

Livestock Feed Safety Training Guide

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Food and Agriculture
Organization of the
United Nations

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Foreword

Livestock feed safety guidelines provide public and private sector actors within the agriculture, livestock and nutrition fields with strategies to ensure livestock feed safety. The public sector is the driver in actualising feeds safety through policy development and implementation, strengthening of related institutions, and safeguarding of human health through public health interventions. The private sector plays a key role in the animal feed industry especially in the production, distribution, storage, processing and importation of feed ingredients.

The guidelines aim to safeguard human health as people are the end consumers of livestock products such as milk, eggs and meat. The information generated will help farmers and actors across the livestock feeds value chain to take into consideration quality and safety of livestock feeds to ensure a safe environment and healthy people. The guidelines also identify key livestock feeds including fodder, soybean, black soldier fly and compounded feeds, and discuss the important aspects pertaining to feed quality and safety from the production, harvesting, transportation, and storage phases.

The guidelines were developed through a broad consultative process. It started with a workshop with experts providing technical information on management of livestock feeds, fodder, soybean, black soldier fly and compounded feeds. The experts were drawn from FAO Kenya and key stakeholders in the livestock, agriculture, health, research and academic sectors. A taskforce selected from the larger team reviewed and drafted the guidelines which were edited and designed by consultants.

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The task force formed to develop the guidelines were cognisant of the audience and of including the end users of these guidelines. Organizations and ministries represented in the refinement process include FAOKE, KEPHIS, KU, JOOUST and KDB.

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Abbreviations and Acronyms

ASF

Animal Source Food

AMR

Anti-Microbial Resistance

BSF

Black Soldier Fly

BSFL

Black Soldier Fly Larvae

CP

Crude Protein

KEBS

Kenya Bureau of Standards

KG

Kilogramme

MJ

Megajoule

NDF

Neutral Detergent Fibre

PPE

Personal Protective Equipment



Chapter **ONE**

1.1 | INTRODUCTION

Animal feeds account for the greatest cost in livestock production but can also be a source of diseases to animals and the public at large. This calls for measures to invest in the quality and safe production of livestock feeds. Subsequently, this results in better public health, increased incomes from better prices for farmers, and creation of decent jobs along the value chain.

Livestock production should ensure a safe environment, healthy people and thriving animals. Poor quality and unsafe livestock feeds have a great negative impact on public health, economy and environment. Safe feeds help mitigate potential risks associated with feed-borne human and animal diseases, contaminants or nutritional imbalances and ensures human and livestock wellbeing as well as reduces the likelihood of diseases or deficiencies. The production of safe livestock feeds also ensures compliance with relevant regulations hence improving access to markets.

Poor quality and unsafe livestock feeds arise from contamination that can occur during the production, harvesting, transportation, processing, and storage phases. Unsafe feeds may contain toxic chemicals such as pesticides, heavy metals and micro-organisms that are harmful to human beings. When human beings consume poisoned products, this can result in ill health and death.

There is a direct and indirect impact that comes from the consumption of unsafe livestock feeds to the animals, families and a country at large. Unsafe animal feeds can make animals sick, leading to the animals expending more energy, producing an excess of gases harmful to the environment, or dying. The loss of animals could lead to loss of jobs and livelihoods whereas safe feeds ensure good livestock health and an increase in their productivity, ultimately leading to increased income.

At the household level, unsafe feeds cause increased cost of treatment for humans and animals. At the national level, unsafe feeds contribute to health challenges and reduced revenues thus limiting national development. Inappropriate disposal of unsafe animal feeds

may introduce toxic chemicals into the soil, water, and air.

The issue of quality and safe livestock feeds is particularly important due to the current challenge of antimicrobial resistance among animals and humans and the phenomenon of climate change.

An increase in the demand of livestock products represent a major opportunity for livestock producers to expand their business. This also presents a significant opportunity for producers and value chain players within the livestock feed industry.

