Ethiopian ATI
Agricultural Transformation Institute
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UREA-MOLASSES BLOCKS LICKS PRODUCTION BUSINESS

TRAINING MODULE FOR YOUTH AGRI- ENTREPRENEURS

Ethiopian Agricultural Transformation Institute

ADDIS ABABA, ETHIOPIA
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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 sugar industries, cereal and pulse screenings, root crops, and crop and alcoholic fermentation byproducts. These feeds are not properly fed to the animals, as farmers don't 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 urea-molasses block 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 urea molasses-block lick, 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 urea-molasses block lick, 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 the training is 2 days (half day theoretical and 1 and half day 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

Ruminant Livestock in Ethiopia largely depend on fibrous feeds like mature pastures and crop residues. These feeds are deficient in protein, minerals and vitamins and are poorly digestible. Both these characteristics keep intake and productivity low. Supplementation with Urea Molasses Blocks (UMB) can increase digestibility of fibrous feeds by up to 20%, increase the nutrients the animal receives and can increase feed intake by 25 to 30%. If another good quality protein source such as cottonseed cake or noug seed cake is added to the block, the animal will grow faster. Animals also benefit if other feedstuffs such as vitamins, minerals, medicines, etc. are added to the block. Blocks are a convenient way to make and store molasses and urea and also feed to animals.

They can easily be made and used in villages. A person may make and sell blocks to farmers as a source of income. The block can be manufactured for use as emergency diet during recurrent droughts and flooding conditions to save millions of cattle lives. It can also be produced for export markets to countries in the near east and gulf states. Organized jobless youths 80% of whom are female can be trained using this module to produce the blocks for commercial purposes using locally available agro-industrial by-product feeds.

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.

SECTION 1. MANUFACTURING UREA-MOLASSES BLOCK LICK

Overview of the section

This section provides with the basic knowledge and skill on the role of feed ingredients in urea-molasses block manufacturing. It also helps to know step by step procedures on how to make urea molasses block licks (preparation of the components, mixing, casting molds and drying).

Learning objectives

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

- To identify and tape alternative but cheaply available local agricultural and agro-industrial feed by-products used for manufacturing of urea-molasses block licks.
- The trainees are expected to independently manufacture the blocks.

Time required: A total of 5 hour (2 hour for theory and 3 hours for practical) is required.

Learning question

1. What is the role of feed ingredients in urea-molasses block manufacturing?
2. What are the four stages of urea molasses block manufacturing?

1.1 THE ROLE OF FEED INGREDIENTS IN UREA-MOLASSES BLOCK MANUFACTURING

- Molasses is used to induce animals to eat the block due to its sweet taste. Molasses provides energy and some other nutrients and minerals like Sulphur. The block should not contain more than 40 to 50% molasses, or it will break too easily and take too long to dry.
- Urea known to farmers as fertilizer for crop production is used to make the blocks. It is advisable that the amount of urea be limited to 10% to avoid poisoning. Urea is essential in improving digestibility and providing protein in low quality fibrous crop residues based diet.
- Cereal bran is the most common fibrous feed used. The bran provides protein and helps hold the block together. Finely chopped straw, bagasse, or finely ground leaves from leguminous shrubs (leucaena, calliandra, etc.) can substitute for cereal bran.
- Salt in the range of 5 to 10% is added to the blocks to supply minerals and to control the rate of consumption.
- Di-calcium phosphate can be added to provide additional calcium and phosphorus.
- Cement is used to make the block hard. About 10 to 15% is sufficient. Higher levels make the blocks too hard. Cement also provides calcium.
- Clay such as that used in brick making can be mixed with cement to improve block hardness and reduce drying time. It can reduce cost of the block.
- Other ingredients can be added to provide additional nutrients. Dried poultry litter, oilseed cakes or brewery by-products can be added to supply protein.
- Trace mineralized salt can be used to provide additional minerals that may be lacking. Use of trace mineralized salt is recommended in the Rift Valley area.
- Alternative ratios of combining the ingredients to constitute various formulations of blocks are shown in Table 1.

INGREDIENTS	ALTERNATIVE FORMULAE						
	A	B	C	D	E	F	G
Wheat bran	25	25	23	25	35	22	35
Molasses	37	37	40	48	39	50	20
Urea	10	10	10	10	10	9	7.5
Table Salt	3	3	4	5	5	5	7.5
Lime		5		5	6	5	5
Cement	10	5	10	5	5	9	5
Triple phosphate				2			
Di-Calcium phosphate			3				
Oil seedcakes	15	15	10				
Clay soil							20
Total	100	100	100	100	100	100	100

1.2 HOW TO MAKE UREA-MOLASSES BLOCK LICKS

Urea Molasses blocks can be manufactured on the farm. Manufacture is easy and simple and different processes exist which may be used according to local conditions. The manufacturing can be divided into four stages:

- Preparation of the components
- Weighing and mixing
- Casting and Molding
- Drying

1.2.1 PREPARATION OF THE COMPONENTS

The amount of the different ingredients depends on the size of the block to be manufactured and the formula to be used. Table 2 shows the amount of ingredients to be mixed to make 1, 5, 15 or 25 kilo grams of block based on formula alternative "A" in Table 1.

