Ethiopian ATI
Agricultural Transformation Institute
የኢትዮጵያ ግብርና ትራንስፎርሜሽን ኢንስቲትዩት

LIVESTOCK RATION FORMULATION AND MARKETING BUSINESS

TRAINING COURSE FOR YOUTH AGRI-ENTREPRENEURS

Ethiopian Agricultural Transformation Institute

ADDIS ABABA, ETHIOPIA
2025

Ethiopian ATI
Agricultural Transformation Institute
የኢትዮጵያ ግብርና ትራንስፎርሜሽን ኢንስቲትዩት

Table of Content

OVERVIEW OF THE MODULE

The major bottleneck to improved livestock productivity in Ethiopia is feed availability both quantitatively and qualitatively. Commercially produced roughage and concentrate feeds are either absent and/or expensive. Moreover, existing knowledge and skill on their utilization is very little or can be said non-existent. On the other hand, there are enormous feed resources that are very cheap but traditionally used to formulate and supplement part of a livestock ration in rural peri and urban settings.

These feeds include byproducts from cereal and pulse screenings, root crops, and crop and alcoholic fermentation byproducts. These feeds are not properly fed to the animals, as farmers do not have the knowledge and skill to formulate or balance the feeds based on the biological and economic responses of the animals for certain levels of production. Moreover, organized youths, farmers, and private investors in the feed sector can produce and sell them to producers and other actors in the feed value chain as a source of income. Conscious of these facts, an attempt was made in this training module to produce least-cost livestock compound feeds, primarily from locally available abundant feed resources.

The training module is structured to provide sufficient knowledge and skills on how best the trainees can produce the least cost livestock compound feed mixtures, along with the inputs and detailed methodologies, technical and record keeping skills required to produce the feeds. The training will be delivered using lectures, practical exercises, pictorial presentations, videos and demonstrations. The total time allotted to complete this training module is 2 days (1 day for theoretical and 1 day for practical). Each section in this training module has its own overview of the section, learning outcomes, time required and learning questions, post assessment questions and key messages. This training module also incorporates the marketing and feasibility study, the potential risks and mitigation strategies that may arise during implementation of the business.

The Agriculture-focused Dignified Employment for Youth (ADEY) program is implemented by the Ethiopian Agricultural Transformation Institute in partnership with the Mastercard Foundation to enable 611,343 inclusive and dignified work opportunities for young women and men and support youth entrepreneurship, employability, and sustainable livelihoods in the agribusiness sector.

INTRODUCTION

Concentrates are feed ingredients that can be used as individual feed ingredients purely meant to strategically address nutrient deficiencies not supplied by the roughage diets, and/or they can be of compounded feed mixtures balanced in a most cost-effective way to address more than one nutrient deficiencies in the roughage feeds. In rural, peri-urban, and urban dairy settings where dairying business is the predominant form of livelihood, several types of conventional and non-conventional feed ingredients are often traditionally put to use for formulating supplemental concentrate feeds for livestock as such without being balanced for specific nutrient requirements of the animals.

This has led to poor productive and reproductive performance of dairy cattle in particular and resulted in subsistent dairy farms operating at low farm incomes. As a result, it is evident that there is opportunity for considerable improvement of these farms with the application of existing knowledge and technology that lead to least cost formulation and production of supplemental livestock concentrate diets. Jobless, but youths residing in rural, peri-urban, and urban dairy settings can be mobilized and organized to receive tailored trainings to alleviate the problem with the availability, supply, and utilization of supplemental livestock feeds produced at a macro level to meet local demands, at least at the initial stages of their business operations.

This module is thus prepared with the ultimate goal of harnessing organized youths from rural settings with proper knowledge and skill for manufacturing of least-cost concentrate diets, primarily from locally available supplemental feed ingredients.

Training Methodology

Training approach: The training will be delivered using lectures, practical exercises, pictorial presentations, videos and demonstrations.

Training materials: Marker, white board, notebook, pen, flipcharts, laptop, LCD

Total time required: 2 days

Target participants: The target groups for this training module are youths with minimum educational background of 8th class.

Ethiopian ATI
Agricultural Transformation Institute
የኢትዮጵያ ግብርና ትራንስፎርሜሽን ኢንስቲትዩት

SECTION 1. IDENTIFICATION AND TAPPING OF COMMONLY AVAILABLE CONCENTRATE FEED INGREDIENTS

Overview of the section

Ecological factors are one factors that determine the productivity and production of potato. These includes altitude, soil factors (such as pH and draining, fertility), temperature, relative humidity, rainfall etc. Hence, this section is intended to describe the ecological requirement of potato that will maximize the production and productivity of the crop.

Learning outcome

At the end of this section the trainees are expected to:

1. Identify and tap alternative but cheaply available local supplemental feed ingredients used for manufacturing of least-cost concentrate diets.

Duration: 1 hours

Learning question

1. What are the ingredients that can be categorized as source of energy concentrate?
2. Mention some of the ingredients that can be categorized as protein, mineral and vitamin source for ration formulation?

1.1 CONCENTRATES

As the name implies, these feeds have concentrated/ high nutritional value. The type of manufactured and locally available concentrate feeds would need to be normally divided into two groups, those that are high in energy and those that are high in protein.

1.1.1 ENERGY CONCENTRATES

Trainees are acquainted as to how they best identify and tap local and manufactured concentrate feeds ingredients that typically contain less than 25% ADF (These feeds contain significant levels of well digested storage carbohydrates (i.e. starch and/or sugars).

Grains: These includes maize, sorghum, wheat, barley and oat grains often fed to livestock as a source of energy. Grains should never consist 40% of the diet DM to avoid acidosis. Trainees are acquainted to identify and tap commonly used local cereal grain types for livestock.

Root and tuber crops: Roots and tubers contain large amounts of sugar and/or starch. As a result, while they are low in DM (15-20%), their energy content in dry matter approaches that of maize grain. Protein, on the other hand, is rather low (6-8% of DM). Examples include fodder beets and potatoes. They can be chopped and fed fresh, but they have also been ensiled with other drier feeds.

By-products: The processing of grains and other agricultural materials results in a wide variety of by-products.