The overall objective of the livestock feed commercialisation project - funded by Mastercard Foundation - is two-fold: to promote the sustainable development of the livestock feed subsector through an improved enabling environment; and to provide support in exploring pathways that can sustain increased access to quality livestock feeds through improved production, value addition, market access, consumption and income generation opportunities. One of the main pillars of these project is ensuring that the feeds being used by diverse livestock producers are sufficient in quantity as well as safe and of high quality.

1.2 | TYPES OF LIVESTOCK FEEDS

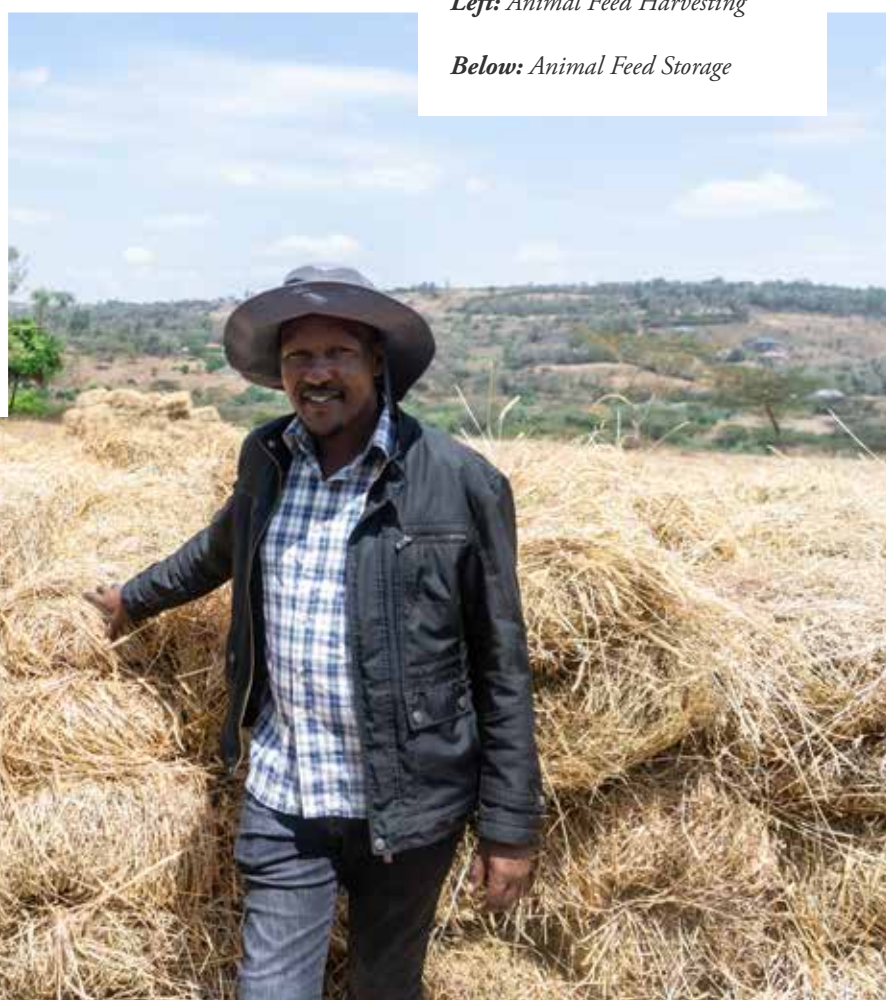
Type	Origin	Examples
Forages	Natural or cultivated	Soybean, hay and fodder
Supplements/concentrates	Manufactured	Cotton seed meal, maize germ/corn, sunflower cake
Minerals	Natural or Manufactured	Natural licks (common salt), high phosphorous
Feed Additives	Manufactured	Aflatoxin binder, nutrient enhancer
Emerging feeds	Natural or manufactured	Black Soldier Fly, range cubes



Above: Animal feed growing

Left: Animal Feed Harvesting

Below: Animal Feed Storage



Chapter TWO

FODDER PRODUCTION

2.1 _

MANAGEMENT OF FODDER FOR QUALITY AND SAFE LIVESTOCK FEEDS

Growing fodder on land that is contaminated with toxic chemicals and harmful microorganisms is a potential cause of animal feed contamination. Feeds should be grown in areas away from dumpsites, open sewers, roadsides, mining sites and industrial areas to prevent contamination from chemicals, heavy metals such as lead, cadmium and mercury which cause cancer (carcinogenic) as well as human and animal birth defects. Additionally, pieces of wood, metal, glass, plastic and other physical hazards pose a danger to livestock health.