INGREDIENTS	%	SIZE OF BLOCK TO BE MADE			
		1KG	5 KG	15 KG	2 KG
Molasses	37	370 gram	1.85 kg	5.55 kg	9.25 kg
Urea	10	100 gram	0.50 kg	1.50 kg	2.50 kg
Wheat bran	25	250 gram	1.25 kg	3.75 kg	6.25 kg
Cement	10	100 gram	0.50 kg	1.50 kg	2.50 kg
Oil seedcakes	15	150 gram	0.75 kg	2.25 kg	3.75 kg
Table salt	3	30 gram	0.15 kg	0.45 kg	0.75 kg
TOTAL	100	1 KG	5 KG	15 KG	25 KG
WATER (TO DISSOLVE THE CEMENT)		40 GRAM	0.20 KG	0.60 KG	1 KG

Table 2. Amounts of ingredients to mix to make different sizes of UMB

1.2.2 WEIGHING AND MIXING

Good mixing is a key for good block making. Urea must be mixed thoroughly by breaking up lumps to avoid pockets of high concentration that could harm animals. Do the following to mix the ingredients:

- Weigh the amount of ingredients based on the formula of the block
- Add urea to the molasses while continuously mixing

1. The urea is mixed with molasses and thoroughly stirred for about 20 minutes.
2. The molasses can be heated in the sun to improve handling and mixing.
3. Never add water to molasses. It has to be tick

- Add bran and any other fibrous material like noug cake, if it is part of the formula, and mix thoroughly.
- Make the cement into a paste with water prior to adding to the rest of the ingredients
- Mixing the salt with cement accelerates hardening.

High levels of molasses and urea tend to decrease block hardness. Check block hardness after drying and make the following adjustments to the formula used if necessary. If the block is too hard, reduce the proportion of cement or clay and slightly increase the proportion of molasses. If too soft, increase cement or clay and reduce molasses.



Figure 1. Procedures to be followed how to mix urea, molasses and wheat bran (ESGPIP,2007)

1.2.3 CASTING AND MOLDING

Once the ingredients are thoroughly mixed, place the mixture into molds. Any local container, such as tin cans or small buckets can be used as a mold. Using a plastic sheet to line the molds will make block removal from the mold easier.



Figure 2. Different types of molds




The mold *Step1, Filling The Mold* *Step2, Compacting* *Step3, Opening the Mold*


Removing The Block The Mold *UMB Ready For Drying*

Figure 3. Process to be followed in the production of UMB (ESGPIP,2007)

1.2.4 DRYING

Remove the blocks from the molds after 24 hours and place on racks to dry under shed. Leave the blocks to dry for at least 5 days depending upon the weather condition.

1.3 INPUTS REQUIRED AND MATERIALS USED

Locally available agricultural and agro-industrial by-products (molasses, urea, brans from wheat, rice and maize), oil seed cakes, mineral mixes, salt and binding

agents (sourced from own farm, local markets and feed processing plants).

Urea

Molasses

Wheat bran

Figure 4. Ingredients need for the production of urea-molasses block (UMB)

- Choppers, grinders and mixers, mechanical/ hydraulic press machine (can be sourced from local dealers/manufacturers, import and export companies)
- Production and storage houses (local construction material suppliers)
- Packaging materials (local suppliers/shops) &
- Transportation vehicles (can be obtained from local dealers and/or renting agencies)

Post assessment question

1. *Can you tell the list of local agricultural and agro-industrial by-product feeds used for manufacturing of urea-molasses block licks?*
2. *Enumerate the step wise production of urea-molasses blocks?*

Key message

Knowing the proper ingredients and the steps to follow in urea-molasses block manufacturing is fundamental for quality block production.

SECTION 2. CHARACTERISTICS, STORAGE AND TRANSPORTATION OF UREA-MOLASSES BLOCKS

Overview of the section

This section provides the basic knowledge and skill for the trainers on how to know the characteristics of good quality urea-molasses block and the conditions to be considered during storage and transportation of urea-molasses blocks.

Learning objectives

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

- To respond to a question how best they can store, package and transport manufactured blocks without being subjected to feed quality and safety deteriorations.

Time required: 30 minutes is required to cover this section

Learning question

- What are the characteristics of a good quality urea-molasses block?
- What care must be given during storage and transportation of urea-molasses blocks?

