\*All estimates sources from Pinar Company for slaughterhouse & meat processing (2017).

**Appendix (3.3): The Prices of the Investment Items of Materials, the Costs of the investment items of the Equipments and Services.**

Description	Prices/unit		Sources
	SDG	\$	
Complete automatic line (Sheep)and repairing the old	900,000	33,333.33	Pinar company (2017)
Ventilation system	25,000	925.92	Pinar company ( 2017)
Thermographs temperature probes	1,323	49	Market services (2017)
Ultra-filtration unit and tanker with pipelines	170,000	6,296.29	Market services (2017)
Equipped well laboratory and lab testing materials	498,100	18,448.14	Pinar company( 2017)
Sluice drag	280,000	10,370.37	Pinar company (2017)
<b>Total</b>	<b>1,874,423</b>	<b>69,423.05</b>	

**Appendix (3.4): The Costs of the investment items of the required training courses**

Description	Prices/unit		Sources
	SDG	\$	
-HACCP, Prerequisite programs and Food safety management	17,010	630\$	Teagasc Food Research Centre ( 2017)
Standard Operating Procedures system	17,010	630\$	Teagasc Food Research Centre ( 2017)
-Animal welfare officer training	9,450	350\$	Teagasc Food Research Centre ( 2017)
<b>Total</b>	<b>43,470</b>	<b>1,610</b>	

\*Sources of estimate from email: [courseadministrator@teagasc.ie](mailto:courseadministrator@teagasc.ie)

\*Sources of estimates from slaughterhouse manage

### Appendix (3.5): The Slaughterhouse Administration Expenses

Occupation	Fees SDG /month/unit	Total Fees cost /SDG		\$/ Year
		Month	Year	
The manager	5,000	5,000	60,000	2,222.22
Deputy manager	4,000	4,000	48,000	1,777.78
Veterinary DOCTOR	4,500	18,000	216,000	8,000
Vet –TECHNICIANS	1,500	12,000	144,000	5,333.33
Hall-monitor	1,200	1,200	14,400	533.33
Health- observer	2,500	2,500	30,000	1,111.11
Technical-cooling	800	800	9,600	355.56
Driver	1000	3,000	36,000	1,333.33
Laborers	800	6,400	76,800	2,844.44
Technical troubleshooter	800	800	9,600	355.56
Courier	500	500	6,000	222.22
Slaughterers& shearers	900	12,600	151,200	5,600
<b>Total costs</b>			801,600	29,688.89

### Appendix (3.6): The Price of Variable Items of the Administration Expenses of the Slaughterhouse

Description	Prices/unit		Sources (2017)
	SDG	\$	
-License	5,000	185.19	Manager
-Training programme cost	26,460	980\$	Teagasc Food Research Centre
-Electricity, telephone	7,600	281.48	Manager (2017)
-Materials of lab testing.	8,000	296.30	Alkadro slaughterhouse lab
-Ultra filtration maintenance costs	30,000	1,111.11	Market services (2018)
Clean materials-Protective clothing	22,100	818.52	Manager (2017)
-Transmission cots	8,920	330.37	Manager (2017)
-Maintenance cost	200,000	7,407.41	Manager (2017)
<b>Total</b>	300,480	11,128.89	

### Appendix (3.7): The Price of Benefits Items

Description	Prices/unit		Sources
	SDG	\$	
The inspection, testing and slaughtering fees cattle /head	70	2.59	EMSH Record (2017)
The inspection, testing and slaughtering fees sheep/head	25	0.93	EMSH Record (2017)
By-product (Cattle)/head	430	15.93	EMSH Record (2017)
By-product/head (Sheep	90	3.33	EMSH Record (2017)
Hide /Kg	4	0.15	EMSH Record (2017)
Skin /piece	25	0.93	EMSH Record (2017)
Meat sales /kg (Beef)	60	2.22	EMSH Record (2017)
Meat sales /kg (Lamb)	80	2.96	EMSH Record (2017)
Administration fees head (cattle)	7	0.26	Geemco slaughterhouse(2017)
Administration fees /head (sheep)	5	0.19	Geemco slaughterhouse(2017)
Medical certifications fees /head	100	3.70	Geemco slaughterhouse(2017)
Meat sales exported /kg (Beef)	108	4	Trade Ministry (2016)
Meat sales exported /kg (Lamb)	135	5	Trade Ministry (2016)
<b>Total</b>	1,139	42.19	

