THE CONCEPT OF VALUE CHAINS IN AGRICULTURE, CLIMATE ACTION AND ENVIRONMENTAL RESOURCES

GLOBAL ISSUES & LOCAL PERSPECTIVES

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Preface

This book adopts an exegetical approach as well as a pedagogic model, making it attractive agriculture and environmental economics teachers, professional practitioners and scholars. It is eschews pedantry and lays bars the issues in such clarity that conduces to learning. The book elaborates on contemporaneous ***The Concept of Value Chains in Agriculture, Climate Action and Environmental Resources*** issues of global significance and at the same time, is mindful of local or national perspectives making it appealing both to international and national interests. The book explores the ways in which climate change, food security, national security and environmental resources issues are and should be presented to increase the public's stock of knowledge, increase awareness about burning issues and empower the scholars and public to engage in the participatory dialogue climate change, food security, national security and environmental resources necessary in policy making process that will stimulate increase in food production and environmental sustainability.

The Concept of Value Chains in Agriculture, Climate Action and Environmental Resources: Global issues and Local Perspectives is organized in three parts. Part One deals with The Concept of Value Chains in Agriculture, Part Two is concerned with The Concept of Climate Actions and Part Three deals with the Concept of Value Chains and Environmental Resources.

Eteyen Nyong/ Ignatius Onimawo

April 2025

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Chapter Eight

Environmental Hygiene and Disease Management Along Beef Value Chain.

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1.0 Introduction

1.1 Brief Overview of Beef Cattle Value Chain in Nigeria

The livestock industry in Nigeria plays an important role in ensuring food security, provision of employment, eradication of poverty and enhancing economic growth and development however the livestock subsector contribution is under-represented due to greater emphasis on crop value chain amidst other factors. Ownership of cattle in Nigeria extend beyond income generation but also a central component of risk management strategies. The production system is characterized by long marketing chain which involves long market distance, numerous phases of weight gain and feeding regimes, many levels of traders and transactions, a multitude of steps and stages of processing, and a variety of employment-creating services and inputs on the supply side while the consumer side is characterized with delivery of products through informal markets.

About 99% of Nigeria's cattle population is managed in smallholder and pastoral systems using indigenous production methods. Pastoralists accounted for majority of beef-cattle in Nigeria. The main challenge of the current model of meat production is the inefficiency of the system as majority of producers utilized small scale production methods with only a small fraction of production making it to the industrial value chains. The system is also faced with challenges of declining availability of pasture and grazing land, overgrazing, recurrent and fatal conflicts between pastoralists and crop farmers. Livestock value chain encompasses all stages involved in the production, processing, and distribution of beef cattle and related products. Livestock value chains such as the beef cattle value chain, entails the full range of activities required to bring beef to the final consumers passing through the different phases of production, processing and delivery. There are different actors within the beef cattle value chain. These actors include input suppliers, beef cattle farmers, beef cattle traders, butchers, raw beef marketer, processed beef marketers and beef consumers. Each of these actors has functional roles that made the chain effective. The input suppliers are relevant in beef cattle value chain as they make available all factor inputs such as

calves, feeds (grass, legumes, concentrates feed, mineral mixtures), drugs, machinery and implements (feeders, knives, ropes, weighing scale, plastic bags, cooking materials, packaging materials) along the value chain in the right place, time, form and quantity required by cattle farmers and other key actors along the value chain. The beef cattle producers in the beef cattle value chain engage in series of activities of putting all factor inputs such as land, calves, labour, feeds, drugs and implements together for the production of beef cattle. The beef cattle producers consist of pastoralists, agro-pastoralist and ranchers and are linked to various actors who purchase cattle from them. The beef cattle traders perform a vital role in the marketing of live cattle from the cattle producers to raw beef markers, processed beef markers and sometimes to consumers and other traders.

The beef cattle butchers perform the function of slaughtering cattle in abattoirs, private slaughter slabs or in their residence. They perform additional functions such as separating the meat from the meat offal and bone, washing the meat and meat offal and undertaking preliminary processing of the meat into different sizes. The raw beef marketers consist of beef marketers who prepare standard cuts of meat for sale in wholesale and retail open-air market outlets as well as meat shops and supermarkets which leads to utility of form. The processed beef marketers comprise of restaurants, hotels, eateries and processed meat vendors and they perform the primary function of processing beef into the different forms desired by consumers and thereby add utility of form. The beef consumers consist of urban beef consumers and rural beef consumers who are linked to various value chain actors, and they consider beef a vital source of animal protein. Consumers purchase beef in different forms such as raw beef or processed beef.