2.1 CHARACTERISTICS OF A GOOD QUALITY UREA-MOLASSES BLOCK

A block is considered to be good when it fulfills the following:

- Ingredients are well – distributed throughout the block;
- It does not have lumps of urea and lime;
- It is hard enough not to be squashed between our fingers and should be resistant enough not to break when a person steps on it;
- Our hands should feel the sticky molasses when we hold the block. The amount of molasses needs to be increased the next time we make a block if it doesn't feel sticky.

2.2 STORAGE AND TRANSPORTATION OF UREA-MOLASSES BLOCKS

Hygienic conditions of the block should always be maintained upon storage, packaging and transporting of the manufactured blocks. Hence, blocks shouldn't be exposed to direct sunlight, dust, urine, faecal matters and any other feed contaminants. Sufficiently dried blocks should be rolled with soft plastic packages to retain block hardiness and consistency upon transporting and marketing of the blocks.

2.3 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 structure of stored feeds.

2.4 MAINTAINING PROPER FEED STORAGE AND HANDLING

- Ingredients should be stored for as short a period as possible.
- 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.

Post assessment question

Key message

Maintaining Proper Feed Storage and Handling is necessary and part of the quality block production process.

SECTION 3. 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 purchased, production and expiry dates, initial cost involved on the procurement of raw feed materials, casual and permanent labor type and monthly salary paid, energy cost of production, selling prices of manufactured blocks etc. would need to be registered.

A sample record-keeping template for manufactured or processed feed may include the following information:

- 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/Note

- 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/Note

- 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 4. 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 objectives

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

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

Time required: 4 hours

Learning question

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

4.1 INITIAL INVESTMENT

- Initial investment is the minimum capital requirement to start the business.

Example of initial investment requirement to start urea-molasses block production business includes tools and equipment, casts, cleaning, sieving machines and feed mixers, conventional and non-conventional supplemental feed ingredients, transport vehicle, working capital, etc

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

Table 3: Template to estimate initial investment requirement for urea-molasses block production agri-business

4.1.1 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, vehicle, casts, cleaning, sieving machines and feed mixers, etc

TYPES OF INVESTMENT	UNIT OF MEASUREMENT	QUANTITY	UNIT COST	TOTAL COST

4.1.2 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 conventional and non-conventional feed ingredients, fuel, packaging material, labor cost etc.
- Operating expenses includes administrative salary, sales commission, promotion, etc
- Working capital excludes long term investments such as warehouse, tools and equipment, vehicle, 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 block manufacturing shade if rental/month	Month			
Total				

Table 5: 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, water and electricity charge, etc

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

Table 6: Template to estimate operating expenses for agri-business

4.2 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 (ha)

- 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

4.3 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 3
a.Gross profit = Total sales revenue – Cost of goods sold
b.Net profit = Gross profit – Total operating expenses

DESCRIPTION	TOTAL COST	REMARK
Sales Revenue		
Sale of UMB feed		
Total Sales revenue		
Cost of goods sold		
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 7: Template for profit and loss statement preparation

4.4 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 capital

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		

Table 8: Template for balance sheet preparation

4.5 CASH FLOW STATEMENT

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

Example:

- Cash inflows include sale of UMB feed, 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 + total cash out flow

DESCRIPTION	AMOUNT OF OUTFLOW	AMOUNT OF INFLOW
Owners' investment		
Debt		
Grant		
Sale of UMB feed		
Warehouse construction cost		
Purchase of equipment		

Purchase of input		
Block manufacturing shade rent		
Labor cost		
Cash Operating costs		
Ending cash balance		
Total		

Table 9: Template for cash flow statement preparation

4.6 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 cost)

4.7 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

Table 9: Template for cash flow statement preparation

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- Variable costs varied in total in response to increase/decrease in level of production
- Example production costs, packaging cost, loading and unloading, etc

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

Learning question

1. Which of the following is part of working capital
   a.Purchase of packaging material, b.Purchase of vehicle, c. Transportation cost,
   d.Purchase of chemical
2. Which of the following should include in profit/loss statement
3. a.Purchase of tools and equipment, b. Sales revenue, c. Debt, d. Owner investment
4. Which of the following is variable cost
5. a.Purchase of feed ingredients b. Administrative salary c. Depreciation d. Rent of storage

Key message

Potential Risks and Mitigation Strategy

The following are some of the Potential risks and mitigation strategies involved in the livestock feed production and marketing business.

S/N	POTENTIAL RISKS INVOLVED	MITIGATION STRATEGIES
1.	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
2.	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
3.	Problem in availing adequate initial capital	• Facilitation of additional credits from government and micro-finance institutions
4.	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
	GROWTH RATE (KG/DAY)						
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)

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)

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