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Improved Production, Safe and Efficient Use of Feed Resources for Dairy in the Highlands of Ethiopia

Getnet Assefa, Kindu Mekonnen, Million Gebreyes, Melkamu Bezabih and Haimanot Seifu

Objectives

- Dairy production and the major limiting factors in Ethiopia, and the importance of improved feeding

- Provide an overview of important feed resources for livestock, their production and safe and efficient utilization practice for scaling up
    - Crop residues
    - Selected forge crops for the highlands
    - Agro-industrial by products and concentrate feeds
    - Concepts of ration formulation

- Highlight the potential of commercializing and marketing forages in the high dairy production areas

The role of livestock in the livelihood of most Ethiopian farmers and pastoralists

- Provides food for the family

- Plow the land for crop production
- Provide manure

- Source of fuel to cook

- Is source of income and social prestige

- Transport goods and Human beings

- Skin provide clothing, and shoes

Current Scenarios of Livestock Production in Ethiopia

- Very low livestock productivity, High demand and increasing price in the market, increase human population and climate change

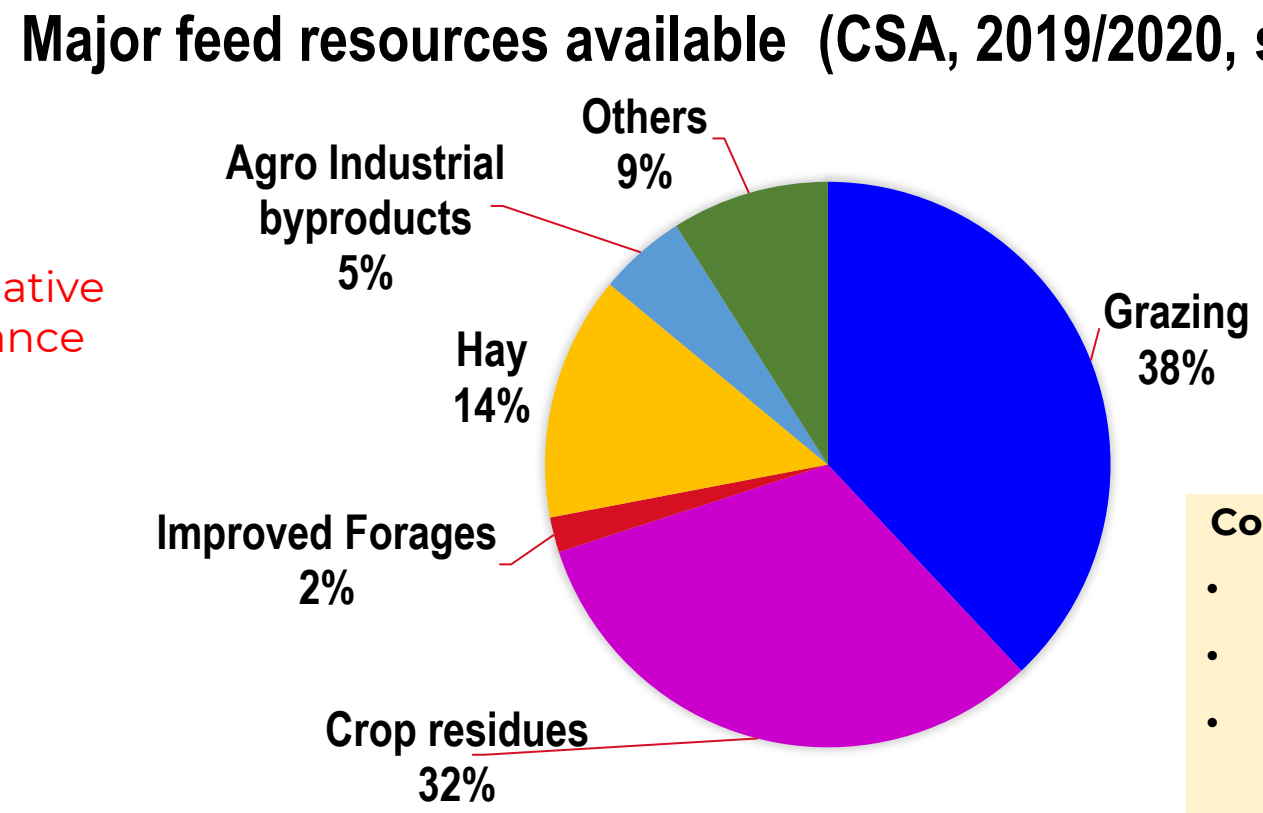
Government and other initiatives

- Ten years development plan of agriculture
- “Yelemat Turufat”