Can land preparation activities lead to feed contamination?

The use of toxic chemicals in land preparation such as weed management will lead to accumulation of harmful chemicals in the soil which are taken up by the feed. When animals feed on harmful feeds they pass the contamination to humans through animal source foods such as milk, meat and eggs.

Is irrigation water a source of contamination to animal feeds?

Irrigation water is a possible source of contamination to animal feeds. Avoid using water contaminated with sewer, industrial waste and pesticides.

Where should one get their farm inputs?

Fertilizers, pesticides and seeds could potentially contain toxic chemicals such as heavy metals and pesticides. Farm inputs should be sourced from registered agro-dealers.

Can pesticides contaminate livestock feeds?

Pesticides may be used in the control of pests such as weeds, insects and diseases, but are also possible sources of contamination to animal feeds. It is advisable to promote responsible use of herbicides to control weeds.

During harvesting what practices can cause feed contamination?

Contamination can occur when harvesting feeds together with poisonous weeds (such as black cherry, datura species) or harvesting feeds without observing the pre-harvest interval when pesticides are applied.

Does the storage of the feeds affect its safety and quality?

Feeds should not be stored in damp or dusty areas. Mould may grow in feeds that contain high moisture content. Additionally, storing feeds together with agricultural inputs such as pesticides and fertilizers may lead to the contamination of the feeds.

Feeds should also be stored in rodent free and well-ventilated stores.

Transportation and Distribution of forages

The feeds should be protected from dust, rain, and other pollutants as follows:

- All farms and feed warehouses should have a foot bath;
- Trucks ferrying hazardous substances should not be used to carry animal feeds;
- Loaders must be hygienic and always wear personal protective equipment (PPE);
- Trucks used in the transportation and distribution of livestock feeds should be cleaned thoroughly with uncontaminated water;
- Trucks should be inspected before loading; and
- Feeds should be transported in well-aerated vehicles.

What best practices should processors follow to avoid contamination of the end product?

Processors of livestock feeds should invest in the following practices:

- Choose reputable suppliers and producers who follow strict quality and safety control measures;
- Inspect and ensure that raw materials meet the recommended technical specifications;
- Ensure that the processing activities do not introduce contamination;
- Processed feeds should be packaged under clean, dry and cool conditions;
- While packaging, adhere to the set weights and measures of the product;
- Develop a traceability plan for raw materials and finished products; and
- Be familiar with relevant local and international processing policies, regulations and laws.



Land Preparation for Forage Production
Forage storage





Chapter **THREE**

SOYBEAN PRODUCTION

3.1 _ MANAGEMENT OF SOYBEANS FOR LIVESTOCK FEED QUALITY AND SAFETY

The land on which the raw products that are used in the manufacture of animal feeds should be healthy and contaminant-free. When animals feed on contaminated feeds they pass these to humans through animal source foods that includes milk, meat and eggs. Toxic chemicals and harmful microorganisms present in the soil can lead to the contamination of plants like soybeans which are used in animal feeds.

Where should I grow soybeans?

Soybeans should be grown in areas away from dumpsites, open sewers, roadsides, mining sites, flood-prone and industrial areas. This is to prevent contamination from chemicals, physical hazards that can pose danger to livestock (such as pieces of wood, metal, glass and plastic), and heavy metals (such as lead, cadmium, and mercury which are carcinogenic and can cause human and animal birth defects).

◀ *Soybeans*



Can land preparation activities contaminate soybeans?

Use of toxic chemicals in land preparation (such as for weed management) will lead to accumulation of harmful chemicals in the soil. These will be absorbed by the soybean plant which when consumed by animals, may be pass on to humans through animal source foods such as milk, meat and eggs.

Farmers should use recommended agricultural land preparation chemicals in correct proportions.