## Appendix (4.8)

### Lairage





## Slaughter-hall



**INCINERATOR**



**ADMINISTRATION OFFICE**



## Appendix (4.9): Data Analysis

Description	Years													
	0	1	2	3	4	5	6	7	8	9	10	11	12	13
Cost/ benefit Analysis														
<b>Investment costs</b>	<b>3962379.16</b>													
benefit foregone in year 0	<b>14,860,400</b>													
The annual variable costs	<b>99,100.86</b>													
<b>total investment costs</b>	18,921,880.02	0	0	0	0	0	0	0	0	0	0	0	0	0
The annual variable costs		<b>99,100.86</b>	<b>99,100.86</b>											
annual benefits		<b>18,994,133.33</b>	<b>18,994,133.33</b>	<b>99,100.86</b>	<b>99,100.86</b>	<b>99,100.86</b>	<b>99,100.86</b>	<b>99,100.86</b>	<b>99,100.86</b>	<b>99,100.86</b>	<b>99,100.86</b>	<b>99,100.86</b>	<b>99,100.86</b>	<b>99,100.86</b>
Net Cash Flow	-18,921,880.02	18,895,032.5	18,895,032.5											
Net Cash Flow	<b>453,453,931.73</b>			<b>18,994,133.33</b>	<b>18,994,133.33</b>	<b>18,994,133.33</b>	<b>18,994,133.33</b>	<b>18,994,133.33</b>	<b>18,994,133.33</b>	<b>18,994,133.33</b>	<b>18,994,133.33</b>	<b>18,994,133.33</b>	<b>18,994,133.33</b>	<b>18,994,133.33</b>
Payback period	1.001420879													
Simple rate of return (SRR)	100.3818506			18,895,032.5	18,895,032.5	18,895,032.5	18,895,032.5	18,895,032.5	18,895,032.5	18,895,032.5	18,895,032.5	18,895,032.5	18,895,032.5	18,895,032.5
Benefit cost ratio (BCR)	25.09546265													
Net Present Value (NPV)	\$89,755,153.77													
Internal Rate of Return (IRR)	100%													

Benefit cost ratio (BCR)	25.0954 6265													
<b>increase total cost by 10%</b>														
annual costs	2081406 8.02	0	0											
annual benefits		<b>18,994,133.3</b>	<b>18,994,133.33</b>											
The annual variable costs		109010.946	109010.946											
Net Cash Flow	-20,814,068.02	18,885,122	18,885,122	0	0	0	0	0	0	0	0	0	0	0
Net Cash Flow	451,313,992			<b>18,994,133.33</b>	<b>18,994,133.33</b>	<b>18,994,133.33</b>	<b>18,994,133.33</b>	<b>18,994,133.33</b>	<b>18,994,133.33</b>	<b>18,994,133.33</b>	<b>18,994,133.33</b>	<b>18,994,133.33</b>	<b>18,994,133.33</b>	<b>18,994,133.33</b>
Payback period	1.102141019			109010.946	109010.946	109010.946	109010.946	109010.946	109010.946	109010.946	109010.946	109010.946	109010.946	109010.946
Simple rate of return (SRR)	91.25622781			18,885,122	18,885,122	18,885,122	18,885,122	18,885,122	18,885,122	18,885,122	18,885,122	18,885,122	18,885,122	18,885,122
Benefit cost ratio (BCR)	22.81405695													
Net Present Value (NPV)	88,054,068													
Internal Rate of Return (IRR)	91%													
Benefit cost ratio (BCR)	22.81405695													
<b>increase total cost by 50%</b>														
<b>Total cost by 50%</b>														

