Assessing the Impact of Infrastructure Development and Training on Meat and Hides & Skins Sector in Somaliland

By

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Declaration

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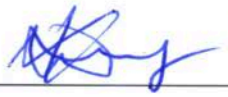
This thesis is my original work and has not been presented for a degree in any other University



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Dedication

This work is dedicated to my late father who championed that hard work bears fruit;

To my wife Aziza and my children Michael and Collins who have been very supportive, patient and encouraging during some difficult time and long absence from home.

To my colleagues and friends at Food and Agriculture Organization of the United Nations; Somalia office, Dr. Massimo Castiello, Obhai George and Dr. Sophycate Njue for their continuous support and friendship

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Glossary of terms

Ante-mortem inspection:- Any procedure or test conducted by a competent person on live animals for the purpose of judgment of safety and suitability and disposition.

Cleaning: - It is the removal of soil, food residue, dirt, grease or other objectionable matter

Competent authority:-The official authority charged by the government with the control of meat hygiene, including setting and enforcing regulatory meat hygiene requirements.

Contamination:-The introduction or occurrence of a contaminant in food or food environment

Disinfection: - Reduction by means of chemical agents and/ or physical methods, of the number of micro-organisms in the environment, to a level that does not compromise food safety or suitability

Food hygiene: All conditions and measures necessary to ensure the safety and suitability of food at all stages of the food chain.

Good hygienic practice (GHP):-All practices regarding the conditions and measures necessary to ensure the safety and suitability of food at all stages of the food chain

Hazard*:*-A biological, chemical or physical agent in, or condition of, food with the potential to cause an adverse health effect.

Hazard Analysis and Critical Control Point (HACCP):-A system that identifies, evaluates and controls hazards that are significant for food safety

Meat hygiene*:*-All conditions and measures necessary to ensure the safety and suitability of meat at all stages of the meat value chain.

Risk-based:-Containing performance and/or process criteria developed according to risk analysis principles.

Sanitation*:* refers to all processes and principles which are applied to ensure that micro-organism count is kept at a safer or lower level.

Sanitation standard operating procedures (SSOPs):-A documented system for assuring that personnel, facilities, equipment and utensils are clean and where necessary, sanitized to specified levels prior to and during operations.

Food safety: Assurance that food will not cause harm to the consumer when it is prepared and/or eaten according to its intended use.

Quality assurance: All the planned and systematic activities implemented within the quality system and demonstrated as needed to provide adequate confidence that an entity will fulfill requirements for quality.

Meat: All parts of an animal that are intended for, or have been judged as safe and suitable for, human consumption.

Organoleptic inspection: Using the senses of sight, touch, taste and smell for identification of diseases and defects.

Quality assurance (QA) system: The organizational structure, procedures, processes and resources needed to implement quality assurance.

List of Abbreviations and Acronyms

AU/IBAR:-African Union/Inter-Bureau Animal Resource

CAC: - Codex Alimentarius Commission

CBO:-Community Based Organization

CCP:-Critical Control Point

EC: - European Commission

FAO: - Food and Agriculture Organization of the United Nations

FGD: - Focus Group Discussion

GAP:-Good Agricultural Practices

GHI:- Gross Happiness Index

GHP: - Good Hygienic Practice

GMP:-Good Manufacturing Procedures

GPS:-Global Positioning System

HACCP:-Hazard Analysis Critical Control Point

ILRI:-International Livestock Research Institute

INGO:-International Non-Governmental Organization

IRR: Internal Rate of Return

KACC:-Kenya Anti-corruption Commission (Ethics and Anti-corruption Commission)

KI: - Key Informants

LNGO:-Local Non-Governmental Organization

OIE:-World Organization of Animal Health

PPCP: - Public-Private Community Partnership

PPP: - Public-Private Partnership

PRA: - Participatory Rural Appraisal

ROI: - Return on Investment

SOP:- Standard Operating Procedures

SPS:-Sanitary and Phytosanitary

SROI: - Socio Return on Investment

SSOP: - Sanitary Standard Operating Procedures

UN: - United Nations

UNDP: - United Nations Development Program

USD: - United States Dollar

VFM: - Value for Money

WB:-World Bank

WHO:-World Health Organization

WTO:-World Trade Organization

Abstract

This study assessed the impact that development of meat marketing infrastructure, supply of equipment and associated training has had on the quality of meat and hides and skins sector in Somaliland State of Somalia. Ahmed Gureh meat market was selected for rehabilitation. Meat vendors operating in the market were supplied with various meat selling equipment and trained in good hygiene practices. Moreover, hides and skins value chain actors were trained to improve the quality of hides and skins along the value chain. The overall objective of the study was to assess the economy, efficiency, effectiveness (3Es) and impact of past meat marketing infrastructure development and the associated training programs in the Somaliland meat sector.

Data collection involved use of a combination of both qualitative and quantitative methodologies whereby a team of enumerators (interviewers) backstopped by the researcher interviewed key informants from the study sites to collect information. Research data was collected using a triangulation of data sources to enhance reliability of both primary and secondary data from the target sites and stakeholders. The study employed four main data collection techniques: (i) document analysis; (ii) in-depth interviews (key informant interviews); (iii) focused group discussions and (iv) observation.

Moreover, the impact evaluation from hides and skins mainstream stakeholders followed Kirkpatrick's four level of training impact assessment that evaluates training modality, knowledge gained, behaviour change and impact realized. The data were analyzed using descriptive statistics involving percentages to determine varying degrees of response-concentration and standard deviations to measure response-disparity particularly for the Likert-scale question items.

To cross-check the accuracy of results obtained from the interviews using questionnaires and visual appraisal of the intervention and control meat markets, 100 swab samples were obtained from meat contact surfaces (meat display tables, hooks and knives) from the rehabilitated Ahmed Gureh meat market (intervention) and another 100 swab samples were collected from Halane 1 meat market (control). Both markets are located in Borama municipality of Awdal region; Somaliland State of Somalia. All the samples were analyzed against Total Viable Counts (TVC) and *E. coli* contamination levels.

Questionnaire results included value for money calculation from the intervention market to be an investment of USD 1 generated USD 4.17 return on investment (ROI). The IRR or ROI from the intervention was less than a quarter a year (three months). The rehabilitated meat market attracted 151 new traders who occupied the market to sell meat. These increased annual meat sale volumes handled through the market by 286% and increased annual profit per trader by US $2,608 following a project investment of US$ 625 per beneficiary. This was in compliance with the 3Es for value for money intervention. Moreover, eighty percent (80%) of the intervention respondents were very satisfied while only 20% were satisfied with the rehabilitation works and supply of meat selling equipment at the market.

The rehabilitation was reported to have resulted in the increase of the number of clients in the meat market where intervention was done. The majority, 67%, of the traders in the rehabilitated market stated that the number of clients had increased, 13% reported no change while 20% reported a decrease in the number of clients.

The regression equation for “Meat Market levels of contamination (Ahmed Gureh and Halane 1 meat markets)” was found significant” (i.e., the regression model was a good fit of the data). The "**R**" = 0.858, indicated a high level of prediction (85.8%) and R^2 value of 0.734 that our independent variable (meat markets) explain 73.4% of the variability of our dependent variable (levels of meat contact surface contamination with TVC and *E. coli*). Meat from the non-rehabilitated Halane 1 meat market was 73.4% more likely to be heavily contaminated as compared with that from intervention market.

Similarly, one hundred (100%) percent of hides and skins respondents reported an increase in the quality of hides and skins after they received the training. They reported an average increase in the number of hides sold from 7 before the training to 11 pieces per trader per day after the training which represented a 54% increase in daily sales. For the skins, the number increased from 8 to 12 pieces per trader per day after the training which represented 55% increase in daily sales. The response was a clear indication that training had an impact on hides and skins quality which was reflected through increased sales.

To improve earnings and number of actors along the meat value chain through improved quality of marketed meat, hides and skins ,the study recommended that there is need for further training and rehabilitation of the existing facilities and/or construction of more infrastructures along the meat value chain to promote meat and hides and skins quality.

Chapter 1

1. Introduction

1.1 Federal Republic of Somalia

The Republic of Somalia has been without a central government since its collapse in 1991 following a civil war which has persisted in South- Central up to date (UN/WB, 2006). Somaliland declared itself an independent state in 1991 but has not been internationally recognized. Despite the setback, Somaliland has since 1991 promulgated a constitution based on which the state has held three relatively free and fair democratic elections that saw the establishment of a parliament and election of a national president. The “state of Somaliland” has established institutions like the judiciary, security including immigration, defense, and public financial management including revenue authority and Central Bank and relevant ministries. These institutions manage government affairs such as raising revenue from taxes that enable it to render some basic services to its citizens like security, health, education, public infrastructure including roads, water supply, telecommunication and power generation and banking (UN/WB, 2006).

1.2 Climate

Climate in Somaliland is for the large part arid and semi-arid with patches of equatorial climate in the Golis ranges. The climate is characterized by a bimodal but highly irregular pattern of rainfall, which is the principal constraint to agriculture and livestock production and productivity. Most parts of Somalia receive low amounts of rainfall in the range of 100-300mm annually. Mean monthly temperatures range from 15–25°C in the northern mountains, to 25–35°C in the south (Bradbury, 2008).

1.3 Human population

According to World Bank report of 2006, the human population of South Central Somalia, Puntland and Somaliland is estimated at 7.7 million. Of these, seventy percent (70%) is rural of which about 55% are pastoralists and agro-pastoralists, 14% is crop farmers and 1% is fishermen. Of the remaining 30%, 20% is engaged in menial services and 10% is engaged in light industrial activities in urban areas (Hashi *et al*., 2007).

1.4 Livestock Population

Somalia as a whole is heavily dependent on livestock production whereby during the normal season without drought and war, it accounts for 80% of total exports, fetching foreign currency for the governments (Somaliland, Puntland and Federal Government) as well as livestock traders and pastoralists. The current livestock population of South-Central Somalia, Puntland and Somaliland is estimated at about 4.6 million cattle, 19 million goats, 11.8 million sheep and 6.3 million camels (UN/WB, 2006; Munyua, 2008; Masake *et al.*, 2008).

Meat and milk are the main staple foods for most of the households in Somalia. In addition, livestock when sold contribute to a source of revenue for households to meet some basic needs including school fees and medical expenses for the families. However, the meat sector has been negatively affected by lack of food safety programs at local livestock slaughter facilities and meat retail facilities that would guarantee wholesome meat for domestic consumers following the collapse of the central Somalia government in 1991 (Hashi *et al.*, 2007). Furthermore, the full potential of trade to contribute to increased incomes and greater food security cannot be realized

without commercial domestic and export-orientated processing and marketing structures and supportive policy and legal frameworks (UN/WB, 2006).

The whole of Somalia has been unable to fully exploit the full potential of livestock based assets of co-and by-products as it is constrained by inadequate capacity in terms of resources and skilled labour to fully comply with international standards (EC, 2008; FAO, 2009). Part of the limitations can be addressed through capacity (human, physical and financial) building and training of livestock sector stakeholders in food safety and quality assurance systems. This will contribute to an uninterrupted local and export trade which has to start with training needs assessment (Janice and Diana, 2002; Wamalwa *et al.*, 2011).The proposed study assessed the economy, effectiveness, efficiency and impact of past training programs and the development of supporting marketing infrastructure in meat sub-sector in Somaliland.

1.5 Training needs and infrastructure development in the food sector

1.5.1 Food safety

Food safety is the assurance that food will not cause harm to the consumer when it is prepared and/or eaten according to its intended use (FAO, 2004; CAC, 2009). Food safety plays a crucial role in the national economy and human and animal health development. It safeguards the health of the nation; enhances tourism, national and international trade of food; promotes production, distribution and consumption of safe food; prevents avoidable losses and promotes conservation of natural resources. Countries with well established food safety assurance systems can export and trade their products without any barriers and become competitive in the global trade (FAO/WHO, 2005; OIE, 2011).

1.5.2 Required training and infrastructure needs for safe food production

Food safety is a critical issue in development. Outbreaks of foodborne illness result in substantial costs to individuals, the food industry and the economy (Kaferstein, *et al.,* 1997; Egan *et al.*, 2007). Within England and Wales, the number of food poisoning notifications rose steadily from approximately 15,000 cases in the early 1980s to a peak of over 60,000 cases in 1996 (Egan *et al*., 2007). Effective food hygiene training needs should target changing stakeholders' behaviour that most likely can result in foodborne illness. Most food hygiene training courses lead to changes in behaviour, based on the knowledge, attitudes and practices (KAP) model (Egan *et al*, 2007). Training in good hygiene practices, standard operating procedures, sanitary standard operating procedures, waste management and environmental hygiene practices, hazard analysis and critical control point systems among others are of paramount importance to minimize food borne safety hazards (Egan *et al.,* 2007). These trainings should follow development and equipping of food production and marketing infrastructure to enhance compliance with food safety standards by food business operators.

1.6 Problem statement and justification

Food safety assurance practices deserve top priority at all stages of the food production chain. Producers and companies dealing with food along the food chain are responsible for ensuring food safety and must accept to shoulder the responsibility, while the government has to provide the legal framework, regulations and controls. Ensuring food safety is a constant challenge to food businesses since it entails continuous adaptation to new scientific findings and technologies, hence the frequent demand for food businesses to continuously review their own activities (German Federation for Food Law and Food Science, 2002).

In the case of Somalia, national animal health and veterinary public health services as well as associated infrastructure collapsed with the collapse of the Federal Government in 1991. Additionally, the conflict led to displacement of trained professionals and experienced individuals in various livestock value addition infrastructures and markets. Meat production, handling and retailing has since been carried out in unhygienic and derelict infrastructure facilities (Hashi *et al.*, 2007).

With the ever changing and advancing food safety technologies and standards, food producers must keep abreast with the new technologies in food safety requirements. These can be achieved through capacity enhancement including infrastructure developments (physical), training of their personnel (human) and financial services in addition to development and/or enforcing supportive legal and policy frameworks. In addition, access to appropriate equipment and tools is equally important.

In the absence of the government with which to work and collaborate with, the international implementing organizations including United Nation agencies and International Non-governmental Organizations designed and implemented livestock sector development initiatives in collaboration with remnants of local veterinary structures, local non-governmental organizations (LNGOs), community based organizations (CBOs), meat sector stakeholders, local municipalities and regional government ministries charged with livestock production activities and trade. However, these initiatives could not substitute the role of the public sector which includes formulation, application and enforcement of policy, legislative and regulatory functions, export certification, quality assurance and meat safety systems. Nevertheless, development and implement-

ing partner-led initiatives could improve the prevailing conditions through activity-specific interventions like infrastructure development, capacity building programs which should be assessed according to value for money concept. Over the years, many food safety training programs have been offered to personnel working in the meat sector by international organizations in addition to recent support to livestock, meat and hides and skins marketing infrastructure development.

Despite all these interventions, there has been no evaluation of the economy, efficiency and effectiveness and impact of these trainings and infrastructural interventions to ascertain the level of benefits that have so far been achieved within the sector. This necessitated the study to be undertaken to establish the impact.

1.7 Hypothesis

Infrastructure development and training has no effect on quality of meat and hides & skins processing in Somaliland

1.8 Overall objective

The overall objective of the study was to assess the economy, efficiency and effectiveness and impact of past training programs and meat marketing infrastructure intervention on the Somaliland meat sector.

1.9 Specific objectives

a. To determine types of trainings and infrastructure development undertaken for the meat sector.

b. To determine the input cost and appropriateness of the training schedules, duration, modules and delivery methods.
c. To determine the effectiveness of infrastructure development and training in improving hygiene standards of meat markets.
d. To determine factors including modifiers that affect implementation of hygiene standards at meat markets.
e. To determine the socio-economic return on investment of training on quality and income generated from hides and skins produced at local slaughterhouses that have benefited from the interventions.

Chapter 2

2. Literature Review

2.1 Trade in livestock and livestock core and by-products

Livestock is a major repository of individual and national wealth in pastoral communities generating abundant employment opportunities for non-skilled and skilled pastoralists in addition to generating foreign currency earnings from export trade for majority of Horn of Africa countries (ILRI, 2005). Globally, livestock contributes 40% of the global value of agricultural output and support the livelihoods and food security of almost a billion people (FAO, 2009[1]). The growth and transformation of the livestock sector offer opportunities for agricultural development, poverty reduction and food security gains. However, the rapid pace of change risks marginalizing smallholders and systematic risks to the environment and human health must be addressed to ensure sustainability (FAO, 2009[1]; Thomson *et al.*, 2004; Weiler, 2004). Targeted capacity building including skills development, formal training and provision of appropriate infrastructure, tools and equipment, are key elements to improve the performance of the livestock sector. Furthermore, supporting animal health inspection and certification systems through capacity building, basic marketing infrastructure development, livestock disease surveillance activities, increasing fodder production, establishing or rehabilitating water catchments along livestock stock routes in arid and semi-arid regions of Horn of Africa countries, promotes livestock export trade (Castiello *et al*., 2011).

2.2 Training needs assessment of mainstream stakeholders along meat value chain

Training needs assessment is a critical activity for the training and development function of any business enterprise and successful livelihood project intervention of all sectors including the meat sector (Janice and Diana, 2002). It is of paramount importance to carry out an assessment of the training requirements of a target group to determine the desired behaviour or skill level acquired at the completion of training, the present level of competence of the potential trainees, the educational and professional background and the optimal number of trainees.

Designing a training and/or development program aimed at conducting a training and/or development needs assessment begins with a "need" identification. A need can be described as a gap between what is currently in place and what is needed now and in the future. For example, in the meat sector, gaps would include discrepancies or differences between what an organization expects to happen and what actually happens in the sector, current and desired job performance to guarantee wholesome, safe and suitable meat for local consumption and export, existing and desired competencies, knowledge and skills in the safety of meat along the production value chain (Janice and Diana, 2002; Wamalwa *et al.*, 2011).

Studies have shown that mishandling of food plays a significant role in the occurrence of foodborne illness. Improper food handling may be implicated in 97% of all foodborne illness associated with catering outlets (Egan *et al.*, 2007).Trainings in good manufacturing practices, good hygiene practices, sanitary standard operating procedures are of paramount importance for operation in any given food production industry to minimize food contamination and improve quality. Egan *et al.*, (2007) showed that food handler training in food quality and safety assurance sys-

tems is one strategy whereby food safety can be increased, offering long-term benefits to the food industry.

2.3 Public health hazards associated with foods of animal origin

2.3.1: Illnesses associated with foods of animal origin

Food safety is an important public health issue, as illness due to contaminated food is perhaps the most widespread health problem worldwide. The publicity given to Bovine Spongiform Encephalopathy (BSE) or mad-cow disease in Europe, the discovery of dioxin and other chemical contaminants in chicken and some fish, the use of antibiotics in animal husbandry, the presence of bacteria and the advent of genetically modified organisms have heightened consumer awareness and concerns about food safety. Transmission of emerging and re-emerging zoonoses and other significant food-borne pathogens as well as chemical residues to man and animals largely occurs through foods of animal origin (FAO/WHO, 2002; FAO/WHO, 2005; FAO/OIE, 2006; Oluwafemi *et al.*, 2013).There is a strong food safety element in transmission and spread of most of these diseases making it an essential public health issue for all countries (WHO, 2002; FAO/OIE, 2006).

Diseases associated with food lead to financial losses related to absenteeism from work, expenditures on medical care, costs of investigation of outbreaks and containment, legal suits and other expenses (WHO, 2001; WHO 2005). Improper practices responsible for microbial foodborne illnesses have been well documented (FAO/WHO, 2005) and typically involve cross-contamination of raw and cooked foodstuffs, inadequate cooking and storage at inappropriate temperatures. Food handlers may also be asymptomatic carriers of food poisoning organisms (Cruickshank, 1990; Egan, 2007).

Available data indicate that food-borne illnesses are a huge and growing public health problem. For example, countries with systems for reporting cases of food-borne illness have documented significant increases in the incidences of *Salmonella sp, Campylobacter jejuni*, enterohaemorrhagic *Escherichia coli*, and other pathogens (WHO, 1999). Up to 30% of the population in industrialized countries may be affected by food-borne illnesses each year and the situation is worse in developing countries (WHO, 2005; WHO, 1999). In many countries, economic productivity and development is adversely affected by food-borne diseases and zoonoses as they impact negatively on the countries' resources and man-hours. Therefore, considering food safety, quality assurance and suitability, and observing hygiene along the line of production to consumption chain is vital and needs renewal of outlook from government agents, producers and industries (WHO, 2002; FAO/WHO,2002; FAO/WHO, 2005; FAO/OIE, 2006).

2. 3.2 Microbial contamination of food contact surfaces

Microorganisms adhering to food contact surfaces and equipment can become potential sources of food contamination, foodborne infections and food spoilage. The number of microorganisms on the surface correlates directly with the levels of contamination (Schlegelova *et al*, 2010). The contaminations can be identified by observation or by microbial examination of surface swabs. Both pathogenic and food spoilage microorganisms that have commonly been isolated from food contact surfaces include *Listeria monocytogenes, Enterobacter aerogenes, Bacillus sp, Streptococcus sp, Staphylococcus sp, Shigella sp, Escherichia sp*, and *Klebsiella sp.* These are common and can survive cleaning and disinfection if done poorly (Schlegelova *et al.*, 2010; Oluwafemi *et al.*, 2013).

2. 4 Food safety quality control systems

Food safety systems can be defined as the set of regulatory and non-regulatory institutions involved in activities aimed at ensuring the safety of the national food supply. It includes the official 'food control system', which is defined by FAO/WHO as being "the mandatory regulatory activity of enforcement by national and local authorities to provide consumer protection and ensure that all foods during production, handling, storage, processing and distribution are safe, wholesome and fit for human consumption; conform to safety and quality requirements; and are honestly and accurately labeled as prescribed by law (WHO, 2005; OIE, 2010). Earlier approaches to food safety were based only on end product testing, which is no longer adequate to ensure food safety (OIE, 2009; FAO/WHO, 2005). This is now being replaced by a food safety management approach that focuses on food hazard prevention, elimination, control or reduction to acceptable levels throughout the food production chain.

This new approach includes the application of Good Agriculture Practices (GAP), Good Hygienic Practices (GHP), Good Manufacturing Practices (GMP), Sanitary Standard Operating Procedures (SSOP), Hazard Analysis and Critical Control Point (HACCP) system, Food Safety Management Systems and Traceability/Recall Systems which can be disseminated to all concerned food production stakeholders and government regulators through infrastructure development and training programs (Felix, 2002; FAO/WHO, 2005). The GAP, GHP, GMP and SSOP are considered as prerequisite systems or programs for implementation of the HACCP system (Felix, 2002; FAO/WHO, 2005). The HACCP system for production of meat are a proactive means of process control for food safety purposes and need to be incorporated into the design and layout of meat production facilities (CAC, 2005). Egan *et al*, (2007) have shown that food handler train-

ing in food quality and safety assurance systems is one strategy whereby food safety can be increased, offering long-term benefits to the food industry.

2. 5 Good agricultural practices, good hygiene practices, sanitary standard operating procedures and good manufacturing practices

The Good agricultural practices (GAP), good hygiene practices (GHP), sanitary standard operating procedures (SSOP) and good manufacturing practices (GMP) are measures that are required to produce safe food (FAO/WHO, 2005). The GAPs are basic food safety principles associated with minimizing biological, chemical and physical hazards at primary production stages. The GHPs mandate that all persons working in direct contact with food, food contact surfaces and food packaging materials conform to sanitation and hygienic practices and standards to the extent necessary to protect against contamination of food from direct or indirect sources (Felix, 2002; FAO/WHO, 2005). One of the elements of GHPs is that food businesses assess their own standards and make decisions regarding the practices and procedures which ensure good food hygiene practices (FAO/WHO, 2005; OIE, 2011). Pre-operational and operational SSOPs minimize direct and indirect contamination of meat to the greatest extent possible and practicable. A properly implemented SSOP system ensures that facilities and equipment are clean and sanitized prior to start of operations and appropriate hygiene is maintained during operations (CAC, 2005; OIE, 2007; CAC, 2008).

Good manufacturing practices are intended to provide criteria for complying with the provisions of requiring that all human foods be free from adulteration. The requirements of the GMPs have some direct or indirect influence on the biological, chemical or physical safety of the finished products (Felix, 2002). Training of workers in these good practices is important to enhance the competitiveness of the meat sector.

2. 6 Hazard Analysis and Critical Control Point (HACCP) System

The Hazard Analysis and Critical Control Point (HACCP) system is a systematic approach that identifies and evaluates food safety hazards and put in place measures and/or procedures that will either prevent, eliminate, control or reduce the food safety hazard to acceptable levels. It is the foremost means of assuring food safety throughout the food chain, from primary production to final consumption, particularly when used in combination with the pre-requisite programmes of GMP and GHP (Brendan *et al*., 2005).

For efficient and effective application of the HACCP system, the establishment operator must apply the seven HACCP principles namely: (1) Conduct a hazard analysis; (2) Identify critical control points (CCPs); (3) Establish critical limits for each CCP; (4) Establish CCP monitoring requirements; (5) Establish corrective actions; (6) Establish procedures for ensuring the HACCP system is working as intended, and (7) Establish record keeping procedures (Brendan *et al.*, 2005). Workers knowledge and skills in HACCP system will positively impact on the quality of meat.

2.7 Quality of hides & skins

2.7.1: Good quality hides & skins

Enough attention must be paid to obtain good quality of hides and skins. Pre-slaughter practices including good animal nutrition and water intake, disease control, avoiding thorny areas during grazing will contribute to good quality hides and skins. Control of Pre-slaughter defects during slaughter and post-slaughter defects during handling, preservation and storage contributes to good quality hides and skins (Mwinyihija 2010 and 2011). Pre-slaughter defects to be controlled include parasites and diseases (such as mange, tick infestations, lumpy skin disease, sheep and

goat pox among others), small size of hides, inappropriately placed brand marks, and mechanical damage of hides by thorns from the thorny grasslands. Careful control of Pre-slaughter defects during bleeding and dressing (ripping and flaying damage) is important. Hand flaying using knives is the most common technique in pastoral areas. Skilled flaying minimizes holes and cuts on the hides and skins, contributing to good quality, and also results in less rejection by tanneries. Proper Post-slaughter management will control defects caused by abrasion, damage by pests and moulds, and inappropriate curing methods (Kagunyu *et al.*, 2011; Mbogo and Malala 2007). Wet salting method of curing hides and skins should be promoted to ensure good quality hides and skins.

2. 7.2 Factors affecting quality of hides and skins

In most cases, pre-slaughter (branding, skin infections and diseases, transport injuries, trauma, starvation among others), during slaughter including poor flaying, lack of skills and absence of, for instance, hide pullers in modern abattoirs lead to production of low quality hides and skins. Post slaughter – (handling, drying, salting among other steps) exacerbates the prevailing bad situation. Mohammad *et al.*, (2002) have reviewed the major defects that are directly caused by slaughter and post slaughter operations. These include:

a) **Rubbed grain*:*** This damage is produced by dragging the un-flayed carcass over rough and uneven ground and can even be caused by rough concrete. The grain is generally rubbed off or ‘frizzed’ and is a definite cause of loss in value to the tanner.
b) **Bad pattern*:*** Ripping’ is the initial opening cut down the centre of the belly and the four legs. Bad pattern is caused by indiscriminate ripping. The correct method of ripping ensures a

uniform pattern, with bellies of equal width, well opened shanks and dewlap, a round butt and adequate tails.

c) **Flay cuts*:*** This damage is caused by the careless use of the knife or by the use of unsuitable knives. Poor flaying causes holes and cuts on the hides and skins, which consequently fetch lower prices because of the poor quality, and also results in higher rejection by tanneries. Flay cuts constitute the most serious mechanical defects on hides and skins. Lack of proper tools like the curved flaying knives, flaying skills and carelessness lead to loss of quality or outright rejection of raw hides and skins (Mbogo and Malala, 2007; Kagunyu *et al.,* 2011).

Furthermore, quality of hides and skins are too affected by pre-slaughter defects accumulated during the life of the animal; pre-slaughter defects during slaughter, and post-slaughter defects during handling, preservation and storage (Mwinyihija 2010 and 2011). Pastoralists brand their livestock with hot irons for identification (as livestock rustling is a common practice among pastoral communities) and as cure for various diseases. Unfortunately, this is done indiscriminately and branding marks are made on the larger part of the body destroying the hide. Other pre-slaughter defects are caused by bleeding and dressing (ripping and flaying damage). Hand flaying using knives is the most common technique in pastoral areas. Post-slaughter defects are caused by abrasion, damage by pests and moulds, and inappropriate curing methods (Kagunyu *et al,* 2011; Mbogo and Malala, 2007). Pastoralists mainly use ground drying and suspension drying to cure hides and skins, which result in inferior quality skins (Kagunyu *et al.,* 2011; Wayua and Kagunyu, 2012).

Hides and skins in Somaliland are graded as good or bad. The grading depends on the defects caused before slaughter like branding marks and after slaughter and post slaughter operations like flay cut, bad pattern and rubbed grain. These constraints can be addressed through training and capacity building of the mainstream stakeholders.