Major Challenges

1. Livestock feed scarcity
2. Genotype (Breed)
   - Low productivity of local breeds
   - Improved breeds of dairy and chickens are in short supply
3. Animal health
   - Inadequate prevention & control services
4. Traditional management practices
5. Marketing, etc

Major Feed Sources



Negative Balance

Constraints

- Limited availability
- Seasonality
- Quality

- Through better management, these feeds could be used more efficiently.
- But to transform livestock production - increasing feed supply is a key element

What are the possible strategies to alleviate feed problems?

- Increase efficient use of available feed resources
- Develop or adopt successful practice
    - Production, Management, Utilization, marketing etc
- Demonstrate and scaling up/out of good practices

Crop Residues Improvement Methods

The **quality and quantity** of crop residues produced could be maximized at different stages of the crop production

1. Preharvest crop management

- **Selection of appropriate varieties**
- **Agronomic practices**
- **Right harvesting stage and time**

2. Postharvest management of crop residues

- **proper threshing, collection, baling, storage practices**
- **physical, chemical and biological treatments to improve feeding quality**

Feeding Value Improvement Methods of Crop Residues

1. Physical treatments of crop residues

Chopping

Chopping is the most common physical treatment of crop residues widely utilized by smallholder farmers.

Grinding of crop residues

- crop residues may also be ground by residue grinding machines to sizes of 0.6 to 0.8 mm sieve size..
- The ground crop residue is usually mixed with other feeds and fed to animals directly or even the mix could be made to pellets.

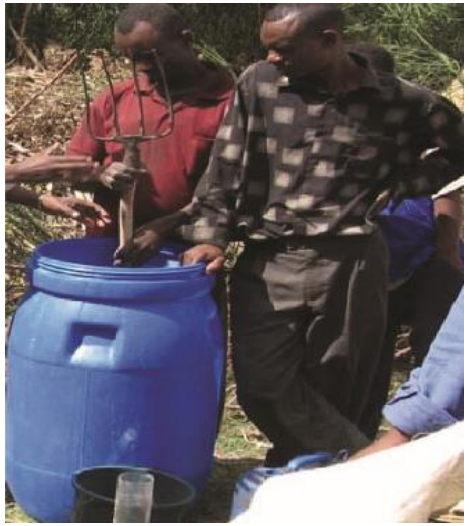
2. Urea treatment of crop residues

- Different chemical treatments used to improve feeding quality of crop residues
- Urea has been utilized for many years
- The main benefits for smallholder farmers are:
    - The treatment procedures are simple
    - Urea is available in most of smallholder farmers
    - Urea treatment doesn’t have any negative health effects both in animals and human beings
    - It remarkably improves the nitrogen (crude protein) and digestibility of cereal crop residues

2. Urea treatment of crop residues

Urea Treatment Procedures of Crop Residues

- Prepare a silo, pit, silage bags, or large volume plastic barrels
- Prepare the crop residues to be treated – it should be chopped and weighed.
- **Prepare 5 kg of fertilizer grade urea to treat 100 kg of crop residue**
- To improve palatability and digestibility of treated crop residues it is advisable to add about 10 kg of molasses for 100 kg of crop residue (but this is optional and not a must).



2. Urea treatment of crop residues

Urea Treatment Procedures of Crop Residues

- The recommended moisture content of the treated product is about 30%. Based on this, depending on the level of moisture in the crop residue and weather conditions 60 to 80 litres of water is enough to treat 100 kg of crop residue

- Mix the 5 kg of urea with 60 to 80 litres of water and then add 10 kgs of molasses and stir to mix uniformly

- Spread the chopped 100 kg crop residue on a plastic sheet and spray with the mixed solution. Spray the solution uniformly

3. Effective Microbes (EM) treatment

- Effective Microbes (EM) is the widely used crop reside biological treatment technology
- Effective microbes is the mixture of lactic acid bacteria, yeast and photosynthetic bacteria.
- Effective microbes help to increase digestibility of fibrous feeds like crop residues by directly producing enzymes, organic acids, amino acids, hormones and other chemicals inside the digestive system of the animals.