- Some contain decent levels of energy (~ 1.00 NE Mcal /kg DM or more).
- Most are high in fiber but, unlike forages, this fiber is low in lignin and very digestible.
- Protein levels for feeds in this group are 20% or less.
- Mineral content is highly variable but grain by-products tend to be low in calcium and high in phosphorous.
- Examples of by-product feeds trainees are expected to know in Ethiopia are wheat middling, wheat bran, rice bran, grain screenings, bakery by-product etc.

Molasses: The liquids typically used in animal feeds are also by-products but due to their unique physical form and nutritional characteristics, they are usually discussed separately. Typical example in Ethiopia is molasses.

- Molasses from the sugar processing industry is extensively used in dairy cattle feeding.
- It is a major component of liquid and lick block supplements and it is also added directly to livestock diets.
- Molasses is highly palatable, reduces dust and contributes significant amounts of energy to the diet (NE 1.10 Mcal /kg DM).
- It is 15-25% water, low in protein (6-8% of DM), contains some calcium, little phosphorous but significant potassium.
- Molasses is usually fed for dairy cattle at 10% of diet DM or less, although in some locations higher levels have been successfully fed. High levels can cause scours and acidosis.

COMPONENTS	WHEAT BRAN	WHEAT MIDDLING	RICE BRAN
Dry matter (%)	91.20	89.67	93.62
OM (% DM)	95.75	95.12	80.15
Crude protein (% DM)	16.16	15.75	7.29
Neutral detergent fiber (% DM)	44.84	43.44	53.47
Acid Detergent Fiber (% DM)	12.67	24.19	36.60
IVDMD (% DM)	71.41	61.63	45.24
ME (MJ/kg DM)	10.57	9.38	6.58
Calcium (g/kg DM)	1.44	1.10	1.33
Phosphorus (g/kg DM)	10.26	7.72	5.85

Table 1. Chemical composition and in-vitro digestibility of commonly used energy diets Source: https://feedsdatabase.ilri.org/

1.1.2 PROTEIN CONCENTRATES

Feeds included in this group contain more than 20% protein in dry matter basis. Most protein sources come from either plant or animal origin (Need to mention here). Common protein feeds include:

Oilseeds cakes. As the name implies, oilseeds are grown and processed for their oil. The oil is removed, and the remainder is available for feeding to livestock.

- Protein ranges from 25 to 46% of DM, although this is somewhat dependent on the extent to which the high fiber fractions (hulls) of the seed are separated out.
- Oilseed cakes contain moderate amounts of calcium and high levels of phosphorous.
- They also contain significant energy (NE 1.00 Mcal / kg DM or more).
- Examples of oilseed cakes the trainees should know include noug, sesame, cottonseed, peanut, linseed, sunflower and rape. The trainers should take care the antinutritional factors present in some of the ingredients for example Cottonseed cake can contain the pigment gossypol which is toxic at high levels.

COMPONENTS	TYPE OF OIL SEED CAKES		
	Noug seed cake	Linseed cake	Cottonseed cake
DM (%)	93.24	92.69	92.93
Dry matter (%)	90.08	91.86	94.38
OM (% DM)	31.94	30.61	26.43
Crude protein (% DM)	36.13	28.08	43.65
Neutral detergent fiber (% DM)	31.24	21.65	39.05
Acid Detergent Fiber (% DM)	11.1	10.31	5.08
IVDMD (% DM)	59.06	67.43	65.35
ME (MJ/kg DM)	7.34	9.16	8.57

Table 2. Chemical composition and nutritive value of major oil seed cakes used as protein sources: https://feedsdatabase.ilri.org/

Agro-industrial by-products: There are numerous by-products resulting from processing of agricultural materials that are high in protein (greater than 20%).

- Protein can range from 20 to 48%.
- Energy is generally high (NE 1.00 Mcal /kg DM or more).
- They contain low to moderate amounts of calcium and typically high levels of phosphorous.
- Examples include tella and areke atela, brewers' grains and distillers grains made from maize, sorghum or other cereal grains.

PARAMETERS	BREWERY DRIED GRAIN	AREKE ATELA	TELA ATELA
DM (%)	95.6	96.7	95.4
Ash (%)	4.3	2.5	4.7
CP (%)	23.9	18.2	21.2
NDF	63.4	54.2	55.8
ADF	29.3	22.0	22.2
Lignin	7.6	7.8	7.8
IVOMD	58.5	67.4	61.4
ME (MJ/kg DM)	8.8	10.1	9.2
Phosphorus (g/kg DM)	10.26	7.72	5.85

Table 3. Chemical composition and nutritive value of brewery residues
Source: Fekede, 2015

1.1.3 MINERAL SOURCES

Most mineral sources are imported despite there are some on-going efforts to produce them locally (example: Ethio. feeds at Adama, and caltec at Holetta). Common minerals for dairy cattle include:

- Calcium carbonate (39% Ca) and limestone (34% Ca);
- Di-calcium phosphate (19% P and, 22% Ca). Other sources include e.g. bone meal and rock phosphate.
- Sodium: Needless to say, common salt (sodium chloride) is the most widely supplemented mineral source. This is because sodium is probably the mineral most likely to be deficient in dairy cattle diets and because salt is typically very inexpensive. Other sources of sodium are used in some circumstances. For example, “Bole” lake soil is about 10% sodium and used in parts of Ethiopia as a supplemental mineral source.
- Trace minerals. Examples of common trace mineral sources include e.g. copper sulphate, zinc sulphate, cobalt carbonate, EDDI (organic iodine), manganous sulphate and sodium selenate.
- Mineral block lick containing major macro and micro mineral elements for dairy cattle are currently produced and available in Ethiopia.

1.1.4 VITAMINS

- Most feeds contain some vitamins, but amounts are highly variable.
- Vitamin K and the water-soluble B vitamins are produced by microorganisms in the rumen and supplementation is rarely necessary.
- Fresh forages are generally high in fat soluble vitamins such as A, D, E (green color is an indicator of better vitamin content).
- Feeding vitamin E can be beneficial in maintaining health in stressful conditions.
- Unlike minerals, vitamins are organic compounds that can deteriorate over time with direct exposure to minerals, moisture and heat, so storage conditions are important.
- Common supplemental vitamin sources include e.g. vitamin A acetate (vitamin A), α-Tocopheryl acetate (vitamin E), Thiamine hydrochloride, etc.