2.7.3 Required infrastructure development to improve the quality of meat and hides and skins

Livestock markets and infrastructure exist for both domestic and export trade in Somaliland (Ombui *et al.*, 2014). Market channels are served by a number of interconnecting primary and secondary markets linked to several production areas. Local markets involve livestock slaughter and meat markets for processing and marketing of meat respectively to local consumers (Ombui *et al.*, 2014). Livestock slaughter and marketing of meat suffer constraints that include poor design and hygiene of slaughter facilities and lack of meat inspection services. Export markets involve trade in live animals and raw hides and skins (Ombui *et al.*, 2014). The latter is affected by derelict slaughter facilities, poor quality preservation and storage facilities. Trading activities are facilitated by availability of important animal handling facilities in livestock markets (Ombui *et al.*, 2014).

To minimize rubbed grain on hides and skins, slaughter of livestock should be carried out in well constructed slaughterhouses and slaughter slabs that have hoists and impervious smooth floors and walls. The facilities should be equipped with modern flaying equipment like hide pullers or uses of banana shaped knives to minimize flay cuts (Mohamed *et al.*, 2002; FAO, 2009[2]). Well constructed and ventilated hides and skins storage infrastructure will help improve handling and preservation of hides and skins to prevent or minimize grain cracks, bacterial damage and fram-

ing defects which are major problems. Proper storage, packaging and transportation will prevent or control scratches and tearing, wetting, contamination, infestation that are major problems too (Mohamed *et al.*, 2002; FAO, 2009[2]).

2.8 Social Network for beneficial skills development and employment creation along livestock by-products

Othieno *et al.*, (2014) emphasizes that information and knowledge exchange between different actors in its generation, dissemination and utilization among various actors in the agriculture extension system as sources, channels and targets of agricultural information and technologies sharing within a social setting.

Some of the adaptation practices can be acquiring skills, knowledge and competence (Mike, 2015) through training of good manufacturing practices of hides and skins from livestock production, recovery, preservation, storage and marketing. Learning tour trips are other options of skills acquisition and development. The acquired skills will have multiplier effect through information sharing and dissemination between various actors through formal and informal settings to enhance behaviour change among actors.

Social capital in the form of groups is used in communities worldwide, especially in the rural areas as safety nets to cope with risks and mutual assistance. The advantage of social capital is its availability thus it is relatively easy to exploit in community mobilization. Rural communities interact within and across social levels on various risks and this form a crucial component in the trade of hides and skins in area of study (Othieno *et al.*, 2014; Mike, 2015).

According to Wamalwa and Mohamed, (2013), employment opportunities and wealth creation can be found all along the livestock value chain by-products such as bones, fats and hides and skins. Their exploitation can be enhanced through skills development and information sharing and dissemination from regions where hides and skins are discarded at site of slaughter especially in the Horn of Africa countries.

2.9 Value for money concept in infrastructural development and capacity building interventions

The value for money (VFM) concept is based on the ability of an investment showing positive returns. In the case of infrastructural interventions in the meat subsector, this would entail realizing benefits from the slaughter and meat retail facilities and the capacity building interventions (Barnett *et al.,* 2010). The VFM is essentially about achieving the right local balance between the 3Es, namely; economy, efficiency and effectiveness, or, spending less, spending well and spending wisely to achieve desired priorities. VFM is high when there is an optimum balance between all the three elements, when costs are relatively low, productivity is high and successful outcomes have been achieved by a development programme (Barnett *et al.,* 2010; DANIDA, 2007).

The assessment of VFM thus involves examining each of the 3-E elements of VFM, identifying the links between them and drawing conclusions based on evidence about how well they perform together. Interestingly, the definitions also refer to an optimal balance, as contrasted with a 'maximum' productivity ratio, suggesting that it is not the case that the cheapest option always represents better value for money, and pointing to the conversion of inputs-outputs and outputs-outcomes as the subject of real interest in value for money judgment. This can be illustrated by constructing a cheap simple slaughter slab without ancillary facilities and modern livestock

slaughter equipment for slaughter of more than 700 shoats, 55 camels and 67 cattle. The slab will be cheap in terms of economy (input) but it will not enable operators to include in the design facilities that will enable compliance with food safety and quality assurance programmes of GHP, SSOP, SOP and HACCP. These programs contribute to production and marketing of high quality meat by mitigating simple preventable foodborne diseases and meat spoilage microorganisms and safe recovery of hides and skins, white offal among others. The capacity to do so would capitalize on return on investment (ROI) for meat sector interest groups and slaughterhouse operators (Barnett *et al.,* 2010; Thomson *et al*., 2004).

2. 10 Definitions and linkages of economy, efficiency and effectiveness as related to interventions

a. **Economy**: For the purpose of this study, economy was defined as a measure of what goes into providing a service in the meat sector and hides and skins interventions in Somaliland. These were costs or inputs. Unit costs of infrastructure development, meat sector stakeholders' trainings and capacity building of government authorized personnel for instituting quality assurance systems were typically used as an economic measure. 'The whole life costs of inputs such as the direct and indirect costs of constructing and equipping slaughterhouses, rehabilitating meat markets and supplying meat retail equipment and tools, cold chain storage, personnel trainings, operational costs, running and disposing of assets or resources were considered (Barnett *et al.,* 2010) as indicated in Figure 2-1 below.

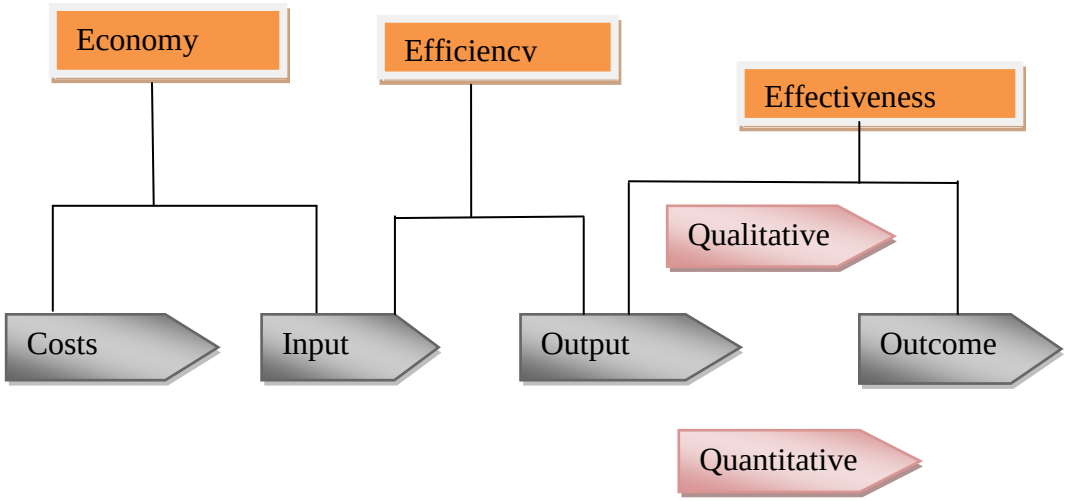

Figure 2-1 Value for money metrics

(Barnett *et al.*, 2010)

b. **Efficiency**: Is defined as a measure of productivity. In other words, how much one gets out in relation to what she or he has invested in. This examined the relationship between inputs and outputs; for example, planned versus actual delivery of milestones by service providers, or benchmarked comparison among programmes working towards same or similar outcomes but using different pathways to achieve intended outcomes.

c. **Effectiveness**: Is defined as the qualitative and quantitative measures of increase or decrease in outcomes that showed that a program 'was effective in delivering its intended objectives'. This examined the relationship between outputs and outcomes.

2.11 The role of project or programme indicators in value for money assessments

Indicators (number of jobs, amount of income, amount of revenue, ROI) have a significant role in VFM assessment since they provide 'a measure of productivity' (efficiency) and 'qualitative and quantitative measures of increase or decrease in outcomes' (effectiveness). Clearly, then, the quality of these indicators and the accessibility of data to support measurement of progress against them have important implications for VFM that were sought from interventions so far

instituted in the meat sector and hides and skins improvement in Somaliland by international aid organizations (Barnett *et al.,* 2010; DANIDA, 2007).

2.12 Challenges and potential limitations to value for money data collections

Some challenges in this sector that affected adoption and institutionalization of the many interventions included limited skills of meat sector and hides and skins workers/players, weak institutions and/or reluctance of government institutions to enforce laws regulating quality production of meat (Wamalwa *et al.*, 2012; Castiello, 2015).These factors compromised achievement of maximum intervention benefits as intended by proponents of the interventions.

2.13 Microbiological analysis of meat contact surface swab samples

2.13.1 Total viable counts

Each tube containing the swab is vortexed for 10 seconds to ensure a homogenized mixture of the sample. This is followed by tenfold step serial dilution in tubes containing 9 ml normal saline upto 10^{-5} before plating for total viable counts (Omer *et al.*, 2006; Robert, 2005; Bridson, 1998). One (1) ml of each dilution is transferred to a 90mm diameter Petri dish. Ten (10) mls of plate count agar (PCA) tempered at 48^0Cis poured into each of the 10 Petri dish plates. Each plate is swirled in figure 8 to mix. The plates are then incubated at 37^0c for 24 hours. Plates with colonies below 300 are selected. Bacterial colonies are enumerated using colony counter (Martínez, 2010; Robert, 2005; Kang'ethe, 1993). Total number of colonies is determined by multiplying the enumerated colonies and the dilution factor of each plate (Ira 1984).

2.13.2 Total coliforms count and fecal coliforms test method

These are determined using the most probable numbers (MPN) method. The method involves thorough mixing of the swab food sample using a vortex mixer. One (1) ml of the mixture is

transferred into the first of the three sterilized test tubes containing 9 ml of peptone water using a sterilized pipette. This constitutes serial dilution 10^{-1}. From tube 1, one (1) ml is transferred into tube 2 making dilution 10^{-2}. This is repeated upto serial dilution 10^{-3} depending on the estimated density of coliforms in meat contact surfaces (FAO, 1992; Martínez, 2010). One (1) ml portion is transferred into 3 sterilized and labeled tubes containing 9 ml single strength MacConkey broth for each dilution using separate sterilized pipettes. All the MacConkey broth tubes contain Durham tubes for holding gas produced as a result of lactose fermentation by the coliforms after the incubation period. Care should be taken to ensure that the whole process takes less than 15 minutes from the time the sample is blended until all dilutions are in appropriate media to minimize external contamination. The tubes are incubated for 48 ± 2 hours at 37^0C. The tubes are examined for gas production that collect in Durham tubes and colour change from purple to brown of the broth after 24 hours of incubation. The negative tubes should be re-incubated for an additional 24 hours. Gas production and colour change of the broth is an indication of coliforms presence (FAO, 1992; Martínez, 2010).

2.13.3 Confirmatory test on all positive tubes for coliforms

Each gassing MacConkey broth tube is agitated followed by transferring loopful of suspension to a tube of 5 ml brilliant green bile broth. The tubes are incubated for 48 ± 2 hours at 37^0C. Tubes that show gas production are recorded. The MPN of total coliforms are counted and calculated based on the combination of confirmed MacConkey broth tubes of 3 consecutive dilutions (FAO, 1992).

2.13.4 Interpretation of results

The results were compared with Gulf Cooperative Council Countries (GCC) standards as indicated in the Table 2.1 below.

Table 2.1 GCC Microbiological meat contamination standards

Grade	Grade	APC (TVC)	E. coli
A	Excellent (E)	<200	<3
B	Good (G)	200-2000	3-10
C	Fair (F)	2001-20,000	11-100
D	Poor (P)	20,001-200,000	101-1,100
E	V. poor (VP)	>200,000	>1,100

Castiello thesis (2015)

Chapter 3

3. Materials and methods

3.1 Study area

The study was conducted in Borama, Hargeisa and Burao municipalities in Somaliland, the self declared “independent” state of the Federal Republic of Somalia from 2011 to end of 2014 for a period of four years. Somaliland is located in the North-Western part of Somalia. It is bordered with Djibouti and Gulf of Aden in the North, Ethiopia on the West, Gulf of Aden on the East and Puntland State of the Federal government of Somalia on the South. The study covered two meat markets located in Borama municipality and hides and skins improvement in Borama, Hargeisa and Burao municipalities that were purposively selected. These are shown in Figure 3-1.

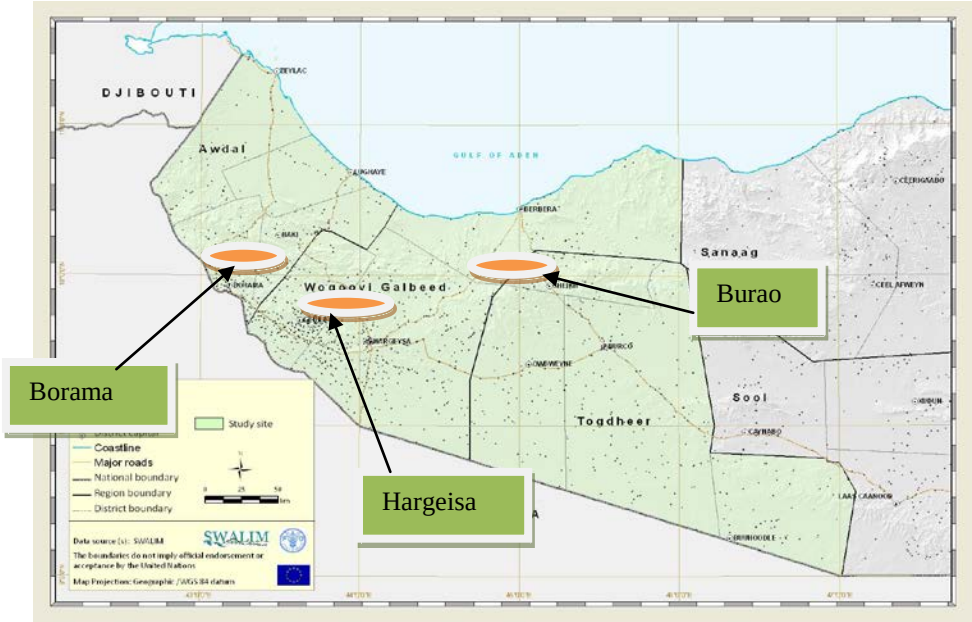

Figure 3-1: Map of North Western Somalia (Somaliland region) showing the locations of the study facilities (www.faoswalim.org/)

3.2 Data collection

3.2.1 Study design for two meat markets in Borama municipality

The basic design used in this study was descriptive research and causal-comparative (ex post facto). The main methodology was a retrospective quantitative survey. Causal-comparative studies are important in attribution of impact because several knowledge variables cannot be manipulated and be used for experimental research. The meat market and hides and skins improvement study was designed / intended to assess the impact of the rehabilitation, supply of equipment in addition to trainings funded by FAO Programmes.

a. **Meat markets**: A team of two enumerators backstopped by the researcher interviewed over 60 participants (50% each from intervention and control groups). The team administered the same study tool at control sites for comparison purposes. Ahmed Gureh meat market rehabilitated by FAO was the intervention group while participants from Halane 1 meat market which was not rehabilitated formed the control group.
b. **Hides and skins improvement**: A total of 63 respondents comprising of pastoralists, flayers and handlers/traders were interviewed. The interviewees were from Borama, Hargeisa and Burao municipalities. The evaluation adopted Kirkpatrick's Four-Level Training Evaluation Model that objectively analyzed the efficiency, effectiveness and impact of training to establish any behaviour change in areas of intervention (Kirkpatrick, 2010).

3.2.2 Sampling methods and data collection instruments

All the study population identified above was treated as sampling units. For the purposes of this survey, intervention and control groups were the sample units (i.e., the entity that represented one data point) was taken as one service recipient or non-stakeholder. A purposive stratified homogeneous random sampling method was used to sample the study subjects (Phil, 2010). And in

some cases, convenient sampling was used within the strata where random sampling method was not possible to employ. The sample size of more than 60 and 63 persons of meat markets and hides and skins stakeholders respectively was reached giving a confidence level of 95%.

A combination of both qualitative and quantitative methodologies was utilized as follows: A team of enumerators (interviewers) backstopped by the researcher interviewed key informants (NAFAQO leadership who manage the rehabilitated Ahmed Gureh meat market, municipal officials involved in daily markets management and revenue collection and Ministry of Livestock personnel who were involved in hides and skins training) in the study sites to collect information. The above research data were collected using a triangulation of data sources to achieve reliability of both primary and secondary data. The study employed four main data collection techniques: (i) documentary analysis; (ii) in-depth interviews (key informant interviews); (iii) focused group discussions and (iv) observation (KACC, 2007). Details of various methods used and criteria for selecting interviewees are elaborated here below:-

3.2.3 Desk or documents review assessment

The researcher reviewed literature to determine the available past trainings and infrastructure development. Review of official research documents was the main source of secondary data. These were collected from official documents including national policies, reports from UN agencies, International NGOs, recent infrastructure market performance surveys and feasibility studies done by other development agencies and FAO Somalia. The literature review allowed the investigator to obtain in-depth knowledge of the study area including its geographical layout, socio-politico-economic status and climate (KACC, 2007). At the same time, the literature review il-

luminated the nature and evolution of Somaliland livestock and meat infrastructure development and performance. Document review was a low-cost source of evidence.

3.2.4 Key informant interviews

The researcher and team planned and carried out a rigorous targeting 60 persons from the two meat markets (Ahmed Gureh and Halane 1), 63 hides and skins mainstream stakeholders from Borama, Hargeisa and Burao municipalities. The team took an informal information gathering approach to interviews with key informants. It sought to understand first-hand the informants' perspectives on Somaliland's livestock infrastructure development, economy and the country status of slaughter facilities and meat retail condition of the existing structures (annex 3). Face to face personal interview was the main mode of data collection. Key informant interviews were conducted with selected Ministry of Livestock staff, Municipal officials, meat vendors' leaders (NAFAQO leadership), meat consumers, butchers supervisors, hides and skins trader's association chairmen and the Community elders from the study towns.

3.2.5 Focused group discussions

To understand better how the beneficiary communities perceived the relevance of the livestock infrastructure developments and rehabilitation, four focus group discussions were held (two per site with male and female participants) with a total of 48 participants in Borama municipality for meat sector stakeholders and 24 hides and skins stakeholders in Borama, Hargeisa and Burao municipalities. Each focused group discussions (FGD) constituted between eight and twelve participants. The FGDs were done in a form and manner that assured the informants that the information generated shall be used in a constructive manner. The characteristics of the participants met the following main categories: members of the community, meat consumers, meat sellers, butchers, pastoralists, flayers, hides and skins traders and opinion leaders. These discussions

helped in market assessment and reflections on the construction, rehabilitation and trainings undertaken for the market beneficiaries and enriched the study with qualitative data.

3.2.6 Sampling for questionnaire administration

The study used a population and sector stratified sample frame. Variables used for stratification included: urbanization, population size of business and number of key informants (KACC, 2007). Ultimate sampling units were geographical towns and sub-sectors (meat market and hides and skins outlets). Sample rotation took place at the ultimate sampling unit and the sampling area level. The sampling strategy developed was revised and agreed upon during the training of the data collection enumerators. The sampling for 63 hides and skins traders, 60 meat sellers and consumers was random.

3.2.7 Administration of direct interviews

A survey using a questionnaire to establish the market performance trend and the impact of infrastructure rehabilitation and training to direct beneficiaries was commissioned and undertaken by the researcher one year after official handover of the facility.

The questionnaires and interviews were administered under controlled room conditions to ensure the standardization of data gathering to decrease non-response errors and to increase response rates (Cooper and Schindler, 1998). The data was gathered by the intercept method (Cooper and Schindler, 1998) using semi-structured questionnaires (Marshall, 1989). Pre-testing survey instruments and questionnaire refining ensured that there was content validity. Questionnaire pre-testing was done after trained enumerators administered the first lot.

The interviews were conducted through the entire study period. The interviews took place at a variety of times throughout day times usually facilitated by one enumerator and note taker. The key informant interviews lasted between 25 to 45 minutes. Each FGD varied in duration from about one hour to over two hours in few cases, depending on the numbers involved and their inquisitiveness. Each interview was analyzed and provided a rich source of comment, testimony, and lively interaction between respondents and interviewers.

Qualitative data collection entailed application of close ended and occasionally open ended questions whereby respondents were given an opportunity to express their views that enabled extraction of quantitative data (Olive and Abel, 2003; Bishnu, 2003). Based on the VFM principles drawn from background or baseline information from intervening organizations and building on the analytical framework regarding interventions, a value for money matrix was developed (Table 3.1). It considered input cost, improved Result Based Management (RBM) based on Public-Private Partnership (PPP) approach, 3Es Rating Approach, Trends Analysis and Socio-Return on Investment (SROI) (Barnett *et al.,* 2010). This helped determine the effectiveness of infrastructure development and training on hygiene standards of meat markets and hides and skins recovery, preservation and marketing.

Table 3.1: Value for money matrix

Output	Target beneficiaries		Annual profit per meat seller		Net profit attributable to intervention	Total net attributable annual profit	Projected attributable income	
	Before rehabilitation	After rehabilitation	Before rehabilitation	After rehabilitation			4 years	5 years

3.2.8 Determination of level of customer satisfaction and gross happiness index

Customer satisfaction and gross happiness index (GHI) of meat retailers, meat consumers and hides and skins traders was obtained through interviews obtained from FGDs. Furthermore, Borama municipality was probed regarding revenue collections following improved infrastructure development after interventions.

3.3 Determination of level of microbial contamination in intervention and control meat markets

This was done by analysing the TVC and coliforms levels of contamination of the meat contact surfaces.

3.3.1 Validation of questionnaire findings with level of contamination on meat contact surface

This was done to cross-check the accuracy of results obtained from the interviews using questionnaires and visual appraisal of the intervention and control meat markets. One hundred (100) samples were swabbed from meat contact surfaces including meat display tables, hooks and knives from the rehabilitated Ahmed Gureh meat market in Borama municipality for work surface testing (Sentence and Husband, 1993). As a control group, 100 similar swab samples were collected from Halane 1 meat market located in Borama municipality which did not receive any intervention. All the swab samples were analyzed for Total Viable Counts and *E. coli* contamination levels. The microbiological analysis was carried out at the Central Hargeisa Veterinary Laboratory in Somaliland.

3.3.2 Surface swab sample size determination

The sample size for the proportion of contaminated surfaces was determined based on the formula of Martin *et al* (1987):

$$\frac{Z_{\alpha}^{2}\ pq}{L^{2}}$$

Where Z; represented normal distribution test when the sample size (n) is more than 40 (large).

α=0.05

$\alpha/_{2}$=0.025

$Z_{\alpha/2}$=1.96

P= proportion of meat contact surfaces found contaminated with *E. coli*. (Estimated prevalence)

q= 1-p

L= the precision of the estimate also called the allowable error

The estimated prevalence of *E. coli* was 94% based on work by Schlegelova *et al*, (2010), ($P < 0.01$) on meat contact surface sites.

Therefore

$$n = \frac{1.96^2 \times 0.94 \times 0.06}{0.0025}$$

=73 samples being the minimum number.

The final figure for the study was rounded to 100 samples.

3.3.3 Surface swab collection

Surface swab samples were taken from the target meat markets a few hours before start of work. Swabs moistened in sterile 0.9% normal saline solution was used to swab an area of 10 cm^2 delineated with aluminium template for meat display tables. Repeat swabbing in the same area was done using a dry swab.

Knives and hooks that were being used in the two target meat markets were also swabbed. The swabs per item were labeled appropriately and immediately placed in tubes containing 10 ml of saline solution containing 0.1% peptone (w/v) and labeled appropriately. The tubes were sealed and placed in coolbox with dry ice and transported to Central Veterinary Laboratory in Hargeisa for analysis against Total Viable Counts and *E. coli* counts within 24 hours of sampling.

3.4 Infrastructure development

This involved rehabilitation, procurement and supply of meat selling equipment and training of meat vendors at Ahmed Gureh meat market. It further involved establishment of a company for management of the market through public private partnership approach.

3.4.1 Rehabilitation work

Ahmed Gureh meat market was selected for rehabilitation by FAO out of four existing markets in Borama municipality located in Awdal region of Somaliland state of Somalia. Rehabilitation of the market included repair of roof, floor, walls, replacement of old meat display tables and construction of new meat display tables. The entire floors, 1.8 m height of internal wall and meat display tables were tiled with white mosaic ceramic tiles to facilitate easy cleaning and sanitation. The remaining upper part of the internal wall was painted with water proof paint. Other rehabilitation work included construction of drainage system, construction of grey water conservancy tank and connection to the drainage lines, fabrication and fixing of meat hanging rails, construction of sun protection shed, connection of market to municipal potable water mainline, water reticulation and distribution within the market with provision of overhead water storage tanks, provision of hand-wash basins and detergents and connection to electricity power line.

3.4.2 Procurement and supply of meat retail equipment

Various meat retail equipment to help meat vendors comply with hygiene meat handling practices to minimize contamination and increase meat shelf-life were procured and supplied to vendors and the market. These included communally shared equipment such as electrical meat cutting bandsaws for cutting bone meat, stainless steel wheelbarrows for solid waste collection and disposal, deep freezers for keeping unsold meat in a chilly/frozen state to minimize wastage through bacterial spoilage (rotting) and thus wastage. Other equipment was distributed to each meat seller as a kit package. These included stainless steel knives, hooks, meat chops or cleavers, manual meat cutting saws, sharpening steel, meat chopping boards and protective gear including white overcoats, plastic aprons and white caps. Figure 3 below shows the hygiene status of Halane 1 and rehabilitated Ahmed Gureh meat markets.

3.4.3 Training of meat vendors

All the 216 meat vendors who operated from the rehabilitated Ahmed Gureh meat market were trained on minimum meat hygiene handling practices and safe utilization and maintenance of meat retail equipment and the meat market. The vendors were shown practical way of minimizing meat contamination and how to use the new equipment. Storage of unsold meat in deep freezers to minimize wastage was also emphasized. The trainees were further trained in good governance and rule of law, institutional building/strengthening, basic bookkeeping and financial reporting. The latter included developing simple financial records and book keeping (receipts, cash book and financial statement/reports) in addition to compliance with modern accounting system. This was meant to assist the vendors keep good records that would enable them to determine if they are making profit or not. The profit enabled them pay taxes in form of municipal revenue tax and maintenance cost to the Public Private Partnership (PPP) established company for management of the meat market and communal equipment. The meat vendors were then provided individually with the meat selling equipment as a kit.

3.4.4 Public-Private Partnership company establishment

For efficient and effective management of the rehabilitated Ahmed Gureh meat market and to facilitate the distribution of the procured equipment, a private company named NAFAQO (meat traders association) was established through Public-Private Partnership (PPP) approach for the management of the market. The company signed a five year lease agreement with the municipality to manage the market. The company board members were trained on various topics including institutional building/strengthening, rule of law, compliance with company covenants, election timelines and procedure and accountability. Participants were further trained on basic bookkeeping and financial reporting, transparency and accountability. This included developing sim-

ple financial book keeping (receipts, cashbook, and financial statement/reports) in addition to compliance with modern accounting system. The objective of this training was to enhance institutional strengthening by enabling the two institutions (Municipality and NAFAQO) to abide by good principles of management and rule of law.

3.5 Data management and Analysis

3.5.1 Data Analysis

The quantitative survey data were coded to allow for easy data entry into EpiData 3.1. Data were then analyzed using the Statistical Package for the Social Sciences (SPSS) Version 17. An analysis plan and tables were prepared that guided the analysis based on the objectives and indicators of the baseline. All regression analyses were adjusted for non-randomized characteristics; that is, the perception versus anticipated benefits/interaction with the program. Beta values (β), adjusted odds ratios (AOR) and 95% confidence intervals (CI) were used. Descriptive statistics was used to describe the characteristics and variables of the participants. The relationship between the characteristics of the respondents and their perception was established using correlation and regression analysis. The qualitative and quantitative data were triangulated to ascertain reliability.

Subsequently, the refined data was analyzed using descriptive statistics involving percentages to determine varying degrees of response-concentration, and standard deviations to measure response-disparity particularly for the Likert-scale question items. Descriptive statistics were invaluable in describing the sample data in such a way as to portray the typical respondent and to reveal the general pattern of responses. Further, the reporting ensured that resulting summaries from the findings presented data in a consolidated and meaningful framework, and thus, the analysis focused on accuracy and reliability in relation to the tracer study and impact assessment

objectives. Finally, for the purpose of effective communication of results, findings are presented using both tabular and graphical representations (histogram, bars and pie charts).

Triangulation was done to ensure consistency of information collected. Scouting was done to fill in the information gaps. SPSS computer package was used to locate and merge codes as well as to allow for identification of categories, VFM indicators and specific IRR and ROI. The data was then categorized and relationship among categories established in accordance with 3Es. Interpretation and the formulation of generalizations were done.