The Federal Ministry of Agriculture and Rural Development reported that 380,000 tonnes of beef were discovered from cattle slaughtered in 2014 and this is projected to grow up to 1.3 million tonnes by 2050. This implied that Nigeria’s domestic market opportunity for beef cattle is large and expected to continue growing with increase in population thus the need to harness the opportunities by actors and other stakeholders within the beef cattle value chain to contribute significantly to economic growth and development and also enhance the achievement of the Sustainable Development Goals.

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1.2 **Beef and Meat By-Products**

A beef animal has about 60% beef and the other 40% are by and co-products such as include skin, fat, bones, tendons, bones etc. The meat industry generated large number of these products yearly while some of the products are edible, others are non-edible requiring disposal and treatment costs to dispose or obtain high added value products. These edible and economically valuable non edible by-products provide additional premiums and increase profit margin for various actors with the beef cattle value chain. These by-products range from edible offals, inedible offals, meat, bone and blood meal, edible and inedible tallow, hides and pharmaceutical products. Edible beef by-products include a variety of muscle and organ meats (liver, tongue, tripe, tripas, heart, oxtail, sweetbreads, edible tallow, and cheek and head meat). Edible tallow is used for cooking and processed foods and bones are the source of gelatin used in many products (think gummy bears). Some tallow that is equivalent to edible grade is also used for cosmetics and soaps. Organs that are inedible are used primarily for pet food, including lungs, trachea, inedible livers, and melts (spleen). Inedible tallow is used for industrial use and more recently for biodiesel production. Hides are a significant part cattle by -products majority of which are used in leather production and exported. Some products, such as gallstones and fetal blood serum are harvested infrequently but have very high values. Hides, hooves, horns, etc. can be reduced by obtaining high added-value products such as molecules that may be of interest in food, feed, pet food, agriculture, energy, chemical, and pharmaceutical industry.

1.3 **Importance of Environmental Hygiene and Disease Management in Cattle Value Chain**

Livestock disease externalities negatively impact production and distort values due to domestic and international market shocks resulting in market inefficiencies (FAO, 2016). Recent emphasis on food safety, food security, biodiversity and improving animal and public health are highly necessary to reduce risk of disease introduction and spread within animal populations and from animal and human population (Smith, 2005). It is important to understand the patterns and risk

factors that can increase or decrease the likelihood of a disease because disease does not occur randomly in a population. Disease which can be infectious and non-infectious can have direct and indirect causes following the traditional model of triads which consist of an external agent (bacteria, virus, parasite, fungi, or prion), a susceptible host and an environment, including management and husbandry practices, which bring the host and agent together. In this model, disease results from the interaction between the agent and the susceptible host in an environment that supports transmission of the agent from a source to that host. Disease can be reduced by manipulating the environment using strategies such as reducing fecal contamination, reducing overcrowding, eliminating the carriers or vectors of pathogens, selecting animals that are resistant to diseases and increasing resistance of the population through natural or artificial means among others (Dohoo et al., 2010).

The meat industry generates large volumes of by- and co-products like blood, bones, skin, trimmings, organs, viscera, horns, hoofs, feet, and skull among others during slaughtering and meat processing and these products must be treated and disposed ecologically (Toldra *et al.*, 2021).According to EC (2009), there are three categories of meat by-products based on their risk to human or animal health. Category 1 by-products are considered a very high risk because they include animals that could be infected with Transmissible Spongiform Encephalopathy (TSE) or killed for TSE eradication and specified risk material. These by-products must be destroyed by incineration or co-incineration, or be used as a fuel for combustion. Category 2 by-products offer a high/medium risk with products containing residues of certain substances above the allowed levels or with presence of foreign bodies, dead animals, manure and digestive tract content. Its products are used for fuel, biodiesel, biogas, fertilizers or soil improvers. Anaerobic digestion is a well-known technology that is able to degrade solid organic waste and generate biogas, a mix of methane and carbon dioxide. In addition, anaerobic fermentation can destroy pathogens and the resulting solid product can be used as fertiliser in land applications (Escudero et al., 2014). Category 3 by- products offer the lowest risk with products such as carcasses and parts of animals slaughtered which are fit for human consumption although for commercial reasons they are not finally destined to human consumption, or rejected as unfit for human consumption even though they do not show any signs of disease communicable to humans or animals. They also include

bones, hides, skins, horns and feet, and blood from ruminants and non-ruminants requiring TSE testing.

