

Silage Industry A Paradigm Shift in Dairy Sector

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Preamble

Punjab is a leading agrarian state, but livestock sector is now emerging as an important remunerative enterprise next to crop farming. Presently, animal husbandry holds a key role in the state economy with second largest contributor (33.4%) to the agricultural GVA (Punjab Economic Survey 2020-21). This sub-sector also provides an alternative source of income to the rural households. Moreover, this region possesses high ruminant population intensity and milk and dairy products holds a significant share in fulfilling the daily food requirements. According to National Dairy Development Board (NDDB), the state has the highest per capita milk availability at 1035 gram per day as against the national average of 406 gram per day (2019-20). The state government is putting special efforts to develop Punjab as '*Dairy State of India*' particularly with greater emphasis on quality germplasm. Despite all these concerted efforts, dairy farming has not moved out from part-time farm production to a commercial venture, and most of the dairy owners are unable to tap the potential of this sector. There exist many constraints; among them one of the major factors is availability of quality feed and fodder to the dairy animals.

Presently, land holdings are very small and farmers are always biased in choice of crop farming. The land available for fodder production has been decreasing. At present, there is tremendous pressure of livestock on available feed and fodder, one of the most important contributing factors for the growth of livestock sector. Feed and fodder has not yet received the desired attention in the past. Despite of this, high-yielding animals need to be fed with balanced ration including good quality protein and energy along with roughage to maintain the production. Therefore, the fodder industry must grow in accordance with the requirement of dairy sector to sustain the growth. In the present context, there is need to overcome the dependency on costly grain-based feed and explore better alternatives to overcome the challenges of feed shortage. Processed fodders like 'silage' and 'hay' has emerged as big industry in the Punjab and gaining popularity among the farmers. Moreover, the introduction of plastic bags and then, plastic wrap packing popularly known

as “Bale Packing”, has given more impetus to this enterprise. After 2018, the Bale silage business became very popular and attracted many entrepreneurs for investment purpose. Albeit, the availability of fodder and silage remains as a real challenge among the producers due to its seasonality of production, climate and irrigation dependence.

Therefore, in this context, a seminar on “Silage Industry: A Paradigm Shift in Dairy Sector” was organized during the 3rd India Agri Progress Expo 2023 at Ludhiana, Punjab.

The major issues and specific objectives of the seminar were:

1. To highlight the role of green fodder availability in dairy sector and importance of silage making in bridging up the fodder requirements.
2. To give an overview on the importance of silage production, its quality determinants, testing and accreditation.
3. To deliberate on various strategies and plans for public-private-partnership in enhancing the farmer’s income and boosting the silage industry.

Technical Session

A seminar on “Silage Industry: A Paradigm Shift in Dairy Sector” was organized on January 21, 2023 as a part of 3rd India Agri Progress Expo 2023 at Ludhiana Exhibition Centre, Sahnewal, Ludhiana, Punjab. The Agri Progress Expo is an International Exhibition on Dairy, Agriculture & Poultry Industries which brings together overseas as well as national partners to come up at a common platform to interact, deliberate and deal with the leading dairy, agricultural and poultry technology companies. It also offers networking opportunities with different stakeholders to explore investment opportunities across India. It is considered to be one of the most comprehensive forum where international agriculture, academia, institutional investors, venture capitalists, analysts, progressive farmers and policy planners get the opportunity to shape up the future collaborations and define



the road map for agricultural growth.

The event was started with a brief introduction of all the distinguished speakers by Dr. Pragya Bhadauria, Scientist (LPM) and Convenor of the Seminar who briefly discussed about the objective and technical programme of the seminar.

The technical session was started with the inaugural address by **Dr. Rajbir Singh, Director, ICAR-ATARI, Zone-I**, Ludhiana who formally welcomed the Chief Guest and other participants. He briefly appraised the house how changing climate scenario is influencing dairy farming in multiple ways. Due to this, cropping pattern has changed a bit and lesser availability of fodder to the livestock. Moreover, the farm mechanization is the biggest reason for the shortage of fodder availability in north India. Farmers cannot get straw if they thresh wheat with a machine. Farmers, instead, have to burn their fields. He also emphasized that due to declining land holdings, farmers now prefer to grow cereals or fruits and vegetables. Also, the village panchayat lands that were used for open field grazing purpose are now being leased out for profit making or commercial agriculture. As a result, the farmers are enforced for stall feeding and livestock predominantly depend on crop residues as their main source of feed, which are substantially poor in nutritional quality.