Post assessment questions

A. Explain the two major groups of concentrates?
B. Can you identify major feed ingredients used as energy, protein, mineral and vitamin sources?
C. List some of the by-product feeds that can serve as source of energy concentrate?

Key message

Identification and/or ensuring local availability of major feed ingredients with season and price is mandatory before rushing on the actual process of the ration formulation.

Ethiopian ATI
Agricultural Transformation Institute
የኢትዮጵያ ግብርና ትራንስፎርሜሽን ኢንስቲትዩት

SECTION 2. HOW TO FORMULATE A CONCENTRATE MIX

Overview of the section

This section provides the basic knowledge and understanding on how to formulate a concentrate mix, the general points to be consider before starting the ration formulation and the different methods of ration formulation.

Learning outcome

At the end of this section participants of this training should know:-

1. Understand the general points to be consider before starting the ration formulation.
2. Run independently the procedures of least-cost ration formulations.

Duration: 1 hours

(2 hours for theory and 2 hours for practical)

Learning question

1. What are the major points to consider before starting ration formulation?
2. What are the steps to follow in Pearson square method of ration formulation when only two feeds are involved?
3. To would be more practical, if you could also add a scenario when more than three feeds/ or nutrients are involved?

2.1 GENERAL CONSIDERATIONS

I. Prepare a list of the requirements of all nutrients to be considered under the given circumstances and target animals.
II. Determine the feeds that are available for the formulation and consult available information on their use.
III. Prepare a listing of the nutrient composition of the feeds to be used. Consulting several sources may be necessary to cover all nutrients and feeds that may be of interest.
IV. Obtain feed costs at the site of mixing.
V. Limitations of inclusion for each ingredient and livestock species
VI. Proceed to balance the ration using the guides for the nutrient requirement of the animal (age, physiological condition etc.) in question.

2.2 NUTRIENT REQUIREMENT FOR DIFFERENT TYPES AND CATEGORIES OF LIVESTOCK

Nutrient requirements of animals depend on their physiological state and function and contain allowances for maintenance and production. The larger the animal, the more feed it needs to maintain its body function. As production increases, so does nutrient demand and feed requirement. Nutrient requirements for different classes and categories of animal in the tropics are presented based on Kearl (1982) (attached in the annex).

2.3 METHODS OF RATION FORMULATION

There are many methods of formulating rations useful for various situations. The result of using any of the methods is a ration that provides the desired allowance of nutrients in correct proportions economically. An illustration of the Pearson square method follows.

2.3.1 SCENARIO 1: WHEN ONLY TWO FEEDS ARE INVOLVED

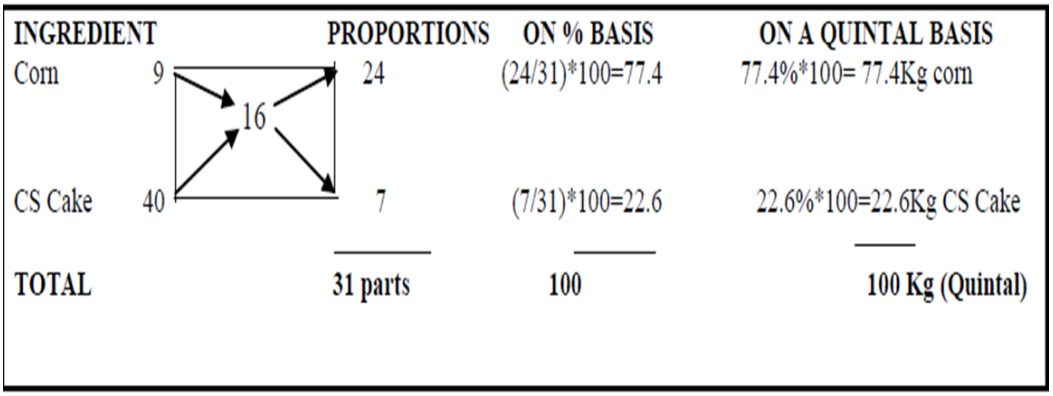
Sometimes it might be necessary to determine what combination of feeds will give a mixture with the desired content of a particular nutrient.

Example: A dairy producer wants to formulate a concentrate supplement that provides 16% Crude protein. He has a corn (9% CP) and Cottonseed cake

(40% CP). What combination of the corn and cottonseed cake will provide a mix of 16% CP the producer wants?

Solution

A. Draw a square at the left side of the page;
B. Insert the % CP desired in the final mixture (16) in the middle of the square;
C. Place corn with its percent CP (9) on the upper left corner and the cottonseed cake with its CP (40) on the lower left corner.
D. Subtract the % CP desired (16) from the % CP in corn (9) and place the difference (7) without the negative sign at the corner of the square diagonally opposite the corn (on the lower right side of the square);
E. Subtract the % CP desired in the final mix (16) from the % CP in the cottonseed cake (40) and place the difference (24) at the corner of the square diagonally opposite from the groundnut cake (at the upper right corner of the square). The above remainders represent proportions of the two feeds that will provide a mix containing the desired % CP.
F. The amounts can then be converted to a percentage basis and then to any other weight basis (e.g. quintal / ton) as desired for mixing purposes. Thus, mixing 77.4% corn (9% CP) and 22.6% Cottonseed cake (40% CP) will provide a mix of 16% CP.



2.3.2 SCENARIO 2: WHEN THREE OR MORE FEEDS ARE INVOLVED

It is common practice to use more than just two feeds in formulating a feed mixture to attain a specific nutrient level.

Example: What combination of corn (10% CP), Wheat bran (13% CP) and cottonseed Meal (CSM 40% CP) will provide a mix of 16% CP?