2.0 beef value chain and their impacts on environment and human health

2.1 breeding and production

Animal breeding and production stage is the first stage at which beef safety problems are encountered during the beef cattle value chain, originating from inappropriate use of feedstuffs or feed additives, inadequate cleaning and disinfection, poor waste and manure management, biosecurity, use of veterinary pharmaceuticals, leading to the presence or accumulation of dangerous chemicals,toxins,gases,hormone/drug residues, heavy metals, and pesticide residues in the meat and meat products. During production stage,animals could be directly or indirectly exposed to certain harmful chemicals,thereby causing harm to the animals (toxic effects) and if not cleared,may leave their residues in meat and meat products.The impacts of various chemicals, toxins, or residues of pesticides, antibiotics, drug, antimicrobials, heavy metals, and hormones in meats and meat products on the environment and human health is a major concern. Unintentionally added chemicals that are man-made from livestock production which might be cleaning agents, disinfectants, pesticides, herbicides, animal drugs, manure, etc. And environmental contaminants like lead,mercury, arsenic,nitrates,and phosphorous have been documented to have negative impacts on environment and in-turn affecting human health.

(Ndukwe,Igara,Nkama,Ibe,Okoro,Nnnachi and Atiaetuk 2023)

2.2 cleaning agents and disinfectants in beef value chain

Cattle belongs to a category of livestock; Being a living thing, is prone to passing waste from their body as well as some other wastes that emanate from their daily activities which include feeding, medication and excretion. It is therefore imperative to avoid accumulation of these wastes as they

contribute largely to pathogens build up, environmental pollution as well as contamination of by-products along the beef value chain making both edible and by-product unwholesome for consumption and usage respectively; which in turn impacts negatively on human health.

Cleaning agents and disinfectants play a crucial role in maintaining hygiene and meat safety in the beef value chain, from cattle sheds, ranches, slaughter houses to processing, storage, and meat shops and shelves. Proper Sanitation prevents contamination, extends meat shelf life and ensure compliance with meat safety regulations and standards. Monitoring cleaning agents and chemicals used, would go a long way to ameliorate environmental pollution and disease transmission along the beef value chain; thus providing safe product and food of good quality globally.

Cleaning agents and decontaminants need to be checked for appropriate use, recommended dosages and adequate disposal into the environment. The use of toxic substances that could cause respiratory, dermatological and other ailing conditions should be avoided. Disinfectants destroys and irreversibly inactivates all specified microorganism within 10minutes is appropriate and ideal in meat processing industries. The recommended sanitation standard for contamination reduction in meat contact surface is generally accepted as 99.999% (a 5 log reduction) achieved in 30secs.

(Salama, Elzeftawy & Kirrella 2024)

Cleaning agents

Cleaning agents have been helpful in removal of organic and inorganic matter from surfaces before disinfection and decontamination. Example of these are: *Detergents*, which are alkaline detergents which are more efficient in removal of fat and protein based stains and grease and there are neutral detergents that remove ordinary dirt. *Acid cleaners* remove mineral based stains and deposits as well as scale buildup. While *Abrasive cleaners*: these help to remove tough stains on the surfaces of equipment used in slaughter houses, meat processing plants and meat shops.

(Kgomotso,Malebo,Mokgaotsa,Mochane,Masinde 2021)

Disinfectants

Disinfectants help to kill or reduce pathogenic load at the slaughter houses and meat processing units. Examples include *Chlorine-based* disinfectants which are effective against bacteria and viruses e.g. *Sodium Hypochlorite*; *Quaternary Ammonium compounds* (Quats) are used in meat

processing plants for surface sanitation, *paracetic acid* are strong disinfectants used in carcass washing and equipment sanitization, *iodophors* are used in footbaths and utensils sanitation, *hydrogen peroxide* is effective against a wide range of microbes, often used in combination with *paracetic* acid for effective disinfection. (Salama,et al,.)

2.3 Impacts of cleaning agents on environmental and human health.

Improper,inappropriate and excessive use of disinfectants could result in adverse effects posing a threats on the environment and human health. Chemical agents used at higher than recommended concentrations could be inhaled or absorbed into the body. These impacts affect both human (applicants) and environment. (Chen et al 2021)

Adverse effects of disinfectants on human are as follows:

- Irritation, inflammation, and ulceration of mucosal linning, as well as upper and lower respiratory tract.
- Severe corrosive damage to gastric, esophageal, and intestinal mucosal and gastro intestinal disorders (nausea, vomiting and diarrhoea)
- Severe damage and irreversible damage to the eyes when in direct contact with cornea or the skin around the eyes.
- Allergic reaction to the skin. E.g bleach (diluted sodium hypochlorite).
- Renal problems e.g Bleach.
- Acute cardiopulmonary arrest.