Fertilizers, pesticides and seeds could potentially contain toxic chemicals such as heavy metals and pesticides. Farm inputs should be certified and sourced from registered agro-dealers.

Is irrigation water a source of contamination to animal feeds?

To avoid the contamination of animal feeds from irrigation water:

- Use clean water uncontaminated by industrial waste and pesticides;
- Avoid using sewer water that can expose the plants to harmful microorganisms.



Soybeans growing in green pods

Can pesticides contaminate livestock feeds?

Pesticides may be used in the control of pests such as weeds, insects and diseases, but are also possible sources of contamination to animal feeds. Remedies include promoting responsible use of herbicides to control weeds.

During soybean harvesting and drying, what can be done to avoid contamination?

The following steps can be followed to ensure soybeans remain free from contamination:

- Maintain farm records (such as planting dates, and herbicides used);
- Ensure farm equipment are clean and disinfected;
- Harvest plants at maturity;
- Avoid harvesting during rainy weather;
- Observe proper drying to the recommended moisture levels (13% and below);
- Use appropriate drying materials (such as clean canvas or tarpauline);
- Maintain proper hygiene and handling practices; and
- Store the soybeans in a well aerated, dry, vermin-proof area.

Does the storage of the soybeans affect their safety and quality?

At harvesting and storage, contamination can occur from aflatoxin, pests, parasites, rodents, and physical contaminants (including pieces of wood, metal, plastic, glass, and jewellery). To ensure the soybeans are not contaminated:

- Use appropriately located storage facilities (which have good drainage, are protected from birds, and are not steep);
- Dry the soybeans to the recommended moisture content level of 13% before storage;
- Use recommended grain preservative in the right proportions;
- Use appropriate storage in hermetic conditions to avoid microbial growth;
- Store the soybeans in a well aerated, dry, vermin-proof area;
- Ensure the produce does not come into contact with high moisture or wet surfaces;
- Maintain storage records; and
- Release soybeans on first-in, first-out basis.

Transportation and Distribution of Soybeans

The process of transportation and distribution can be a source of germs, aflatoxins, heavy metals, vehicle emissions and physical contaminants (such as stones, metal, soil, plastic, pieces of glass, and jewellery). To avoid contamination:

- Maintain proper hygiene and sanitation for the loader and equipment (which requires adherence to occupational safety and health requirements);
- Use potable water in cleaning vessels and disinfect vehicles after cleaning;
- Use properly covered means of transport to avoid contamination;
- Use clean canvas material that is not torn to cover soybeans during transportation; and
- Avoid transporting soybeans with materials that can contaminate it.

What are the best practices for processors to avoid contamination of the end product?

During processing, hazards such as anti-nutritive factors (tannins), aflatoxins, physical impurities, chemical (oil, emissions) and germs can contaminate the products. To avoid contamination at processing stage:

- Appropriately train staff on their roles; lay out workflows clearly;
- Ensure sanitation and hygiene practices are adhered to;
- Use appropriate packaging material;
- Label appropriately using batch numbers.