Solution

Construct the Pearson Square and do the following:
A. Categorize the feeds into two groups since the square can handle only two categories at a time;
B. Specify the proportion of each feed in each group;
C. Calculate the weighted average % protein in each group.
D. For this example, let us assume that corn and wheat bran are grouped together in the proportion of 2:1 with cottonseed meal being used alone. The weighted average % CP in the corn/bran must then be calculated as follows:

*2 parts corn contributes 2*10(%CP) = 20*
*1part wheat bran contributes 1*13 (%CP) = 13*
TOTAL 33

A mixture of 2 parts corn and 1part bran (total of 3 parts) will, therefore, contain 33/3 = 11% CP. This %CP will be used for the "2 parts corn + 1part bran" designated as CB (corn + bran) to occupy one corner of the square and the cottonseed meal the other corner. Proceed with the calculations as in the previous example.

Divide the final figure for "corn + bran" into 2/3 corn and 1/3 bran (the proportion of each feed in each group must always be indicated initially and complied with in the final mixture)

INGREDIENT	PROPORTIONS	ON % BASIS	ON A TON BASIS
CB 11 → 16 ← CSM 40	CB 24	(24/29)*100=82.76	82.76%*1000=827.6Kg CB
	CSM 5	5/29*100=17.24%	17.24%*1000=172.4Kg CSM
TOTAL	**29 parts**	**100**	**1000**

Ration composition will, therefore, be as follows:
*Corn (2/3*82.76) = 55.17%*
*Wheat bran (1/3*82.76) = 27.59%*
Cotton seed meal = 17.24%
TOTAL 100.0%

2.3.3 SCENARIO 3: WHEN DEFINITE AMOUNTS OF TWO NUTRIENTS ARE REQUIRED

Under normal circumstances, rations are formulated to meet animal requirements for many nutrients at the same time. A modification of the Pearson's Square Method known as the "Double Pearson's Square" method can be used to formulate a ration mixture that has exact amounts of two nutrients. Consideration of more than two nutrients using this method becomes too complicated. The use of the Double Pearson Square method to formulate a ration that meets two nutrients is demonstrated by the following example.

EXAMPLE: Suppose we want to formulate a mix with 16% CP and 2.8 Megacalories/Kg (Mcal/Kg) Metabolizable Energy (ME) by using the following feeds:

A. Corn- 9% CP and 3.4 Mcal/Kg ME;
B. Cottonseed meal-42% CP and 2.86 Mcal/Kg ME;
C. Alfalfa hay- 18% CP and 2.49 Mcal/Kg ME

Solution

To solve this problem, one has to go through two squares and get a mix exact for one of the nutrients. Any one of the nutrients can be taken first. Let us take CP. The first step is to formulate two different mixes- one having exactly 16% CP and ME greater than the desired (>2.8Mcal/Kg); and another mix with 16% CP and ME less than the desired level (<2.8 Mcal/Kg ME). At least three feedstuffs are needed to do this.

INGREDIENT	PROPORTIONS	ON % BASIS	CALCULATE ME
Corn 9 → 16 ← Cotton SM 42	Corn 26	(26/33)*100=78.7%	78.7%*3.4=2.68
	Cotton SM 7	7/33*100=21.3%	21.3%*2.86=0.61
TOTAL	**33 parts**	**100**	**3.29**

Step 1. Mix 1 (16% CP; >2.8 Mcal/kg ME)

This mix supplies 16% CP and 3.29 Mcal/kg ME
(greater than the desired 2.8 Mcal/Kg ME level)

INGREDIENT	PROPORTIONS	ON % BASIS	COMPUTE ME
Corn 9	2	(2/9)*100=22.2%	22.2%*3.4=0.75
Alfalfa 18	7	7/9*100=77.8%	77.8%*2.49=1.94
TOTAL	9 parts	100	2.69

Step 2. Mix 2 (16% CP; <2.8 Mcal/kg ME)

This Mix supplies 16% CP and 2.69 Mcal/kg ME (less than the desired ME level)

Step 3. Then solve for ME

Mixing the two mixes formulated in steps 1 and 2 above in any proportion will not change the CP composition of the final mix since both contain 16% CP. The nutrient that will vary would be the ME. The last step is, therefore, to find the proportions of the two mixes that should be combined to give 2.8 Mcal / kg ME.

Mix 3 (final mix) 16% CP and 2.8 Mcal / kg ME

INGREDIENT	PARTS	ON % BASIS
Mix 1 81.7	11.0	(11.0\90)*100=18.3%
Mix 2 18.3	7.0	7.0\9.0*100=81.7%
TOTAL	18.0 parts	100

Step 4. Calculate ingredient composition in final mix

Corn:

*-In mix 1, 78.7 (18.3% of mix 1 in mix 3) = (78.7*18.3/100) =14.40*
*-In mix 2, 22.2 (81.7% of mix 2 in mix 3) = (22.2*81.7/100) =18.14*
Total Corn = 14.4+18.14=32.54%

Cotton Seed Meal:

-Only in mix 1, 21.3 (18.3% of mix 1 in mix 3) = (21.3*18.3/100)) =3.90

Alfalfa

-Only in mix 2, 77.8 (81.7% of mix 2 in mix 3) = (77.8*81.7/100) =63.56

Therefore, the ingredient composition of final ration will be:-

Corn 32.54
CSM 3.90
Alfalfa 63.56
Total 100.00

2.4 INPUTS REQUIRED

- Locally available conventional and non-conventional supplemental feed ingredients sourced from own, local markets and nearby feed processing plants
- Grinders, cleaning, sieving machines and feed mixers sourced from local manufacturing industries at Addis and importing private companies.
- Production and storage houses sourced from local construction material suppliers
- Packaging materials can be sourced from local suppliers and,
- Transportation vehicles sourced from local dealers and/or can be rented out

Post assessment questions

1. What are the major factors to be considered in formulating least cost ration?
2. What are the steps to follow in Pearson square method of ration formulation when three feeds are involved?

Learning outcome

At the end of this section participants of this training should know:-

1. Define how best raw feed materials and processed feeds can be stored, packed, transported and marketed without any deteriorations in feeds' quality and safety.

Key message

Understanding the methods of ration formulation is key for effective and least cost ration formulation

Duration: 30 minutes

Learning question

1. What special care need to be taken while storing both raw and processed concentrate diets?
2. What special care needs to be taken while packaging and transporting of both raw and processed concentrate diets?