(Maitreyi,Julander,Erfani,Schenk 2022. Abdullahi, Hasssan, Kadarman, Junaidu, Adeyemo and Lua 2016).

Adverse effects of disinfectants on Environment are as follows:

- Organic matters in wastewater from slaughter houses and meat processing industries reacts with chlorine to form organic chlorine compounds that are environmental contaminants posing a risk and threat to acquatic eco-systems.
- Overuse of disinfectants and their release into water bodies and run offs had led to death of animals and birds due to toxicological effects exerted on their source of water.

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- Emergence of antibiotic resistant genes of bacteria had also been linked with excessive use of disinfectants.
- Frequent and continuous use of disinfectants on metallic surfaces; As in slaughter equipment and metallic cutting surfaces in meat processing units may exert adverse effects.

(Ndukwe, et al., 2023)

It is hereby recommended that abuse of cleaning agents should be avoided by farmers and workers at meat processing units; Antibiotics withdrawal periods should also be observed.

2.4 Biosecurity practices in beef value chain.

Biosecurity along beef value chain; to be acceptable must have possessed a coherence that seeks a healthy relationship between health (human and animal) and the environment. This process must address how safe substances and chemicals used are, the practices and their impacts. The primary aim of biosecurity is to maintain and improve livestock health status and standards by protecting against disease pathogens and invasive species but a case of unintended negative impacts could arise on the environment and human health. These adverse occurrences could be because of the use of inappropriate use of chemicals, high concentration, and fake products.

As necessary as biosecurity practice is, several chemicals and substances used in biosecurity can have negative environmental and human health .example include:

a) **Disinfectants**

- Formaldehyde used in sterilization and fumigation, when abused in its concentration could be carcinogenic causing respiratory issues and skin irritation.
- Glutaraldehyde used in healthcare and animal biosecurity has been reported to pollute water bodies and have toxic effect on aquatic animals, also can cause eye, skin and lung irritation in Humans.
- Quaternary ammonium compounds are common component in disinfectants; they can persist in the environment leading to antimicrobial resistance. (Maitreyi, et al, 2022).

b) **Pesticides**

- Organophosphates (e.g Malathion, chlorpyrifos) that are used to control insect vectors; can contaminate water bodies and cause neurological damage in humans.

C) **Fumigants**

- Methyl Bromide used in pest control when used in excess could deplete the ozone and is highly toxic to humans, aquatic and wildlife.
- Hydrogen cyanide used in pest fumigation could be highly toxic and can cause acute poisoning in humans.

(Taiwo 2019, Muncke, Andersson, Backhaus, Boucher, Almroth,Castillo, Chevrier, Demeneix, Emmanuel, Fini, J.B 2020).

Usage of chemicals for its purpose in the correct proportion and wearing of protective clothing is hereby advocated.

3.0 Waste management in beef value chain.

The beef value chain generates waste at various stages, from production to consumption. Effective waste management is crucial for environmental sustainability and public health.

Waste generation along beef value chain ranges from production stage; where manure and urine contribute to soil and water pollution. Animal waste or manure on land either by spreading or the animals being on pastures results in the addition and buildup of phosphate, nitrogen and potassium to the soil and to agricultural run-offs into water sheds after heavy rainfall. Animal excreta is a potential source of pathogens which could be through animal mortalities (dead livestock) or those killed to prevent disease spread) from zoonotic diseases; that are incinerated or composted or buried to preclude the release of pathogen to the environment.

Nitrates and are generated from cattle waste through the conversion of ammonia from cattle waste into nitrites ($N0_2^-$) by an ammonia oxidizing bacteria, through a process called ‘‘ *Ammonia oxidation*” and also ammonia reacts oxygen to form nitrite ($N0_2^-$) is "Nitrification”. Environmental factors like oxygen availability,pH of cattle waste and temperature aid the processes.

Bacteria pathogens to humans are found in animal waste and in run-off water e.g fecal coliforms and *campylobacter spp* have been shown to leach from animal waste into ground water. *E.coli 0157:H7*, clearly from cattle are responsible for a proportion of O157.H7 outbreak (6.6%).