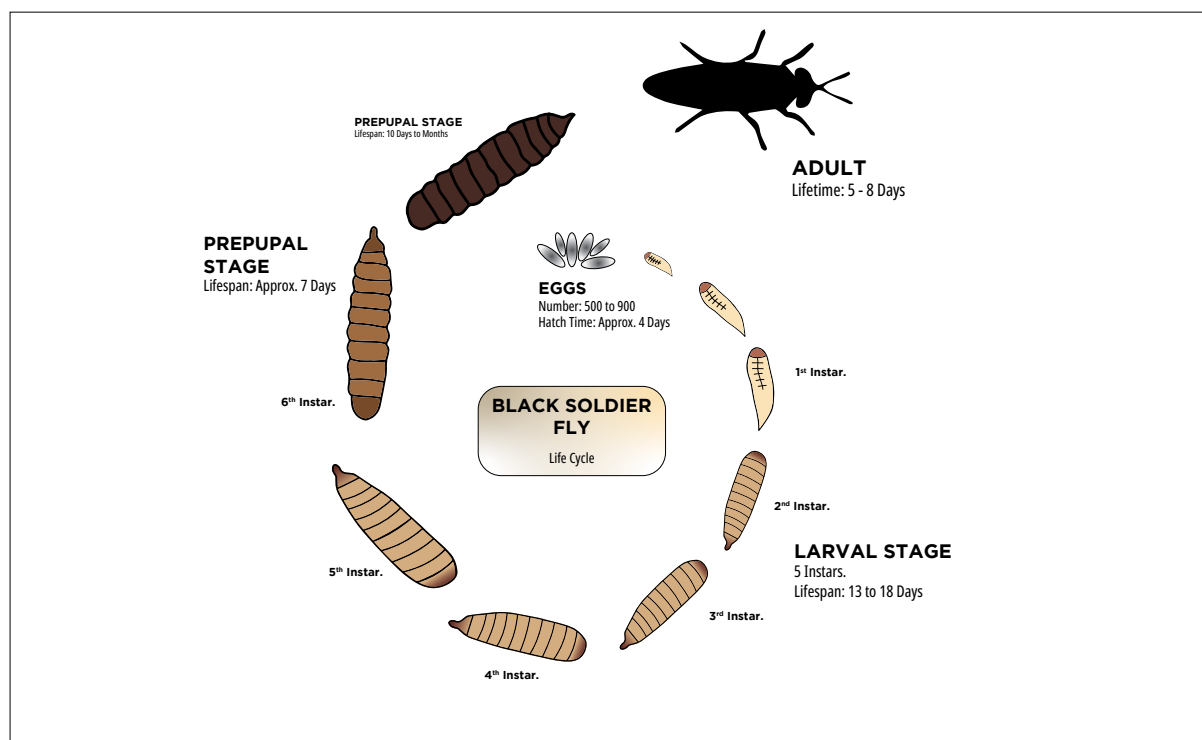
Soybean Drying

Chapter **FOUR**

BLACK SOLDIER FLY PRODUCTION

4.1 _ MANAGEMENT OF THE BLACK SOLDIER FLY (BSF) FOR LIVESTOCK FEED QUALITY AND SAFETY

Black soldier fly (BSF) farming is presently the most widespread form of insect farming in the world. The insects are considered among the most promising alternatives to common protein feed ingredients, such as soybean and fish meals. This intervention focuses on building the local production capacity of the protein ingredient for livestock feeds. Improving the availability of this protein ingredient could potentially have an effect on lowering the cost of animal feeds and also contribute towards the stabilization of prices. BSF can be used to compost organic waste and its immature flies (larvae) are used in the production of animal feeds.



Life-cycle stages of the Black Soldier Fly

Can site selection of the insect rearing house (insectarium) affect the safety and quality of BSF larvae?

Insectariums should be located in areas away from roadsides, mining sites and industrial areas to prevent contamination from chemicals, and heavy metals such as lead, cadmium, mercury. The metals are cancer-causing (carcinogenic) and can cause human and animal birth defects.

Insectariums should also be constructed on a raised ground and where bio-ponds are used, proper drainage should be used.

Does the substrate/attractant (brewers waste, pig and chicken droppings) affect the safety and quality of BSF larvae?

The safety and quality of BSF larvae are affected by the substrate/attractant. Substrate/attractant should be obtained from clean and safe sources to prevent contamination from disease causing microorganisms, heavy metals and toxic chemicals. Where possible, pasteurize (a high-pressure processing method that uses heat the substrate to eliminate microbial pathogens).

What should be done during egg production and larvae development?

Egg production should be done in a clean and safe environment as follows:

- Provide egg laying spaces;
- Transfer of eggs to the larvae rearing house (larvarium) should be done using clean equipment;
- During larvae development, substrates should be stored under clean and cool conditions.

Can contamination occur during harvesting and drying of BSFL?

It is important to remove the organic matter that remains after the larvae has been sieved (frass) as follows:

- During sieving, remove physical hazards such as pieces of wood, metal and glass plastics which can be a cause of death to livestock;
- Wet BSF larvae should be blanched at 70-100°C to clean and kill larvae, as well as to destroy disease-causing microorganisms. It is recommended that blanching be done in boiling water for 3 to 5 minutes; and

- Drying should be done on clean, dry surfaces to attain the recommended moisture content of <10%.