3.5.2 Microbiological analysis of surface swab samples

Sample collection

To cross-check and triangulate the perception, organoleptic observation, behaviour change and questionnaire administration survey findings, two hundred (200) meat contact surface swab samples were collected for TVC and *E. Coli* analysis to establish the levels of bacterial contamination from the intervention and control meat markets. One hundred (100) samples were collected from the rehabilitated Ahmed Gureh meat market (intervention) and another one hundred (100) from non-rehabilitated Halane 1 meat market (control). The two markets are located in Borama municipality within a distance of 250-300 meters apart. The samples were analyzed in Hargeisa Central Veterinary Laboratory against total viable counts and fecal *E. coli*. The meat contact surfaces swabbed were meat display tables, hooks and knives.

a) **Total viable counts**

Each tube containing the swab was vortexed for 10 seconds to ensure a homogeneous sample mixture. This was followed by tenfold step serial dilution in tubes containing 9 ml normal saline

upto 10^{-5} before plating for total viable counts. One (1) ml of each dilution was transferred to a 90 mm diameter Petri dish. Ten (10) mls of PCA tempered at 48^0C was poured into each of the 5 petri dish plates. Each plate was swirled in figure 8 to mix. The plates were incubated at 37^0C for 24 hours. Plates that had colony forming units (cfu) below 300 were selected. Bacterial colonies were enumerated using colony counter. Total numbers of colonies were determined by multiplying the enumerated colonies and the dilution factor of each plate.

Total Coliforms count and *E. coli* test method

These were determined using the most probable numbers (MPN) method. It involved thorough mixing of the swab surface sample using a vortex mixer. One (1) ml was transferred into the first of the three sterilized test tubes containing 9 ml of peptone water using a sterilized pipette. This made serial dilution 10^{-1}. From tube 1, one (1) ml was transferred into tube 2 making dilution 10^{-2}. The same was repeated upto serial dilution 10^{-3}. One (1) ml portions was transferred into 3 sterilized and labeled tubes containing 9 ml single strength MacConkey broth for each dilution using separate sterilized pipettes. All the MacConkey broth tubes contained Durham tubes for holding any gas that was produced as a result of lactose fermentation by the Coliforms after the incubation period. Care was taken to ensure that the whole process took less than 15 minutes from the time the sample was blended until all dilutions were in appropriate media to minimize external contamination. The tubes were incubated for 48 ± 2 hours at 37^0C. The tubes were examined for gas production that collected in Durham tubes and colour change of MacConkey broth from purple to brown after 24 hours of incubation. Negative tubes were re-incubated for additional 24 hours. Gas production and colour change of the broth was an indication of coliforms presence.

Confirmatory test on all positive tubes for coliforms

Each gassing MacConkey broth tube was agitated and a loopful of suspension transferred into a tube containing 5 ml brilliant green bile broth. The tubes were incubated for 48 ± 2 hours at 37^0C. Tubes that showed gas production were recorded. The MPN of total coliforms were counted and calculated based on the combination of confirmed MacConkey broth tubes of 3 consecutive dilutions.

3.5.3 Comparison of Results

The results were compared with Gulf Cooperative Council Countries (GCC) standards (Castiello, 2015).

3.5.4 Microbiological data analysis using dependent and independent variables

The analysis included both dependent and independent variables. The variables were categorized as either independent (meat markets, hooks and knives) or dependent (levels of TVC and *E. coli* contaminations).

A model summary analysis *was* conducted to determine how well the above models fit the data. The *multiple correlation coefficient* "R" value and the coefficient of determination "R Square" was considered to be one measure of the quality of the prediction of the dependent variable by the independent variable and was used to accurately report the data.

Using multiple linear regression analysis in SPSS, statistical levels of significance between geographical site levels of contamination of meat contact surfaces from both rehabilitated and none rehabilitated meat markets was determined.

3.6 Intervention in hides and skins value chain production

This targeted pastoralists, flayers, handlers at stores and traders.

3.6.1 Country contextual analysis of hides and skins situation

To determine the level of existing gaps in hides and skins production, recovery, preservation and marketing to allow for intervention, a country situation analysis was conducted for a period of 30 days. The assessment revealed a number of anomalies or gaps including poor animal husbandry practices such as heavy clan branding marks on prime areas of the hides, inadequate feeding and poor disease and ectoparasites control that affected quality of hides and skins. During slaughter, identified common factors affecting hides and skins recovery included bad pattern due to poor ripping, flay cuts, gouges and scores. Gaps identified during preservation included poor preservation through air drying and wet salting. At storage, poor stacking, poor control of pests and vermin and poor transportation methods were identified as some of the poor practices though not exhaustive.

The researcher in collaboration with the consultant conducted a validation workshop with mainstream stakeholders including Ministry of Livestock staff, Municipality staff, flayers, pastoralists and hides and skins traders to consolidate field findings. The findings were used to develop a tailor-made training manual which was used to train trainers of trainers (TOTs) who in turn were used to carry out training of mainstream stakeholder in hides and skins improvement and marketing to address the identified gaps.

3.6.2 Training of Trainers and stakeholders

Six (6) Animal Health Certificate holders employed by the Ministry of Livestock, were selected and trained for a period of 10 days by using the developed tailor-made training manual. The training of trainers (TOTs) in turn trained 300 hides and skins mainstream stakeholders who included pastoralists, flayers, butchers and hides and skins handlers and traders in sessions of four

days for each group. The training objectives were to enable the target trainees to improve animal husbandry practices for production of good quality hides and skins, be equipped with knowledge on how to minimize factors that affect quality of hides and skins at pre- slaughter, during slaughter and post-slaughter and to improve traders' marketing skills of hides and skins as preserved or value added products to wet blue.

3.6.3 Training focus, number trained and regions

The main criteria for the selection of trainees was their involvement in hides and skins activities. The selected candidates were trained for four days using adult learning methods that included: Question and answers to assess existing knowledge, group discussions and presentations, practical demonstration of hides and skins recovery and preservation, picture illustrations and storytelling, buzzing and humming, brainstorming and power point presentations- visual displays.

Ninety five (95) pastoralists (25 from Borama, 35 from Burao and 35 from Hargeisa municipalities) were trained in animal husbandry practices for production of high quality hides and skins during livestock production and transportation to market. The training focused on livestock breeds, unwholesome brands, feeding, watering, disease and parasites control practices, animal welfare conditions during transportation to ensure good quality hides and skins.

One hundred and forty five (145) flayers and butchers (55, 50 and 40 trainees from Burao, Hargeisa and Borama municipalities respectively) were trained on simple flaying techniques and handling to minimize rubbed grains, limit bad patterns, flay cuts, scores in addition to mitigate transmission of zoonoses and other public health hazards that can affect handlers and marketability of the product.

Sixty (60) hides and skins preservation personnel, hides and skins handlers, store keepers and traders were trained on proper handling and storage of hides and skins as well as factors that affect quality of hides and skins during collection and transportation of green hides and skins, drying and storage. The training targeted twenty (20) participants each from Burao, Borama and Hargeisa municipalities. The trainings were facilitated by six (6) training of trainees (TOTs) from the Ministry of Livestock who had been trained earlier.

3.7 Evaluation of the impact of the training on hides and skins

The impact evaluation followed Kirkpatrick's four level of training impact assessment that assesses training modality, knowledge gained, behaviour change and impact realized.

The evaluation targeted three hundred (300) pastoralists, butchers/ flayers, hides and skins handlers and traders located in Burao, Hargeisa and Borama municipalities in Somaliland who had received the training.

The purpose of this survey was to evaluate the training modality, knowledge gained, behaviour change and any impact in terms of income generated. Below are the findings of the evaluation/survey detailed in three categories of pastoralists, flayers and traders.

Chapter 4

4. 1 Results

The evaluation targeted meat vendors operating in rehabilitated Ahmed Gureh and non- rehabilitated Halane 1 meat markets.

4.1.1 Evaluation of training

One hundred percent of meat vendors operating in Ahmed Gureh meat market had received training related to their income compared to 16.7% from Halane 1; the control market. From the intervention market, about 12.5% of the participants received the training from CARE International, 75% from FAO and SAVE the Children and the remaining 12.5% could not remember the organization that offered the training. The participants from the control group were trained by CARE-International and could not remember the topic/title of the training. The various topics covered that could be recalled by some trainees are detailed in figure 4-1 below.

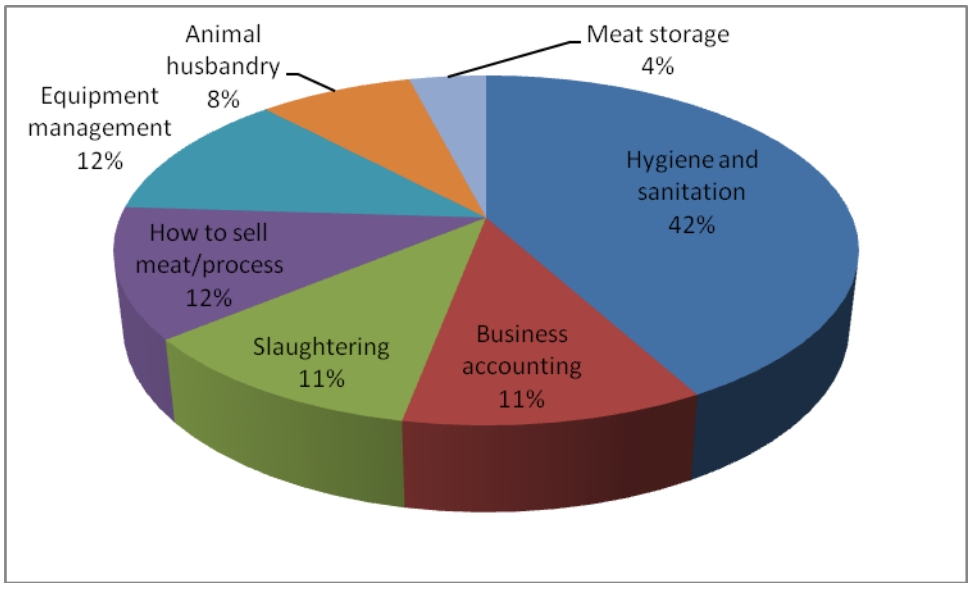

Figure 4-1: Training received

Interviewees requested for refresher training to enable them apply what was learned. They further requested for more trainings as detailed in Figure 4-2 below.

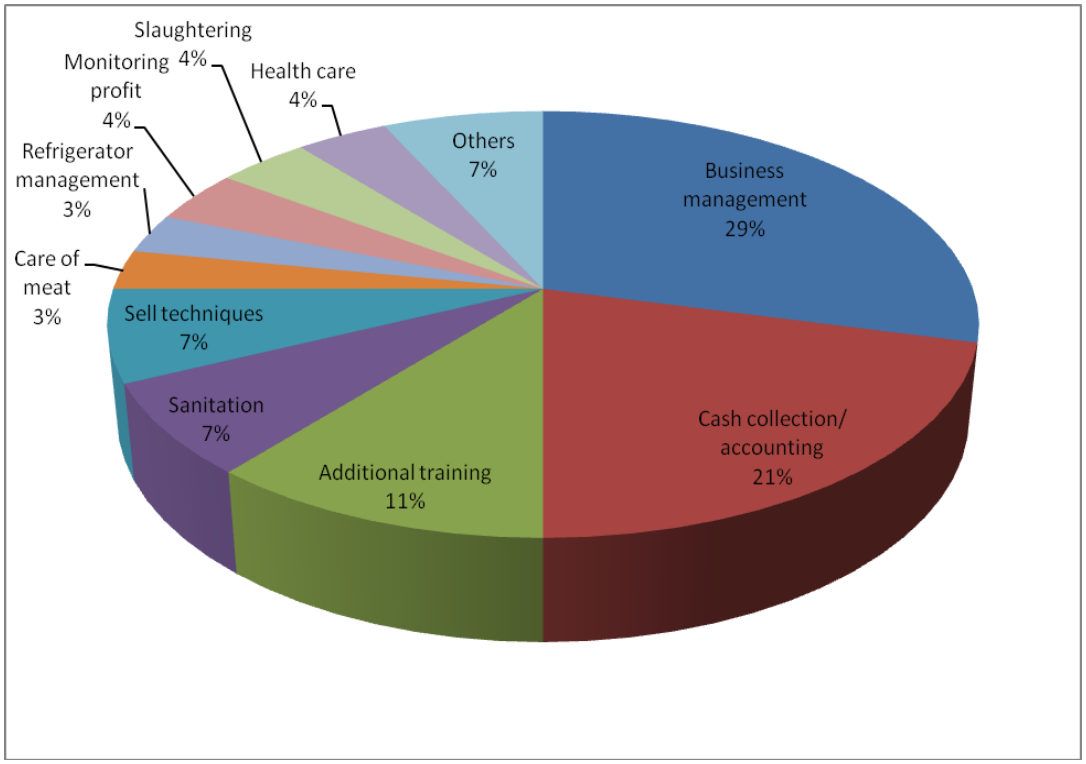

Figure 4-2: Further required trainings by meat vendors

4.1.2 Tracer study findings one month and one year after handover

The rehabilitated meat market attracted 151 new meat vendors into the market which added upto 216 occupants from the initial 65 before the intervention. These increased annual meat volumes handled by the market by 286% and increased annual profits per vendor by US $2,608 following a project investment of US$ 625 per beneficiary (Table 4.1).

Value for money calculations for rehabilitation of Ahmed Gureh meat market indicated that for a total investment of US$ 135 000 which was used, 216 meat display tables were rehabilitated or constructed in addition to procurement and supply of meat selling equipment. Therefore, support

to each vendor was approximately US$ 625. This resulted in an annual income of US $572,513 (US$563,328 from individual benefits to meat sellers plus US $9,186 to the municipality) per year (Table 4-1). Over a period of 4-5 years before next rehabilitation safe for minor maintenance, net attributable income was estimated to be US $2,290,055 and $2,862,569 respectively (Table 4.1). The total cost of rehabilitation and supply of equipment could be recovered in less than one year, while the annual depreciation and maintenance cost was estimated at US $25,482.

Secondary benefits included reported reduction of meat wastage by 15-20% (2.2kg) equivalent to $12 per small ruminant carcass per day. Therefore, the total loss of meat due to spoilage saved annually was estimated to be US $84,499. Meat price increased by US $2 to US $6/kg from US $4 /kg for goat/sheep meat in the new meat market compared to US $4 in non-rehabilitated meat markets including Halane 1 (control) in the same locality. Additional benefits included short term employment with direct cash injection of US $21,063 (6,018 man-days @ a cost of US $3.5/person/day).

Other attributable benefits that could not immediately be monetized included 786 different business persons who were attracted to operate within the vicinity or around the market aesthetics (working in a cleaner environment). Those attracted included 700 agricultural produce and general grocery retailers and tea kiosks, 36 meat mincers and 50 passenger taxi vehicles dropping and picking passengers. Value for money calculation indicated that an investment of USD 1 generated US$ 4.17 return on investment (ROI). The IRR or ROI from the intervention was less than a quarter a year. This was in compliance with the 3Es for worthy intervention.

The tracer study established that on average, 40% of meat vendors employed 3.5 persons who earned a livelihood from the market. This too was counted as long term jobs attributed to the intervention. More attributable benefits were that Borama municipal council collected US $ 0.083 (500 Somaliland shillings) per meat seller per day while NAFAQO (meat traders association) which was managing the meat market in a PPP arrangement charged US $ 0.17 (SlSh 1000) per meat retailer per day. The NAFAQO fee was used to pay costs of electricity, water and sanitation of the meat market while the municipality was mandated to collect solid waste from the meat market and surrounding in addition to carrying out minor maintenance requirements.

Table 4.1: Value for money matrix from Ahmed Gureh meat market in Borama

Output	**Target beneficiaries**		**Annual profit per meat seller**		**Net profit attributable to intervention**	**Total net attributable annual profit**	**Projected attributable income**	
	Before rehabilitation	**After rehabilitation**	**Before rehabilitation**	**After rehabilitation**			**4 years**	**5 years**
Annual profit per meat seller	65	216	$2,978	$5,586	$2,608	$563,328	$2,253,312	$2,816,640
Municipal revenue	65	216	$3,954	$13,140	$9,186		$36,743	$45,929
Total			$6,932	$18,726	$11,794		$2,290,055	$2,862,569

4.1.3 Short term employment and workdays

A total of 6,018 workdays were generated during the rehabilitation period creating 235 short-term jobs from skilled and unskilled labour. These were involved in casual labour like loading and offloading construction materials, excavation work, plumbing, electrical wiring, carpentry

and so forth. Figure 4-3 below shows that skilled labour constituted 16%, unskilled labour constituted 71% while others who included tea/food vendors, grocery/clothes sellers, and public service vehicles transport constituted 13%. All these groups earned an income from the rehabilitation work of the meat market improving their living standard.

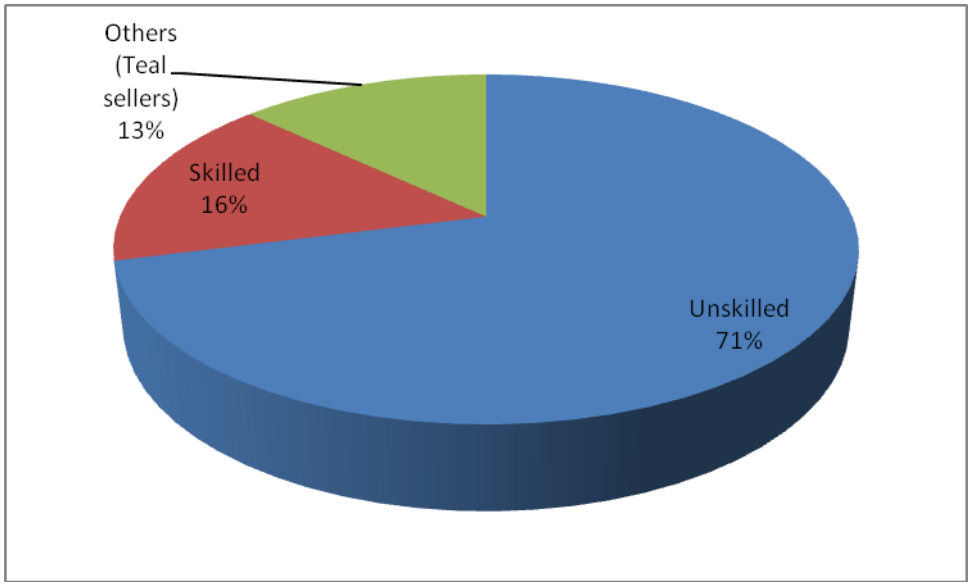

Figure 4-3: Short term jobs created during rehabilitation

4.1.4 Impact assessment and behaviour change survey of market performance after one year of rehabilitation and training

Immediately after official handover, a need-based training was done in June, 2012 for all the meat vendors. This was followed by the impact and behaviour change assessment in July, 2013 for two weeks. Below is the outcome of the survey by the researcher.

4.1.5 Organoleptic and observation survey findings

Management of the rehabilitated Ahmed Gureh meat market in terms of hygiene and sanitation was in compliance with hygiene standards as articulated in the Codex Alimentarius Commission guidelines. The communally used equipment like electrical bandsaws and fridges were well maintained and operational. Unsold meat was kept in the deep freezers for sale the next day.

Many meat consumers had developed a preference for deep frozen meat since they claimed that it was tender, of good quality and soft. This was a contrast to the time the deep freezers were introduced to the market. Meat consumers preferred fresh meat by then. Storage of meat in the deep freezers reduced meat losses as a result of bacterial spoilage by about 15% as compared to when they did not use it.

The meat display tables were maintained clean and meat was not displayed on cartons as before rehabilitation and training. Meat was suspended on meat hanging rails or displayed on cleaned tiled tables to minimize contamination through contact. The drainage line was clean and clear of solid waste while the grey water conservancy tank was clean and free of solid waste. No solid waste and rubbish heap was found near the market. The municipality was regularly collecting the solid waste.

Clients desisted from touching the desired meat before purchasing. They instead pointed using a pointer provided by meat vendors. Meat sellers were not sitting on meat display tables as it used to be the practice or as compared to the other three un-rehabilitated meat markets including Halane 1.

The market was supplied with adequate potable running water and well distributed hand-wash well maintained basins for washing hands and equipment before, during and after selling. The electricity supply was constant ensuring 24/7 hour operation of the deep freezers and 12/7 hour use of the electrical bandsaws. The PPP established NAFAQO Company ensured timely payment of all bills of water, electricity and waste collection. It also ensured well maintenance of communally used equipment like wheelbarrows, bandsaws and deep freezers. Table 4.2 below

details hygiene practices observed at rehabilitated Ahmed Gureh meat market before and after rehabilitation and training of meat vendors.

Table 4.2: Meat hygiene handling practices before and after intervention at Ahmed Gureh meat market

No.	Type of practice	
	Before	**After rehabilitation and training**
1	Vendors display meat on dirty old re-cycled cartons	Vendors display meat on clean tiled tables or hang it on pipe rails using stainless steel hooks
2	Vendors sit on meat display tables	Vendors sit on chairs
3	Customers touch desired meat for se-lection	Customers use pointer
4	Vendors cut meat on tables	Vendors cut meat on chopping boards
5	Dirty blocked and non-functional drai-nage channel	Cleared and cleaned functional drainage channel
6	Cracked market floor full of potholes	Few cracked floor tiles observed
7	Sellers had no water for washing hands and equipment within the market	Adequate flowing potable water available for use
8	Solid waste scattered all over the mar-ket	Solid waste collected in strategically positioned bins
9	Vendors without protective gear	Majority of vendors put on protective gear
10	Vendors mixed white offal with red meat	Vendors separated red meat from white offal
11	Vendors avoided storing meat in deep freezers	Vendors used deep freezers to full capacity
12	Vendors reluctant to use electric band-saws	Vendors used the bandsaws for cutting bone meat
13	Surrounding market environment full of garbage	Surrounding market environment free of garbage

4.2 Questionnaire survey findings -meat markets

This was administered to meat vendors in rehabilitated Ahmed Gureh and non-rehabilitated Halane 1 meat markets.

4.2.1 Demographic characteristics

The detailed results are both presented using figures and narrative presentation by marital status, age, education and number of children.

4.2.2 Marital status

From the intervention market (Ahmed Gureh), 13 (50%) of the respondents were married, 11 (42%) were unmarried while 2 (8%) were widowed (Figure 4-4).

From the control market (Halane 1), 10 (38%) of the respondents were married, 15 (58%) were unmarried while 1(4%) were widowed (Figure 4-4).

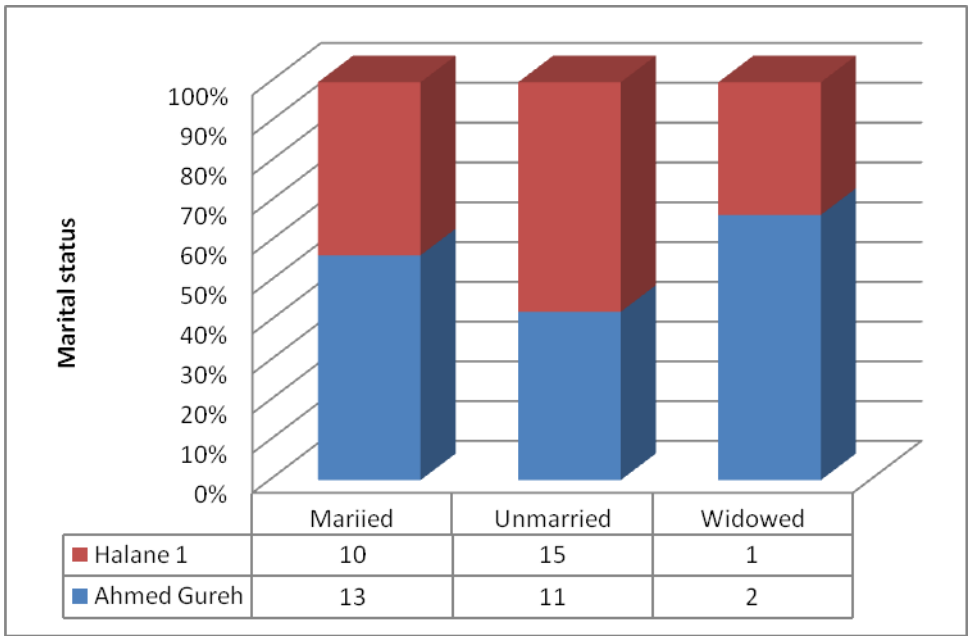

Figure 4-4: **Marital status by market type**

4.2.3 Age

The mean age of intervention group participants was 45.2 years (with a standard deviation of ±7.45 years), while that of the control group participants was 43.7 years (with a standard deviation of ±9.11 years). The mean age for all the participants was 44.5 years (with a standard deviation of ±13.7 years).

4.2.4 Number of children

The intervention group had more children than control group. The mean number of children of intervention group participants was 8.3 children (with a standard deviation of ±4.04 children), while that from control group was 8.0 children (with a standard deviation of ±2.38 children).

4.2.5 Number of years in meat business

The mean number of years in business for the control group was 17.5 (with s.d. ±10.35) while that of the intervention group was 15.2 (with s.d. ±8.00) years in business.

4.2.6 Level of education

Majority of the participants had no formal schooling. About 78% of the participants did not have any formal education. Only 11% had quranic level of education, 4% primary and 7% had secondary education (Figures 4-5).

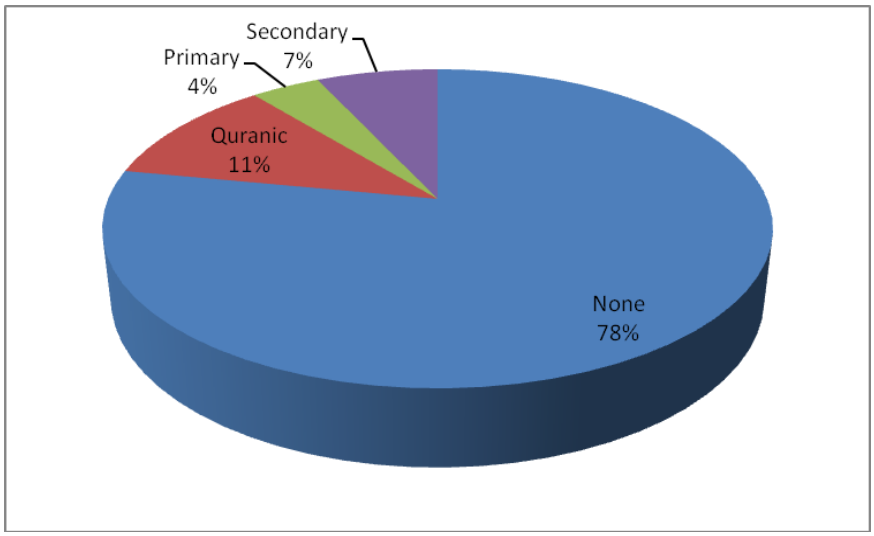

Figure 4-5: Education level of meat vendors by type

4.3 Business analysis

This targeted intervention and control meat markets.

4.3.1 Business performance for the intervention and control groups before and after intervention

None of the participants interviewed from the intervention group sold camel meat. There seemed to be an increase in the mean number of camel meat sold at the control market at the time of data collection (May, 2013) compared to 2 years previously. Majority of the meat vendors at the control markets were selling camel meat. At the same time, there was an increase in the sale of beef (cattle meat) in the intervention market but a decline of the same in the control market. Finally, there was a decline in the number of shoats sold per meat vendor per day at both the intervention and the control group. This decline in the intervention group was attributed to the increase in number of players in the market (Figure 4-6).

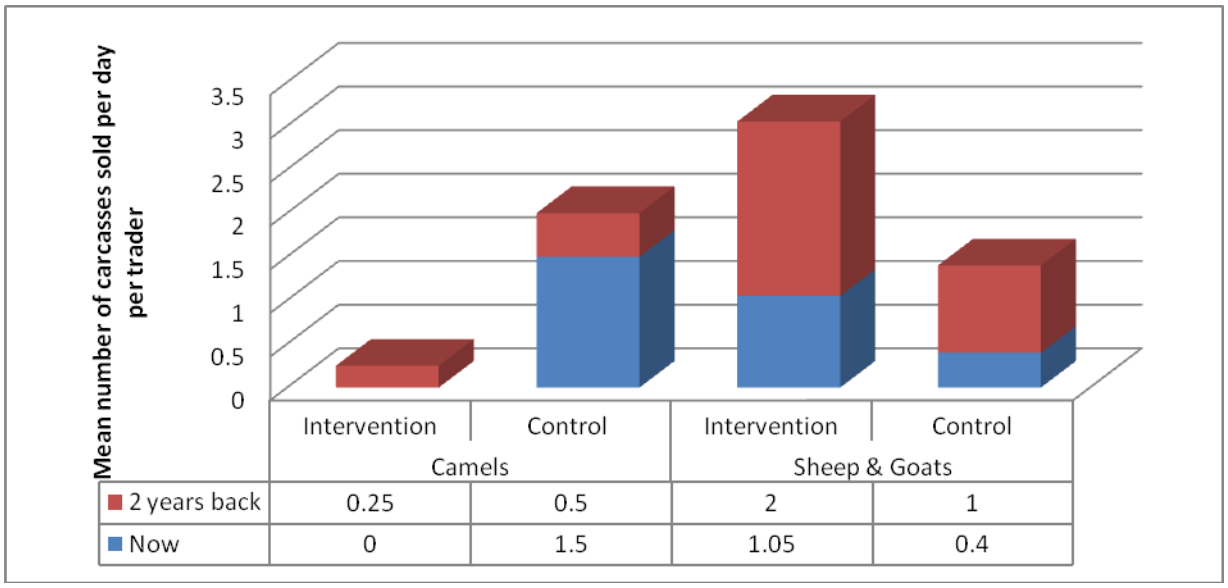

Figure 4-6: Number of carcasses sold before and after intervention

4.3.2 Income

Although there was an increase in the mean income from both groups, the participants from the control group reported higher increase in income; 326% compared to intervention group; 242%. The difference was attributed to the fact that majority of the respondents from the control market were selling large ruminant carcasses hence more profit margin as compared to intervention group who were selling only small ruminant carcasses. The respondents who were selling goat and sheep meat (mutton) reported a sharp increase in live animal prices thereby diminishing their profit (Figure 4-7).

