Stock Feed Making Workshop organized by ZONFA and held at Harare Show grounds

on the 6th of August 2016

Introduction

- Workshop objectives
  - Train participants on how to make their own stock feed
  - Understand the benefits of making pelleted feeds over mash or crumbs
  - Participants should be able to significantly reduce the stock feed expense

Why make your own feeds?

- Up 70% of production cost are feed related
  - Need to reduce cost
  - Increase profit margins
- Most livestock producers have arable land
  - Can produce the feed ingredients
- Limited use of non conventional feed resources
  - Need to reduce competition with conventional feed
- Organic livestock production
  - Requires organically produced feed which might not be available on the market
  - Ned for certification regarding organic production

Moisture (water)

- is an important diluent of the nutrients in feedstuffs.
- It is necessary to know the moisture content of raw materials and compound feeds as a check on their feeding requirements,
- For use in calculating analytical data on a dry matter basis and also because moisture has an important function in determining the form of the diet
- It also has an effect on feed stability and its shelf life.

Feed composition

- **Fats**
  - Fats are the fatty acid esters of glycerol and are the primary means by which animals store energy
  - Sources on the farm include oils seed meals, e.g. SBM, GNM, SFC, RSM

- **Proteins and Amino Acids**
  - Essential role in the structure and functioning of plants and animals.
  - Animals cannot synthesise protein from simple inorganic materials, have to rely on ingesting them through their diet or on their synthesis by gut bacteria.
  - Dietary protein is therefore essential for all animals.
  - The 'optimum' dietary level of protein is that which produces maximum growth.
  - Excessive levels of dietary protein may form an expensive way to supply energy
  - Sources legumes and legume seeds, NPN for ruminants
  - Most expensive ingredient of a complete diet (70/30)
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Feed composition cont’

- **Carbohydrate**
  - usually the cheapest source of energy in foods and feed
  - excess or insufficient dietary energy levels result in reduced growth rates.
  - energy needs for maintenance and movement will be fulfilled before energy is used for growth.
  - if the energy/protein ratio is too low, protein will be used to satisfy energy requirements first; what is left will be available for growth
  - Sources largely cereal grains
- **Minerals**
  - They provide strength and rigidity to bones and the exoskeleton of livestock.
  - In body fluids they are involved mainly with the maintenance of osmotic equilibrium and in the nervous and endocrine systems.
  - They are components of enzymes, blood pigments and other organic compounds.
  - They are essentially involved in the metabolic processes concerned with energy transport.
  - Macro and micro minerals
  - Calcium (Ca), phosphorus (P), potassium (K), sodium (Na), chlorine (Cl), magnesium (Mg) and sulphur (S) -and fifteen trace elements - iron (Fe), zinc (Zn), copper (Cu), manganese (Mn), nickel (Ni), cobalt (Co), molybdenum (Mo), selenium (Se). chromium (Cr), iodine (I), fluorine (F), tin (Sn), silicon (Si), vanadium (Va), and arsenic (As)
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Feed composition cont’

- **Vitamins**
  - Vitamins are complex organic compounds required in trace amounts for normal growth, reproduction, health and general metabolism
  - Vitamins are particularly susceptible to losses in potency caused by heat, rancidity or feed processing.
  - The water soluble vitamins also tend to leach into the aquatic environment.

- **Other components of Feeds**
  - Synthetic substances added for special purposes by the manufacturers, such as hormones, antibiotics, pellet binders, and pigments.

Feed composition cont’

- When compound feeds are formulated for any animal it is necessary to know the composition (analytical characteristics) of each of the raw materials which are to be considered for use
  - CP, DM, Fat, CF, Ca and P
- DM basis desirable because moisture content can be so variable, particularly for cereals

WHAT FEEDS CAN I USE ON MY FARM?