Can transport vessels be hazardous to dry BSF larvae?

Transport vessels can be a source of contamination from toxic chemicals and harmful microorganisms. To avoid contamination of the BSF larvae:

- Transportation of dry BSF larvae should be done in clean, dry and cool conditions;
- The handler/loader should maintain proper hygiene and sanitation for themselves and the equipment. This ensures adherence to occupational safety and health requirements.

Can storage facilities be a source of contamination for dry BSF larvae?

Storage facilities can be a conducive environment for biological, chemical and physical hazards hence the larvae should be stored in a vermin-free, cool, dry area that is raised above the ground.

What are the best practices for processors to avoid contamination of the end product?

Contamination from chemical, microbial and physical impurities can occur during handling and processing of dried BSF larvae. To avoid contamination:

- Ensure that processing equipment is cleaned and disinfected;
- Install metal detectors to eliminate ferrous and non-ferrous materials;
- Packaging should be done in clean, dry, air and watertight materials;
- Labelling should include batch number, manufacture and expiry dates; and
- The recommended shelf life for dried BSF larvae should be one year.



Above: BSF production nets

Left: BSF Larvae Processing

Below: Adult BSF





Chapter **FIVE**

PROCESSING OF FEEDS

5.1 _ **PRODUCTION AND MANAGEMENT OF COMPOUNDED LIVESTOCK FEEDS.**

To ensure feed safety and guarantee quality, producers of livestock feeds should comply with regulatory requirements for the import of premixes, additives and animal feed raw materials. It is essential to ensure adherence to personal hygiene and sanitation so as to prevent contamination of the feeds from bacteria transmitted by people and from the environment.

The processing equipment should also be cleaned and sanitized appropriately. As process workflows affect feed safety and quality, it is advisable to invest in proper layout including signage and process flow to avoid cross contamination.

Livestock Feed Processing



Does the process of packaging affect feed safety and quality?

Different livestock feeds should be properly labelled using batch and lot numbers for ease of traceability as follows:

- Different packaging labels should be used for each of the processed product;
- Each product should have a unique labelling color;
- Different product categories should have universal product codes (bar codes) and Kenya Bureau of Standards (KEBS) standardization marks.

Can poor storage of processed feeds affect its safety and quality?

To avoid contamination of processed feeds during storage:

- Warehouse facilities should be free from contaminants such as vehicle oil, vermin, and toxic chemicals;
- Appropriate labelling and batching should be used for ease of identification;
- Feeds should be released on first-in first-out basis to ensure feeds are used while they are of good quality.

Do farmers have a role in ensuring quality and safety of compounded feeds?

Farmers should use the compounded feed as per the labelling instructions. This is to avoid nutritive imbalances which can cause toxicity and low productivity. During storage, handling and use of compounded feeds:

- Store feeds in a cool dry place to avoid contamination with fungus and moulds;
- Store separately from human foodstuff to avoid mistaken human consumption;
- Store in appropriate stores that are rodent insulated to avoid biological contaminants and pests;
- Store separately from chemical contaminants such as vehicle oils, pesticides and veterinary drugs;
- Store in a clean safe environment to avoid physical contaminants such as metals, plastics and glass.



Chapter **SIX**

CLIMATE CHANGE EFFECTS

6.1 _ **IMPACT OF CLIMATE CHANGE ON QUALITY AND SAFETY OF LIVESTOCK FEEDS**

Climate change refers to long-term shifts in temperatures and weather patterns. Some of the effects of climate change on daily life include:

- Frequent floods and droughts;
- Unpredictable weather patterns;
- Increased outbreak of animal and plant diseases;
- High global temperatures than normal;
- Increased exposure to dangerous sun rays;
- Food insecurity; and
- Economic losses.

How can we mitigate the effects of climate change?