SECTION 3. STORAGE, PACKAGING AND TRANSPORTATION OF MANUFACTURED CONCENTRATE DIETS

Overview of the section

- This section provides an understanding and basic knowledge about storage, packaging and transportation of raw feed materials and manufactured concentrate diets.

3.1 STORAGE

The storage shed should be constructed in a way it maintains the standard and recommended procedures for keeping the quality and safety of processed animal feeds. Thus, to prevent from rain and sun heat, it is always good to construct a shed that serves as a storage place for both raw materials and manufactured feeds. The shed should prevent

insects and mouse, and allow free movement of air, goods and people. Depending upon the annual and/ or quarterly amount of feed processed a storage space has been suggested below.

- To store a quintal of processed feed there requires having a space equivalent to 0.2 m3
- To store a quintal of oilseed cakes there requires to have a space equivalent to 0.17 m3
- To store a quintal of flour by-products there requires to have a space equivalent to 0.5 m3

3.1.1 LOSSES AND DETERIORATIVE CHANGES WHICH OCCUR DURING FEED STORAGE

- Physical loss upon storage: this is loss due to scavenging animals like rats and mices. Higher temperature in stored feeds can raise fire.
- Water and heat damage: High moisture and relative humidity can lead to fungal growth and,
- Insect damage: Moths, weevils and beetles can feed on stored feeds.
- Fungal damage: Higher temperature and moisture can favour fungal growth known to produce mycotoxins. Fungal damage can lead to change in the physical form of stored feeds.

It is worthwhile to give due attention to the following points in terms of maintaining proper feed storage and handling.

- Ingredients should be stored for as short a period as possible and compounded feeds used quickly, especially in hot weather conditions.
- Vitamins should not be mixed with minerals before storage due to potential interactions that can reduce their stability and absorption.
- Provide a building for storage which is secure and can be adequately locked.
- Ensure that its roof will protect the feed from rain and that surface water cannot enter the store. Provide it with ventilation points.
- Plan your ingredients purchases carefully so that you do not need to keep too large quantities in stock.
- If possible, raise sacks off the ground by stacking them on wooden pallets.
- Do not allow sacks to rest against the outer walls of the store – leave a space between the sacks and the wall.

3.2 PACKAGING AND TRANSPORTATION

Proper care shall be taken during loading, unloading and transportation of both processed and unprocessed concentrate feeds. These minimizes wastage and deteriorations in feed quality and safety. Maintain hygienic conditions of the transporting vehicle and avoid moisture and contact with grease, dust and other adulterants. With regard to packaging, it should be waterproof and should be able hold a label on feed quality as recommended by the feed regulatory and standard authority, expiry date, and branding issues.

Post assessment questions

1. Explain the special care need to be taken while storing both raw and processed concentrate diets?
2. What are the major losses and deteriorative changes which occur during feed storage?

Key message

Proper storage, packaging and transportation of raw feed materials and manufactured concentrate diets is the key factor for maintaining the quality.

SECTION 4. RECORD KEEPING

Proper record of feed procurement and production should be kept by category of feed to serve as data base for monitoring feed production. Data on the type and quantity of feed, date of purchase, production and expiry dates, initial cost involved on the procurement of raw materials, casual and permanent labour type involved, energy cost of production, selling prices of

manufactured feeds etc would need to be registered.

The levels should be kept in the packaging material. It should preserve non-cost related data such as full information about the date of production, expiry date and major data that indicate the quality of the processed feed as recommended by the feed regulation and standard authority. A sample record-keeping template for manufactured or processed feed may include the following sections:

- Date of Production, Batch Number, Raw Materials Used (including types, quantities, and supplier information), Processing Parameters (temperature, time, machine settings), Quality Control Tests (results of nutrient analysis, microbial tests), Production Outcome (total quantity produced, inventory tracking), Personnel Involved (names and roles of staff), Equipment Used (machine details and maintenance records), Safety Records (incident reports or safety checks), Comments/Notes (any observations during production).

On the other hand, a record keeping sample template for purchased feed items may include the following information:

- Date of purchase, Supplier name (coop, union, farmer's name), Type of raw material, Quantity received, Unit of measure, Batch number, Quality assurance certificate, Storage location, Receiver's name, Expiry date, comments/No

Record keeping sample template on operational cost for manufactured feed may include the following information:

- Date, Batch number, Feed type, Raw material cost, Labor cost, Energy cost, Overhead cost, Total cost, Quantity produced, cost per unit, Comment/Not

Sample template for record keeping of manufactured feeds, purchased feed items and operational costs for manufactured feeds is provided in Annex 11-13.

Time required: 1 hr

SECTION 5. FINANCIAL FEASIBILITY

Overview of financial feasibility

Financial feasibility describes whether agri-business is financially viable. It involves determining initial investment (resource) requirement to start the business, estimating production cost, operation expenses, and sales revenue. These are used to determine the initial investment requirement, profitability of the business, break-even point (minimum level of production) to attain the profit zone, and pay-back period (number of years required to recover initial investment). These series procedures are used to make wise decisions to accept or reject the agribusiness investment alternative.

Learning outcome

At the end of this section participants of this training should know:-

1. How to determine initial investment requirement to start the business
2. How to estimate periodical production costs, operating expenses, and sales revenue of the business
3. How to determine profitability and cash flow of the business
4. How to calculate break-even point (minimum level of production) to recover total cost and generate profit.
5. How to calculate payback period (time requirement to recover initial investment and
6. How to make decision to accept or reject the investment alternative

Duration: 4 hours

Learning question

Do you know how to determine financial feasibility of the given specific agri-business to make wise investment decision?

5.1 INITIAL INVESTMENT

- Initial investment is the minimum capital requirement to start the business.
- Example of initial investment requirement to start seed production business includes tools and equipment, seed storage, land, tractor, working capital, etc

DESCRIPTION	TOTAL COST	REMARK
Tools and equipment		
Grinder		
Cleaning machine		
Sieving machine		
Feed mixer		
Feed ingredients		
Transport vehicle		
Working capital		
Etc		
Total		

Table 4: Template to estimate initial investment requirement for livestock ration formulation agri-business

5.1.1 LONG-TERM INVESTMENT

- Long-term investment in agri-business involves all asset requirement for the business which can serve for more than one year.
- Example tools and equipment, tractor, storage, land, etc

TYPES OF INVESTMENT	UNIT OF MEASUREMENT	QUANTITY	UNIT COST	TOTAL COST

Table 5: Template to calculate total cost for acquisition of long-term investment

5.1.2 WORKING CAPITAL

- Working capital for the planned agri-business includes all payments requirement for day-to-day operating activities such as production costs and operating expenses.