3. Effective Microbes (EM) treatment

EM is commercially available as effective microbes' solution one (EM-1). EM-1 is available from a local company called Weljeje in Debre Zeit

In treating crop residues and other feeds sources this EM-1 will be brewed to effective microbes' solution two (EM-2). This EM-2 solution will be directly used to treat feeds. The following are the procedures to prepare EM-2 solution.

Material required to prepare EM-2 solution

1. EM-1 solution
2. Molasses or sugar
3. Warm water
4. Air tight jerricans

3. Effective Microbes (EM) treatment

EM treatment procedures

- Prepare an ensiling facility either a pit silo, or large volume barrels and other similar materials.
- Chop the crop residues with a size of 2 to 4 cm.
- Prepare the EM solutions – you can use EM-1 solution (unfermented) or EM-2 solution fermented
- If one wants to use EM-1 then mix l litre of molasses (if not available, use 30 to 50 g of sugar) with 18 litres of warm water (about 35^{o}C) and stir it to mix very well.
- Add EM-1 solution and stir to mix properly. This solution is ready to treat the crop residues to be ensiled.

3. Effective Microbes (EM) treatment

- If one wants to use EM-2 – prepare 20 litres of EM-2 solution
- The above prepared EM solution (EM-1 and EM2) is enough to treat About 50 to 70 kg of dry crop residues in silage making
- The crop residues to be treated with EM will be sprayed very well with water and kept for overnight. Use 2 litres of water for 1 kg of crop residues.

3. Effective Microbes (EM) treatment

- At the end seal the EM treated crop residue with plastic sheet and put heavy things on it and leave for 4 to 6 weeks.
- The EM treated straw will be ready to be used as feed for ruminant animals after 4 weeks in warmer areas and in about 6 weeks in cooler areas.
- A good EM treated crop residue smells very nice, with light yellow to light brown colour and no any decay or fungus on it.

4) **Improved use of crop residues through supplementation**

- Supplementation of crop residues with high protein and energy feeds is one of the best methods of maximizing the efficiency of its utilization.
- crop residues (even treated crop residues) need to be supplemented with quality feeds like green fodder or concentrate feeds,
- The level of supplementation, however, is lower for treated straws relative to the untreated crop residues
- Many smallholder farmers may have limitation to afford concentrate feeds. Under such condition cultivation of forages especially those with high crude protein contents and higher biomass yields like alfalfa and elephant grass are alternative options.

Cultivated Forage Crops

Forage crops are the most appropriate in most parts of the farming system in Ethiopia

Comparative Advantages of Forage Crops

- Farmers can produce around their vicinity
- Productive and high in quality
- Could be integrated with NRM and many other options -**multiple functions**
- Diversified species and means of production
- Relatively cheaper
- Positive contribution to climate change - carbon sequestration

Well adapted forages in cooler highlands

Type	Annuals	Perennials
Grasses	**Oats**	**Phalaris**
		Lolium
		Desho grass
Legumes	**Vetches**	Alfalfa
	Clovers	Clovers
	Lupin	
Browse trees		**Tagasaste**
Tubers	**Fodder beet**	

Available forage production packages

- Many varieties / species are registered and recommended
  - Suitable to different agro-ecologies and production systems
- Productive and profitable agronomic practices are available
- Integration methods developed
- Conservation practices
- Major quality parameters known
- Feeding strategies are available

Forage Crops Adoption

- Intensification is a must to increase productivity due to the rapid changes of population, production practices, investment, etc,

- Demand for improved forage crops is increasing

- **But still adoption is very low**

1. Oats (*Avena sativa*)

- An annual grass that grow up to 2m height
- Different varieties –tall/short, forage/grain, early/late, hay/grazing
- Established from seeds, need to plant 90-100 kg/ha if planted in rows of 15-20 cm spacing
- Makes a good mixture with vetch 25/75 kg/ha (vetch/oats)
- Fertilizer - based on soil fertility condition 18 kg N + 20 kg P/ha at planting and 23 kg N /ha top dressing

Oats (*Avena sativa*) Count.