To mitigate against the effect of climate change:

- Plant more trees and gain carbon credits (which are cash gains from planting trees);
- Practice agroforestry (growing of trees and crops together);
- Use range land management practices e.g. paddocking;
- Use easily digestible feeds for livestock such as Desmodium and Brachiaria among others to reduce methane production;
- Use compost manure in the livestock feed fields;

- Improve animal health through disease-prevention measures as a sick animal consumes more than a healthy animal resulting in the increase of methane the environment; and
- Use clean energy such as biogas.

How does climate change affect feed safety and quality?

Changes in climate can negatively affect feed safety and quality. The washing away and transfer of toxicants into rivers and fields results in poor quality feeds due to biological and chemical contamination. Examples of the former include E. coli bacteria, salmonella, and intestinal worms while the latter include heavy metals from fertilizers and contaminated sites, oils and pesticides. Increased storage temperatures can also lead to quick spoilage of feeds and microbial growth and mycotoxin production.



Chapter **SEVEN**

IMPACT OF UNSAFE FEEDS

7.1 _

IMPACT OF UNSAFE LIVESTOCK FEEDS ON PUBLIC HEALTH, ENVIRONMENT AND ECONOMY

Food safety is the assurance that the food intended for consumption will not cause harm to the consumer, either when prepared or eaten. Safe livestock feeds produce safe livestock products for human use. Indications of unsafe feeds include discoloration, bad smells, and mould, among others.

How does the production and use of unsafe livestock feeds affect public health?

Unsafe animal feeds may affect public health in the following ways:

- Poisoning of animals leading to poor productivity (low yield, delayed and low production of eggs, poor livestock health), growth and death;
- Poisoning of animal products such as milk, meat, and eggs which when consumed by humans, can lead to infection, inflammation and possible death;
- Feeding of animals on unsafe feeds can be a source of toxic chemicals such as pesticides, heavy metals and harmful microbial organisms to the human. For instance, when animals consume animal feeds that have aflatoxin, traces of the contaminant have been found in milk and milk products. In humans, aflatoxin toxicity can cause liver disease and may also lead to liver cancer;
- The creation of a vicious cycle of disease and malnutrition especially affecting young children and other vulnerable groups. Consuming unsafe foods can also expose humans to micronutrient deficiencies caused by a reduction in micronutrient absorption;
- A lack of access to nutritious and safe livestock products; and
- Exposure to a range of illnesses and health challenges including zoonotic diseases,

food-borne illnesses, increased health budgets due to illness, reduced nutritional quality of animal source foods, anti-microbial resistance, allergenic reactions, carcinogenic diseases, impaired cognitive development, congenital anomalies, damage to the immune and reproductive systems, kidney and liver failure, and death.

How does the production and use of unsafe animal feeds affect the environment?

Unsafe human food (such as that which is expired, mouldy or rotten) should not be converted to livestock feed but should be disposed of safely and appropriately. Animal waste should also be disposed of appropriately – such as by decomposing into manure and producing biogas - to avoid environmental contamination. There are multiple ways in which the production and use of unsafe animal feeds affect the environment including:

- Poisoning the environment (air, soil, water);
- Polluting the air through greenhouse gases emission;
- Harming the environment through the inappropriate use of pesticides and fertilizers in the production of feeds;
- Poisoning livestock and subsequently affecting human health;
- Exposing consumers to poor-quality food of animal origin;
- Introducing toxic chemicals into the soil, water and air through the inappropriate disposal of unsafe animal feeds; and
- Making animals sick. Animals that are unwell use more energy than healthy animals, which leads to the excessive production of harmful gases that are released to the environment.

How do unsafe livestock feeds affect farm income (economy)?

Safe feeds ensure good livestock health and the production of high-value livestock products, which enable the generation of greater revenues for the livestock farmers. Unsafe feeds can affect the economy at micro (household) and macro (national) levels.

At the micro level, unsafe feeds have the following effects on economic livelihoods:

- Reduced income from sales of animal and animal products;
- Increased treatment costs for animals and humans;
- Increased cost of cleaning the environment;

- Increased cost of destroying unsafe feed;
- Job losses that come from loss of animals;
- Loss of reputation which affects the farmer's ability to conduct business as at previous levels.