Waste products from slaughter houses and meat industry like blood, internal organs, intestines, claws and waste water from meat processing industries contain accumulation of pathogens and harmful substances released into the environment. A number of pathogenic bacteria, parasites and viruses can be transmitted to human through meat E.g Salmonella (spread by routes of animal feed). In the process of cleansing, excessive use of Sanitizers in processing plants and livestock farms environment may kill helpful bacteria essential for natural decomposition and nutrient cycling. (Rajpal, Ali, Choudhury, Amohana, Alali, Munshi, Khursheed, Kazmi 2022)

Adequate waste disposal directly by incineration in an approved incineration plant and other solid wastes should be finally disposed off as waste by means of burial in an approved landfill with recommended chemicals at the right proportion while the applicants and workers should wear protective clothings.

3.1 Waste and Water quality along meat processing units.

Population and industrial growth had contributed to water quality due to high concentrations of pollutants that are discharged from slaughter houses and industries related to beef value chain.

Animal wastes impacts the environment , specifically water quality and public health is in danger due to the release of antibiotics and pathogens emanating from different industrial processes ranging from slaughtering, washing and meat processing. Water waste from meat industry contain high level of organic matter and nutrients. These pose a threat to the environment if released without treatment. Blood has a biological oxygen demand of 150.000mg/ltr, is also released ; A tremendous Eutrophication (excessive nitrogen and phosphorus, causing overgrowth of algae and depleting the oxygen in water) and saprobiation (decomposition of organic matter by microorganism in the absence of oxygen) effect is observed when untreated effluents reach water bodies. (Rajpal, et al., 2022,)

3.2 Water contamination and human health

Nitrate and phosphorous are most common chemical contaminant in world's groundwater and surface water respectively. Nitrite ordinarily has no toxic effect on human health, its adverse effect has only been linked to its conversion into nitrite, nitric oxide and N-nitroso compounds.

Impacts of Nitrates on human health.

- The conversion of nitrate to nitrites causes methaemoglobinaemia,thus interfering with the ability of haemoglobin to take up oxygen.
- High level of nitrites in drinking water could cause cancer of the digestive tract
- Heavy presence of nitrogen and phosphorous in surface water lead to harmful algal blooms, thus impacting negatively on several ecosystem services.
- Cynosis in infants has been linked to presence of nitrates in drinking water.
- Recurrent acute respiratory tract infection from pathologic changes in bronchi and lungs parenchyma.

Elimination of pollutants through multi-stage systems for recovery and to remove heavy metals,suspended solids,loose meat,fats,soluble protein, grease, oils and undigested foods. Use of ETP (Effluent treatment plants) to remove organic matter and heavy metals which include;

- The use of activated sludge process to treat slaughter house waste water in single unit.
- Pre-treatment process E.g chemical dosing, DAF (Dissolved air flotation unit) to reduce oil,grease and TSS(Total suspended solids) load.
- Waste waters from abattoirs can be reduced by treatment of immesion chille effluent by membrane filteration which can produce recyclable water.

(Rajpal, et al,. 2022, Bamigboye, Amao, Ayodele, Adebayo, Ogunleke, Abass, Oyedare, Adetutu, Adeeyo, and Oyedemi, 2020).)

4.0 Beef value chain and air quality

Worldwide, abattoirs have been one of the major sources of air pollution and a compromise of air quality as emissions are allowed into the environment and as well posing threats to human health. There are zoonotic pathogens in Air E.g viruses which can e transmitted between animal faciliites and humans via aerosols particles. Manure can as well be a source of airborne viruses in the environment.

Elements and gases emission along beef value chain.

Green house Gas emission (GHG): livestock makes a disproportionately large contribution to global agricultural GHG emission, animals feed production gives 36% of GHG emission. Animal production contribution to GHG emission is enteric (39%) and manure is 10%. Therefore methane from enteric and manure of ruminants converts about 6% of feed intake to methane. There are increase in agric GHG emissions globally but disproportionately greater increase in the production of meat.

Globally, cattle contribute 61% of direct GHG emission from livestock with beef cattle having 41% and dairy cattle with 20%. The intensity of GHG emission is 82% greater from beef cattle on a grazing system than on a mixed system (grazing and concentrates consumption).GHG is however 11 fold greater from beef than pork.

CO_2 (Carbondioxide), **N_2O(** Nitrous oxide), **NH_3** (Ammonia), **CH_4** (Methane) and **H_2S** (Hydrogen sulphide).

These are gasses that are released . **CO_2** and **NH_3** are released from respiration and excreta respectively, thus affecting the workers in the facility, **CH_4** is emitted from cattle digestive process, **N_2O** is from manure.