- Weeding – hand weeding or use herbicides
- Harvesting – sickle / scythe, or machine at 50% flowering stage
- Conservation – hay or silage
- Utilization – good quality basal diet as green feed, hay and silage

- Yield – 8 to 15 t/ha DM, it can have regrowth if moisture is available
- Seeds – produce good quality seed depending on variety from 0.5 to 3 t/ha
- Grain used as livestock and human food
- Straw – good quality roughage for animal feeding

Oats (*Avena sativa*) –Different Varieties






Vetches *(Vicia Species)*

- An annual herbaceous legume – scrambling and climbing habits
- Different species, early/late, (*dasycarpa, villosa, sativa*)
- Established from seeds 25 kg/ha in rows 20-30 cm spacing
- Makes a good mixture with oats 25/75 kg/ha (vetch/oats)
- Could be under-sown in highland maize and other crops

Vetches *(Vicia species)*

- Weeding – hand weeding
- Harvesting – sickle / scythe, at 50% flowering stage
- Conservation – hay or silage with other grass forages

- Utilization – good supplement as green feed, hay and silage
- Yield – 8 to 15 t/ha DM
- Seeds – produced good quality seed depending on varieties from 0.2 to 0.6 t/ha – **frost sensitive**

Desho grass *(Pennisetum glaucifolium)*

- Indigenous perennial grass
- Wider adaptation for mid to highland areas (2800 masl)
- Establish from root splits and stem cuttings (10cm by10 cm)
- Fertilizer – manure or fertilizer helps better establishment.
- Yield – produces 10 to 20 t/ha DM, 2 - 4 cuttings / year
- Utilization - very good as cut and carry system (at height of 80 cm)
- Conservation – hay and silage
- Seed – rarely produces seeds and propagate vegetatively

Alfalfa *(Medicago sativa)*

- Highly nutritious perennial herbaceous legume
- Well adapted to diverse soil and weather conditions (highland to lowlands).
- Readily established from seeds (2 to 10 kg/ha), broadcasting
- Can be established in mixture with staylo and other legumes
- Fertilizer 100 kg/ha DAP at planting and 50 to 75Kg/ha urea annually

Fodder beet *(Beta vulgaris)*

- An annual tuber fodder crop
- Grows well in cooler highlands on light and drained soils

- Established from seedlings planted in rows 30 to 60 cm spacing

- Fertilizer- Requires fertile soils (back yards)

Fodder beet *(Bita vulgaris)*

- Weeding – hand weeding
- Conservation – could stay in the soil
- Utilization – chopping and feeding as good energy supplement
- Yield – 12 to 16 t/ha DM under rain fed and under irrigation yield is much higher
- Seeds – set seed in very high altitude and cool areas in the highlands

Tree lucerne *(Chamaecytisus palmensis)*

- Perennial leguminous tree
- Well adapted in well drained soils in the cooler highlands
- Established from seedlings (seeds require treatment)
- Fertilizer – helps for good establishment
- Yield – produces 4 -10 t/ha edible dry matter
- Flowers are good bee forages
- Utilization - very good as cut and carry system (Fresh, wilted or dried forage)
- Seed – a good seeder

Recommended Forage Promotion Approaches

1. Linking forage production to market oriented livestock systems
2. Linking forage production to the current farming practice, NRM, marginal lands, etc.
3. Strong extension system, support and promotion
   - Training,
   - Strong follow up
   - Create market linkage
4. Establish efficient input / output supply and marketing systems
   - Specially forage seeds

Energy and protein supplement Feeds

Also called Concentrate feeds

- Agro-industrial by products
- Formulated / compound feeds
- Grains

- Very low in availability and supply
- Very high in price
- Not accessible to most livestock producers

- In recent years Dairy farmers started using Brewery spent grain (A byproduct from the brewery factories)

Brewery Spent Grain

- Brewery spent grain is the byproduct of the brewing process of beer. It is mostly the by product of barley grain. It is used for

  - Human food additive
  - Animal feed
  - Fertilizer
  - Other uses

- It is high in Fiber and Crude protein
- Brewery spent grain used as animal feed, in fresh, dried form or stored as silage.