1. Grasses
2. Legumes
3. Miscellaneous fodder plants
   - Largely non conventional feeds – e.g. moringa
4. Fruits and vegetables
   - By-products in this category which are often wasted are those from grapes, tomatoes, the palms, bananas and plantains, mangos, melons, citrus fruits, pineapple, and breadfruit.
5. Root crops
   - Root crops are excellent sources of energy for many classes of livestock, being rich in carbohydrates
   - E.g. potato, cassava, sugar beet molasses, yams, carrots, etc

WHAT FEEDS CAN I USE ON MY FARM? Cont’

1. Cereals
   - Cereals and cereal by-products, despite their high carbohydrate content, form an important component in livestock diets
   - Cereals are often one of the cheapest raw materials that can be included in compound feeds for aquaculture.
   - The brans (wheat or rice) are excellent sources of the B group vitamins.
2. Oil-bearing seeds and oil cakes
   - Many plants are grown specifically for the oil which their seeds or fruits produce, which is utilized for human food and other purposes.
   - Vast quantities of by-products from the vegetable oil industry are produced and these are the staple ingredients of animal feedstuffs, being high in protein and low in carbohydrate.
   - Examples are the leguminous plants soybean and groundnut, together with mustard, rape, sunflower, coconut, kapok, cotton, oil palm, linseed, sesame
   - These are 'cakes' and 'meal'. Normally, if a product is referred to as a 'cake' it means it is an expeller residue. Similarly a 'meal' normally refers to an extracted product.

WHAT FEEDS CAN I USE ON MY FARM? Cont'

1. Feeds of animal origin
   - These ingredients are either from terrestrial, avian or marine animals
   - Animal protein is necessary to balance the amino acid and vitamin deficiencies in cereals and other plant products.
   - E.g. blood meal, feather meal, poultry by-products meal, fish meal, meat meal, raw fish, fish oils, fish silage, shrimp meal and milk by-products
1. Miscellaneous feedstuffs
   - Non convention feed resources

WHAT FEEDS CAN I USE ON MY FARM? Cont’

- Binders
  - Substances used to improve the durability (preserve the physical form of the diet during storage e.g., prevent pellets breaking down into 'fines')
- Antioxidants
  - Usually included in vitamin premixes or added to lipids (especially fish oils) during manufacture,
  - substances capable of preventing or delaying the onset of rancidity.
  - Feed rancidity results in the unpalatibility of feeds and the generation of toxic chemicals.
  - Antioxidants can be naturally occurring substances, such as vitamin E, or synthetic chemicals.
  - The commonly available commercial antioxidants, under a variety of trade names, are BHT (butylated hydroxytoluene), BHA (butylated hydroxyanisole) and ethoxyquin.
- Preservatives
  - Several substances may be added to feeds to control the rate of deterioration, particularly that due to fungal attack.
  - Most are sodium or potassium salts of propionic, benzoic, or sorbic acid.

Advantages of Compound Feeds

- Feed ingredients can be fed singly or in simple or complex mixtures.
- The latter are usually known as compound or compounded feeds.
- They are sometimes fed simply as a meal or mash (mixed ground ingredients), or in some form of dry pellet,
- A single ingredient is most unlikely to supply all the nutrients required by the animal in the balance in which it needs them.
- A single feed ingredient may, for example, be too high in indigestible fibre which may be largely wasted, or in carbohydrate of limited digestibility.
- Conversely, the ingredient may be too high in expensive protein which may be consume
  d to satisfy the energy requirement of the animal rather than for growth

- Suppose we consider four ingredients only - wheat, rice bran, expeller groundnut cake and fish meal.
- It is very unlikely that fish meal would ever be used as a single feedstuff because of its cost - it is used in this example for illustrative purposes only.
- For the purpose the analysis of the four materials is assumed as follows:

Ingredients	Lipid (%)	Protein (%)	Fibre (%)	
Rice bran	49	125	183	
Fishmeal	60	550	24	Ex.
Exp. Groundnuts	11.5	37.7	13.2	
Wheat	1.5	122	27	

- If the dietary requirements of the fish being cultured are assumed as 6% lipid, 23% protein and less than 8% fibre the effect of feeding any of the four ingredients can be demonstrated as follows

Effect of Feeding Single Ingredients

(% of Dietary requirement fulfilled)

Ingredient	Lipid	Protein	Fibre
Rice bran	82	54	229
Fish meal	100	239	30
Exp. Groundnut	192	164	165
Wheat	25	53	34
(Dietary requirement =	6.0	23.0	<8.0)

- It can be seen at once that, none of the ingredients complies with the dietary requirements of the animal.
- Wheat supplies neither enough lipid nor protein, although it does not exceed the maximum fibre level which was set.
- Expeller groundnut supplies too much of all three components when fed alone.