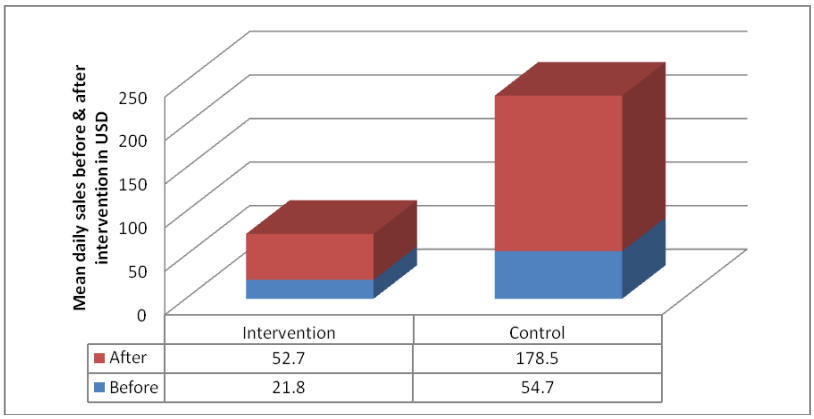

Figure 4-7: Mean daily income before and 1 year after rehabilitation

4.3.3 Reasons for the decline and increase in income

The interviewees cited various reasons for drop in income. Reasons cited by intervention group included stiff competitions as a result of many meat vendors having migrated to the rehabilitated market. Other reasons included high prices of sheep and goats and mutton, high transport cost and fewer customers (Figures 4-8 and 4-9).

On the other hand, there were respondents who reported an increase in income. The main reasons mentioned included the increase in sales and improved hygiene and sanitation thereby attracting many clients.

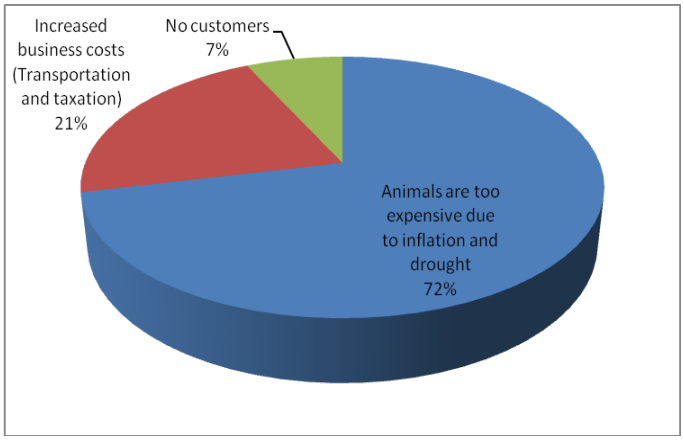

Figure 4-8: Decline income-Intervention

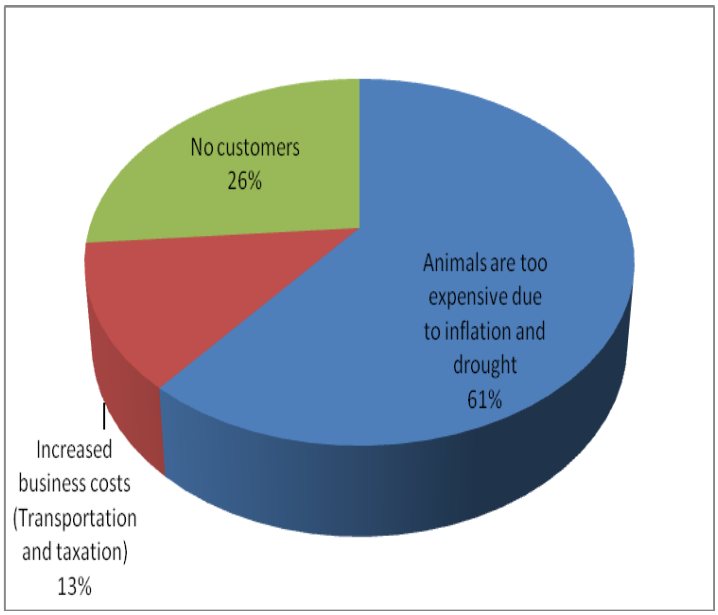

Figure 4-9: Declined income- Control

4.3.4 Meat sale trends

There was a general increase in the amount of meat left overnight in both the intervention and control groups. There was also a general decline in the number of people able to sell all the meat they had in a day in both intervention and control groups. This was attributed to stiff competition due to many entrants in the business. Moreover, there was a change in consumer behaviour since consumers of meat from the intervention market preferred deep frozen meat to fresh meat (Figure 4-10).

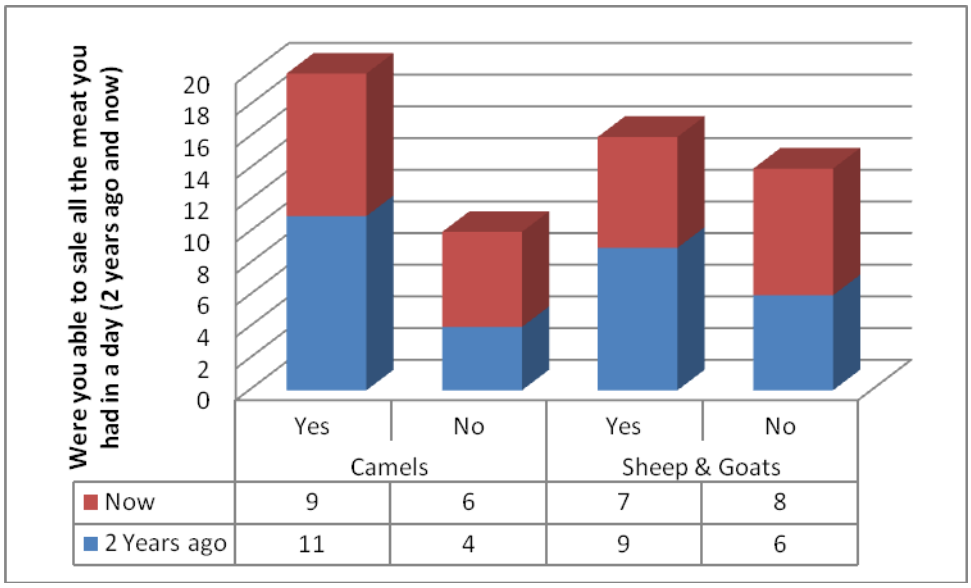

Figure 4-10: Trend of meat sale 2 years ago and now

4.3.5 Quantity of meat sold

There was an increase in the mean number of kilograms of meat sold at the intervention group from 3.5 Kg two years previously to 4.8 Kg at the time of data collection. This represented an increase of 37% in the meat that was sold while fresh (on the same day).

This change was attributed to the influx of meat vendors and consumers from the other markets to Ahmed Gureh meat market after rehabilitation which improved the hygiene and sanitary standards attracting more clients.

There was a decline in the sale of meat from the control group from an average of 3 Kg to 2.6 Kg per day (Figure 4-11). This was attributed to the outflow of customers from un-rehabilitated Halane 1 meat market to the rehabilitated Ahmed Gureh meat market.

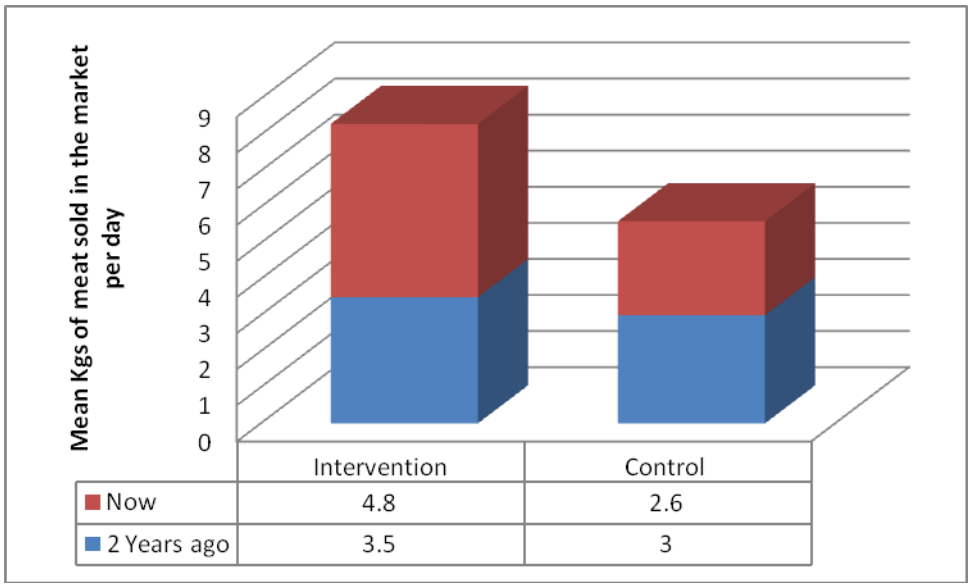

Figure 4-11: Trend of meat sale in control and intervention

4.3.6 General Reasons for not selling all meat

Respondents cited several reasons by both groups (intervention and control) for not being able to sell all the meat. Decline of customers was one of the reasons especially for the control group while from the intervention group, 20% stated that meat was too expensive but they sell the remaining meat on the following day. Another reason was that clients preferred deep frozen meat stored in deep freezers overnight as compared to fresh meat. This contributed to reduced daily sales of fresh meat from the intervention market (Figure 4-12). Moreover, with the influx of many meat sellers into the rehabilitated Ahmed Gureh meat market, stiff competition contributed to some vendors not selling all the meat the same day and a decline in clients even though, in general, there were many customers in the market compared to un-rehabilitated Halane 1 (Figure 4-13).

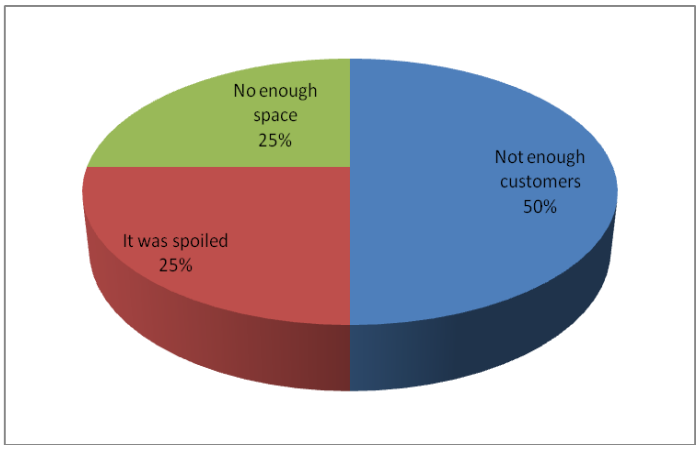

Figure 4-12: Reason for not selling all meat 2 years ago

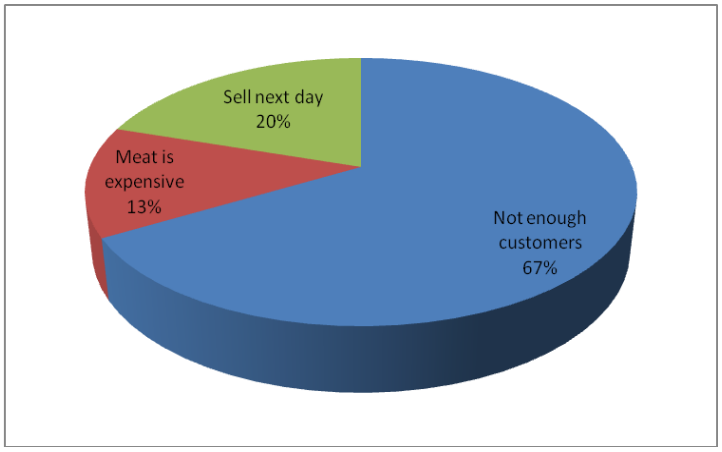

Figure4-13: Reasons for not selling all meat now

Figures 4-14 and 4-15 below show reasons of not selling all meat 2 years ago and during data collection

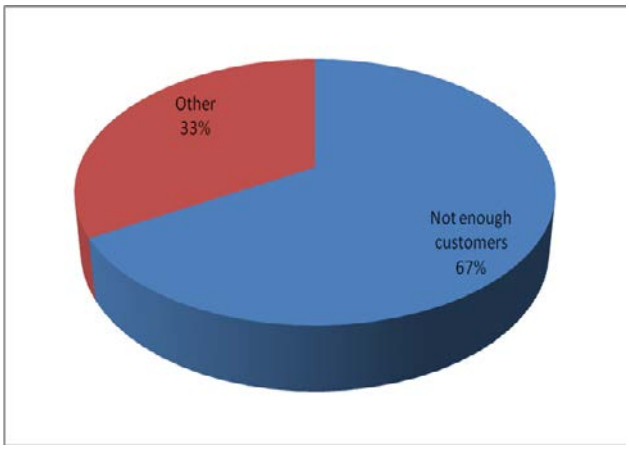

Figure 4-14: Reasons for not selling all meat 2 yrs ago

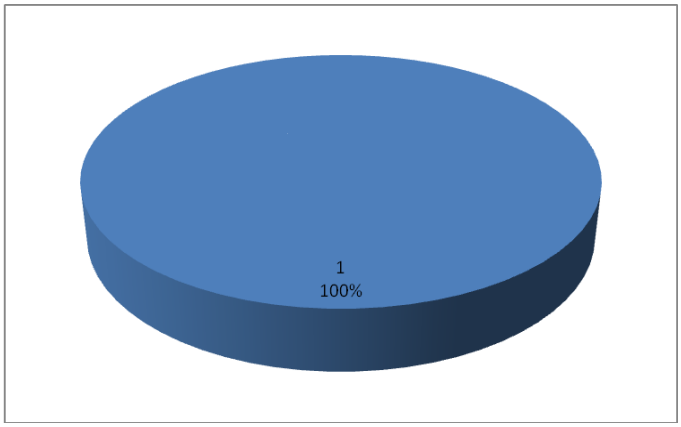

Figure 4-15: Reasons for not selling all meat now

4.3.7 Reported changes at Ahmed Gureh meat market

Table 4.3 below show reported changes at Ahmed Gureh meat market after rehabilitation. Many respondents reported sale of good hygienic and quality meat as compared to before rehabilitation and training. Hygiene and sanitation greatly improved at the market as compared to before rehabilitation.

Table 4.3: The main changes the rehabilitation of the meat market made in your business

Three main changes the rehabilitation of the meat market made in your business	1st Response n=15	2nd Response N=15	3rd Response n-15	Total Frequency n=15	Ranking
Good quality meat and improved shelf life	5	3	1	9	1st
Improved sanitation/cleanliness	7	1	_	8	2nd
Increased sales /more customers	1	1	2	4	3rd
Beautiful market	1	2	_	3	4th
Water supply	_	2	_	2	5th
Use of clean equipment	_	1	1	2	6th
Rain protection	1	_	_	1	7th
Less customers	_	1	_	1	8th
Electricity	_	1	_	1	9th

4.3.8 Customer satisfaction and gross happiness index with rehabilitation and number of clients

The majority (80%) of the intervention respondents were very satisfied by the rehabilitation works at the market. Twenty (20%) percent were satisfied and none was not satisfied (Figure 4-16). The rehabilitation was reported to have had an impact on the increase of number of clients. The majority (67%) said the number of clients had increased, 13% reported no change while 20% reported decrease in the number of clients (Figure 4-17).

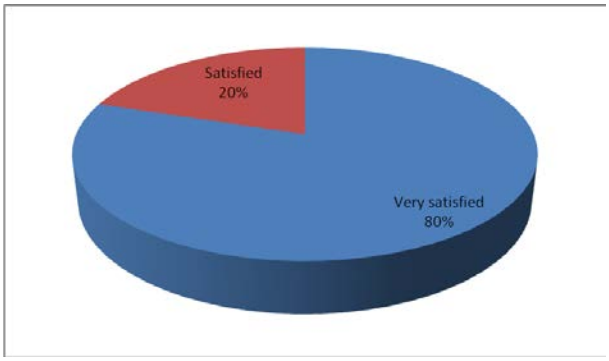

Figure 4-16: Customer satisfaction

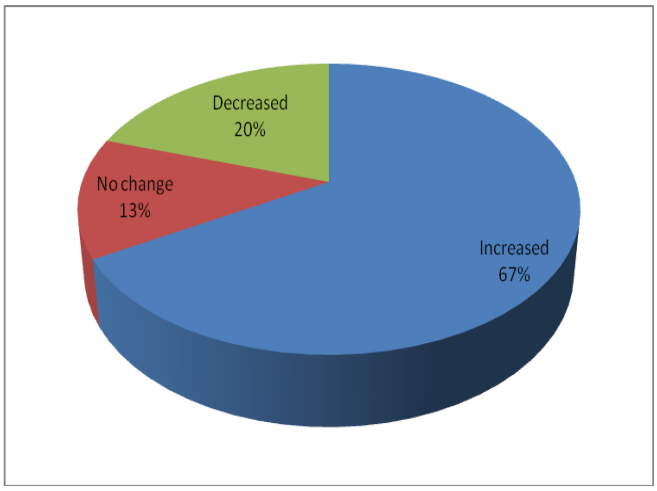

Figure 4-17: No. of customers into the market

4.3.9 Meat vendors' satisfaction with meat market management and observed changes

The majority; 79% were very satisfied and happy with the Nafaqo management, 14% were satisfied and 7% did not know whether they were satisfied (Figure 4-18). The majority of vendors; 46% reported that management had improved. Other changes reported included: Improved relationship between vendors, PPP management team and government. Meat vendors reported that NAFAQO responds quickly to problems (Figure 4-19).

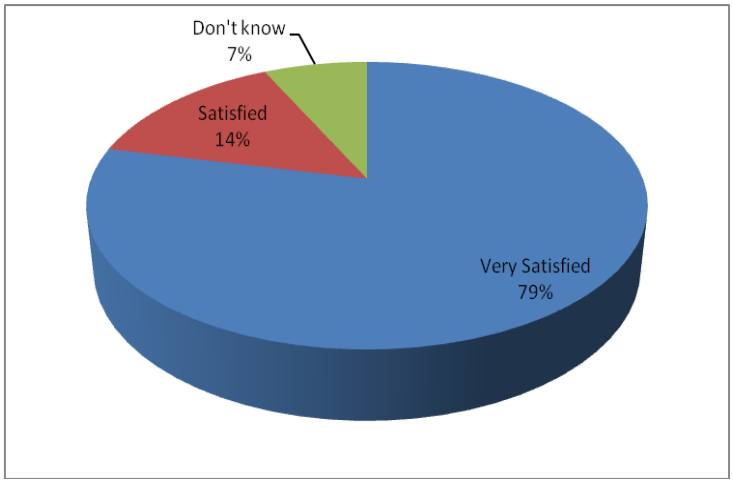

Figure 4-18: Vendors satisfaction with Nafaqo Management

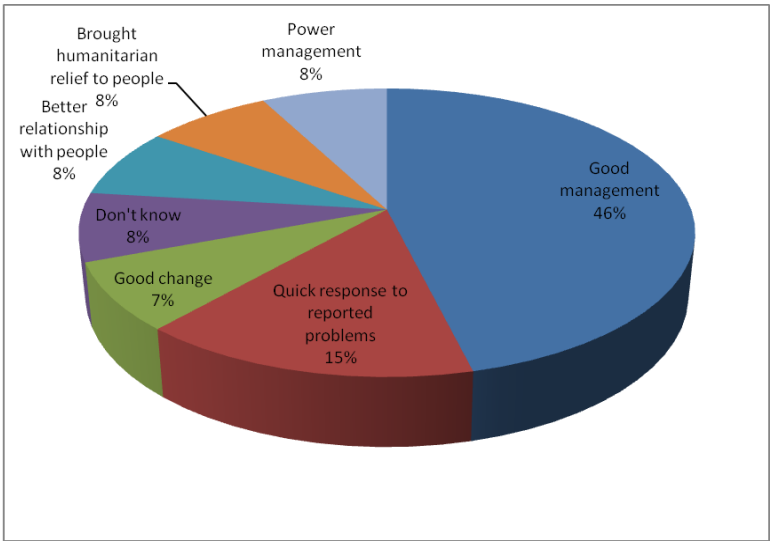

Figure 4-19: Vendors perception on what has changed

4.3.10 Employment

Forty (40%) percentage of participants from the intervention group and 55% from the control group reported that they employed other people in their business. The mean number of people employed by vendors in the intervention group increased by 128% while that of the control group increased by 113%. The mean for the intervention group increased from 1.8 to 2.3 persons while the control group increased from 3.1 to 3.5 persons per vendor (Figure 4-20). The control group employed many persons because they sold carcasses of large animals (camel and cattle) whereas the intervention group mainly sold sheep and goat carcasses (mutton).

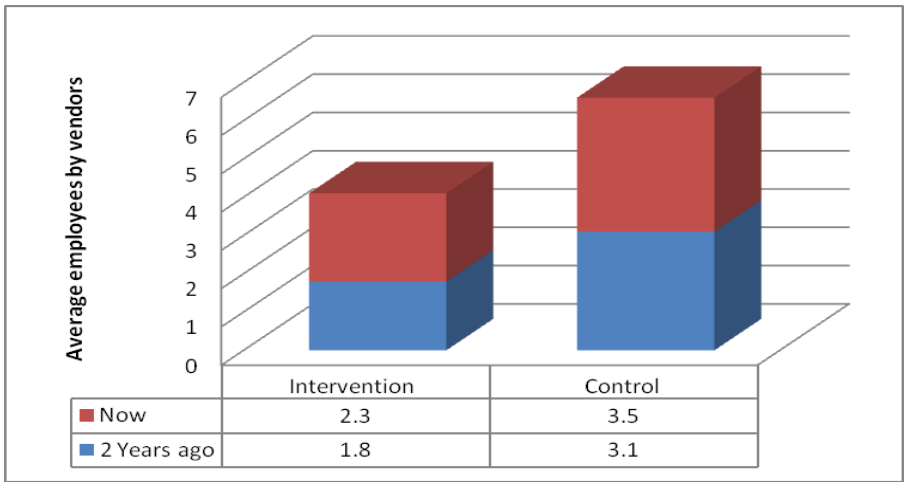

Figure 4-20: Average employees by meat vendors

Those who reported increase in number of people employed attributed the change to increase in customers, improved sanitation and increased knowledge. Others reported no change in the number of people they employed 2 years ago and time of data collection.

Figures 4-21 and 4-22 detail types of employment to different beneficiaries at intervention and control markets. These included slaughtering, meat transport, meat loading and offloading.

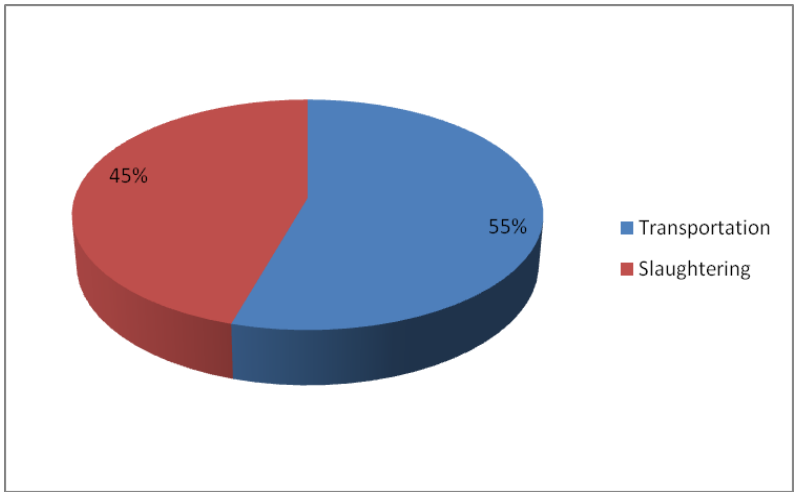

Figure 4-21: Type of employment -intervention

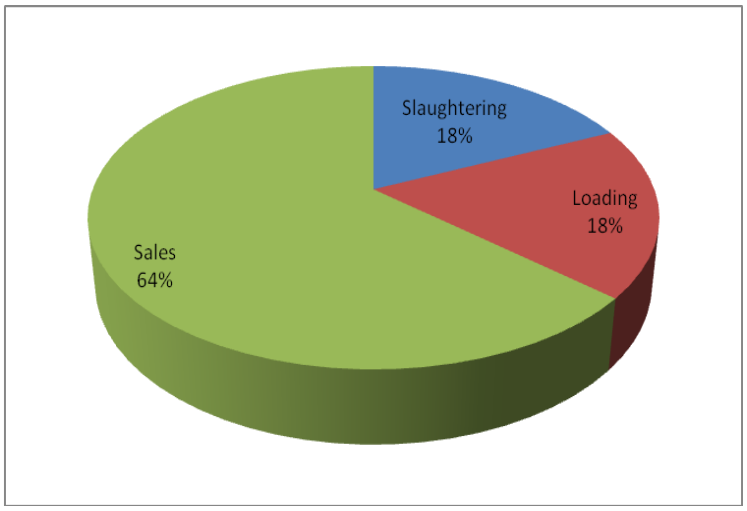

Figure 4-22: Type of employment-Control

4.4 Triangulation of questionnaire, organoleptic and observation survey findings

This was carried out by analyzing the samples collected from the meat contact surfaces of hooks, knives and meat display tables.

4.4.1 Total viable counts analysis from intervention and control sites

Ahmed Gureh meat market

Total Viable Counts (TVC) analysis results on samples collected from Ahmed Gureh meat market posted low levels of contamination at p- value < 0.001. Of the 25 samples each collected from hooks and knives used in the market, 96% and 4% were categorized as excellent and good grades respectively according to GCC microbiological standards. The level of TVC contamination on meat display tables was very variable. It was 2%, 38%, 46%, 10% and 4% categorized as excellent, good, fair, poor and very poor respectively according to GCC microbiological standards (Table 4-4). This showed that the standard of hygiene maintenance is good to fair.

Halane 1 meat market

Levels of TVC contamination on meat contact surfaces indicated that the hygiene standard at the market and equipment (hooks, knives and tables) was very poor. Out of 25 samples analyzed from hooks, 16%, 16% and 68% were graded as fair, poor and very poor. A similar number of samples from knives posted 12%, 16%, 24% and 48% as good, fair, poor and very poor respectively according to GCC standards. Out of 50 samples collected from meat tables and analyzed, 4% and 96% were graded as fair and very poor respectively according to GCC microbiological performance criteria as can be seen in Table 4.4.

Table 4.4: Total viable counts grading by experiment site

Swab site	A. Gureh Meat Market	Halane 1 Meat Market	
Hooks	**N=25**	**N=25**	**p-value**
Excellent	96%	0%	<0.001
Good	4%	0%	
Fair	0%	16%	
Poor	0%	16%	
Very Poor	0%	68%	
Knives	**N=25**	**N=25**	**p-value**
Excellent	96%	0%	<0.001
Good	4%	12%	
Fair	0%	16%	
Poor	0%	24%	
Very Poor	0%	48%	
Tables	**N=50**	**N=50**	**p-value**
Excellent	2%	0%	<0.001
Good	38%	0%	
Fair	46%	4%	
Poor	10%	0%	
Very Poor	4%	96%	

4.4.2 *Escherichia coli* analysis from intervention and control sites

Ahmed Gureh meat market

E. coli analysis results from this meat market showed that hygiene practice in the market is good. The levels of bacterial contamination of meat contact surfaces (hooks, knives and tables) were low or moderate, an indication of minimum contamination. Out of 25 samples collected from hooks used in this market and analyzed, 84% and 16% were graded as excellent and good respectively at p- value < 0.001. Ninety six (96%) and four (4%) percent of 25 samples collected from knives were categorized as excellent and good grades respectively according to GCC standards. Out of 50 samples from meat tables analyzed, 10%, 12%, 46%, 28% and 4% were graded as excellent, good, fair, poor and very poor respectively according to GCC microbiological performance criteria as can be seen in table 4.5. This was an indication of good to fair hygiene practices.

Halane 1 meat market

Analysis results from the meat market at p-value < 0.001 indicated that hygiene standards and practices were very poor. Out of 25 samples analyzed from hooks, 52% and 48% were graded as poor and very poor respectively. A similar number of samples collected from knives posted 4%, 48% and 48% as fair, poor and very poor grades respectively according to GCC standards. Out of 50 samples collected from meat tables, 2%, 22% and 76% were graded as fair, poor and very poor respectively according to GCC microbiological standards as seen in Table 4-5 below.

Table 4.5: E*scherichia coli* grading by Experiment site

Swab site	A. Gureh Meat Market	Halane 1 Meat Market	
Hooks	**N=25**	**N=25**	**p-value**
Excellent	84%	0%	<0.001
Good	16%	0%	
Fair	0%	0%	
Poor	0%	52%	
Very Poor	0%	48%	
Knives	**N=25**	**N=25**	**p-value**
Excellent	96%	0%	<0.001
Good	4%	0%	
Fair	0%	4%	
Poor	0%	48%	
Very Poor	0%	48%	
Tables	**N=50**	**N=50**	**p-value**
Excellent	10%	0%	<0.001
Good	12%	0%	
Fair	46%	2%	
Poor	28%	22%	
Very Poor	4%	76%	

4.5 Multiple linear regression analysis

The evaluation targeted samples collected from meat contact surfaces (mea table, hooks and knives) from rehabilitated Ahmed Gureh and none rehabilitated Halane 1 meat markets.