Brewery Spent Grain

- Brewery spent grain could be used fresh from 2 to 5 days in warmer areas and 5 to 7 days in cooler areas.

- Prolonged storage could reduce palatability and nutritional quality

- It also grows mold and fungus which could cause the production of mycotoxins

- Farmers in the highlands commonly store for longer time with the addition of salt, they also use the dried form

Brewery Spent Grain

- The best way of using brewery spent grain is fresh or by preserving as silage

- The silage could be used starting from 21 days of ensiling and could be kept from 6 to 12 months

- Farmers feed brewery spent grain in mixture with water, straw and other feeds as mixed ration

Animal Feed Ration Formulation

Ration formulation involves the selection and allocation of feed ingredients. in such a way that the cost of the ration is kept low while sufficient nutrients. are supplied to the animal for its maintenance and for its desired production.

The main and essential activity for successful and profitable husbandry is planning efficient feed utilization practices

In commercial farms about 70 % of the coat is allocated for feed

Why ration formulation?

- It ensures animals are fed properly, so we can reach the set production targets.
- It ensures minimization of feed wastage and increase profitability.
- It helps to predict feed surpluses and deficits to act accordingly.
- It helps to design strategies of acquiring required feeds including roughages in time
- The supplement feed requirements can be foreseen a long way in advance and therefore purchased at the lowest possible price.

Basic information required for ration formulation

1) The animals

- The details of animals in the farm.
- Which type and number of animals are in the farm? (Cattle, Goats, Sheep, etc)
- What is the level of productivity?
- Weight of the animal
- Physiological condition (pregnant, dry, growing)

Based on the above information the targeted animal feed requirement can be determined based on

- Total dry matter (TDM), Nutrient, Total digestible Nutrient (TDN), Net energy,

Basic information required for ration formulation

2) Information on the feeds

a) Available feed type and quantity (Crop residues, hay, green feed, concentrate feeds and others)

b) Average quality profiles of the feeds for major nutrients like protein, energy, digestibility, etc

c) Prices of roughages and concentrate supplements over the months of the year

Formulating the ration

Nutrient requirements of animals may be found in published tables such as published by national research council (NRC)

Two components of nutrient requirements

- **Maintenance** - nutrients for basic activities, with out any body weight change
- **Production** – meat, milk, reproduction, power, etc

The proportion of the different feeds will be determined. These ingredients will be mixed to produce the ration.

The proportion of the ingredients can be determined by calculating manually or using a computer software

Total Mixed Rations (TMR)

What is TMR?

The practice of blending different feedstuffs in recommended proportions into a complete ration and provides adequate nourishment to meet the needs of dairy cows

In conventional TMR, chopped green fodder or silage are blended with cereals, cereal by-products, protein sources, minerals, vitamins and feed additives in order to provide balanced ration

Total Mixed Rations (TMR)

What are the advantages?

- Total Mixed Ration is an efficient system of delivering nutrients to dairy cattle.
- It enables better feed intake, reduces feed wastage, maintains stable rumen environment and improves digestibility.
- It can be customized to the different requirements of the animal groups and therefore contributes to higher productivity.
- The roughage portion of TMR primarily comprises of crop residues such as wheat straw, which are available in abundance locally.
- The TMR is normally economical than the conventional cattle feed of similar nutrient composition.

Total Mixed Rations (TMR)

Dairy farmers practice in Ethiopia

- In many places dairy farmers feed their animals a mix of different feed ingredients available in the farm.
- Most farmers indicated this improves intake of poor-quality roughages like straws.
- However, what is lacking in this farmers practice is
  - To know the nutrient requirements of their animals and
  - To mix the different ingredients proportionally.

- This is an innovative practice of farmers. Development and research workers need to support this practice to make it more efficient, economical and nutritionally optimum.

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