- The fish meal complies with the maximum fibre level imposed but is in gross and wasteful excess in protein level.
- The rice bran is deficient in lipid and protein and very much in excess of the desired fibre content

- One of the ways in which these four ingredients could have been used to achieve greater compliance with the dietary requirements which were set for the animal would have been to have used 20% rice bran, 35% exp. groundnut, 5% fish meal and 40% wheat.
- The result would have been as follows:

Inclusion Level of Ingredient		Contribution to Mixture		
		Lipid (%)	Protein (%)	Fibre (%)
40% wheat		0.60	4.88	1.08
20% rice bran		0.98	2.50	3.66
35% exp. groundnut		4.03	13.20	4.62
5% fish meal		0.30	2.75	0.12
	Total	5.9	23.3	9.5
(Dietary requirement =		6.0	23.0	<8.0)

Physical Form of Diets

- The feed may be dry (about 10% moisture), moist (about 30-45% moisture) or wet (>50% moisture) or an intermediate between these.
- Dry feeds are easier to manufacture on a large scale and easier to store, transport and feed.
- There is evidence however that moist feed may be more palatable and attractive to the animals and can give better results than a dry feed.

Physical Form of Diets cont’

- Dry and moist feeds are usually formed into a definite physical shape - pellets, crumbles, granules, balls, cakes, etc. Dry pellets are normally tubular in shape with a fixed length and diameter.
- Their diameter depends on the size of the orifice through which they are extruded.
- Usually, dry pellets are cut by the pelleting machine into pre-selected lengths.
- The hardness of pellets may be varied by manufacturing technique, choice of ingredients, and the use of binders.
- The particle size of raw materials is also important for it governs the durability and acceptability of the compound feed it is included in.
- Generally, finer particles make better pellets but poor grinding techniques can damage the nutritional quality of the feed.

Advantages of pellet feeds

- 1. Reduce dust
  2. Reduce waste
  3. Require less storage area
  4. Reduce the appearance of hay belly
- Pelleting process requires temperature, moisture and pressing; so pelleted feeds have a special smell and odour
- Pelleted feeds are less influenced by external factors; such as oxidation,moisture etc

CAN I MAKE MY OWN COMPOUND FEEDS? HOW?

- First of all - yes, you can make your own feeds.
- professional advice would be essential in designing the feed manufacturing plant, selecting and installing equipment, and training staff to operate it.

How do I Choose my Ingredients?

- Three major factors govern the choice of ingredients, once you have decided to make your own feeds. These are:

a) Suitability for species being cultured (type and quality)

- Choosing the ingredients to be used in feed manufacture on your farm is firstly a matter of matching the types available locally with the needs of the formulae of feed suitable for the livestock being farmed.
- The first thing to do therefore is to prepare a list of the raw materials available to you.

- Having prepared that list, you must make an assessment of the quality of the ingredients available.
- This means you must carefully define each raw material and allot to it a real or theoretical analytical composition.
- This information is essential before formulation work can be done.

- Real analyses of local ingredients may be available from the suppliers or from surveys conducted by local government departments other livestock production departments or by local universities.
- In the absence of local information, ingredient compositional tables have to be used
- This is less satisfactory than the use of accurate local information but is often necessary.

b) Quantity available locally and regularity of supply

- Choose ingredients which are regularly available in sufficient quantities.
- Some ingredients are only available seasonally. The more regular the supply of each ingredient is, the better.
- you will have to make frequent changes in your feed formulation because of the lack of a specific ingredient which is not available in sufficient quantities to supply your needs.
- So, the message is: choose ingredients which are available in sufficient quantities on a regular basis

c) Cost

- can vary quite markedly from one location to another, depending on supply and demand.
- What may be a very acceptable ingredient in one place may have to be rejected, or used in smaller quantities, in another because it is too expensive.
- Cost obviously interacts with availability and suitability.
- cost per unit at the farm site

How do I Decide How Much of Each Ingredient to Use (Formulation)?

- Each ingredient used should be included because it contributes a particular component necessary in the diet.
- For example, it may be a good source of protein, etc.
- Also the object is to satisfy the dietary requirements of the animal at the cheapest cost.
- This is known as 'least cost formulation'.