(Odekanle, Ebenezer , Sonibare, Olubukola, Johnson, Sunday; Akeredolu, Alaba 2020)

4.1 Effects of emitted gasses on human health

Manure contributes 85% of ammonia release which causes formation of aerosols that cause haze and hence, eye irritation, and aerosols particles passing into the lungs and depositing into the land groundwater when there is heavy rainfall . Carbon dioxide contributes to ocean acidification, thus having negative impact on marine animals. Methane contributes to ground-level ozone formation triggering respiratory disorders, Nitrous oxide causes atmospheric ozone depletion, increasing ultraviolet radiation from reaching the earth. Hydrogen sulphide are also emitted from breakdown of cattle manure and excreta causing offensive odour to neighbour and workers. Example of the volatile chemicals that are emitted are formalin and peracetic acid, which release toxic fumes that contribute to air pollution and pose respiratory risk. Extreme weather causing Heat stress, respiratory issues has resulted from emission of these gasses.

(Odekanle, et al,.)

Nitrates and human health

Nitrates concentrates in water and can be hazardous to health; a standard of $>10mgL^{-1}$ of nitrates in drinking water is recommended. Nitrates can be a risk to the health of babies; particularly under

6 months old; If the babies consume it in baby formula. It is converted into Nitrite in GIT and can bind to haemoglobin, thus imparing oxygen transport causing ‘’blue baby syndromme’’. Nitrite consumption has been linked with miscarriage ; and its concentration in well water is positively linked to closeness of animal feeding operations.

The use of Nitrites is allowed in meat processing industries at a low concentration of 0.015% for meat preservation and colouring purposes to give reddening in meat at a Level of 150 mg/kg in meat product. Traces of nitrite have been reported as not poisonous in meat. However, they have a number of additional beneficial impacts so that the meat industries widely make use of this substance. A mixture with common salt in the proportion 0.5% nitrite and sodium chloride 99.5%; which is called ‘’N**itrite curing salt’’** is adopted. This has been formulated to check for nitrites overdose. A dosage level of 1.5-3% added to meat product is generally practiced giving the desired salty flavour and the small amount of nitrite needed for the curing reaction is also provided. (Gupta, Gupta, Seth, Bassin and Gupta 2020).

locations at 100 meters or less to abattoirs risk lung cancer and other respiratory diseases. Citing of abattoirs, slaughter houses and meat processing industry should be moved far away at distances above 100meters or more from residential areas. As harmful air pollutants and odour emanating from these facilities would be avoided. (Rajpal,et al.2022)

5.0 Drugs, pesticides and growth hormones.

These substances are chemical and biological in nature and can be introduced into meat and the environment by various technological practices which include residues of drugs used in treatment,incorrect meat storage and preservation and also and meat processing methods.

(Olasoju, Olasoju, Adebowale, and Adetunji 2021)

5.1 impacts of Drugs,pesticides and growth hormone on Environment and Human health.

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Abuse of few antibiotics like penicillin have the potential to exert allergic reactions in sensitized individuals and toxicity such as aplasia of the bone marrow by residues of chloramphenicol. Residues of antibiotics which have ability to alter human gut microbial populations, and transfer antibiotic resistance genes to human pathogens has been reported, and the reasons for the presence of antibiotic residues in meat and meat products could be due to quackery, poor management,indiscriminate use of antimicrobials, extended usage or inappropriate dosages, violation of regulations regarding drug withdrawal period prior to slaughter, and above all, the lack of consumer awareness about the risk of human health hazards associated with antimicrobial residues consumed in meat and meat products. (Olasoju et al 2021).

5.2 Pesticides and human health

Environmental protection agency (EPA) information reports that; of the over 1 billion tons of pesticides used in US annually. This is 22% of the estimated 5.2billion pounds of pesticides used world wide,where agriculture accounted for 80%, inappropriate use has resulted into intoxication of animals and or accumulation in meat and meat products.

Organochlorine (OC), DDT, hexachlorobenzene, heptachlor, aldrin/dieldrin are mostly persistent in the environment and can cause health hazards which include neurologic and endocrine (hormone) system disorders, birth defects, and cancer. A case of highly toxic parathion that was used instead of trichlorphon was reported to have caused over 300 cases of poisoning and 3 deaths. (Muncke, Andersson, Backhaus, Boucher, Almroth, Castillo, Chevrier, J.; Demeneix, Emmanuel, Fini 2020).

5.3 Effects of pesticides on various body system include.

Eyes: Tearing, irritation and conjuctivitis

Skin: rashes, blistering, burns, jaundice

Nervous system: headache,dizziness, muscle twitching,seizures, paralysis, losss of consciousness and coma.