Example

- Production costs include cost of seed, fertilizer, chemical, labor cost etc
- Operating expenses includes administrative salary, sales commission, promotion, etc
- Working capital excludes long term investments such as warehouse, tools and equipment, land, tractor, and etc

A. Production cost

- Production costs are a key component in agri-business.
- It includes all costs associated with production including value addition to make the product ready for sale.

TYPE OF COSTS	UNIT OF MEASUREMENT	QUANTITY	UNIT COST	TOTAL COST
Feed ingredient	kg			
Fuel cost	Litter			
Labor cost	Person			
Packaging	Kg			
Loading and unloading	kg			
Transporting	Kg			
Storage and feed Processing room if rental/month	Month			
Total				

Table 6: Template for estimating production cost

B. Operating expenses

- Operating expenses are all costs not directly associated with production.
- They are common costs incurred for administrative and selling activities.

Example administrative salary, promotion cost, sales commission, transport cost to sale,

TYPES OF COSTS	TOTAL COSTS
Administrative salary	
Utility (electric, water, tele.)	
Interest	
Promotion	
Sales commission	
Tax	
Etc…	

Table 7: Template to estimate operating expenses for agri-business

5.2 ESTIMATED PRODUCTION AND SALE REVENUE

- Production volume is the main source of revenue for the agri-business to generate profit.
- Producers should determine the estimated average production volume from the planned production season.

Formula -1
Tolal production volume = Average production per hectare X Land size

- After determining the estimated volume of production, it is possible to determine the expected sales revenue for the planned production.

Formula -2
Total sales revenue = Tolal production volume X unit selling price

5.3 PROFIT AND LOSS STATEMENT

- The primary objective of any business is to generate profit.
- Profit and loss statement is the main tool to calculate profitability of the business.
- It is used to accept or reject the investment based on estimated profit.

Formula -1
a. Gross profit = Total sales revenue – Cost of goods sold
b. Net profit = Gross profit – Total operating expenses

DESCRIPTION		
Sales Revenue		
Sale of concentrate feed		
Total current asset		
Fixed asset		
Ingredients cost		
packaging cost		
Ending inventory		
Cost of goods sold		
Gross profit		
Operating Expenses		
Salary if any		

Utility (electric, water, tele.)		
Interest		
Promotion		
Depreciation		
Tax if any		
Total operating expense		
Net profit		

Table 8: Template for profit and loss statement preparation

5.4 BALANCE SHEET

- Balance sheet used to know the total resource owned, amount of claim by creditors and amount of owners' equity
- Balance sheet contains asset, liability, and own capital
- Assets are all resources available for use or for sale
- Example cash, inventory, warehouse, land, equipment etc
- Liabilities are all debts obtained from bank, microfinances, individuals or others
- Own equity/capital involves own/member contribution, grant/donation, etc

Formula - 4
Total Asset = Total liability + Total own

DESCRIPTION		
Asset		
Current asset		
Cash		
Inventory		
Total current asset		
Fixed asset		
Tools and equipment		
Warehouse		
Total fixed asset		
Total asset		
Liability and Capital		
Liability		
Bank loan		
Debt from relative		
Total liability		
Owners capital		
Own capital contribution		
Grant/donation		
Total owners' capital		
Total liability and capital		

5.5 CASH FLOW STATEMENT.

Cash flow is all cash inflow and outflow for any purpose in the business operation

- **Example**
- Cash inflows include sale of seed/seedling, debt obtained from banks, members capital contribution, etc
- Cash out flow includes purchase of input, payment for construction, repayment of debt, payment for salary, etc

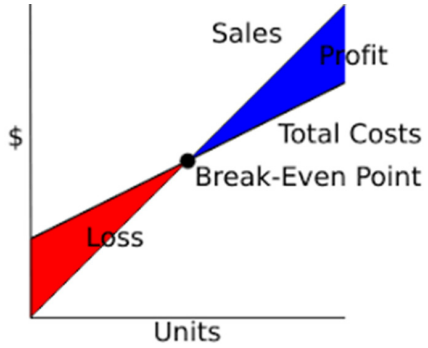
Formula - 5
Beginning cash balance + total cash inflow = ending cash balance

DESCRIPTION	AMOUNT OF OUTFLOW	AMOUNT OF INFLOW
Owners' investment		
Debt		
Grant		
Sales revenue		
Wate house construction cost		
Purchase of equipment		

Purchase of input		
Land rent		
Irrigation cost		
Labor cost		
Cash Operating costs		
Ending cash balance		
TOTAL		

5.6 BREAK EVEN ANALYSIS

- Break even analysis is used to determine the minimum level of production to cover total cost
- At break-even point no profit no loss
- To make profit, level of production and sale should exceed/greater than breakeven point.
- Fixed cost are fixed in total amount regardless of increase/decrease in volume of production.
- **Example:** depreciation, warehouse rent, administrative salary, promotion cost, etc
- Variable costs varied in total in response to increase/decrease in level of production
- **Example:** production costs, packaging cost, loading and unloading, etc



Formula - 6
Break-even point = Fixed cost/(Unit selling price – unit Variable

5.7 PAYBACK PERIOD

- Payback period is used to determine number of years/periods it takes to recover initial investment.

Formula - 7
a. When the annual profit of the business is uniform/equal
Payback period = Initial investment/annual profit
b. When the annual profit fluctuate/vary from year to year
Pay back period = # of year before coverage + uncovered amount/profit of the next year

Payback Period
The amount of tirne it takes to recover the cost of an investment.

Key message

Analyzing financial feasibility of agribusiness enables to pre-determine the applicability of the business in terms of initial investment requirement, profitability, and sustainability.