annual costs	2838282 0.03	0	0	0	0	0	0	0	0	0	0	0	0	0
annual benefits		<b>18,994,133.3</b>	<b>18,994,133.33</b>	<b>18,994,133.33</b>	<b>18,994,133.33</b>	<b>18,994,133.33</b>	<b>18,994,133.33</b>	<b>18,994,133.33</b>	<b>18,994,133.33</b>	<b>18,994,133.33</b>	<b>18,994,133.33</b>	<b>18,994,133.33</b>	<b>18,994,133.33</b>	<b>18,994,133.33</b>
The annual variable costs		148651.29	148651.29	148651.29	148651.29	148651.29	148651.29	148651.29	148651.29	148651.29	148651.29	148651.29	148651.29	148651.29
Net Cash Flow	-2838282 0.03	18,845,482	18,845,482	18,845,482	18,845,482	18,845,482	18,845,482	18,845,482	18,845,482	18,845,482	18,845,482	18,845,482	18,845,482	18,845,482
Net Cash Flow	442,754,231													
Payback period	1.506080872													
Simple rate of return (SRR)	66.39749687													
Benefit cost ratio (BCR)	16.73030843													
Net Present Value (NPV)	\$81,249,726.49													
Internal Rate of Return (IRR)	66%													
Benefit cost ratio (BCR)	16.73030843													
<b>Decrease total benefit by 10%</b>														
annual costs	18,921,880.02	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
annual benefits		17094720	17094720	17094720	17094720	17094720	17094720	17094720	17094720	17094720	17094720	17094720	17094720	17094720
Net Cash Flow	-18,921,880.02	17,094,720.00	17,094,720.00	17,094,720.00	17,094,720.00	17,094,720.00	17,094,720.00	17,094,720.00	17,094,720.00	17,094,720.00	17,094,720.00	17,094,720.00	17,094,720.00	17,094,720.00
Net Cash Flow	408,446,119.91													
Payback period	1.106884466													

Simple rate of return (SRR)	90.3436 6553													
Benefit cost ratio (BCR)	22.5859 1638													
Net Present Value (NPV)	\$79,635, 598.79													
Internal Rate of Return (IRR)	90%													
Benefit cost ratio (BCR)	22.5859 1638													
<b>Decrease Total benefit by 50%</b>														
annual costs	18,921.8 80.02	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
annual benefits		9497 066. 665	94970 66.66 5	94970 66.66 5	94970 66.66 5	94970 66.66 5	94970 66.66 5	94970 66.66 5	94970 66.66 5	94970 66.66 5	9497 066. 665	94970 66.66 5	94970 66.66 5	9497 066. 665
Net Cash Flow	- 18,921.8 80.02	9,49 7,06 6.7	9,497, 066.7	9,497, 066.7	9,497, 066.7	9,497, 066.7	9,497, 066.7	9,497, 066.7	9,497, 066.7	9,497, 066.7	9,49 7,06 6.7	9,497, 066.7	9,497, 066.7	9,49 7,06 6.7
Net Cash Flow	218,504, 786.61													
Payback period	1.99239 2039													
Simple rate of return (SRR)	50.1909 2529													
Benefit cost ratio (BCR)	12.5477 3132													
Net Present Value (NPV)	\$36,929, 195.46													
Internal Rate of Return (IRR)	50%													
Benefit cost ratio (BCR)	12.5477 3132													
<b>Increase total cost by 10% &amp; decrease</b>														

<b>total benefit by 10%</b>														
annual costs	20,814,068.02	0	0	0	0	0	0	0	0	0	0	0	0	0
annual benefits		17094720	17,094,720	17094720	17094720	17094720	17094720	17094720	17094720	17094720	17094720	17094720	17094720	17094720
The annual variable costs		109010.946	109010.946	109010.946	109010.946	109010.946	109010.946	109010.946	109010.946	109010.946	109010.946	109010.946	109010.946	109010.946
Net Cash Flow	-20814068.02	16985709.05	16985709.05	16985709.05	16985709.05	16985709.05	16985709.05	16985709.05	16985709.05	16985709.05	16985709.05	16985709.05	16985709.05	16985709.05
Net Cash Flow	403,828,658													
Payback period	1.225387057													
Simple rate of return (SRR)	81.60686817													
Benefit cost ratio (BCR)	20.53265126													
Net Present Value (NPV)	\$77,377,467.48													
Internal Rate of Return (IRR)	82%													
Benefit cost ratio (BCR)	20.53265126													
<b>Increase total cost by 50% &amp; Decrease benefit by 50%</b>														
annual costs	28382820.03	0	0	0	0	0	0	0	0	0	0	0	0	0
annual benefits		9497066.665	9497066.665	9497066.665	9497066.665	9497066.665	9497066.665	9497066.665	9497066.665	9497066.665	9497066.665	9497066.665	9497066.665	9497066.665
The annual variable costs		148651.29	148651.29	148651.29	148651.29	148651.29	148651.29	148651.29	148651.29	148651.29	148651.29	148651.29	148651.29	148651.29
Net Cash	-28,382,841.5	934815.37	934815.37	934815.37	934815.37	934815.37	934815.37	934815.37	934815.37	934815.37	934815.37	934815.37	934815.37	934815.37