4.5.1 Level of contamination from the swab sites regression equation

The “Swab surface site level contaminations (hooks, knives and tables)” regression equation was found not significant (i.e., the regression model was a bad fit of the data) (Table 4.6). The "**R**", *multiple correlation coefficient* sample site level contaminations (hooks, knives and tables) -a value of 0.158, indicates a low level of prediction (15.8%). The "R Square" (coefficient of de-

termination), value of 0.015 that our independent variables explain 1.5% of the variability of our dependent variable, “Swab surface site level contaminations” with the "Adjusted R Square" (*adj.* R^2) accurately confirming the data reported.

Table 4.6: Model fit of hooks, knives and tables swab level of contaminations -model summary[b]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. F Change
1	0.158	0.025	0.015	0.827	0.025	2.493	2	196	0.085

a. Predictors: (Constant), contamination levels of *E. coli*, TVC

b. Independent variable: swab surface site

4.5.2 Meat market site regression equation

The regression equation for “Meat Market levels of contamination (A. Gureh and Halane 1 meat markets)” was found **significant**” (i.e., the regression model was a good fit of the data) (Table 4.7). The "**R**" = 0.858, indicates a high level of prediction (85.8%) and R^2 value of 0.734 that our independent variables explain 73.4% of the variability of our dependent variable.

Table 4.7: Model fit of Ahmed Gureh and Halane 1 meat markets levels of contamination - model summary[b]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. F Change
1	.858[a]	0.736	0.734	0.259	0.736	273.755	2	196	0.000

a. Predictors: (Constant), Contamination levels of E. *coli*, TVC

b. Independent Variable: Experiment site

4.5.3 Total viable counts level of contamination regression equation

For TVC site level of contamination, the "**R**" = 0.831, indicates a high level of prediction (83.1%) and R^2 value of 0.687 that our independent variables explain 68.7% of the variability of our dependent variable (levels of contamination) (Table 4.8).

Table 4.8: Model fit of total viable counts level of contamination of Ahmed Gureh and Halane 1 meat market and level contaminations of hooks, knives and tables -model summary[b]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. F Change
1	0.831	0.690	0.687	53384.544	0.690	217.892	2	196	0.000

a. Independent variables: Experiment site, Swab site

b. Dependent Variable: Contamination level of TVC

4.5.4 *Escherichia coli* level of contamination regression equation

Likewise, for *E. coli*, the "**R**" = 0.792, indicates a high level of prediction (79.2%) and R^2 value of 0.624 that our independent variables explain 62.4% of the variability of our dependent variable (Table 4.9). Consequently, further analysis was only done to the dependent variables which were statistically significant.

Table 4.9: Model fit of *Escherichia coli* level of contamination of Ahmed Gureh and Halane 1 meat markets and level contaminations of hooks, knives and tables- model summary[b]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. F Change
1	0.792	0.628	0.624	300.545	0.628	166.207	2	197	0.000

a. Independent variable: Experiment site, Swab site

b. Dependent Variable: Contamination level of E. *Coli*

From the above analysis, the results show that the independent variables (meat markets) statistically significantly predicted the dependent variables. Therefore, meat market site could be used to predict the levels of contamination with TVC and E. *coli* on meat contact surfaces (tables, knives and hooks).

4.6 Hides and skins impact assessment

This targeted pastoralists, flayers and hides and skins handlers and traders.

4.6.1 Pastoralists

The evaluation targeted hides and skins mainstream stakeholders.

4.6.2 Respondents' information

The trainees hailed from Awdal (Borama municipality), M. Jeex (Hargeisa municipality) and Togdheer (Burao municipality) regions (Table 4.10).

Table 4.10: Respondents by gender and region

Region	District	Female	Male	Total
Awdal		**0**	**5**	**5**
	Borama	0	5	5
M. Jeex		**1**	**6**	**7**
	Gabiley	0	1	1
	Hargeisa	1	5	6
Togdheer		**4**	**3**	**7**
	Burao	4	3	7
Total		**5**	**14**	**19**

A total of nineteen (19) trainee respondents were interviewed of whom seventy four percent (74%) were male and twenty six per cent (26%) were female (Figure 4-23).

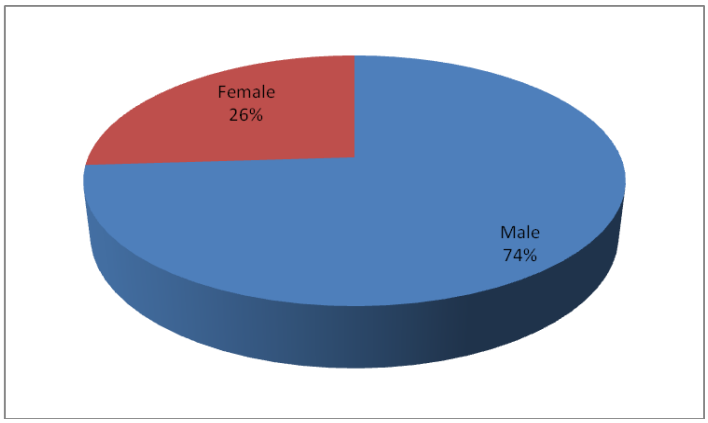

Figure 4-23: Gender of respondents

4.6.3 Evaluation of the training

The respondents were asked to indicate whether they agreed or disagreed with some pre-set statements and were provided with a scale to guide them on the same as indicated in Table 4.11.

Table 4.11: Scoring scale by respondents

Statement	Scale					
	SA	A	N	D	SD	Total
The training was very helpful to me	6	13	0	0	0	19
The presenters were knowledgeable of the topics presented	6	12	1	0	0	19
The training was generally successful and worthy my time	8	10	1	0	0	19
The training has improved my knowledge on hides and skins processing	4	11	4	0	0	19
I will be able to apply the knowledge I gained from the training in my livelihood activities	3	15	1	0	0	19
The training room was comfortable	1	14	4	0	0	19
I was satisfied with the food, refreshments and facilities in the	7	12	0	0	0	19

training venue					
Statement	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
Key	**SA**	**A**	**N**	**D**	**SD**

4.6.4 Value of training and knowledge of trainers

Thirty two percent (32%) strongly agreed while sixty eight percent (68%) agreed that the training was helpful to them (Figure 4-24).

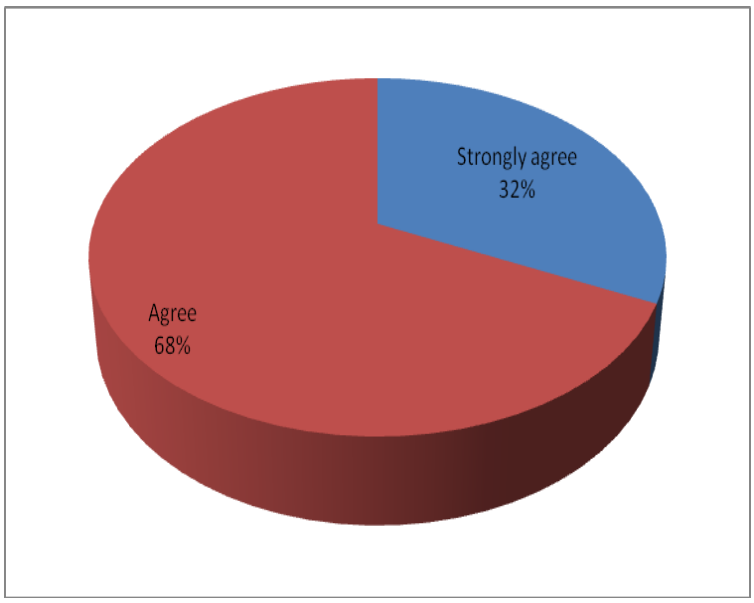

Figure 4-24: Training was helpful to trainee

Thirty two percent (32%) strongly agreed while sixty three percent (63%) agreed that the presenters were knowledgeable of the subject matter. Five percent (5%) were however neutral on this (Figure 4-25).

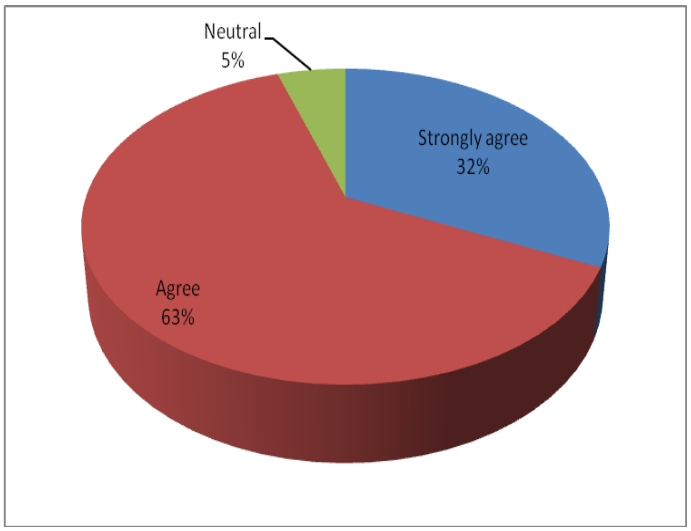

Figure 4-25: Trainers were knowledgeable

4.6.5 Importance of training

Forty two percent (42%) strongly agreed and fifty three percent (53%) agreed that the training was generally successful and worthy their time. Five (5%) percent were neutral (Figure 4-26).

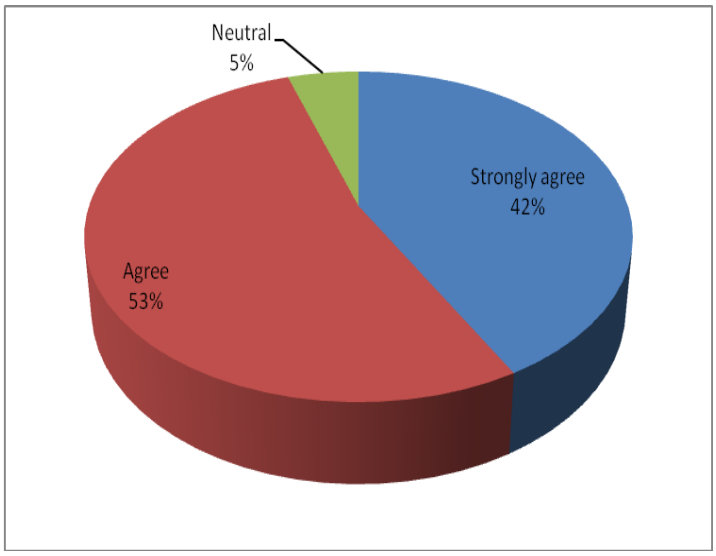

Figure 4-26: Training was successful

Twenty one percent (21%) strongly agreed and fifty eight percent (58%) agreed that the training had improved their knowledge on hides and skins processing. Twenty one percent (21%) were neutral on this (Figure 4-27).

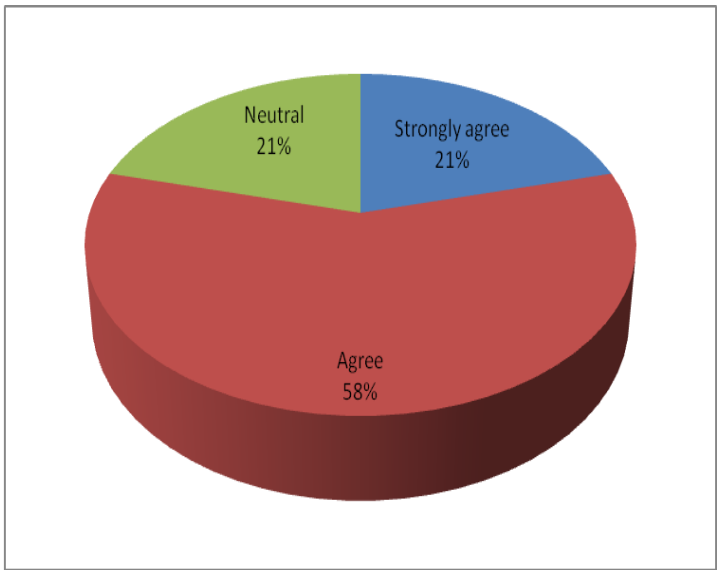

Figure 4-27: Training improved my knowledge

4.6.6 Willingness by trainees to apply knowledge acquired

Sixteen percent (16%) strongly agreed while seventy nine percent (79%) stated that they would be able to apply the knowledge they had gained from the training in their livelihoods. Five per-cent (5%) were neutral on this (Figure 4-28).

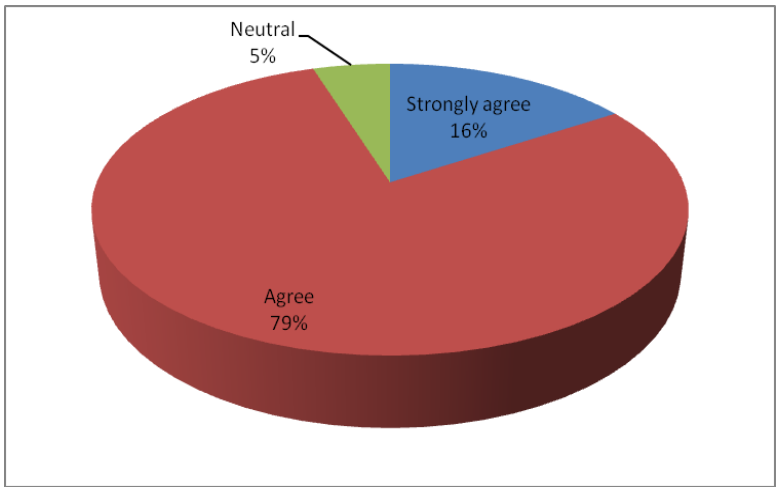

Figure 4-28: Trainees willingness to apply acquired skills

Five percent (5%) strongly agreed while seventy four percent (74%) agreed that the training room was comfortable. However, twenty one per cent (21%) were neutral about this (Figure 4-29).

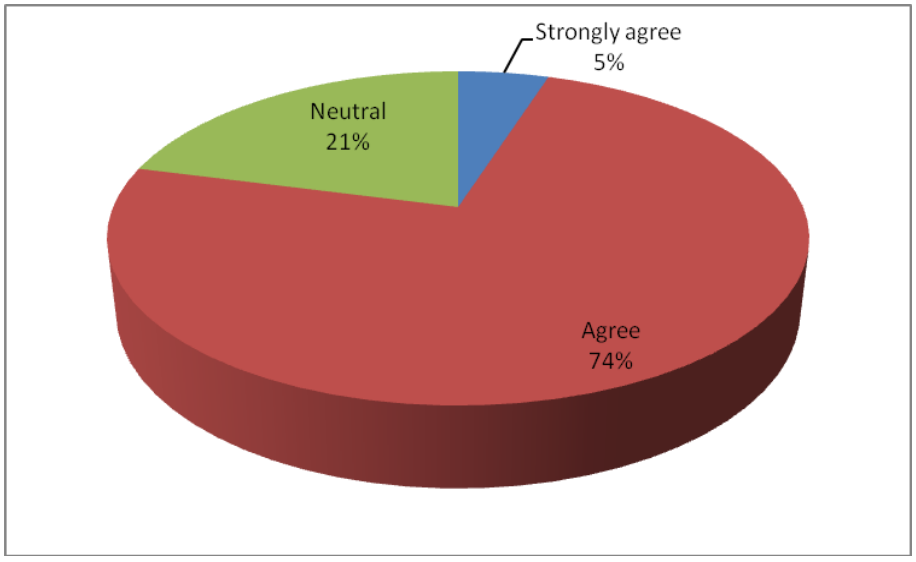

Figure 4-29: Training venue was conducive

4.6.7 General animal husbandry practices for production of quality hides and skins

All 19 respondents (100%) agreed that good animal feeding results in good quality hides and skins. This included enough pasture and water. Control of external parasites such as ticks and flies also contributed to good quality hides and skins according to 100% of the respondents. All 100% responded that ticks can be controlled using acaricides by using plunge dips or spraying.

4.6.8 Livestock branding

All the 19 respondents (100%) gave the lower part of the hip as the most preferred location for branding of livestock.

4.6.9 Livestock grazing

All the 19 respondents (100%) said cleared fields (no thorns) were the best grazing fields to obtain good quality hides and skins.

4.6.10 Livestock transportation

Seventy nine percent (79%) stated that it was important to separate horned from un-horned animals during transportation while sixteen percent (16%) said it was okay to mix the horned and un-horned animals during transportation. Five percent (5%) were not sure/didn't know how to deal with it (Figure 4-30).

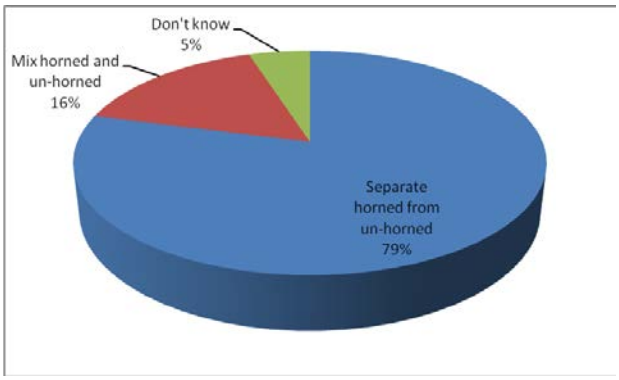

Figure 4-30: Requirement of transporting livestock

4.6.11 Assessment comments

Nearly 100% of the trainee respondents benefitted from the training as evidenced by the answers obtained during interviews. However, further training should be done to help them understand better the various aspects of animal husbandry practices and their relationships.

4.7 Flayers and butchers

Those operating in Borama, Hargeisa and Burao municipalities were targeted.

4.7.1 Number of respondents

A total of 29 respondents were interviewed of whom nineteen, 19 (66%) were female and ten (10) (34%) were male (Figure 4-31 and Table 4.12).

Table 4.12: No. of respondents by gender and region

Region	District	Female	Male	Total
Awdal		**2**	**6**	**8**
	Borama	2	6	8
M/Jeex		**10**		**10**
	Hargeisa	10		10
Togdheer		**7**	**4**	**11**
	Burao	7	4	11
Total		**19**	**10**	**29**

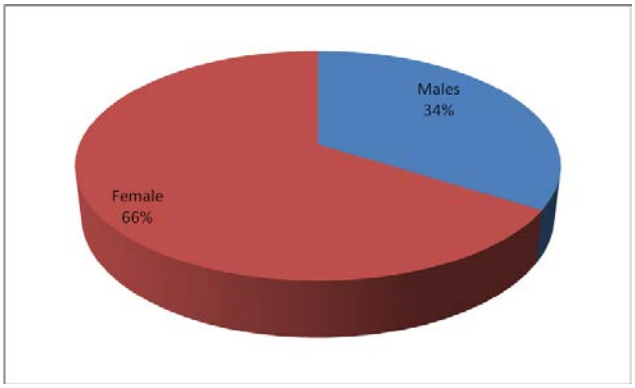

Figure 4-31: Gender of respondents

4.7.2 Evaluation of the training

Table 4.13 below gives a summary of the general training requirement questions. Respondents strongly agreed, agreed or were neutral in a few cases.

Table 4.13: Scoring scale by respondents

Statement	Scale					
	SA	A	N	**D**	**SD**	**Total**
The training was very helpful to me	16	13		0	0	29
The presenters were knowledgeable of the topics pre-sented	10	17	2	0	0	29
The time allocated for presentations was appropriate	5	19	5	0	0	29
The training was generally successful and worthy my time	13	14	2	0	0	29
The training has improved my knowledge on hides and skins processing	10	18	1	0	0	29
I will be able to apply the knowledge I gained from the training in my livelihood	13	14	2	0	0	29
The training room was comfortable	6	18	5	0	0	29
I was satisfied with the food, refreshments and facilities in the training venue	9	16	4	0	0	29

Statement	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree	
Key	**SA**	**A**	**N**	**D**	**SD**	

4.7.3 Value of training and manner of presentation

Fifty five percent (55%) and forty five per cent (45%) of the respondents strongly agreed and agreed respectively that the training was helpful to them (Figure 4-32).

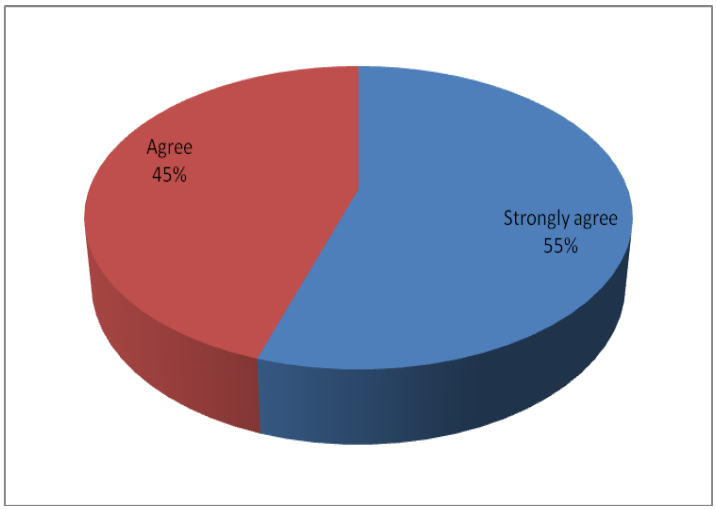

Figure 4-32: Training was helpful to trainees

Thirty four percent (34%) and fifty nine percent (59%) strongly agreed and agreed that the presenters were knowledgeable of the topics presented. Seven percent of the respondents were neutral on this statement (Figure 4-33).

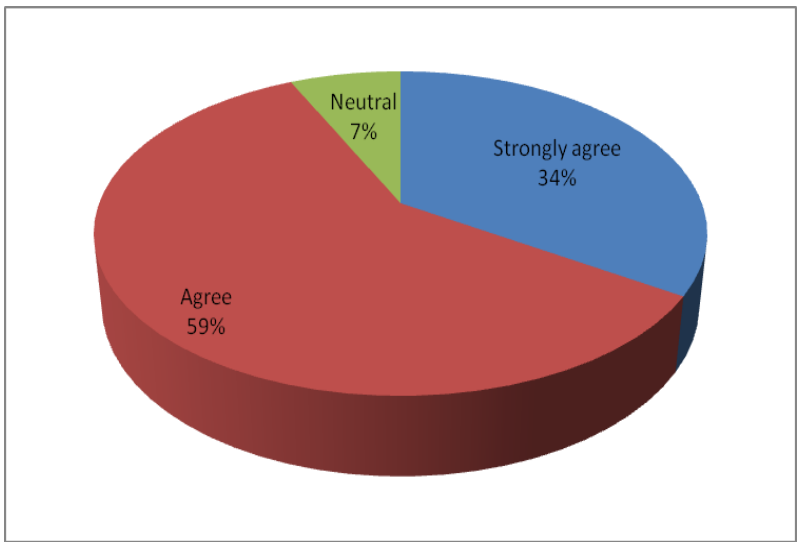

Figure 4-33: Trainers were knowledgeable

4.7.4 Allocated time of training and importance

Seventeen percent (17%) and sixty six percent (66%) strongly agreed and agreed respectively that the time allocated for presentations was appropriate. Seventeen percent (17%) however were neutral on this (Figure 4-34).

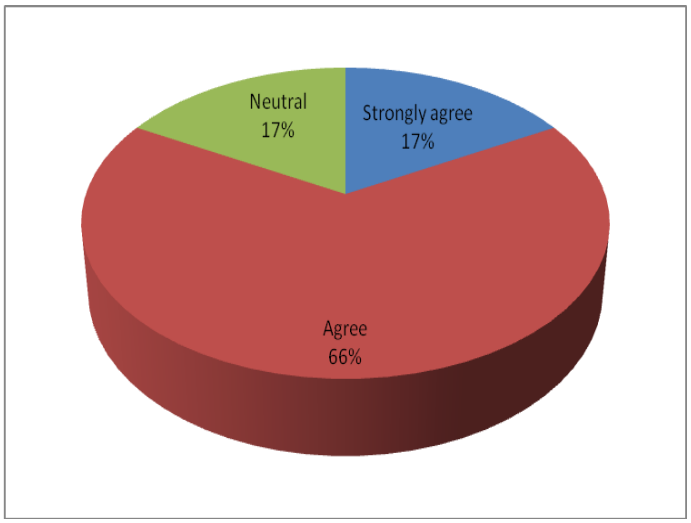

Figure 4-34: Allocated time was appropriate

Forty five percent (45%) and forty eight per cent (48%) strongly agreed and agreed respectively with the statement that the training was generally successful and worthy of their time. Seven per cent were however neutral on this (Figure 4-35).

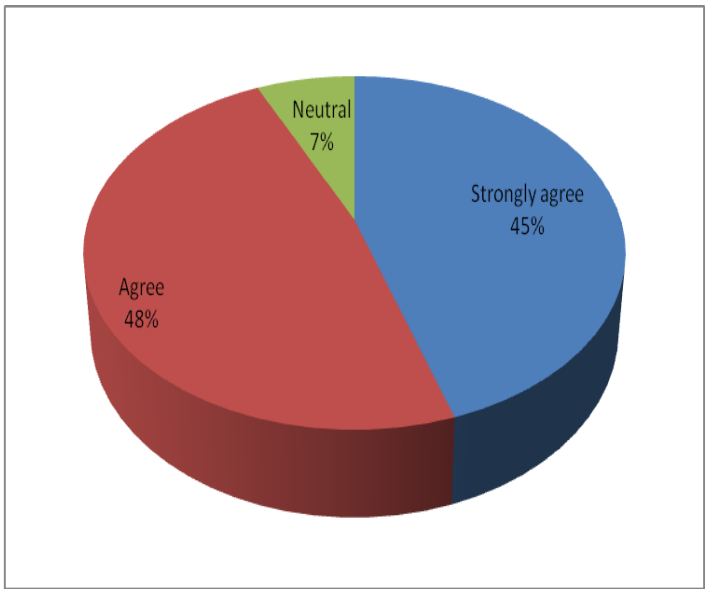

Figure 4-35: Training was successful and worthy

4.7.5 Relevance of training

Thirty five percent (35%) and sixty two per cent (62%) strongly agreed and agreed respectively that the training had improved their knowledge on hides and skins processing. Three percent (3%) were neutral (Figure 4-36).

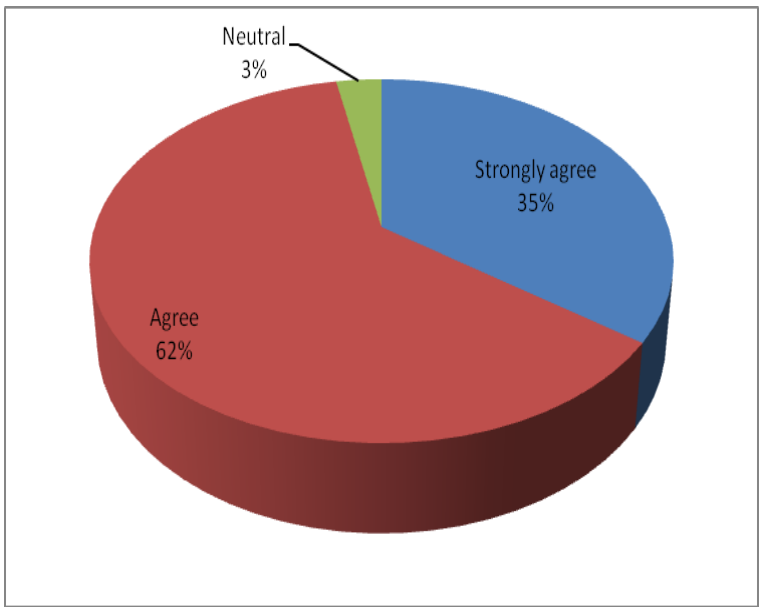

Figure 4-36: Training improved my knowledge

Forty five percent (45%) strongly agreed while forty eight percent (48%) agreed that they would be able to apply in their livelihood activities the knowledge they gained from the training. Seven percent (7%) were neutral (Figure 4-37).

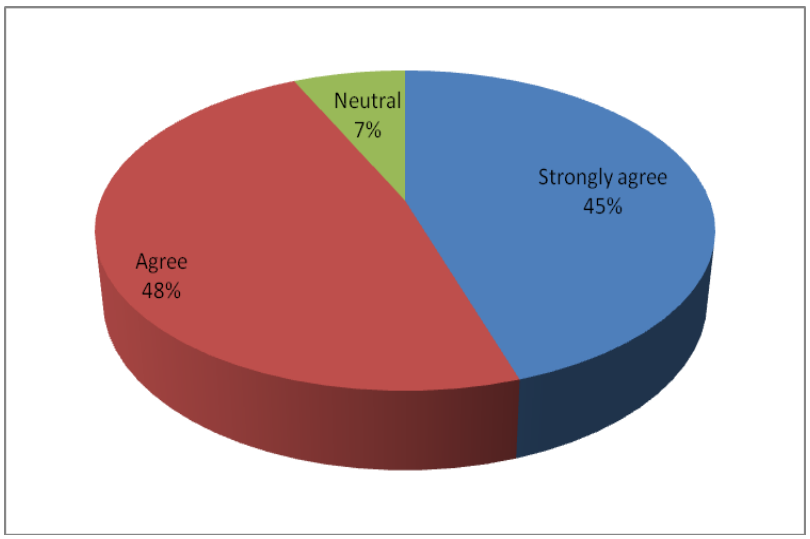

Figure 4-37: Trainees to apply what was learned

4.7.6 Pre-slaughter handling of livestock

Twenty nine (29) respondents or 100% responded that livestock handlers should avoid hitting and pulling livestock by hair or skin before slaughter.

