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Silage Making: A Way of Enhancing Livestock Feed Under Climate Change Scenario

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The livestock and fodder scenario of India

Livestock is the backbone of Indian economy. It is the key source of income for more than 70% of Indian population and critical in alleviating poverty. Its contribution to overall agriculture and allied sector Gross Value Added (GVA) was 30.19% in 2021-22. It plays a significant role in contribution to the GDP by 4.11% and accounts for 25.6% of total agricultural GDP. According to the 20th livestock census (Department of Animal Husbandry and Dairying), the total livestock population has increased from 512.06 million in 2012 to 536.76 million in 2019, corresponding to a 4.6% increase in growth rate. India host approximately 11% of the world's total livestock population and is the largest milk producing country in the world. However, area under fodder production remains stagnant at 4% of the gross cropped area for the last 40 years. According to ICAR - National Institute of Animal Nutrition and Physiology, there is a net shortfall of green fodder, dry fodder and protein by 36%, 23% and 36%, respectively. It is estimated that by 2025 the deficiency of green fodder, dry fodder and protein will further increase by 40%, 23% and 38%, respectively. Furthermore, fodder crisis is critical during the lean period of floods and drought which is frequent under present day climate change scenario. It is imperative to generate easily accessible high quality livestock feed when livestock rearing has emerged as a commercial adventure against the prevailing situation of increasing area under foodgrain cultivation and increased events of lean period. Hence, this article aims at emphasizing the need for fodder conservation in the form of silage to boost the socio-economic condition of the farmers.

Silage and the procedure of silage making

Silage is a preserved animal feed resulting from the storage and fermentation of green or wet crops under anaerobic conditions. It involves the process of chopping green fodder and storing them in structures below or above ground under air tight conditions.

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It is highly palatable and nutritious green fodder containing nutrients in its original form. The conversion of water-soluble carbohydrates (WSCs) into organic acids (particularly lactic acid) by bacteria (lactic acid bacteria) under anaerobic condition forms the background of ensilage. An anaerobic environment is necessary to inhibit the growth of aerobic spoilage microorganisms (such as moulds, yeasts, and aerobic bacteria), which may thrive at low pH (<4.0). Thus, closing a silo is crucial to create and maintain an anaerobic environment. The elimination of clostridial bacteria is crucial to efficient silage preservation. These bacteria create butyric acid and amines by fermenting carbohydrates, lactic acid, and amino acids, respectively. Such fermentations induce losses of dry matter (DM), lower nutritional value, and decrease silage intake by ruminants.

The key points to be considered during silage making are (i) rapid and continuous exclusion of air and (ii) rapid generation of lactic resulting in rapid pH drop. The lactic acid bacteria (*Lactobacillus plantarum*) abundantly present in the fresh forage are responsible for producing the lactic acid and subsequent decrease in pH. Any forage material is considered suitable for ensiling that contains water soluble or fermentable carbohydrates, low moisture content (30 – 40%) and has low buffering capacity. Glucose is the most commonly fermented sugar present in the forage. Lactic acid bacteria (LAB) are unable to ferment larger oligosaccharides and polysaccharides like cellulose, hemicellulose and starch. Some LAB strain can also ferment organic acids like citric and malic. Forage with high buffering capacity are considered not suitable for ensiling as they resist pH decline. Crops such as maize, oats, sorghum, napier, etc. contains high concentration of water-soluble carbohydrates and has relatively low buffering capacity and hence, highly suitable for silage making. On the other hand, berseem and alfalfa has high buffering capacity and possesses significant difficulties in converting to silage.

The commonly used silo is a trenched silo of dimensions 10 m x 4 m x 1.5m that is to be installed near the cattle shed. One cubic feet of such a trench can accommodated almost 15 kg of green fodder and can store 350 – 400 quintal of chopped green fodder. The trenches should be covered with a plastic sheet followed by filling with the chopped materials layer wise. It is desirable to fill the silo upto 1m above the ground level and arrange it in a semi-circular dome structure. After chopping the harvested green fodder to 6 – 60 mm, plant respiration and enzymatic activities continues for several hours to days if poorly packed.

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Removal of air is critical to inhibit the development of unwanted aerobic bacteria, yeast and molds that competes for the substrates. Also, inefficient exclusion of air generates high temperature and causes prolonged heating. Elimination of air can also be done by wilting on a good sunny day to reduce the moisture content to 65 – 70% or by adding 5 – 20% hay/ straw or can be accomplished by mixing both low and high moisture containing forage. Under anaerobic conditions, LAB acts upon the carbohydrates and convert them into lactic acid and reduces the pH. The decline in the pH limits the breakdown of protease enzyme and also inhibits the growth of harmful anaerobic bacteria like enterobacteria and clostridia. On completing the filling, cover the silo with one feet thick layer of straw and plaster with mud and wheat bhusa mixture to ensure air tight condition. In order to enhance the activity of LAB, improve nutrient content and prevent bacterial damage, additives such as urea, molasses, limestone, sodium metabisulphite, etc. can be added while layering. The silage is ready for feeding within 45 days. A good quality silage is one having pH between 4.5 – 5.5, less than 10% of ammonical nitrogen, less than 0.2% butyric acid and lactic acid in the range of 3 – 12%.

Fig 1: The procedure of silage making

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The advantages and disadvantages of silage

The advantages of silage are:

- Silage prevents the degradation of nutrients and preserve them in their original form.
- It improves the palatability of hard stem by softening under the bacterial action.
- It improves the quality of green fodder by reducing the concentration of anti-nutritional factors generally present in green fodder.
- It improves animal appetite.
- It reduces field losses of leafy material that are rich in minerals and proteins.
- The probability of nutrient leaching is reduced manifold.
- There is no danger of fire as silage is prepared in air tight containers.

The disadvantages of silage include:

- It involves capital investment in the initial periods of silage making.
- It is not suitable for forage containing high crude and having high buffering capacity like berseem, alfalfa, cowpea, etc.
- Voluntary consumption by animals is limited by high acid production.
- The preparation of silage is critical from the point of exclusion of air as inefficient air removal leads to the develop of clostridia, yeast and mold that reduces the quality.
- Chopping is a must to prevent the entrapment of air that is labour intensive and time consuming.
- High moisture storage leads to heat generation, undesirable bacterial growth and loss of nutrients.

Conclusion

Climate change over the past few decades has changed the climate and rainfall pattern. Extreme vagaries in monsoons have led frequent events of droughts and floods affecting foodgrain and fodder production. It has also demanded changes in agricultural practices for increasing food grain production to sustain the burgeoning population of the country. Under such a situation, sustainable and climate smart livestock management practices are crucial. When the increment of area under fodder production is certainly not the option under present day condition it is important to enhance their accessibility throughout the year via adopting different preservation techniques. Silage is one of the viable options for increasing year-round fodder accessibility. During lean period when greater emphasis is laid to maintain foodgrain

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production than fodder, silage is an affordable technique for providing nutritious feed. Hence, it can be said that silage helps in achieving feed and nutritional security and subsequently genetic yield potentiality of livestock. The usefulness of silage also extends to the prospects of generating employment by providing scope for development of industries and market and thus fuelling the process of socio-economic progress.

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