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Respiratory system: Throat pain, cough, Respiratory failure.

Cardiovascular: carsiac arythmias.

GIT tract: Nauses, diarrhoea, vomiting, abdominal pain. (Taiwo 2019,. Aiyar, Pingali 2020)

5.4 Growth hormone and their effects.

Hormones of note in animal production are Somatotropins, Thyroxine, Glucocorticoids, androgen and estrogens and there are Hormone growth promotants (HGPs) that are synthetically made to enhance beef production; these are zeranol, Trenbolone and Melengestrol. Androgen and Trenbolone are implanted or injected in cattle to increase growth rate . Trenbolone can be found in soils and water runoffs, mostly when heifers implanted with trenbolone and estradiol are held on pastures. Lagoons receiving waste from cattle implanted with estradiol and trenbolone contained estrone and 17 trenbolone, and are used in irrigation which could lead to ecotoxicity.

Abuse and overdosage of synthetic hormones originating from treated beef cattle and whose residue consumed in meat has recorded harmful impacts on human's health. Contamination of groundwater near cattle feedlots by Trenbolone hormones found in the animals excreta has been documented to cause mineral imbalance in water and soil and can cause cancer and infertility in human. Commercial meat products and environmental exposure has been major sources of human exposure to synthetic growth hormones leading to cancer, reproductive effects and endocrine disruption. (Itana, & Duguma, 2021)

One of the examples of an additive is polyphosphate. In adequate quantities, it provides a wide range of benefits starting from maintaining texture and also increasing the nutritional profile by holding higher amounts of water in the products. Likewise, nitrite, one of the important chemical additives, is used to enhance colour—a major sensory attribute in meat-processing and product development. In spite of these facts, the additives of chemical origin, when used consistently over

a longer period of time at a concentration other than prescribed, often pose questions of doubts in terms of their effect on human health. Sometimes they are even collated with a reduction of oxidation of certain proteins, resulting in the genesis of certain dangerous health hazards, like proliferation of cancer cells

Important among them are alkaloids, the natural chemicals present in weeds, grasses, plants, and herbs. Pyrolizidine alkaloid (PA) is also a naturally occurring contaminant found in some plants, herbs, leaves, and flowers. Animals exposed to such plants, herbs, leaves, and flowers may be a source of deporting the alkaloids into their products. People may get serious illnesses through PAs directly or indirectly through the consumption of products like meat and milk (Itana, & Duguma, 2021)

It is therefore recommended to monitor abuse and overdosage of drugs, chemicals and growth hormones through laws and regulations by Ministry of livestock and enforced by Animal health professional bodies and Environmentalists. Enlightenment and education should be given to livestock farmers and meat industries by extension workers in livestock ministry as well as through workshop from Animal health and environmental association on the harmful impacts of these substances on environment and human.

6.0 Storage ,preservation and packaging in beef value chain.

The factors associated with meat safety are not limited to animal production but also cover complex stages which include: processing, chilling/freezing, and transportation to the retail level and then consumption . World Health Organization (WHO) described food safety as a process of storage, preparation, and handling of food in such a way that it prevents illness caused by food. ,Hence the reason for the slogan “FROM FARM TO PLATE, MAKE FOOD SAFE” as its theme for World Health Day . (WHO, 2024)

6.1 Refrigeration and freezing

Various substances are used to preserve and extend the shelf life of meat, prevent spoilage, maintain its quality and wholesomeness, these include refrigerator,freezer,preservatives and packages; however each has gotten their impact on human health and environment when used inappropriately.

Hydrofluorocarbons and chlorofluorocarbons emitted from refrigerator and freezer contribute significantly to global warming and depletion of ozone layer; also prolonged exposure of Hydrofluorocarbons causes neorological issues.Toxicity and high pressure of ammonia and the Co_2 emitted also require careful handling as its excess is harmful as leakage of ammonia can lead to respiratory problems. (cheng ,et al,. 2020)

6.2 Chemical preservatives

- Nitrates and Nitrites (E249,E250,E251,E252) used to prevent bacterial growth and enhance colour in cured meat can contaminate water sources causing algae blooms and harmful to aquatic ecosystems. Excess consumption of nitrates could lead to high blood pressure , methemoglobinaemia (oxygen deficiency in blood) and colorectal cancer.
- Sodium benzoate used in meat processing industry to prevent microbial growth is a non-biodegradable substance which accummulation in water bodies affects marine life. It could however trigger allergic reactions and hyperactivity in sensitive individuals; and could cause cancer when when consumed in combination with vitamin C.
- Over use of salt (Sodium chloride) in curing and drying meats can lead to soil and water salinization affecting aquatic life. Excessive consumption of salt has also been lnked to risk of hypertension and heart diseases in humans.
- Excessive use of Vineger being acetic acid, may cause acid reflux and dental erosion in humans .
- Chlorine used to disinfect equipment and storage facilities can release toxic chlorine gas causing harm to the environment, causing toxicity to acquatic animals and skin and eye irritation as well as respiratory problem to humans.