At the macro level, unsafe feeds have the following effects:

Loss of trade which lowers country revenues. The reduced revenues limit national development as there is a lack of money for schools, healthcare and infrastructure;

- There is loss of human labour and resources due to illness;
- Production of unsafe animal products which can result in human diseases and high treatment costs; and
- Economic losses due to the rejection of unsafe animal products by government regulatory agencies and consumers.

It is therefore worthwhile to avoid feeding livestock with suspected unsafe feeds, and to report any suspected unsafe feed to relevant government offices. Relevant government offices can also offer guidance on the appropriate disposal of unsafe feed.



Chapter **EIGHT**

VALUE PROPOSITION

8.1_ VALUE PROPOSITION

Value proposition refers to why a customer would choose a particular product or service. The term communicates the unique selling point of the product that the customers receive.

The value proposition from **safe feeds** can be framed as follows;

- Poor quality and unsafe feeds could lead to livestock diseases, low production, low income, loss of animal, loss of human life and degradation of environment.
- Investing in safe and quality feeds would lead to availability of affordable quality feeds that guarantees increased productivity, leading to increased job opportunities and income. This consequently leads to improved livelihood of communities, improved animal and human health as well as economic growth for the country.
- Safe feeds lead to production of safe livestock products which are acceptable to the market and fetch better prices.
- Safe feeds help mitigate potential risks associated with feed borne diseases, contaminants or nutritional imbalances ensuring their well-being and reducing the likelihood of diseases or deficiencies.
- Safe feeds will prioritize animal nutritional needs that promotes optimal growth, development and overall health.
- Safe livestock feeds adhere to relevant regulations therefore ensuring regulatory compliance.
- Sustainable feed formulations focus on reducing the environmental footprint to minimize green gas emissions.

APPENDICES

ANNEX 1 - LIVESTOCK FEEDS NUTRIENT CONTENT

NUTRITION PROFILE

Forages- pasture/fodder (Hay/silage)

- Harvest at 25% level flowering to attain maximum nutritive value with crude protein (CP) between 6 – 15%;
- Energy between 5 – 11 megajoules (MJ)/kilogrammes (KG) of dry matter;
- Neutral detergent fibre (NDF) at less than 40%;
- Dry matter at 40%;
- Bale to reduce deterioration through decomposition, infestation by rodents, and amount of storage space used.

Note: increased animal productivity will only be achieved on condition that CP is not less than 8%, ME is not less than 7MJ/Kg of dry matter, and NDF not more than 40%.

Black Soldier Fly (BSF)

- Harvest 2 weeks before pupa stage when the nutritional value is highest
- CP at 42 to 56 percent, fat at approximately 35%;
- Wash with adequate clean water;
- Dry the larvae to the recommended moisture content (25 – 30 % of the fresh weight) to reduce the fat content to 30 to 40%;
- Properly store the larvae to ensure minimal loss in quality and keep records to ensure use before expiry.

Soybeans

- Harvest when dry (up to 14 percent moisture content) to attain maximum nutritive value (CP between 33 – 37%);
- Energy between 17 - 20 MJ/Kg of dry matter
- Fiber NDF at less than 6 – 7 percent;
- Dry the beans to bring the moisture content to below 14%

Compounded feeds e.g., brans, meals, cakes, cubes, and creep feeds

- Ruminants (dairy cattle - complete) – ME min.11.5MJ/Kg of dry matter, CP 16%, Fat max 8% Fibre 12, moisture max 13, Cal 1.2%, P 0.6 – 0.7%.
- Beef cattle ME min. 10.5MJ/kg of dry matter, CP min.14%, Fat max 8% Fibre 12, moisture max 13, Cal 0.8 - 1%, P 0.6 – 0.7%

(KS EAS 75-2019)

- Non-Ruminants, supplementary feeding (poultry – indigenous also referred to as kienyeji) ME 2400kCal/kg of dry matter, CP min 13%, Fat max 8% Fibre max 8, moisture max 13, C min. 0.8%, P 0.2 % Ash max 12. (KS EAS 90 – 2019) and (KS 2957 – 2022).