POTENTIAL RISKS AND MITIGATION MEASURES

POTENTIAL RISKS	MITIGATION MEASURES
Lack of raw material availability and cost	• Studying price trends and identifying seasons when the raw materials are cheap to purchase • Looking for more cheaper alternative feeds that can be used as a substitute for expensive feeds
Marketing problems for manufactured feeds	• Facilitation of marketing conditions including through arrangements of pre-contractual purchase agreements • Reaching out to more local and export market destinations
Problem in availing adequate initial capital	• Facilitation of additional credits from government and micro-finance institutions
Availability and cost for some of the machineries	• Sourcing out the machineries in need from well-organized coops/Unions, private feed industries through renting • Strengthening the production capacities of local manufacturers

ANNEX

NRC 2001

BODY WEIGHT (KG)	PROTEIN (G)	TDN (G)	ME (MJ)
200	233	1900	34.5
250	256	2200	38.7
300	276	2500	42.9
350	299	2800	47.2
400	321	3100	51.4
450	344	3400	55.7
500	366	3700	60.0
550	389	4000	64.2
600	411	4300	68.4

Annex Table 1. Daily maintenance requirement of adult cow

NRC, 2001

% FAT IN THE MILK	PROTEIN (G)	TDN (G)	ME (MJ)
2.5	72	255	4.19
3.0	78	280	4.53
3.5	84	305	4.87
4.0	90	320	5.21
4.5	96	340	5.55
5.0	102	365	5.89
5.5	108	390	6.23
6.0	114	415	6.57
6.5	120	440	6.91
7.0	126	465	7.25

Annex Table 2. Nutrient requirement for milk yield and milk quality per day

ANNEX

NRC 2001

CATEGORY	COWS					HEIFER (AGE IN MONTHS)			
250	Dry	Fresh	Early	Mid	Late	6	12	18	24
MACRO ELEMENTS REQUIRED IN % OF DM									
Calcium (%)	0.44	0.79	0.60	0.61	0.62	0.47	0.41	0.44	0.40
Phosphorus (%)	0.22	0.42	0.38	0.35	0.32	0.25	0.23	0.18	0.23
Magnesium (%)	0.11	0.29	0.21	0.19	0.18	0.11	0.11	0.08	0.14
Chlorine (%)	0.13	0.20	0.29	0.26	0.24	0.11	0.12	0.10	0.16
Sodium (%)	1.10	0.34	0.22	0.23	0.22	0.08	0.07	0.12	0.10
Potassium (%)	0.51	1.24	1.07	1.04	1.07	0.47	0.48	0.46	0.55
Sulfur (%)	0.2	0.2	0.20	0.20	0.20	0.20	0.20	0.20	0.20
MICRO ELEMENTS IN MG PER KG DM									
Iron	13-30								
Cobalt	0.11								
Copper	10-16								
Manganese	14-24								
Zinc	22-70								
Iodine	0.3-0.4								
Selenium	0.30								
Fluorine	Maximum concentration 30 mg/kg dry matter								
Molybdenum	Maximum concentration 6 mg/kg dry matter								
VITAMINS IN IU PER DAY									
Vitamine A	58,000	75,000	75,000	75,000	75,000	16,000	24,000	36,000	60,100
Vitamine D	11,700	21,000	21,000	21,000	21,000	6,000	9,000	13,500	10,000
Vitamine E	1,168	545	545	545	545	160	240	360	1,202

Annex Table 4. Mineral and vitamin requirements of dairy cattle

LIVE WEIGHT (KG)	GAIN (KG/DAY)	DE (MJ/DAY)	DCP (GM/DAY)
150	0.00	41.6	130
	0.25	50.8	250
	0.50	56.3	280
	0.75	60.9	320
200	0.00	52.5	160
	0.25	65.5	300
	0.50	75.6	380
	0.75	83.9	390
300	0.00	72.0	220
	0.25	88.6	250
	0.50	107.9	520
	0.75	119.0	620
350	0.00	88.5	270
	0.25	110.7	380
	0.50	133.7	550
	0.75	149.4	560

Annex Table 5. Digestible Energy (DE) and Digestible Crude Protein (DCP) requirements for the maintenance and growth of heifers at pasture

ANNEX

Source NRC, 1981

LIVE WEIGHT (KG)	ME (MJ/KG DM)		DIGESTIBLE CRUDE PROTEIN	
	Sheep	Goat	Sheep	Goat
10	2.32	3.25	15	30
20	3.91	5.47	26	50
30	5.30	7.42	35	67
40	6.58	9.21	43	83
50	7.78	10.89	51	99
60	8.92	12.49	59	113

Annex Table 6. Daily maintenance requirement estimates for energy and digestible crude protein for sheep and goat

ANNEX

Source NRC, 1981

	NUTRIENTS	BODY WEIGHT IN KG					
		200	250	300	350	400	450
MAINTENANCE REQUIREMENT	NEm (Mcal/d)	4.1	4.48	5.55	6.23	6.89	7.52
	MP (g/day)	202	239	274	307	340	371
	Calcium (g/d)	6	8	9	11	12	14
	Phosphurus (g/d)	5	6	7	8	10	11
NE REQUIREMENT FOR GROWTH (MCAL/DAY)	GROWTH RATE (KG/DAY)						
	0.5	1.27	1.5	1.72	1.93	2.14	2.33
	1.0	2.72	3.21	3.68	4.13	4.57	4.99
	1.5	4.24	5.01	5.74	6.45	7.13	7.79
	2.0	5.81	6.87	7.88	8.84	9.77	10.68
	2.5	7.42	8.74	10.06	11.29	12.48	13.68
MP REQUIREMENT (G/DAY)	GROWTH RATE (KG/DAY)						
	0.5	154	155	158	157	145	133
	1.0	299	300	303	298	272	246
	1.5	441	440	442	432	391	352
	2.0	580	577	577	561	505	451
	2.5	718	721	710	687	616	547
	GROWTH RATE (KG/DAY)						

CA (G/D)	0.5	14	13	12	11	10	9
	1.0	27	25	23	21	19	17
	1.5	39	36	33	30	27	25
	2.0	52	47	43	39	35	32
	2.5	64	59	53	48	43	38
P (G/D)	0.5	6	5	5	4	4	4
	1.0	11	10	9	8	8	7
	1.5	16	15	13	12	11	10
	2.0	21	19	18	16	14	13
	2.5	26	24	22	19	17	15