Flow	20.03	375	5	5	5	5	5	5	5	5	5	375	5	5	375
Net Cash Flow	2053275 64.3														
Payback period	3.03611 0281														
Simple rate of return (SRR)	32.9368 8														
Benefit cost ratio (BCR)	8.36515 4216														
Net Present Value (NPV)	\$8,129,0 56.85														
Internal Rate of Return (IRR)	33%														
Benefit cost ratio (BCR)	8.36515 4216														

## Continues Data Analysis

14	15	16	17	18	19	20	21	22	23	24	25		Total	NPV
													18,92 1,880. 0	
0	0	0	0	0	0	0	0	0	0	0	0		18,92 1,880. 02	\$16,4 53,80 8.71
99,10 0.86	99,10 0.86	99,10 0.86	99,10 0.86	99,10 0.86	99,10 0.86	99,10 0.86	99,10 0.86	99,10 0.86	99,10 0.86	99,10 0.86	99,10 0.86			
18,99 4,133. 33	18,99 4,133. 33	18,99 4,133. 33	18,99 4,133. 33	18,99 4,133. 33	18,99 4,133. 33	18,99 4,133. 33	18,99 4,133. 33	18,99 4,133. 33	18,99 4,133. 33	18,99 4,133. 33	18,99 4,133. 33		474,8 53,33 3.25	\$412, 915,9 41.96
18,89 5,032. 5	18,89 5,032. 5	18,89 5,032. 5	18,89 5,032. 5	18,89 5,032. 5	18,89 5,032. 5	18,89 5,032. 5	18,89 5,032. 5	18,89 5,032. 5	18,89 5,032. 5	18,89 5,032. 5	18,89 5,032. 5		453,4 53,93 1.73	







066.7	066.7	066.7	066.7	066.7	066.7	066.7	066.7	066.7	066.7	066.7	066.7	6.61		
0	0	0	0	0	0	0	0	0	0	0	0		20,814,068.02	\$18,099,189.58
17094720	17094720	17094720	17094720	17094720	17094720	17094720	17094720	17094720	17094720	17094720	17094720		427367999.9	\$371,624,347.76
109010.946	109010.946	109010.946	109010.946	109010.946	109010.946	109010.946	109010.946	109010.946	109010.946	109010.946	109010.946			
16985709.05	16985709.05	16985709.05	16985709.05	16985709.05	16985709.05	16985709.05	16985709.05	16985709.05	16985709.05	16985709.05	16985709.05		403,828,658	
0	0	0	0	0	0	0	0	0	0	0	0		28382820.03	\$24,680,713.07
9497066.66	9497066.66	9497066.66	9497066.66	9497066.66	9497066.66	9497066.66	9497066.66	9497066.66	9497066.66	9497066.66	9497066.66		237426666.	\$206,457.9

5	5	5	5	5	5	5	5	5	5	5	5		6	70.98
14865 1.29	14865 1.29	14865 1.29	14865 1.29	14865 1.29	14865 1.29	14865 1.29	14865 1.29	14865 1.29	14865 1.29	14865 1.29	14865 1.29			
93484 15.37 5	93484 15.37 5	93484 15.37 5	93484 15.37 5	93484 15.37 5	93484 15.37 5	93484 15.37 5	93484 15.37 5	93484 15.37 5	93484 15.37 5	93484 15.37 5	93484 15.37 5		20532 7564. 3	