4.7.7 Quality flaying and hides and skins grades

Twenty nine (29) respondents or 100% responded that use of curved banana shaped knives minimises flay cuts on hides and skins. All respondents said that good quality hides and skins should have ≤ 1 flay cut.

4.7.8 Hides and skins grading

Majority of the respondents; sixty two percent (62%) responded that grade-1 hides and skins should have less than one flay cut. Responses were varied; 10% = less than two flay cuts; 4% =

two flay cuts; 7% = three flay cuts;7% = less than three flay cuts;7% = no knives' marks; and 3% = well preserved (Figure 4-38).

Only 62% of trainees responded correctly. This is because there are no hides and skins grading system in the country. Grading is either good or bad based on no benchmark. Further training is required so that stakeholders can value grading since grade I hides or skins should be sold at higher prices to encourage good quality products.

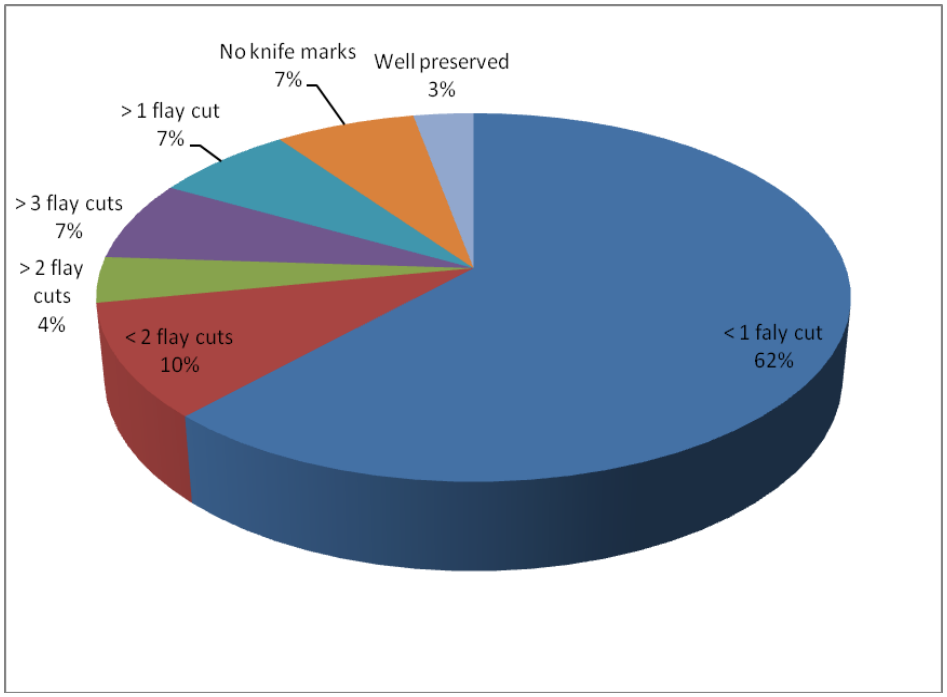

Figure 4-38: Hides and skins grade quality

4.7.9 Meat trimming and washing of hides and skins

Fifty five percent (55%) responded that meat should be trimmed thoroughly from hides and skins for good quality and high grade products while forty one percent (41%) responded that high grade product was the reason why meat should be trimmed. Only four percent (4%) gave the reason as good quality (Figure 4-39).When a lot of meat is left on hides and skins, it lowers both its quality and grade. Therefore, as much as permitted, much meat as possible should be trimmed

from hides and skins for good quality. Further training should be carried out. It should be theory and practical lessons to fully instill the practice in flayers and hides and skins handlers about how to produce good quality and high grade products.

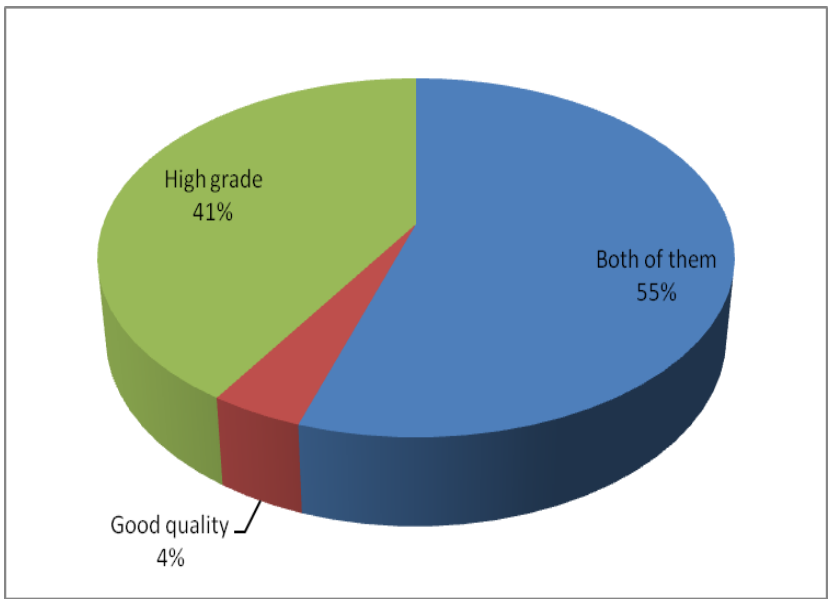

Figure 4-39: Why trim meat thoroughly

Eighty six per cent (86%) of the respondents agreed with the statement that trimming of meat ensures good quality and minimizes spoilage of hides and skins while fourteen per cent (14%) said the statement was false (Figure 4-40). Blood left on hides and skins promote bacterial multiplication and putrefaction. Therefore, thorough cleaning of blood will safeguard and prolong the shelf life of hides and skins. The response was adequate from respondents.

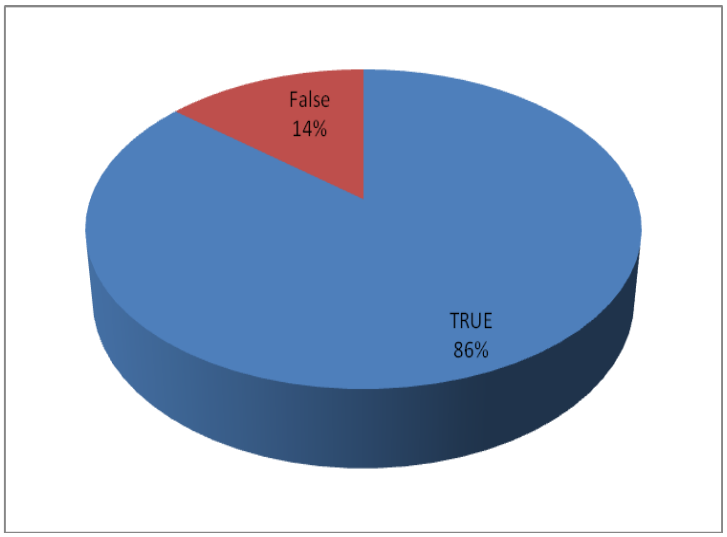

Figure 4-40: Wash blood from hides and skins for good quality

4.7.10 How to avoid rubbed grain on hides and skins

Fifty five percent (55%) responded that rubbed grains can be minimized with or without dragging the carcass on rough ground. Thirty eight percent (38%) responded that rubbed grains can only be minimized by not dragging the carcass on rough ground while seven percent (7%) said that it can be minimized by dragging the carcass on rough ground (Figure 4-41). Respondents needed further training to fully conceptualize and internalize what rubbed grain is and how it comes about on hides and skins during slaughter. The response indicates that the concept was not clear to trainees.

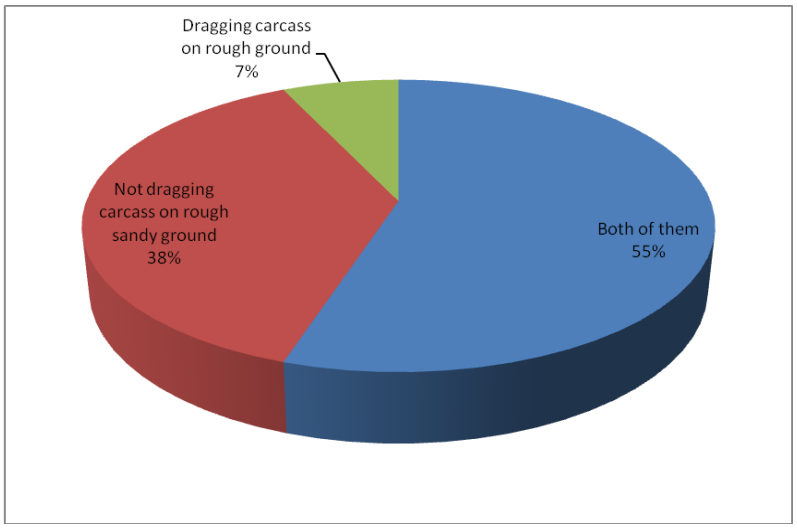

Figure 4-41: Rubbed grain on hides and skins can be minimized by

4.7.11 Hides and skins grades

Eighty three percent (83%) of the respondents knew of four grades (I, II, III or reject) of hides and skins while ten percent (10%) knew of only two grades (good or bad). Seven percent (7%) were not sure about the grades (Figure 4-42). Further training should be done to introduce grading system in hides and skins production and marketing to promote quality sales as happens in other countries.

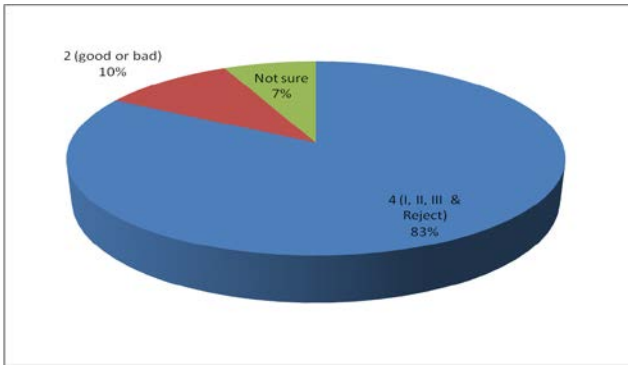

Figure 4-42: Types of hides and skins grades

4.7.12 General assessment on the outcomes of the training

Further training should focus on hides and skins grading system to help the stakeholders get value for money of their high grade and good quality hides and skins. Correct response to most questions was above 70%; an indication of how suitable the training was. The trainees were operators in the target slaughterhouses and therefore had every opportunity to apply what was learned practically leading to improved quality of hides and skins.

4.8. Hides and skins handlers and traders

This targeted handlers in the slaughterhouses, stores and transporters.

4.8.1 Number of respondents

Table 4.14 shows the gender and distribution of handlers and traders interviewed.

Table 4.14: Respondents by gender and region

Region	District	Female	Male	Total
Awdal		**0**	**5**	**5**
	Borama	0	5	5
M/Jeex		**0**	**5**	**5**
	Hargeisa	0	5	5
Togdheer		**3**	**2**	**5**
	Burao	3	2	5
Total		**3**	**12**	**15**

A total of fifteen (15) past trainees were interviewed of whom eighty percent (80%) were male and twenty percent (20%) female (Figure 4-43).

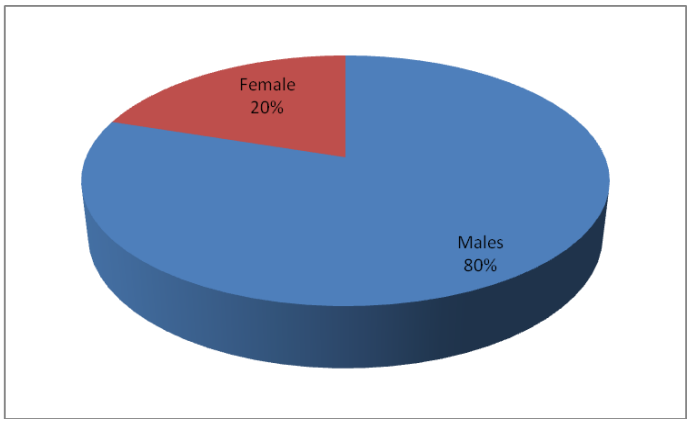

Figure 4-43: Gender of hides & skins handlers and traders

4.8.2 Evaluation of the training

Table 4.15 below shows the reaction of trainees to the training. No respondent disagreed or strongly disagreed with the questionnaire inquiries.

Table 4.15: Scoring scale by traders

Statement	Scale					
	SA	**A**	**N**	**D**	**SD**	**Total**
The training was very helpful to me	2	13		0	0	15
The presenters were knowledgeable of the topics presented	9	6		0	0	15
The time allocated for presentations was appropriate	6	8	1	0	0	15
The training was generally successful and worthy my time	5	9	1	0	0	15
The training has improved my knowledge on hides and skin processing	4	10	1	0	0	15
I will be able to apply the knowledge I gained in the training in my livelihood	6	8	1	0	0	15
The training room was comfortable	4	8	3	0	0	15
I was satisfied with the food, refreshments and facilities in the training venue	3	8	4	0	0	15

Statement	Strongly Agree	Agree	Neutral	Disagree	Strongly Disag-ree
Key	**SA**	**A**	**N**	**D**	**SD**

4.8.3 Value of training and knowledge of trainers

Thirteen percent (13%) strongly agreed while eighty seven percent (87%) agreed that the training was helpful to them (Figure 4-44).

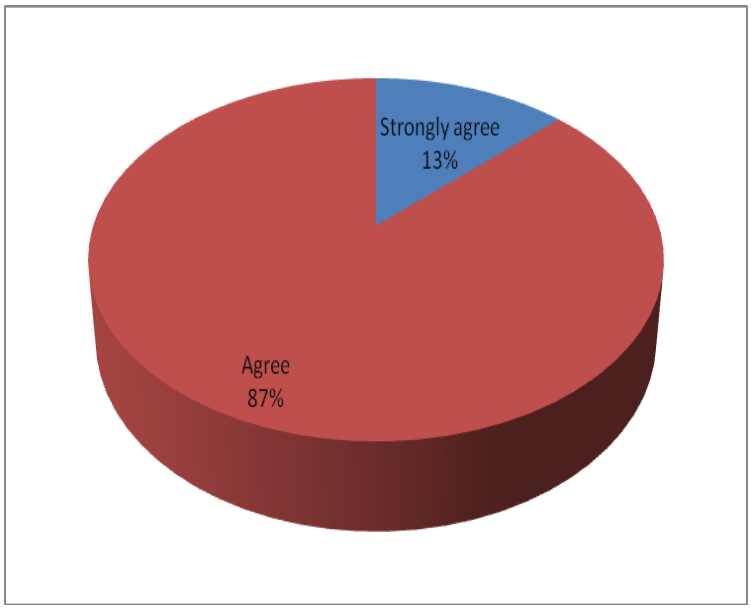

Figure 4-44: The training was helpful

Sixty percent (60%) strongly agreed and forty percent (40%) agreed that the presenters were knowledgeable of the topics presented (Figure 4-45).

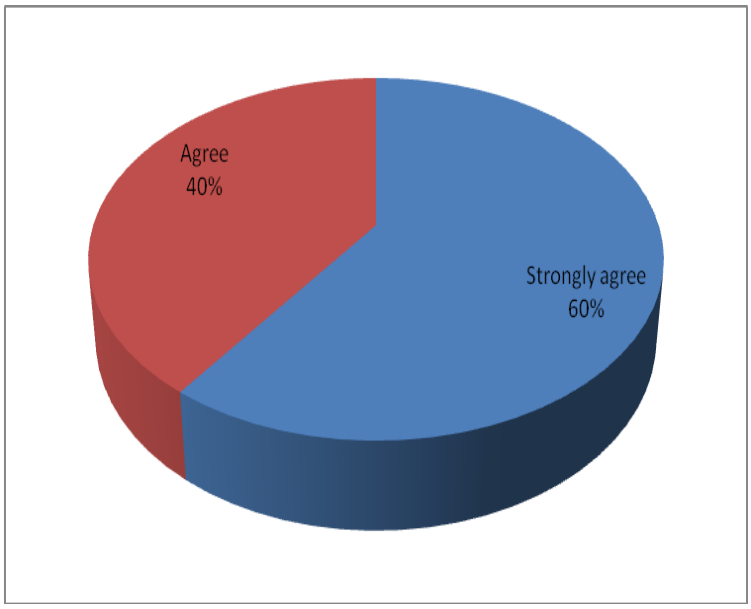

Figure 4-45: Trainers were knowledgeable

4.8.4 Time allocation and worthiness of training

Forty percent (40%) strongly agreed while fifty three percent (53%) agreed that the time allocated for presentations was appropriate. Only seven percent (7%) were neutral (Figure 4-46).

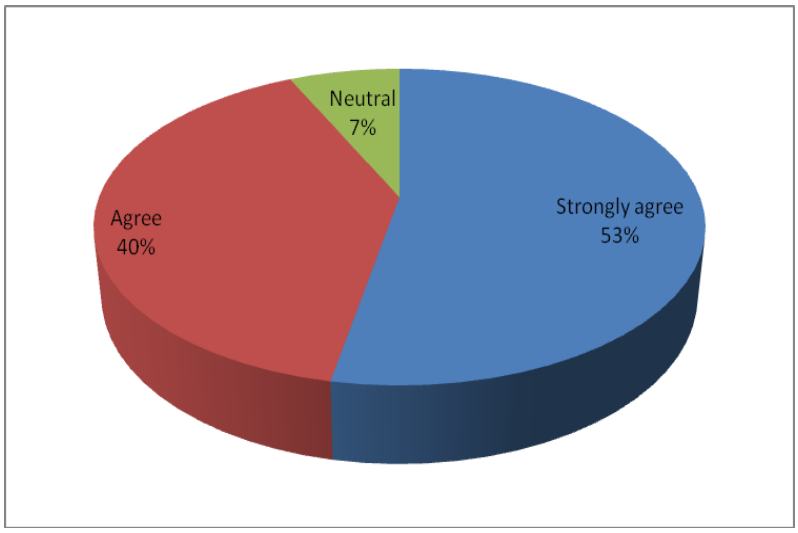

Figure 4-46: Time was adequate for presentation

Thirty three percent (33%) strongly agreed and sixty percent (60%) agreed that the training was generally successful and worthy their time. Seven percent (7%) were neutral (Figure 4-47).

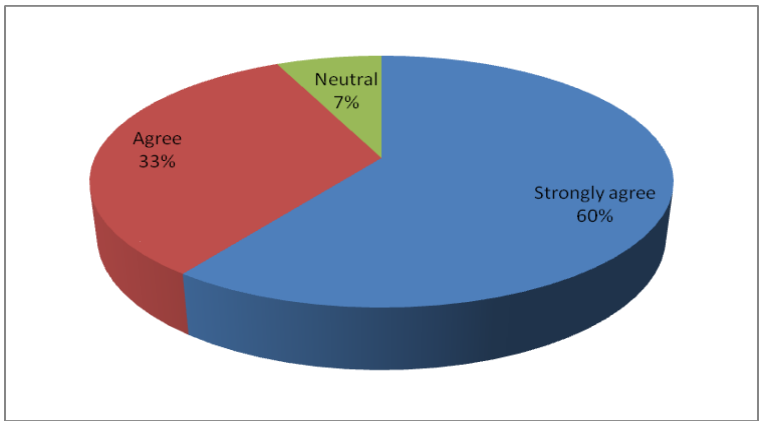

Figure 4-47: Training succeeded and worthy my time

4.8.5 Skills improvement and knowledge application

Twenty seven percent (27%) strongly agreed and sixty seven percent (67%) agreed that the training improved their knowledge on hides and skins processing. Six percent (6%) were neutral (Figure 4-48).

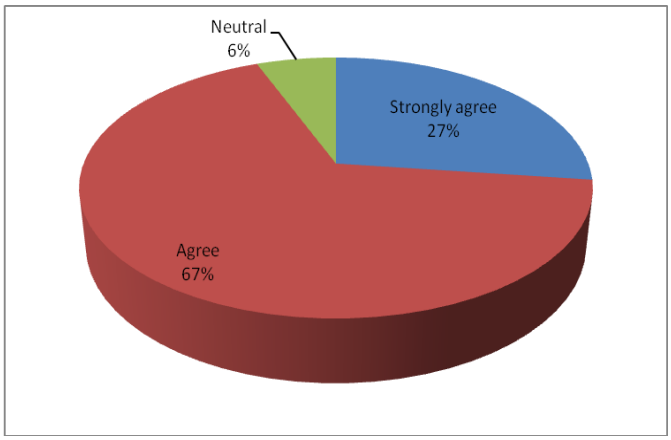

Figure 4-48: Training improved my skills

Forty percent (40%) strongly agreed and fifty three percent (53%) agreed that they would be able to apply knowledge gained from the training in their livelihoods while seven percent (7%) were neutral (Figure 4-49).

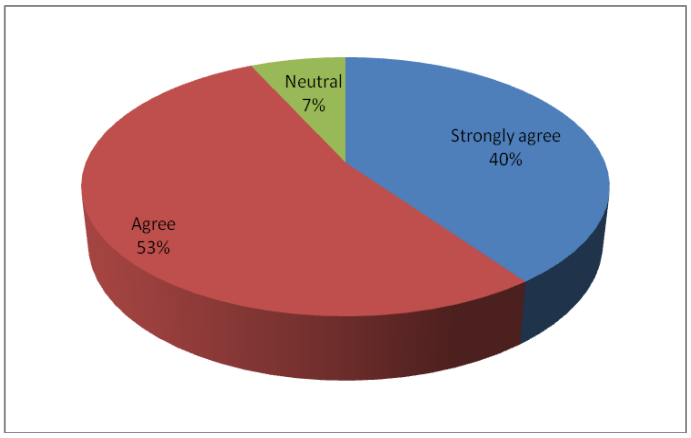

Figure 4-49: Will apply what I learned

4.8.6 Hides and skins preservation

Forty percent (40%) and thirteen percent (13%) said that air drying and industrial salt treatment respectively are the preferred methods of hides and skins preservation. Forty seven percent (47%) gave both methods as preferable (Figure 4-50). Industrial salt treatment of hides and skins results to high quality products as compared to sun drying. In Somaliland, many traders use both methods in equal measure. More training with practical lessons should be done to demosntrate the difference.

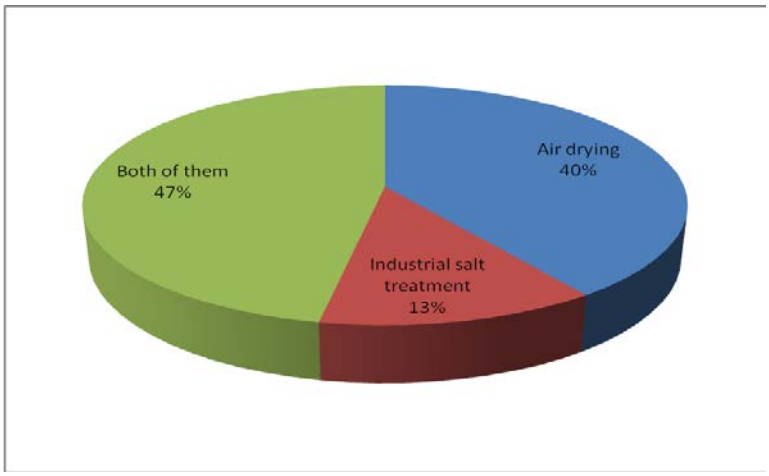

Figure 4-50: Preferred method of hides and skins preservation

4.8.7 Recommended type of salt for hides and skins preservation

Eighty percent (80%) confirmed as true the statement that industrial white salt is recommended for preservation instead of table salt. Thirteen percent (13%) said the statement was false while seven percent (7%) were not sure (Figure 4-51). Further training should be done to help the handlers and traders get the concept of which type of salt should be used. However, the correct response was above average, a clear indication that trainees benefited.

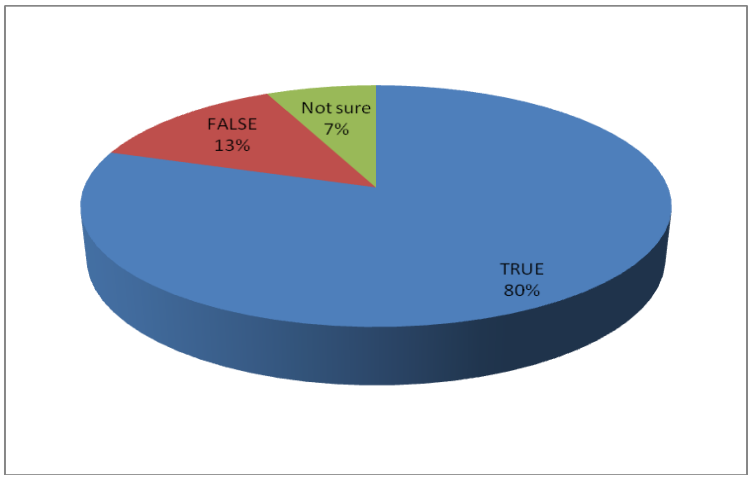

Figure 4-51: Industrial salt recommended instead of table salt

4.8.8 Control of vermin and pests controls damage and spoilage of hides and skins

Ninety three percent (93%) said this was true (Yes) while seven percent (7%) said the statement was false (No) (Figure 4-52). Pests and vermin destroy hides and skins. Controlling them will safeguard the products.

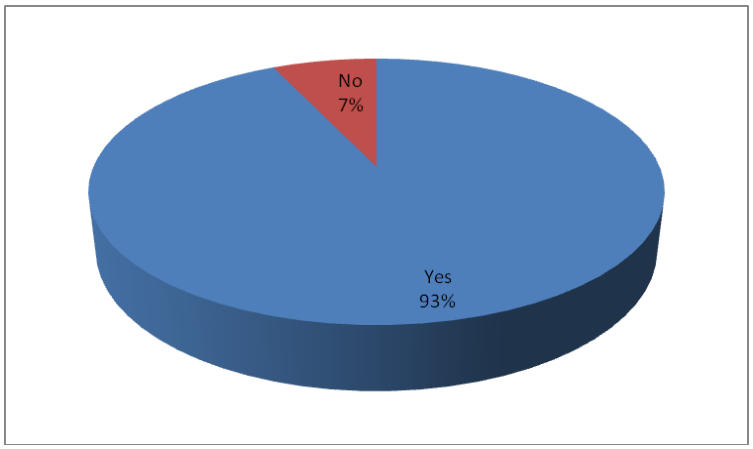

Figure 4-52: Control of pests and vermin mitigates spoilage of hides & skins

4.8.9 How to store preserved hides and skins

Fifty three percent (53%) said that folding of the dry skin should be with flesh side outside while seven percent (7%) said it should be done with flesh side inside. Forty percent (40%) said both methods were okay (Figure 4-53). Handlers and traders should be trained further to appreciate why the flesh side should be folded outside in order to minimize damages to the hides and skins during storage.

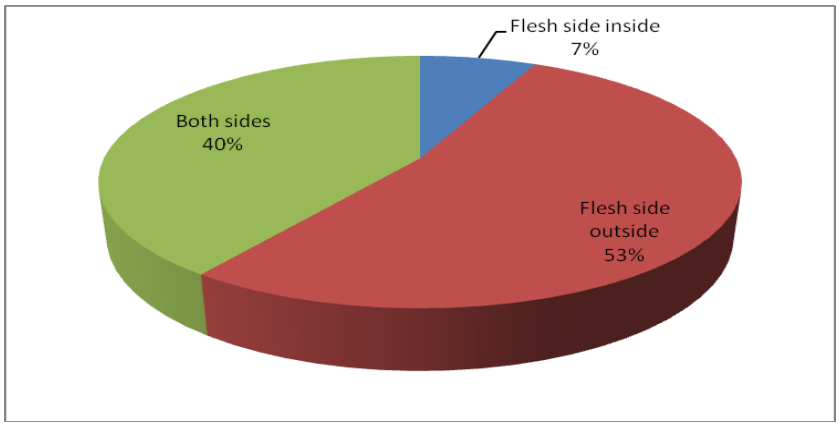

Figure 4-53: How hides & skins should be folded

4.8.10 Hides and skins stacking

Fifty three percent (53%) gave the recommended stacking height of stored hides and skins as less than 1.5 meters while forty percent (40%) gave the height as more than 1.5 meters. Seven percent (7%) were not sure (Figure 4-54).The height should be equal to or less than 1.5 m high. Further training should be carried out to help handlers and traders appreciate the reasons behind the correct response of why stacking height should be equal to or less than 1.5 m.