(Gupta, et al,. 2020 ,Muncke, et al,. 2020)

Use of Chemical preservatives by food processors should be done in appropriate amount and the workers should strictly use protective equipment to avoid hazards. Water should be added to reduce the concentration of wastes and effluents before being released into the environment to avoid harmful impacts on aquatic animals.

6.2 Packaging

Proper packaging of the meat and meat products is important as it protects against environmental and human effects, thus safeguarding meat quality. The use of plastics for preservation of meat contribute to plastic waste and pollution due to their improper disposal. This has resulted to environmental problems which include pollution and global warming as they are nonrenewable and nondegradable (Gil, and Rudy 2023).

Quality of meat products is dependent on the packaging materials and technology used. New technology has come up with bioplastics, paper and paper board, and corn starch packaging to replace plastics.Natural bioactive substances and application of natural antioxidants e,g essential oils and nisin could be used to package meat.

7.0 Best Practices and Standards in Beef Cattle Value Chain

7.1 Regulations and sanctions in Beef Cattle Value Chain: Roles and Compliance Level

In the Nigeria livestock sectors, there are series of laws, policies and guidelines aimed at ensuring adherence to international standards and the adoption of best practices. The regulatory framework also encompasses regulations related to food safety, animal welfare, environmental sustainability, and trade standards. The aims of these regulations are to enhance the awareness of legal landscape of the livestock sector, safeguard livelihood, enhance quality assurances, safeguard health and ensure safety compliance, promote environmental stewardship, enhance market access, mitigate risks and

uncertainties, enhance innovation and investment, promote ethical practices and collaboration among relevant stakeholders. Some of these regulations include:

Animal Diseases (Control) Act: This act provides the legal framework for disease control, prevention, and eradication measures in the livestock sector with the object of preventing the introduction and spread of infectious and contagious diseases among animals, hatcheries and poultry in Nigeria.

National Livestock Transformation Plan (2019-2028): The NLTP outlines the government's strategy for transforming the livestock sector through modernization, value addition, and market-oriented production systems.

Pest Control Measures for the Livestock Industry: These measures aim to control and prevent the spread of pests that could harm livestock and agricultural production.

National Policy on Animal Welfare and Livestock Production: This policy emphasizes the humane treatment of animals and promotes sustainable livestock production practices.

National Policy and Strategy for Livestock Value Chain in Nigeria: As at 2023, this policy is under draft. The Policy aimed at providing a framework for addressing the challenges faced by the sector, including issues related to supply-side measures, the business environment, market development, monetary and fiscal interventions, and value addition, logistics, and consumption. By providing a coherent framework for addressing these challenges, the policy shall create a conducive environment for the growth and development of the sector.These regulations provide a foundation for the development and growth of the livestock sector in Nigeria. By adhering to these regulations, livestock producers can ensure the production of safe and high-quality products while minimizing environmental impacts and promoting sustainable practices. Moreover, compliance with these regulations enables Nigeria to participate in international trade by meeting the standards and requirements set by importing countries. Nigeria livestock farmers show compliance to government policies

based on the way the policy affect them. This is because some policies are believed to promote sustainable practices and enhance productivity while others are believed to inadvertently create obstacles and exacerbate challenges. For instance, the ban on open grazing in some states has forced pastoralists to adopt alternative grazing methods, leading to conflicts and displacement.

Similarly, trade policies, such as tariffs on imported feed ingredients affect production costs and profitability of the farmers therefore policies should be designed to address more existing challenges than creating new ones. Several government policies have significantly influenced livestock farmers in Nigeria. The ban on open grazing in some states has forced pastoralists to adopt alternative grazing methods, leading to conflicts and displacement. Similarly, trade policies, such as tariffs on imported feed ingredients, affect production costs and profitability. In general, government policies play a pivotal role in shaping the realities faced by livestock farmers in Nigeria. While some policies aim to promote sustainable practices and enhance productivity, others inadvertently create obstacles and exacerbate challenges

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