Annex Table 7. Nutrient requirement of Beef cattle

BODY WEIGHT (KG)	DAILY GAIN (G)	DIT MATTER INTAKE		ENERGY		PROTIEN		CA(G)	P(G)
		KG/DAY	%LIVE W	ME(MCAL)	TDN(KG)	TOTAL(G)	DIGESTINLE(G)		
10	0	0.33	3.3	0.52	0.14	26	12	2.2	1.5
	25	0.36	3.6	0.64	0.18	30	15	2.2	1.5
	50	0.39	3.9	0.76	0.21	35	18	2.3	1.5
	100	0.42	4.2	1	0.28	43	24	2.3	1.6
	150	0.39	3.9	1.24	0.34	49	30	2.4	1.6
15	0	0.45	3	0.71	0.2	36	17	2.7	1.7
	25	0.49	3.3	0.87	0.24	42	21	2.7	1.7
	50	0.53	3.5	1.04	0.29	49	25	2.8	1.8
	100	0.56	3.7	1.37	0.38	58	33	2.9	1.9
	150	0.52	3.5	1.69	0.47	65	41	3	2
20	0	0.55	2.8	0.88	0.24	44	21	3.2	2.1
	25	0.61	3	1.08	0.3	52	26	3.2	2.2
	50	0.66	3.3	1.29	0.36	59	31	3.3	2.3
	100	0.71	3.6	1.69	0.47	72	41	3.4	2.4
	150	0.65	3.3	2.1	0.58	81	50	3.6	2.4
25	0	0.65	2.6	1.04	0.29	53	25	4	2.6
	25	0.72	2.9	1.28	0.36	61	31	4.1	2.7
	50	0.78	3.1	1.52	0.42	70	36	4.1	2.7
	100	0.83	3.3	2	0.55	85	48	4.2	2.8
	150	0.77	3.1	2.48	0.69	96	60	4.3	2.9
30	0	0.75	2.5	1.19	0.33	59	27	4.4	3
	50	0.89	3	1.74	0.48	81	42	4.6	3.1
	100	0.95	3	2.29	0.63	98	55	4.8	3.2
	125	0.94	3.1	2.57	0.72	103	60	4.9	3.3
	140	0.87	2.9	2.73	0.75	106	66	5	3.3

35	0	0.85	2.4	1.34	0.37	68	32	5.6	3.1
	50	0.99	2.8	1.96	0.54	100	47	5.7	3.1
	100	1.07	3.1	2.58	0.71	111	62	5.8	3.2
	125	1.06	3.1	2.89	0.8	117	69	5.9	3.3
	140	0.98	2.8	3.07	0.85	121	74	5.9	3.4

Annex Table 8. Daily Nutrient requirements of Sheep (Ewes and Lambs-Maintenance, Growth, non-lactating and first 15 weeks of gestation) (Kearl, 1982)

MAINTENANCE AND GROWTH									
Body weight (kg)	Daily gain (g)	Dry Matter Intake		Energy		Protein		Ca(g)	P(g)
		Dry Matter Intake	%Live Weight	ME(Mcal)	TDN(KG)	Total(g)	Digested(g)		
30	120	1.15	3.8	2.59	0.72	113	62	5.9	3.2
40	110	1.43	3.6	3.07	0.85	137	74	6.3	3.5
50	100	1.69	3.4	3.48	0.96	159	84	6.8	3.8
60	100	1.94	3.2	3.99	1.1	181	96	7.2	4
70	80	2.18	3.1	4.08	1.13	194	98	7.5	4.3

Annex Table 9. Daily Nutrient requirements of Sheep (Rams) (Kearl, 1982)

Date	Batch Number	Manufactured Feed type	Raw material used	Quantity	Processing parameters	Feed quality results	Production outcome	Personnel used	Equipment used	Comments/ Not
YYY-MM-DD	Batch-001	Grower feed	Corn Soybean meal	1000 kg	Temp: XX0C Time: XXmin	CP: XX% Fat: XX%	950 kg	Kedir Ayele	Mixer, Grinder	Adjusted moisture levels
YYY-MM-DD	Batch-002	Starter feed	Wheat bran, Fish meal	500 kg	Temp: XX0C Time: XXmin	CP: XX% Fat: XX%	490 kg	Lema Chala	Mixer, Grinder	No issues noted during processing

Annex table 10. Sample template for record keeping of manufactured feeds (example)

Date Of purchase	Supplier name (coop, union, farmer's)	Raw material	Quantity received	Unit measurement	Batch number	Quality assurance certificate	Storage location	Received by	Expiry date	Comments/ Not
YYY-MM-DD	Supplier A	Corn	2000	Kg	Batch -001	Yes	Storage bin 1	Alemu	YYY-MM-DD	Check for moisture content
YYY-MM-DD	Supplier B	Soybean meal	1500	Kg	Batch -002	Yes	Storage bin 2	Aster	YYY-MM-DD	Ensure proper sealing
YYY-MM-DD	Supplier C	Wheat bran	1000	Kg	Batch -003	Pending	Storage bin 3	Yohannes	YYY-MM-DD	Follow upon QA certificate

Annex table 11. Sample template for record keeping of purchased feed items (example)

Date Of purchase	Batch Number	Manufactured Feed type	Raw material cost	Labor cost	Energy cost	Overhead cost	Total cost	Quantity produced	Cost /unit	Comments/Not
YYY-MM-DD	Batch-001	Grower feed	500000	200000	5000	80000	785000	950 kg	4.5 birr/kg	Adjusted for labor over time
YYY-MM-DD	Batch-002	Starter feed	380000	150000	35000	50000	583500	490 kg	6.5 birr/kg	Reduced energy usage this batch
YYY-MM-DD	Batch-003	Finisher feeds	290000	170000	1800	65000	461865	780 kg	5.75 birr/kg	Increased production efficiency

Annex table 12. Sample template for record keeping of operational costs for manufactured feeds (example)

Ethiopian ATI

Agricultural Transformation Institute

የኢትዮጵያ ግብርና ትራንስፎርሜሽን ኢንስቲትዩት