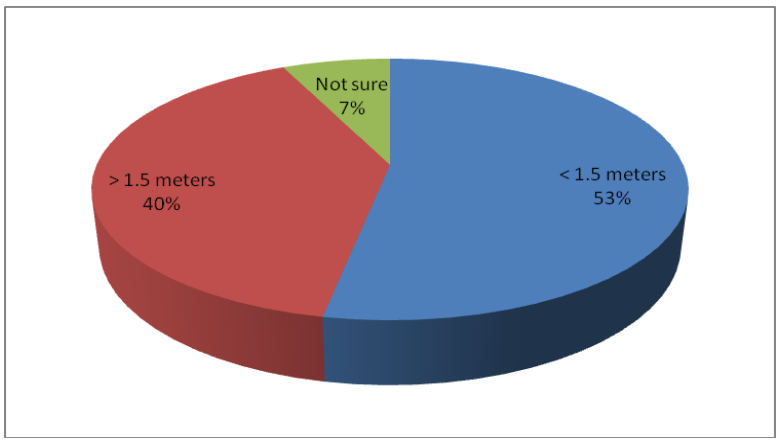

Figure 4-54: Recommended stacking height of hides & skins

4.8.11 Impact of training

All the respondents (100%) reported an increase in the quality of hides and skins after they received the training (Table 4-16).

The average pieces of hides sold per trader per day increased from 7 to 11 before and after the training respectively. This represented a 54% increase in daily sales per trader. For the skins, the pieces sold per trader per day increased from 8 to 12 before and after training which represented 55% increase in sales (Table 4.16).

Table 4.16: Daily sales of hides and skins per trader

Product	**Before**		**After**		**Avg. Percentage increase**
	Range	**Average**	**Range**	**Average**	
Hides	5-9	7	9-13	11	**54**
Skins	6-10	8	10-14	12	**55**

4.8.12 Weighting of parameters

Cumulatively, thirty nine (39) interviewees strongly agreed with the statements, seventy (70) agreed, while eleven (11) were neutral of the importance of the training. Using the representative percentages, 33% strongly agreed, 58% agreed and 9% neutral, a score of 1.8 was arrived at which can be rounded off to 2. This means that the respondents/interviewees agreed or were generally comfortable with the training (Table 4.17).

Table 4.17: Weighting of parameters score

Training evaluation statements	Strongly Agree	Agree	Neutral	Total
Scores/Counts	39	70	11	120
Percentage score	33%	58%	9%	100%

Key

Strongly agree	Agree	Neutral	Disagree	Strongly disagree	Don't know
1	2	3	4	5	6

4.8.13 Overall general assessment comments

The average of 54% and 55% increase in sales of hides and skins respectively as reported by respondent traders was a clear indication that the quality of hides and skins had improved. This was attributable to the training received. Trainees should further be trained on qualify as trainers of trainees at the local levels to ensure adequate dissemination of the knowledge gained for wider scale improvement.

The evaluation data indicated that the quality of hides and skins improved. This was due to improved skills of flayers and hides and skins handlers. Flayers minimized flay cuts whereas hides and skins handlers improved in the preservation techniques thereby increasing quality and sales.

Chapter 5

5. Discussion

From the study, it was established that meat vendors from Halane 1 meat market had not received much training in good hygiene practices and food safety quality control programmes before, during and after meat retail as per the secondary data collected through the questionnaire with the interviewed market vendors and government line ministry officials. Only 16.7% of meat vendors operating from this market had received training from Care International. Samples collected from Halane 1 market had the highest level of bacterial contamination (total viable counts and *E. coli*) as compared with samples collected from Ahmed Gureh meat market which had been rehabilitated, meat vendors supplied with modern meat selling equipment and trained. Presence of high levels of *E. coli* (which is an indicator organism) in food indicates poor hygiene food handling practices (Siham and Taha, 2009).

Egan *et al*, (2007) showed that effective food hygiene training needs to target changing people whose behaviour most likely is to result in contamination and foodborne illness. Most food hygiene training courses rely heavily on the provision of information. There is an implied assumption that such training leads to changes in behaviour, based on the knowledge, attitudes and practices (KAP) model. This was confirmed by the observations made at the rehabilitated Ahmed Gureh meat market whose meat vendors had received training and new equipment.

The meat display tables were maintained clean and meat was not displayed on cartons as was the case before rehabilitation and training. Meat was suspended on meat hanging rails or displayed on cleaned tiled tables to minimize contamination through contact. The drainage line was clean

and clear while the grey water conservancy tank was clean and free of solid waste. No solid garbage heaps were found near the market as the municipality regularly collected the garbage. More than seventy (70%) of vendors were in protective gear at the time of data collection.

After the training, clients desisted from touching meat before purchasing and instead pointed the pieces of meat that appealed to them using a pointer provided by meat vendors. In addition, meat sellers were not sitting on meat display tables as they used to and as they continued to do in the other three none rehabilitated meat markets including Halane 1.

The observations in Ahmed Gureh meat market was a big contrast with what was observed at Halane 1 meat market that served as control. In this market, meat vendors used unhygienic and poorly cleaned meat display tables, tools and equipment in addition to displaying meat on old recycled cartons and sitting on meat display tables. Furthermore, they kept all sorts of materials and items on the tables, mixed white offal (rumen and intestines) with red meat, had no water for washing hands and equipment compounding the already poor hygiene standards due to derelict status of the market.

Value for money calculations for rehabilitation of Ahmed Gureh meat market indicated that for a total investment of US$ 135,000 used, 216 meat display tables were either rehabilitated or constructed in addition to procurement and supply of meat selling equipment and training in meat hygiene and safe utilization of meat selling equipment. This contributed to an annual attributable income of US $2,608 per trader per year and US $9,186 for the municipality. Value for money calculation indicated that an investment of USD 1 generated US$ 4.17 return on investment (ROI).

Moreover, there was a reduction of meat wastage by 15-20% amounting to approximately 2.2kg @ $12 per small ruminant carcass per day. As a result of intervention, meat price in the rehabilitated meat market increased by US $2 from US $4 to US $6/kg for goat/sheep meat as compared to US $4 in non-rehabilitated meat markets including Halane 1 (control) in the same locality. All these benefits were attributed to the intervention; market rehabilitation, supply of equipment and training of meat vendors.

Even though there was an increase in the mean income from both groups, the participants from the control group reported higher increase in income; 326% compared to intervention group; 242%. The difference was attributed to the fact that majority of the respondents from the control market were selling large ruminant carcasses hence more profit margin as compared to intervention group who were selling only small ruminant carcasses (Asfaw *et al*, 2012).

Different studies on the same topic (Ferry and Kevin, 2009) yielded results relatively similar to the present study. It highlighted that training, knowledge and skills transfer to meat producers and sellers is fundamental to producing and retailing respectively high quality meat with low levels of bacterial contamination. Moreover, an earlier study carried out by Nottingham (1982) and a later one by Wamalwa *et al* (2011) showed that the skill of the slaughter men and women and meat retailers can reduce carcass or meat contamination even under primitive conditions of processing.

According to FAO (2004), training of personnel in any food production facility on hygiene standards in addition to considerations such as the design and layout of buildings, provision of

equipment, systems of quality control, inspection, hygiene of personnel besides the parasites and micro-organisms which the meat may contain is a pre-requisite requirement for production and marketing of high quality meat with low levels of bacterial contamination. From the study, stakeholders' trainings appeared to be one of the building blocks of producing and retailing meat with low levels of bacterial contamination.

Moreover, the effectiveness of the training was further confirmed following an impact evaluation assessment of hides and skins stakeholders training. The average increased sales of 54% and 55% of hides and skins respectively per trader per day as reported by respondent traders was a clear indication that the quality of hides and skins had improved. This was attributed to the training received from FAO through the Ministry of Livestock training of trainees. Opportunities for improvement are many. However, a study in Somaliland carried out by Castiello (2015) indicates that there are many challenges the meat sector faces including weak legal framework coupled with incapacity of law enforcement agencies to enforce what is available. The Meat Inspection and Control Act (2013) enacted into law by Somaliland for regulation of meat sector is only on paper.

Chapter 6

6. Conclusion and Recommendations

6.1 Conclusion

Despite the weak institutional capacity and legal framework in the fragile state of Somaliland, the infrastructure and capacity development intervention by international aid agencies demonstrated that an impact can be achieved in the meat and hides and skins sectors.

The improved management, level of hygiene and sanitary conditions in rehabilitated Ahmed Gureh meat market as compared with poor standards observed in un-rehabilitated Halane 1 meat market was a clear prove of the impact infrastructure development and training can have on the sector.

An observed increase in the mean number of kilograms of meat sold at the intervention group from 3.5 Kg two years ago to 4.8 Kg during the time of data collection was another prove of impact triggered by the intervention. The increased sale represented 37% increase of the meat sold per day. The increase was attributed to the influx of meat vendors and consumers from the other markets to the rehabilitated meat market.

The regression equation for “Meat Market levels of contamination (A. Gureh and Halane 1 meat markets)” was found significant” (i.e., the regression model was a good fit of the data). The "**R**" = 0.858, indicated a high level of prediction (85.8%) and R^2 value of 0.734 that our independent variables (meat markets) explain 73.4% of the variability of our dependent variable (TVC and *E. coli* contamination levels). There was a high likelihood of getting high levels of bacterial contamination from samples collected from meat contact surfaces from non-rehabilitated Halane 1 meat market as compared to rehabilitated Ahmed Gureh meat market.

Value for money calculation indicated an investment of USD 1 generated USD 4.17 return on investment (ROI). The IRR from the intervention was less than a quarter a year. This was in compliance with the 3Es for worthy intervention and was a clear prove of the impact of infrastructure development.

All hides and skins stakeholder respondents (100%) reported an increase in the quality of hides & skins after they received the training.

The average number of hides sold increased from 7 before the training to 11 per trader per day after the training. This represented a 54% increase in sales. For the skins, the number increased from 8 to 12 per trader per day after the training which represented 55% increase in sales.

6.2 Recommendation

The study revealed that training and infrastructure development has great impact on the meat and hides and skins sector. The following recommendations will however, propel the sector to greater heights:

i. Hides and skins stakeholders should continuously be trained on animal husbandry, flaying techniques, handling, preservation and storage of hides and skins to ensure adequate dissemination of the knowledge gained for wide-scale improvement of hides and skins quality.
ii. It is recommended that training of workers from the slaughter facilities should be continuous in order to improve hygiene meat handling practices so as to minimize levels of bacterial contamination on carcasses.
iii. Dilapidated meat markets should be rehabilitated and modernized to assist vendors comply with hygiene and sanitary standards.
iv. Meat vendors should be supplied with modern stainless steel equipment that are easy to wash and sanitize.

Chapter 7

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Annex 1: Demographic Characteristics

	How old are you?		
Statistics	**Intervention**	**Control**	**Total**
N	**n=13**	**n=10**	**n=23**
Mean	45.2	43.7	44.5
Std. Deviation	±7.45	±11.28	±9.10
Range	25	36	36

	How many children do you have		
Statistics	**Intervention**	**Control**	**Total**
N	**n=15**	**n=13**	**n=28**
Mean	8.3	8.0	8.1
Std. Deviation	±4.04	±2.38	±3.32
Range	14	8	14

	When did you start engaging in this business/work		
Statistics	**Intervention**	**Control**	**Total**
N	**n=15**	**n=12**	**n=27**
Mean	15.2	17.5	16.2
Std. Deviation	±8.00	±10.35	±9.01
Range	32	33	33

Annex 2: Wastages

	About how much were you not able to sell per day (2 years ago)					
	Intervention		Control		Total	
	2 Yrs ago s.d. ±0.71	Now s.d. ±4.26	2 Yrs ago s.d. ±1.63	Now s.d. ±2.7	2 Yrs ago s.d. ±1.33	Now s.d. ±3.66
N	2	6	4	5	6	11
Mean	3.5	4.8	3	2.6	3.2	3.8
Std. Deviation	±0.71	±4.26	±1.63	±2.7	±1.33	±3.66
Range	1	9	4	6	4	10
		137%		87%		

Annex 3: Semi-structured questionnaires

Revenue			Number of people employed	
Before Market Rehabilitation		Currently	Before Market Rehabilitation	Currently
High seasons	Low seasons			

Type	Before Market Rehabilitation				Currently			
	High seasons		Low seasons		High seasons		Low seasons	
	Qty	% Wastes	Qty	% Wastes	Qty	% Wastes	Qty	% Wastes
Shoats								
Cattle								
Camel								

A. Intervening International Development and implementing partners

1. Name and position in organization
2. Has your organization been involved in providing/facilitating training activities and infrastructure development to the:-
   - Line ministry officials in the meat sector? (Yes/No)
   - If yes, which ministries and how many staff did you train for each identified beneficiaries?
   - Slaughterhouse workers (yes/no),
   - Meat transporters (yes/no)
   - Meat sellers (Yes/No)
   - Animal health service providers organizations (Yes/No)
   - Local meat and hides and skins traders associations (Yes/No)
3. Did you train on:
   - Livestock transportation?(yes/no)
   - Abattoir cleaning, hygiene and sanitation? (yes/no)
   - Good hygiene meat handling practices? (yes/no)
   - Sanitary standard operating procedures? (yes/no)
   - Slaughterhouse waste management and environmental hygiene? (yes/no)
   - Hazard analysis critical control points principles covered? (yes/no)
   - Safe recovery and preservation of hides and skins
4. How much did your organization spend in USD for the intervention?
5. Has your organization done some tracer studies to determine the impact of the interventions? (yes/no)
6. If yes, briefly explain

B. Trained Beneficiaries (abattoir workers, hides and skins traders)

Name Sex:____ Age:____

1. Have you attended any training supported by international organizations? Y/N_____
2. What type of trainings did you attend?_____
3. If yes, what 3 key things did you learn from the training?
4. From the above response, what has been easy to implement and why?
5. What has been difficult for you to implement and why?
6. Are you really implementing what you learnt during the training?
7. If yes, explain what you are implementing?
8. If No, What is making you not to implement what you were trained on?
9. Has the training changed the way you do your business?
10. If yes, how?
11. If no, why?
12. What changes have you seen since the training in relation to:-
    a. Compliance with hygiene standards?
    b. Meat quality?
    c. Operations?
    d. Change in income? By how much?
13. Did the trainings cause any problem to any of you or colleagues?
14. Are you aware of any public health risks associated with meat consumption? Y/N
15. If yes, what are some of them and how can they be controlled?
16. Do you have any changes or recommendation you would like to make for future trainings?
17. Are you satisfied with the hygiene standards of the livestock slaughter facility or meat market? Yes/No
18. If no, what do you think is/are reason(s) for the poor hygiene?

- Lack of water or inadequate water supply
- Poor design of the facility
- Lack of or inadequate sanitation facilities
- Lack or inadequate hand washing facilities

- Inadequate training of meat handlers
- Lack or inadequate waste disposal facilities
- Lack of qualified meat inspectors or no meat inspection services
- Lack of enforcement of meat hygiene legal laws
- Lack or inadequate light or lighting facilities
- Lack or inadequate livestock slaughter equipments/tools
- Lack or inadequate protective gear for meat handlers

C. Municipal Council Beneficiary

Name _____

Position in council_____

1. Have you been involved in meat market rehabilitation and slaughterhouse construction?_____
2. If yes, how?
3. What changes have you seen since the construction of the new slaughterhouse and rehabilitation of the meat market?
4. What have been your main benefits from the meat market rehabilitation?
5. Have you seen any changes in your revenue? 1=Yes 2=No 3=Don't know
6. Why?
7. If yes, by how much?
8. How much revenue did you collect per month before the market rehabilitation and currently?
9. How many people are employed by the municipal council in this market?
10. What changes have you seen since the rehabilitation of the market in relation to:-
    a. Hygiene?
    b. Meat quality?
    c. Operations?
11. Are there any negative impacts as a result of market rehabilitation?
12. Are there grievances related to the rehabilitation of the market?

13. Are you aware of any public health risks associated with meat consumption? Y/N

14. If yes, what are some of them and how can they be controlled?

15. Do you have any recommendation you would like to make for future interventions?

16. Are you satisfied with the hygiene standards of the livestock slaughter facility/meat retail market? Yes/No

17. If no, what do you think is/are reason(s) for the poor hygiene?

- Lack of water or inadequate water supply
- Poor design or maintenance of the facility
- Lack of or inadequate sanitation facilities
- Lack or inadequate hand washing facilities
- Inadequate training of meat handlers/retailers
- Lack or inadequate waste disposal facilities or cabbage collection trucks
- Lack of qualified meat inspectors or no meat inspection services
- Lack of enforcement of meat hygiene legal laws
- Lack or inadequate livestock slaughter or meat retail equipments/tools
- Lack or inadequate protective gear for meat handlers

D. Meat Market Beneficiaries

Name Sex____Age:____

1. How long have you operated in this market?_____
2. What type of meat do you sell?
3. How much meat did you sell per day before the market rehabilitation and currently?
4. What proportion of your meat get spoilt or wasted?

5. What changes have you seen since the rehabilitation of the meat market?
6. What has been your main benefit from the meat market rehabilitation?
7. Have you seen any changes in your income? 1=Yes 2=No 3=Don't know
8. Why?
9. If yes, by how much?
10. What changes have you seen since the rehabilitation of the market in relation to:-
    a. Maintenance of hygiene practices?
    b. Meat quality?
    c. Operations
11. Has the market rehabilitation created any problems? If yes, for whom and how?

12. Are you aware of any public health risks associated with meat consumption? Y/N
13. If yes, what are some of them and how can they be controlled?
14. What would you recommend for future interventions?

15. Are you satisfied with the hygiene standards of the meat retail market? Yes/No

16. If no, what do you think is/are reason(s) for the poor hygiene?

- Lack of water or inadequate water supply
- Poor maintenance of the meat market
- Lack of or inadequate sanitation utilities
- Lack or inadequate hand washing facilities/tools
- Inadequate training of meat retailers
- Lack or inadequate waste disposal facilities or cabbage collection trucks
- Lack or inadequate meat retail equipments/tools
- Lack or inadequate protective gear for meat retailers

E. Customer Satisfaction (meat consumers)

Name Sex_____ Age:_____

1. How long have you been buying meat from this market?

2. Why do you choose to buy meat from this market?

3. What is your feeling when you purchase meat from the rehabilitated market?

4. What changes have you seen since the rehabilitation of the meat market in relation to:-
    a. Hygiene?
    b. Meat quality?
    c. Operations? (flow of meat buyers, ease of movement)
5. Are there any negative impact as a result of the rehabilitation of the meat market?

6. What would you recommend for future interventions?

F. Customer Satisfaction (hides and skins traders)

Name Sex_____ Age:_____

1. How long have you been buying hides and skins from this slaughterhouse?

2. Why do you choose to buy from this slaughterhouse?

3. How do you see the quality of hides and skins you purchase from this slaughterhouse after training as compared to before training?

4. What changes have you seen since the training of flayers from this slaughterhouse in terms of:-
    a. Hides and skins cuts?

b. Quantity of meat left on hides and skins?

c. Quality of air tried hides and skins

d. Quality of hides and skins preserved using industrial salts

5. What would you recommend for future interventions?

G. Impact assessment at slaughter facilities and meat markets (visual appraisal)

Hygiene and sanitation (transect walk, observation and organoleptic tests)

This will be grated as Excellent-1, Good-2, Fair-3, Poor-4 and Very Poor-5

1 Slaughterhouse environment and surrounding

2 Livestock holding pens and lairages maintenance

3 Livestock slaughtering area maintenance and hygiene

4 Carcass dressing procedures

5 State and condition of the slaughterhouse and associated facilities maintenance

6 Slaughterhouse equipments cleanliness & maintenance

7 Slaughterhouse personnel conduct and practices during operations

8 Slaughterhouse personnel hygiene standards (clean bodies, wash hands before start of work and after visiting toilets)

9 Layout and condition of the drainage system

10 Solid and liquid waste disposal methods

11 Clear demarcation between dirty and clean areas either physically or workers desisting from cris-crossing

12 Proper use and maintenance of protective gear

13 Proper cleaning of the slaughterhouse during slaughter process

14 Clear identification of equipments used in dirty areas from those used in clean areas

15 Clean and well maintained slaughterhouse compound

16 Meat transportation hygiene standards

17 Hygiene standards of meat market and equipments

Hides and skins **Socio-economic return and behaviour change questionnaire**

HIDES AND SKINS TRAINING EVALUATION QUESTIONNAIRE: – PASTORALISTS

Hides and skins are considered an end product of animal production, though more correctly they are a by-product and thus are an important and valuable resource. The potential of hides and skins as a source of income in developing world is overly under exploited due to lack of proper recovery and handling skills. In many regions of Somalia, these are usually discarded at site of slaughter or municipal landfills. This is mainly due to lack of skills and equipment for preservation and processing. Those that are processed are done so improperly/unprofessionally, greatly reducing their potential value as an additional source of income and employment for the vulnerable youth and women along the livestock value chain.

Fully aware of this, the DFID UKaid funded Sustainable Employment and Economic Development (SEED) Programme sought to explore hides and skins potential as an additional source of sustainable employment and income generation along the livestock value chain. To achieve this, FAO signed a Letter of Understanding (LOU) with the Ministry of Livestock (MOL) to conduct a training of 300 butchers/ flayers, pastoralists and hides and skins handlers and traders in Burao, Hargeisa and Borama municipalities in Somaliland in May and June, 2014.

Section A: Identification and Respondent Information

Questionnaire Number		Date of Interview (DD/MM/YY)	
Region		District	
Place of Interview		Name of Respondent	
Respondent Phone Number		Gender of Respondent	M□ F□
Name of interviewer		Questionnaire checked by	

Section B: Evaluation of the Training:

Please indicate if you agree or disagree with the following statements using the provided scale

Statement:	**SA**	**A**	**N**	**D**	**SD**	DK

1	The training was very helpful to me	□	□	□	□	□	□
2	The presenters were knowledgeable of the topics presented	□	□	□	□	□	□
3	The time allocated for presentations was appropriate	□	□	□	□	□	□
4	The training was generally successful and worthy my time	□	□	□	□	□	□
5	The training has improved my knowledge on hides and skin processing	□	□	□	□	□	□
6	I will be able to apply the knowledge I gained in the training in my livelihood	□	□	□	□	□	□
7	The training room was comfortable	□	□	□	□	□	□
8	I was satisfied with the food, refreshments and facilities in the training venue	□	□	□	□	□	□

The purpose of this questionnaire is to evaluate the training modality and knowledge gained from the same. ***The information collected will be treated with utmost confidentiality.***

Section C: Knowledge Gained from Training: We would like to assess the knowledge you gained from this training. Please answer the following questions**.**

	Statement:	**SA**	**A**	**N**
9	Good animal feeding results in good quality hides and skins	True	False	Don't Know
10	Good feeding includes enough pasture and water	True	False	Don't Know
11	External parasites include	Ticks and Flies	Worms	Don't Know
12	To control external parasites, I should use:	Acaricides	Rugs	Just leave them
13	Which is the most preferred location of branding:	Hip	Ribs	Abdomen
14	Handling horned animals, especially during transportation should:	Mix horned and un-horned animals	Separate horned and un-horned animals	Not sure/Don't Know
15	To obtain good hide and skin, animals should graze in:	Thorny areas	Cleared fields (No thorns)	Not Sure/Don't Know

Key: SA: Strongly Agree; **A**: Agree; **N**: Neutral; **D**: Disagree; **SD**: Strongly Disagree; **DK**: Don't Know

Section D: General Impression and Remarks:

16. What did you like most about this training?

_____

17. What would you change in this training to make it better?

_____

18. Do you have any other comments/suggestions?

_____

FAO Somalia

HIDES AND SKINS TRAINING EVALUATION QUESTIONNAIRE: – FLAYERS AND BUTCHERS

Hides and skins are considered an end product of animal production, though more correctly they are a by-product and thus are an important and valuable resource. The potential of hides and skins as a source of income in developing world is overly under exploited due to lack of proper recovery and handling skills. In many regions of Somalia, these are usually discarded at site of slaughter or municipal landfills. This is mainly due to lack of skills and equipment for preservation and processing. Those that are processed are done so improperly/unprofessionally, greatly reducing their potential value as an additional source of income and employment for the vulnerable youth and women along the livestock value chain.

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The purpose of this questionnaire is to evaluate the training modality and knowledge gained from the same. ***The information collected will be treated with utmost confidentiality.***

Section A: Identification and Respondent Information

Questionnaire Number		Date of Interview (DD/MM/YY)	
Region		District	
Place of Interview		Name of Respondent	
Respondent Phone Number		Gender of Respondent	M□ F□

Name of interviewer		Questionnaire checked by	

Statement:		SA	A	N	D	SD	DK
1	The training was very helpful to me	□	□	□	□	□	□
2	The presenters were knowledgeable of the topics presented	□	□	□	□	□	□
3	The time allocated for presentations was appropriate	□	□	□	□	□	□
4	The training was generally successful and worthy my time	□	□	□	□	□	□
5	The training has improved my knowledge on hides and skins processing	□	□	□	□	□	□
6	I will be able to apply the knowledge I gained in the training in my livelihood	□	□	□	□	□	□
7	The training room was comfortable	□	□	□	□	□	□
8	I was satisfied with the food, refreshments and facilities in the training venue	□	□	□	□	□	□

Section B: Evaluation of the Training:

Please indicate if you agree or disagree with the following statements using the provided scale

<u>Section C:</u> Knowledge Gained from Training:

We would like to assess the knowledge you gained from this training. Please answer the following questions**.**

9	Handling of livestock before slaughter should avoid hitting and pulling by hair or skin	True	False	Don't know
10	No or few flay cuts on hide/skins can be done through use of	Straight knives	Curved knives	Not sure
11	Grade-1 hides or skin should have	≤ 1 flay cut	< 2 cuts	>3 cuts
12	Why should meat be trimmed thoroughly from skin?	For good quality	High grade	Both of them
13	Washing and trimmingof meat from hides and skins will ensure good quality and will minimize its spoilage	True	False	Not sure
14	Rubbed grains can be minimized by:	Dragging carcass on	Not dragging car-	Both of them

		rough ground	cass on rough sandy ground	
15	How many grades of hides and skins do you know	2 (good or bad)	4 (I, II, III or re-ject)	Not sure

Section D: General Impression and Remarks:

16. What did you like most about this training?

_____

17. What would you change in this training to make it better?

_____

18. Do you have any other comments/suggestions?

FAO Somalia

HIDES AND SKINS TRAINING EVALUATION QUESTIONNAIRE: – HANDLERS AND TRADERS

Hides and skins are considered an end product of animal production, though more correctly they are a by-product and thus are an important and valuable resource. The potential of hides and skins as a source of income in developing world is overly under exploited due to lack of proper recovery and handling skills. In many regions of Somalia, these are usually discarded at site of slaughter or municipal landfills. This is mainly due to lack of skills and equipment for preservation and processing. Those that are processed are done so improperly/unprofessionally, greatly reducing their potential value as an additional source of income and employment for the vulnerable youth and women along the livestock value chain.

Fully aware of this, the DFID UKaid funded Sustainable Employment and Economic Development (SEED) Programme sought to explore hides and skins potential as an additional source of sustainable employment and income generation along the livestock value chain. To achieve this, FAO signed a Letter of Understanding (LOU) with the Ministry of Livestock (MOL) to conduct a training of 300 butchers/ flayers, pastoralists and hides and skins handlers and traders in Burao, Hargeisa and Borama municipalities in Somaliland in May and June, 2014.

The purpose of this questionnaire is to evaluate the training modality and knowledge gained from the same. ***The information collected will be treated with utmost confidentiality.***

Section A: Identification and Respondent Information

Questionnaire Number		Date of Interview (DD/MM/YY)	
Region		District	

Place of Interview		Name of Respondent	
Respondent Phone Number		Gender of Respondent	M□ F□
Name of interviewer		Questionnaire checked by	

Section B: Evaluation of the Training:

Statement:		**SA**	**A**	**N**	**D**	**SD**	DK
1	The training was very helpful to me	□	□	□	□	□	□
2	The presenters were knowledgeable of the topics presented	□	□	□	□	□	□
3	The time allocated for presentations was appropriate	□	□	□	□	□	□
4	The training was generally successful and worthy my time	□	□	□	□	□	□
5	The training has improved my knowledge on hides and skin processing	□	□	□	□	□	□
6	I will be able to apply the knowledge I gained in the training in my livelihood	□	□	□	□	□	□
7	The training room was comfortable	□	□	□	□	□	□
8	I was satisfied with the food, refreshments and facilities in the training venue	□	□	□	□	□	□

Please indicate if you agree or disagree with the following statements using the provided scale

Key: SA: Strongly Agree; **A**: Agree; **N**: Neutral; **D**: Disagree; **SD**: Strongly Disagree; **DK**: Don't Know

<u>Section C:</u> Knowledge Gained from Training:

We would like to assess the knowledge you gained from this training. Please answer the following questions**.**

9	Preferred method of hides and skins preservation is:	Industrial salt treatment	Air drying	Both of them
10	Industrial white salt is recommended for preservation instead of table salt	True	False	Not sure

11	Controlling vermin and pests at store will control damage/spoilage of hides and skins	True	False	Not sure
12	Folding of the treated & dry hide/skin should be with:	Flesh inside	Flesh outside	Both of them
13	The recommended stacking height of stored hides and skins should be:	≤1.5 m	> 1.5 m	Not sure

Section D: General Impression and Remarks:

16. What did you like most about this training?

_____

17. What would you change in this training to make it better?

_____

18. Has the quality of hides and skins increased since you received the training?

    Yes /No

19. If yes, how many pieces are you selling now as compared to before you received the training?

Before		**After**	
Hides	Skins	Skins	Skins

20. Do you have any other comments/suggestions?

_____

Annex 4: Meat sampling report in Borama meat market facilities.