- Least cost formulation is best done using a specifically designed computer programme.
- The computer stores all the data gathered about the available raw materials (analyses and cost), together with the specifications of the feeds to be formulated.
- It will then do the necessary calculations and will turn out a least-cost formulation
  - Available here
  - Feed formulation by 'hand' calculation is a tedious and repetitive (but not difficult) process of trial and error

- For formulation, the following information is necessary:

1. A list of available raw materials, together with compositional data and cost information;
2. The specifications of the diet to be made, in terms of levels of protein, moisture, crude fibre, fat/lipids, Ca and P
3. Knowledge of the special suitability of certain individual raw materials for the animal to be fed- ruminants (cattle, sheep goats) VS non ruminants (pig, poultry, fish)

Mixing 2 feed ingredients

- Pearson square
- Remember 2 ingredients do not supply all nutrients
- Used in mixing concentrates and crushed maize grains mainly

Feed Pelleting

- The process of pelleting consists of forcing a soft feed through holes in a metal die plate to form compacted pellets which are then cut to a pre-determined size.
- Most pelleters now have a conditioning unit mounted above them where liquids such as water and molasses can be added to improve pelletability.

- From the conditioner, the feed falls (Figure 12) into the centre of the pelleter itself.
- In the pelleter two or more rollers and feed ploughs push the material through the holes of the die plate
- Usually the die plate itself rotates and, on its outer side, stationary knives cut the pellets to a pre-set length.

- From there, they are transferred to a cooler/drier to remove the heat which is generated during the pelleting process or is often added during steam conditioning.
- The moisture content of the pellets also needs to be reduced for proper storage.
- All makers of pelleting equipment provide instruction in their use and some organize training courses in this and related topics.

What Special Problems Am I Likely To Have In Making Compound Feeds?

- Most of the problems which are likely to occur in small scale feed manufacture can be avoided by good management
- Plant hygiene is also important. It is essential to take precautions to exclude pests and other forms of spoilage from raw material and dry compounded feed stores
- keep the machinery used for making feeds clean

HOW SHOULD I STORE MY FEEDS?

- to prevent deterioration in quality, and loss.
- Prevent theft.
- Feed spoils during storage -whether it deteriorates quickly or slowly depends partly on its quality when you receive it but very largely on how you store it on your farm.

- The following are the major factors which affect the quality and weight of feedstuffs during storage:
  - losses due to human theft, fire and the consumption of scavenging animals, such as rats and birds
  - damage due to rain and condensation, and to high temperatures
  - damage by insects and fungi
  - changes in the quality of the feeds due to enzymatic actions and the development of oxidative rancidity

IF I MAKE FEEDS MYSELF, SHOULD I SELL THEM TO OTHER FARMERS?

- My personal opinion is that the answer to this question is 'no', unless you already have a feedstuff business, (registered)

WILL I HAVE ANY NEW PROBLEMS THROUGH STARTING TO USE FEED ON MY FARM? IF SO, HOW DO I TACKLE THEM?

Toxic or Poor Quality Feed

- Toxic feed, which will cause growth depression and possibly mortalities, can occur if you are not careful enough to apply the advice given in this manual.
- In particular, feeds may be toxic if your quality control of bought-in ingredients or compound feeds is not good enough.

Feed storage

- ALWAYS keep the store clean. Floors and walls should be regularly swept. Spilled material must be removed and the contents of broken bags or containers used first. Cleared areas of the store must always be cleaned before new materials are placed there.
- ARRANGE your store so that new deliveries are not put in front of old stocks. The oldest materials MUST be used first.
- MAKE small stacks. Large stacks of sacks lessen insect damage, which occurs mainly at the surface, but cause heat generation, with other consequential damage. In the tropics, I believe that small stacks which are used rapidly are better than large ones which remain stagnant for long periods. If possible, RAISE the sacks off the ground by stacking them on wooden pallets (platforms).
- ENSURE that ingredients are clearly and indelibly labelled so that those drawing from the store are sure that they are drawing the correct ingredient (some look very similar when ground) from the oldest batch.
- DON'T walk on the stacks of compounded feeds unnecessarily. This will break the pellets on the surface and lead to the production of a lot of wasteful fines (dust).
- DON'T allow sacks to rest against the outer walls of the store - leave a space between the stacks and the wall.