I hereby to summit the sampling report in overall two meat markets of Ahmed Gureh and Halane 1 located in Borama municipality, Awdal region of Somaliland. The samples have been analyzed in central veterinary laboratory, Hargeisa, Somaliland.

Hargeisa Central Veterinary Laboratory

Surface swab samples from rehabilitated Ahmed Gureh meat market			

Central Vet. Lab., Hargeisa	Swab samples meat tables	Lab. Results	Interpretation	Counts	Code
	Surface swabs from meat tables				
B156	1	TVC = 450 cfu/cm^2	Good	450	2
		E. coli = 75 MPN index/ml	Fair	75	3
B157	2	TVC = 5400 cfu/cm^2	Fair	5,400	3
		E. coli = 450 MPN index/ml	Poor	450	4
B158	3	TVC = 30,000 cfu/cm^2	Poor	30,000	4
		E. coli > 1100 MPN index/ml	V. poor	1,101	5
B159	4	TVC = 60 cfu/cm^2	Excellent	60	1
		E. coli <3 MPN index/ml	Excellent	2	1
B160	5	TVC = 230 cfu/cm^2	Good	230	2
		E. coli <3 MPN index/ml	Excellent	2	1
B161	6	TVC = 230 cfu/cm^2	Good	230	2
		E. coli = 33 MPN index/ml	Fair	33	3
B162	7	TVC = 900 cfu/cm^2	Good	900	2
		E. coli = 203 MPN index/ml	Poor	203	4
B163	8	TVC = 290 cfu/cm^2	Good	290	2
		E. coli = 13 MPN index/ml	Fair	13	3
B164	9	TVC = 2300 cfu/cm^2	fair	2,300	3
		E. coli = 23 MPN index/ml	Fair	23	3
B165	10	TVC = 1900 cfu/cm^2	good	1,900	2
		E. coli = 9 MPN index/ml	good	9	2
B166	11	TVC = 2000 cfu/cm^2	good	200	2
		E. coli = 33 MPN index/ml	fair	33	3
B167	12	TVC = 4465 cfu/cm^2	fair	4,465	3
		E. coli = 44 MPN index/ml	fair	44	3
B168	13	TVC = 2235 cfu/cm^2	fair	2,235	3
		E. coli = 230 MPN index/ml	Poor	230	4
B169	14	TVC = 8900 cfu/cm^2	Fair	8,900	3
		E. coli = 453 MPN index/ml	Poor	453	4
B170	15	TVC = 900 cfu/cm^2	good	900	2
		E. coli = 23 MPN index/ml	fair	23	3
B170	16	TVC = 15600 cfu/cm^2	fair	15,600	3
		E. coli = 301 MPN index/ml	Poor	301	4
B171	17	TVC = 640 cfu/cm^2	Good	640	2
		E. coli <3 MPN index/ml	Excellent	2	1
B172	18	TVC = 5000 cfu/cm^2	fair	5,000	3
		E. coli = 143 MPN index/ml	Poor	143	4

B173	19	TVC = 1170 cfu/cm^2	good	1,170	2
		E. coli = 43 MPN index/ml	fair	43	3
B174	20	TVC = 6000 cfu/cm^2	fair	6,000	3
		E. coli = 93 MPN index/ml	fair	93	3
B175	21	TVC = 7000 cfu/cm^2	fair	7,000	3
		E. coli = 73 MPN index/ml	fair	73	3
B176	22	TVC > 200000 cfu/cm^2	V. poor	200,001	5
		E. coli >1100 MPN index/ml	V. poor	1,100	5
B177	23	TVC = 2790 cfu/cm^2	Poor	2,790	4
		E. coli = 933 MPN index/ml	Poor	933	4
B178	24	TVC = 5460 cfu/cm^2	Fair	5,460	3
		E. coli = 330 MPN index/ml	Poor	330	4
B179	25	TVC = 2370 cfu/cm^2	fair	2,370	3
		E. coli = 8 MPN index/ml	good	8	2
B180	26	TVC = 1190 cfu/cm^2	good	1,190	2
		E. coli <3 MPN index/ml	Excellent	1	1
B181	27	TVC = 3530 cfu/cm^2	fair	3,530	3
		E. coli= 43 MPN index/ml	fair	43	3
B182	28	TVC = 30000 cfu/cm^2	Poor	30,000	4
		E. coli = 870 MPN index/ml	Poor	870	4
B183	29	TVC = 10650 cfu/cm^2	fair	10,650	3
		E. coli = 63 MPN index/ml	fair	63	3
B184	30	TVC = 2360 cfu/cm^2	fair	2,360	3
		E. coli = 25MPN index/ml	fair	25	3
B185	31	TVC = 17000 cfu/cm^2	fair	1,700	3
		E. coli = 830 MPN index/ml	Poor	830	4
B186	32	TVC >200000 cfu/cm^2	V. poor	200,001	5
		E. coli = 1045 MPN index/ml	Poor	1,045	4
B187	33	TVC = 1610 cfu/cm^2	good	1,610	2
		E. coli <3 MPN index/ml	Excellent	2	1
B189	34	TVC = 1180 cfu/cm^2	good	1,180	2
		E. coli = 10 MPN index/ml	good	10	2
B190	35	TVC = 9000 cfu/cm^2	fair	9,000	3
		E. coli = 650 MPN index/ml	Poor	650	4
B191	36	TVC = 11590 cfu/cm^2	Poor	11,590	4
		E. coli = 93 MPN index/ml	fair	93	3
B192	37	TVC = 1150 cfu/cm^2	good	1,150	2
		E. coli = 7MPN index/ml	good	7	2
B193	38	TVC = 5467 cfu/cm^2	fair	5,467	3

		E. coli = 23 MPN index/ml	fair	23	3
B194	39	TVC = 30000 cfu/cm^2	Poor	30,000	4
		E. coli = 670 MPN index/ml	Poor	670	4
B195	40	TVC = 2345 cfu/cm^2	fair	2,345	3
		E. coli = 13 MPN index/ml	fair	13	3
B196	41	TVC = 1230 cfu/cm^2	Good	1,230	2
		E. coli = 8 MPN index/ml	good	8	2
B197	42	TVC = 20000 cfu/cm^2	fair	20,000	3
		E. coli = 33 MPN index/ml	fair	33	3
B198	43	TVC = 8980 cfu/cm^2	fair	8,980	3
		E. coli = 630 MPN index/ml	Poor	630	4
B199	44	TVC = 1790 cfu/cm^2	good	1,790	2
		E. coli = 23 MPN index/ml	fair	23	3
B200	45	TVC = 10000 cfu/cm^2	fair	10,000	3
		E. coli = 63 MPN index/ml	fair	63	3
B201	46	TVC = 1290 cfu/cm^2	good	1,290	2
		E. coli = 10 MPN index/ml	good	10	2
B202	47	TVC = 2300 cfu/cm^2	fair	2,300	3
		E. coli = 15 MPN index/ml	fair	15	3
B203	48	TVC = 4465 cfu/cm^2	fair	4,465	3
		E. coli = 45 MPN index/ml	fair	45	3
B204	49	TVC = 1135 cfu/cm^2	good	1,135	2
		E. coli = 34 MPN index/ml	fair	34	3
B205	50	TVC = 1890 cfu/cm^2	good	1,890	2
		E. coli = 13 MPN index/ml	fair	13	3
	Surface swabs from knives				
B250	1	E. coli<3 MPN index/ml	Excellent	1	1
		TVC = 290 cfu/cm2	good	290	2
B251	2	E. coli<3 MPN index/ml	Excellent	2	1
		TVC = 1130 cfu/cm2	good	1,130	2
B252	3	E. coli= <3 MPN index/ml	Excellent	2	1
		TVC = 130 cfu/cm2	Excellent	130	1
B253	4	E. coli <3 MPN index/ml	Excellent	1	1
		TVC = 1850 cfu/cm2	Excellent	1,850	1
B254	5	E. coli = <3 MPN index/ml	Excellent	1	1
		TVC = 160 cfu/cm2	Excellent	160	1
B255	6	E. coli = <3MPN index/ml	Excellent	2	1
		TVC = 70 cfu/cm2	Excellent	70	1

B256	7	E. coli = <3 MPN index/ml	Excellent	1	1
		TVC = 170 cfu/cm2	Excellent	170	1
B257	8	E. coli = <3 MPN index/ml	Excellent	2	1
		TVC = 610 cfu/cm2	Excellent	610	1
B258	9	E. coli = <3 MPN index/ml	Excellent	2	1
		TVC = 180 cfu/cm2	Excellent	180	1
B259	10	E. coli = <3 MPN index/ml	Excellent	2	1
		TVC = 90 cfu/cm2	Excellent	90	1
B260	11	E. coli = <3 MPN index/ml	Excellent	1	1
		TVC = 190 cfu/cm2	Excellent	190	1
B261	12	E. coli = <3 MPN index/ml	Excellent	2	1
		TVC = 150 cfu/cm2	Excellent	150	1
B262	13	E. coli = <3 MPN index/ml	Excellent	1	1
		TVC = 130 cfu/cm2	Excellent	130	1
B263	14	E. coli = <3 MPN index/ml	Excellent	1	1
		TVC = 30 cfu/cm2	Excellent	30	1
B264	15	E. coli = <3 MPN index/ml	Excellent	1	1
		TVC = 60 cfu/cm2	Excellent	60	1
B265	16	E. coli = <3 MPN index/ml	Excellent	1	1
		TVC = 230 cfu/cm2	Good	230	2
B266	17	E. coli = <3 MPN index/ml	Excellent	1	1
		TVC = 20 cfu/cm2	Excellent	20	1
B267	18	E. coli = <3 MPN index/ml	Excellent	1	1
		TVC = 80 cfu/cm2	Excellent	80	1
B268	19	E. coli = <3 MPN index/ml	Excellent	2	1
		TVC =220 cfu/cm2	Good	220	2
B269	20	TVC = 90 cfu/cm2	Excellent	90	1
		E. coli = <3 MPN index/ml	Excellent	1	1
B270	21	TVC = 100 cfu/cm2	Excellent	100	1
		E. coli = <3 MPN index/ml	Excellent	1	1
B271	22	TVC = 190 cfu/cm2	Excellent	190	1
		E. coli = <3 MPN index/ml	Excellent	1	1
B272	23	TVC = 200 cfu/cm2	Excellent	200	1
		E. coli = <3 MPN index/ml	Excellent	1	1
B273	24	TVC = 465 cfu/cm2	Good	465	2
		E. coli = 4 MPN index/ml	Good	4	2
B274	25	TVC = 135 cfu/cm2	Excellent	135	1
		E. coli <3 MPN index/ml	Excellent	2	1
		Surface Swab Samples from hooks			
B300	26	E. coli <3MPN index/ml	Excellent	1	1

		E. coli = 250 cfu/cm2	Excellent	250	1
B301	27	E. coli = <3 MPN index/ml	Excellent	1	1
		TVC = 190 cfu/cm2	Excellent	190	1
B302	28	E. coli = <3 MPN index/ml	Excellent	0	1
		TVC = 130 cfu/cm2	Excellent	130	1
B303	29	E. coli = <3 MPN index/ml	Excellent	2	1
		TVC = 30 cfu/cm2	Excellent	30	1
B304	30	E. coli = <3 MPN index/ml	Excellent	1	1
		TVC = 50 cfu/cm2	Excellent	50	1
B305	31	E. coli = <3 MPN index/ml	Excellent	1	1
		TVC = 160 cfu/cm2	Excellent	160	1
B306	32	E. coli = <3MPN index/ml	Excellent	2	1
		TVC = 70 cfu/cm2	Excellent	70	1
B307	33	E. coli = <3 MPN index/ml	Excellent	1	1
		TVC = 170 cfu/cm2	Excellent	170	1
B309	34	E. coli = <3 MPN index/ml	Excellent	0	1
		TVC = 610 cfu/cm2	Excellent	610	1
B310	35	E. coli = <3 MPN index/ml	Excellent	2	1
		TVC = 180 cfu/cm2	Excellent	180	1
B311	36	E. coli = <3 MPN index/ml	Excellent	180	1
		TVC = 90 cfu/cm2	Excellent	90	1
B312	37	E. coli = <3 MPN index/ml	Excellent	2	1
		TVC = 190 cfu/cm2	Excellent	190	1
B313	38	E. coli = <3 MPN index/ml	Excellent	0	1
		TVC = 150 cfu/cm2	Excellent	150	1
B314	39	E. coli <3 MPN index/ml cfucm2	Excellent	2	1
		TVC = 130 cfu/cm2	Excellent	130	1
B315	40	E. coli = <3 MPN index/ml	Excellent	1	1
		TVC = 30 cfu/cm2	Excellent	30	1
B316	41	E. coli = <3 MPN index/ml	Excellent	1	1
		TVC = 60 cfu/cm2	Excellent	60	1
B317	42	E. coli = <3 MPN index/ml	Excellent	1	1
		TVC = 230 cfu/cm2	Good	230	2
B318	43	E. coli = <3 MPN index/ml	Excellent	1	1
		TVC = 20 cfu/cm2	Excellent	20	1
B319	44	E. coli = <3 MPN index/ml	Excellent	-	1
		TVC = 80 cfu/cm2	Excellent	80	1
B320	45	E. coli = <3 MPN index/ml	Excellent	-	1
		TVC = 80 cfu/cm2		80	1
B321	46	TVC = 90 cfu/cm2	Excellent	90	1

		E. coli = 4 MPN index/ml	Good	4	1
B322	47	TVC = 100 cfu/cm2	Excellent	100	1
		E. coli = <3 MPN index/ml	Excellent	2	1
B323	48	TVC = 190 cfu/cm2	Excellent	190	1
		E. coli = <3 MPN index/ml	Excellent	1	1
B324	49	TVC = 200 cfu/cm2	Excellent	200	1
		E. coli = <3 MPN index/ml	Excellent	1	1
B325	50	TVC = 465 cfu/cm2	Excellent	465	1
		E. coli = 4 MPN index/ml	Excellent	4	1

Key: Code: 1-Excellent, 2-Good, 3-Fair, 4-Poor and 5-Very poor

Surface swab samples from Halane 1 meat market					
Central Vet. Lab., Har-geisa	**Swab samples meat tables**	**Lab. Results**	**Interpretation**	**Counts**	**Code**
	Surface swabs from meat tables				
H001	1	TVC >200,000 cfu/cm^2	V. poor	200,001	5
		E. coli >1079 MPN index/ml	Poor	1,079	4
H002	2	TVC >200,000 cfu/cm^2	V. poor	200,001	5
		E. coli >1100 MPN index/ml	V. poor	1,101	5
H003	3	TVC > 200,000 cfu/cm^2	V.Poor	200,001	5
		E. coli > 1100 MPN index/ml	V. poor	1,101	5
H004	4	TVC >200,000 cfu/cm^2	V. poor	200,001	5
		E. coli >1100 MPN index/ml	V. poor	1,101	5
H005	5	TVC >200,000 cfu/cm^2	V. poor	200,001	5
		E. coli >1100 MPN index/ml	V. poor	1,101	5
H006	6	TVC >200,000 cfu/cm^2	V. poor	200,001	5
		E. coli = 1020 MPN index/ml	Poor	1,020	4
H007	7	TVC >200,000 cfu/cm^2	V. poor	200,001	5
		E. coli >1100 MPN index/ml	V. poor	1,101	5
H008	8	TVC >200,000 cfu/cm^2	V. poor	200,001	5
		E. coli >1100 MPN index/ml	V. poor	1,101	5
H009	9	TVC >200,000 cfu/cm^2	V. poor	200,001	5
		E. coli >1100 MPN index/ml	V. poor	1,101	5
H010	10	TVC >200,000 cfu/cm^2	V. poor	200,001	5
		E. coli >1100 MPN index/ml	V. poor	1,101	5
H011	11	TVC >200,000 cfu/cm^2	V. poor	200,001	5
		E. coli >1100 MPN index/ml	V. poor	1,101	5

H012	12	TVC >200,000 cfu/cm^2	V. poor	200,001	5
		E. coli >1100 MPN index/ml	V. poor	1,101	5
H013	13	TVC >200,000 cfu/cm^2	V. poor	200,001	5
		E. coli >1100 MPN index/ml	V. poor	1,101	5
H014	14	TVC >200,000 cfu/cm^2	V. poor	200,001	5
		E. coli = 453 MPN index/ml	Poor	453	4
H015	15	TVC >200,000 cfu/cm^2	V. poor	200,001	5
		E. coli >1100 MPN index/ml	V. poor	1,101	5
H016	16	TVC >200,000 cfu/cm^2	V. poor	200,001	5
		E. coli = 301 MPN index/ml	Poor	301	4
H017	17	TVC >200,000 cfu/cm^2	V. poor	200,001	5
		E. coli >1100 MPN index/ml	V. poor	1,101	5
H018	18	TVC >200,000 cfu/cm^2	V. poor	200,001	5
		E. coli >1100 MPN index/ml	V. poor	1,101	5
H019	19	TVC >200,000 cfu/cm^2	V. poor	200,001	5
		E. coli >1100 MPN index/ml	V. poor	1,101	5
H020	20	TVC >200,000 cfu/cm^2	V. poor	200,001	5
		E. coli >1100 MPN index/ml	V. poor	1,101	5
H021	21	TVC >200,000 cfu/cm^2	V. poor	200,001	5
		E. coli >1100 MPN index/ml	V. poor	1,101	5
H022	22	TVC > 200000 cfu/cm^2	V. poor	200,001	5
		E. coli = >1100 MPN index/ml	V. poor	1,101	5
H023	23	TVC >200,000 cfu/cm^2	V. poor	200,001	5
		E. coli = 933 MPN index/ml	Poor	933	4
H024	24	TVC >200,000 cfu/cm^2	V. poor	200,001	5
		E. coli = 330 MPN index/ml	Poor	330	4
H025	25	TVC >200,000 cfu/cm^2	V. poor	200,001	5
		E. coli >1100 MPN index/ml	V. poor	1,101	5
H026	26	TVC >200,000 cfu/cm^2	V. poor	200,001	5
		E. coli >1100 MPN index/ml	V. poor	1,101	5
H027	27	TVC >200,000 cfu/cm^2	V. poor	200,001	5
		E. coli >1100 MPN index/ml	V. poor	1,101	5
H028	28	TVC >200,000 cfu/cm^2	V. poor	200,001	5
		E. coli = 870 MPN index/ml	poor	870	4
H029	29	TVC >200,000 cfu/cm^2	V. poor	20,000	5
		E. coli >1100 MPN index/ml	V. poor	1,101	5
H030	30	TVC >200,000 cfu/cm^2	V. poor	200,001	5

		E. coli >1100 MPN index/ml	V. poor	1,101	5
H031	31	TVC >200,000 cfu/cm^2	V. poor	200,001	5
		E. coli = 830 MPN index/ml	V. poor	830	5
H032	32	TVC >200,000 cfu/cm^2	V. poor	200,001	5
		E. coli = 1045 MPN index/ml	poor	1,045	4
H033	33	TVC >200,000 cfu/cm^2	V. poor	200,001	5
		E. coli >1100 MPN index/ml	V. poor	1,101	5
H034	34	TVC >200,000 cfu/cm^2	V. poor	200,001	5
		E. coli >1100 MPN index/ml	V. poor	1,101	5
H035	35	TVC >200,000 cfu/cm^2	V. poor	200,001	5
		E. coli = 650 MPN index/ml	poor	650	4
H036	36	TVC >200,000 cfu/cm^2	V. poor	200,001	5
		E. coli = 93 MPN index/ml	Fair	93	3
H037	37	TVC >200,000 cfu/cm^2	V. poor	200,001	5
		E. coli >1100 MPN index/ml	V. poor	1,101	5
H038	38	TVC >200,000 cfu/cm^2	V. poor	200,001	5
		E. coli >1100 MPN index/ml	V. poor	1,101	5
H039	39	TVC >200,000 cfu/cm^2	V. poor	200,001	5
		E. coli = 670 MPN index/ml	poor	670	4
H040	40	TVC >200,000 cfu/cm^2	V. poor	200,001	5
		E. coli >1100 MPN index/ml	V. poor	1,101	5
H041	41	TVC >200,000 cfu/cm^2	V. poor	200,001	5
		E. coli >1100 MPN index/ml	V. poor	1,101	5
H042	42	TVC >200,000 cfu/cm^2	V. poor	200,001	5
		E. coli >1100 MPN index/ml	V. poor	1,101	5
H043	43	TVC >200,000 cfu/cm^2	V. poor	200,001	5
		E. coli >1100 MPN index/ml	V. poor	1,101	5
H044	44	TVC >200,000 cfu/cm^2	V. poor	200,001	5
		E. coli >1100 MPN index/ml	V. poor	1,101	5
H045	45	TVC >200,000 cfu/cm^2	V. poor	200,001	5
		E. coli >1100 MPN index/ml	V. poor	1,101	5
H046	46	TVC >200,000 cfu/cm^2	V. poor	200,001	5
		E. coli >1100 MPN index/ml	V. poor	1,101	5
H047	47	TVC >200,000 cfu/cm^2	V. poor	200,001	5
		E. coli >1100 MPN index/ml	V. poor	1,101	5
H048	48	TVC = 4465 cfu/cm^2	V. poor	4,465	5
		E. coli >1100 MPN index/ml	V. poor	1,101	5

H049	49	TVC >200,000 cfu/cm^2	V. poor	200,001	5
		E. coli >1100 MPN index/ml	V. poor	1,101	5
H050	50	TVC >200,000 cfu/cm^2	V. poor	200,001	5
		E. coli >1100 MPN index/ml	V. poor	1,101	5
	Surface swabs from knives				
H100	1	TVC >200,000 cfu/cm^2	V. poor	200,001	5
		E. coli >1100 MPN index/ml	V. poor	1,101	5
H101	2	TVC = 3530 cfu/cm^2	fair	3,530	3
		E. coli = 543 MPN index/ml	Poor	543	4
H102	3	TVC = 30000 cfu/cm^2	Poor	30,000	4
		E. coli = 870 MPN index/ml	Poor	870	4
H103	4	TVC >200,000 cfu/cm^2	V. poor	200,001	5
		E. coli = 63 MPN index/ml	fair	63	3
H104	5	TVC >200,000 cfu/cm^2	V. poor	200,001	5
		E. coli >1100 MPN index/ml	V. poor	1,101	5
H105	6	TVC >200,000 cfu/cm^2	V. poor	200,001	5
		E. coli >1100 MPN index/ml	V.Poor	1,101	5
H106	7	TVC >200000 cfu/cm^2	V. poor	200,001	5
		E. coli >1100 MPN index/ml	V.Poor	1,101	5
H107	8	TVC = 1610 cfu/cm^2	good	1,610	2
		E. coli = 103 MPN index/ml	Poor	103	4
H108	9	TVC = 1180 cfu/cm^2	good	1,180	2
		E. coli >1100 MPN index/ml	V. poor	1,101	5
H109	10	TVC = 9000 cfu/cm^2	fair	9,000	3
		E. coli = 650 MPN index/ml	Poor	650	4
H110	11	TVC = 11590 cfu/cm^2	Poor	11,590	4
		E. coli >1100 MPN index/ml	V. poor	1,101	5
H111	12	TVC = 101150 cfu/cm^2	Poor	101,150	4
		E. coli =780 MPN index/ml	Poor	780	4
H112	13	TVC = 200000 cfu/cm^2	Poor	200,001	4
		E. coli >1100 MPN index/ml	V. poor	1,101	5
H113	14	TVC = 30000 cfu/cm^2	Poor	30,000	4
		E. coli = 670 MPN index/ml	Poor	670	4
H114	15	TVC = 2345 cfu/cm^2	fair	2,345	3
		E. coli >1100 MPN index/ml	V. poor	1,101	5
H115	16	TVC >200,000cfu/cm^2	V. poor	200,001	5

		E. coli = 890 MPN index/ml	Poor	890	4
H116	17	TVC = 120000 cfu/cm^2	Poor	120,000	4
		E. coli = 333 MPN index/ml	Poor		4
H117	18	TVC = 8980 cfu/cm^2	fair	333	3
		E. coli = 630 MPN index/ml	Poor	630	4
H118	19	TVC >200,000 cfu/cm^2	V. poor	200,001	5
		E. coli >1100 MPN index/ml	V. poor	1,101	5
H119	20	TVC >200,000 cfu/cm^2	V. poor	200,001	5
		E. coli = 963 MPN index/ml	V. Poor	963	5
H120	21	TVC >200,000 cfu/cm^2	V. poor	200,001	5
		E. coli >1100 MPN index/ml	V. poor	1,101	5
H121	22	TVC >200,000 cfu/cm^2	V. poor	200,001	5
		E. coli = 1015 MPN index/ml	Poor	1,015	4
H122	23	TVC >200,000 cfu/cm^2	V. poor	200,001	5
		E. coli >1100 MPN index/ml	V. poor	1,101	5
H123	24	TVC = 10135 cfu/cm^2	Fair	10,135	3
		E. coli >1100 MPN index/ml	V. poor	1,101	5
H124	25	TVC = 103000 cfu/cm^2	Poor	103,000	4
		E. coli = 1013 MPN index/ml	Poor	1,013	4
	Surface Swab Samples from hooks				
H125	26	TVC =100,000 cfu/cm^2	poor	100,000	4
		E. coli >1100 MPN index/ml	V. poor	1,101	5
H126	27	TVC >200,000 cfu/cm^2	V. poor	200,001	5
		E. coli = 543 MPN index/ml	Poor	543	4
H127	28	TVC >200,000 cfu/cm^2	V. poor	200,001	5
		E. coli = 870 MPN index/ml	Poor	870	4
H128	29	TVC = >200,000 cfu/cm^2	V. poor	200,001	5
		E. coli = 563 MPN index/ml	Poor	563	4
H129	30	TVC >200,000 cfu/cm^2	V. poor	200,001	5
		E. coli >1100 MPN index/ml	V. poor	1,101	5
H130	31	TVC >200,000 cfu/cm^2	V. poor	200,001	5
		E. coli >1100 MPN index/ml	V.Poor	1,101	5
H131	32	TVC >200000 cfu/cm^2	V. poor	200,001	5
		E. coli >1100 MPN index/ml	V.Poor	1,101	5
H132	33	TVC = 11610 cfu/cm^2	Fair	11,610	3
		E. coli = 103 MPN index/ml	Poor	103	4

H133	34	TVC >200,000cfu/cm^2	V. poor	200,001	5
		E. coli >1100 MPN index/ml	V. poor	1,101	5
H134	35	TVC = 9000 cfu/cm^2	fair	9,000	3
		E. coli = 650 MPN index/ml	Poor	650	4
H135	36	TVC >200,000cfu/cm^2	V.Poor	200,001	5
		E. coli >1100 MPN index/ml	V. poor	1,101	5
H136	37	TVC >200,000 cfu/cm^2	V.Poor	200,001	5
		E. coli =780 MPN index/ml	Poor	780	4
H137	38	TVC = 200000 cfu/cm^2	Poor	200,001	4
		E. coli >1100 MPN index/ml	V. poor	1,101	5
H138	39	TVC = 30000 cfu/cm^2	Poor	30,000	4
		E. coli = 670 MPN index/ml	Poor	670	4
H139	40	TVC >200,000 cfu/cm^2	fair	200,001	3
		E. coli >1100 MPN index/ml	V. poor	1,101	5
H140	41	TVC >200,000cfu/cm^2	V. poor	200,001	5
		E. coli = 890 MPN index/ml	Poor	890	4
H141	42	TVC = 120000 cfu/cm^2	Poor	120,000	4
		E. coli = 333 MPN index/ml	Poor	333	4
H142	43	TVC = 8980 cfu/cm^2	fair	8,980	3
		E. coli = 630 MPN index/ml	Poor	630	4
H143	44	TVC >200,000 cfu/cm^2	V. poor	200,001	5
		E. coli >1100 MPN index/ml	V. poor	1,101	5
H144	45	TVC >200,000 cfu/cm^2	V. poor	200,001	5
		E. coli = 963 MPN index/ml	V. Poor	963	5
H145	46	TVC >200,000 cfu/cm^2	V. poor	200,001	5
		E. coli >1100 MPN index/ml	V. poor	1,101	5
H146	47	TVC >200,000 cfu/cm^2	V. poor	200,001	5
		E. coli = 1015 MPN index/ml	Poor	1,015	4
H147	48	TVC >200,000 cfu/cm^2	V. poor	200,001	5
		E. coli >1100 MPN index/ml	V. poor	1,101	5
H148	49	TVC = 10135 cfu/cm^2	Fair	10,135	3
		E. coli >1100 MPN index/ml	V. poor	1,101	5
H149	50	TVC = 103000 cfu/cm^2	Poor	103,000	4
		E. coli = 1013 MPN index/ml	Poor	1,013	4

Key: Code: 1-Excellent, 2-Good, 3-Fair, 4-Poor and 5-Very poor