Under given situation the farmers are shifting their feeding management practices of their animals towards silage as popularly known as “*Makke Da Achar*”. Most of the commercial dairy farmers in the state are well aware about the process of ensiling. Furthermore, he emphasized the immense need of promotion of scientific technologies for quality silage making in sustaining the profit margins through quality milk production. He highlighted that majority of our population is vegetarian and depends on milk and milk products to fulfill their protein requirements. To sustain the regular supply of quality milk at desired level it is very important that the nutritional requirement of milch cattle should be met properly. He further emphasized that quality silage making may enable dairy farmers to sustain their production potential of their milch cattle even under adverse climatic conditions and during the

deficit periods of green fodder. He underlined the purpose of organizing the seminar to develop the road map and ensure the upcoming option for year round fodder availability to the dairy farmers. He emphasized that through these kinds of collaborative programmes, the various issues related to farmers and industry can be taken up by the researchers and policy makers.



Dr. Praveen Malik, CEO Agri-innovate and Former Animal Husbandry Commissioner (GoI), the **Chief Guest** of the event highlighted the importance of livestock husbandry in Indian context. He pointed that India has the world's largest number of livestock population with 535 million animals as per 20th Livestock Census; most of them are cattle, followed by buffaloes. He termed livestock as '*ATM of poor farmers*' that can be turned with cash anywhere and anytime. He emphasized the dire need to deliver potent agricultural technologies and timely delivery of services to the farmers through public private partnerships (PPP) to boost the country's dairy farming sector and address the challenges of sustainability.

Dr. Malik raised his concern towards unavailability of good quality silage along with reliable baling machines in the present scenario. Indian manufactures are still competitive with the imported machines which are costly, unavailability of spares, and technical know-how for their maintenance. To resolve this, synergy between government's mandate and



ability to deliver public services with the private sector is required for capital investments, technology generation, products and distribution systems. Under a Public Private Partnership (PPP) model, a start-up ecosystem can better drive a reliable mechanism between emerging technology innovations and agile business models, while universities and research institutions can contribute huge level agricultural expertise and validate these solutions for future scaling. In addition, the role of farmer organizations and non-governmental organizations may further add value to extending products and better services to the farmers. The government can also take initiatives to build a standardized common platform involving various stakeholders necessary to cater the researchable issues, hi-tech services, farm level agriculture advisories and market connect platforms. He further appreciated the ATARI Ludhiana initiative for showcasing of the latest technologies along with sharing of knowledge at one platform in creating a stronger research-farmer-industry tie-up.

Dr. Udeybir Singh Chahal, Principal Scientist-cum-Head, Animal Nutrition Department, Guru Angad Dev Veterinary and Animal Sciences University, Ludhiana highlighted the importance of green fodder in dairy animals for maintaining a good rumen health. Fodder contributes more than 75% in animal feed and is considered as a cheap source of nutrients rich in essential vitamins, more palatable with easy digestibility and slightly laxative. He continued about the issue of excessive use of concentrate mixture and related metabolic disorders in ruminant animals.

He further added that in most part of the country nutritional requirements of ruminants are mainly met by feeding green fodder and dry roughages as well as post-harvest crop residues. A farmer can maintain up to 8 liters of milk solely on green fodder without any concentrate supplementation. The animals usually produce low if any of the requirements are compromised. As the land available for cultivation of green fodder crops is getting restricted day by day and the rising trend of cultivation of cereals and other commercial crops will further restrict its growth. Despite of their importance in dairy feeding, only 4% of total arable land is under fodder cultivation and there is deficit up to 35.6% in green fodder availability. Thus, the feed and fodder

requirements for animals normally remained below the recommended levels further restricting the utilization of the potential of animals by 26-51%. Therefore, the regular supply of fodder is essential for the production and economic returns from the dairy farming sector.

More specifically in northern India, the supply of green fodder throughout the year is limited due to extreme seasonal severity during May to June and November to December. During this period green fodder availability with optimal nutritional contents remains low and has been identified as one of the reason for poor livestock productivity. Furthermore, the routine farmer's practice of daily cutting and carrying of green fodders in conventional feeding system lead to increase in lignin content with maturity and advancement of age which is hard to digest and also requires more energy effecting net energy balance of the animals. Therefore, poor supply of nutrients to livestock along with scarcity of green fodder during lean period is a matter of concern. He also suggested important strategies to improve round the year green fodder production and availability through adoptions of various agronomic practices as well as processing techniques at farmer's fields.

Dr. Maninder Kaur, Agronomist (Forages), Punjab Agricultural University, Ludhiana briefed about the basic function of silage-making, storage and preservation processes with minimal loss of nutritional qualities and silage making is less dependent on good weather conditions compare to hay-making. Moreover, the scarcity of green fodder during the lean months can be conveniently overcome by conserving surplus fodder as silage. For quality silage making, green fodder crops like maize, sorghum or *jowar*, *bajra* (pearl millets) are cut fresh, chaffed and packed in silo/bunkers under anaerobic conditions. The desired fermentation is being conducted in an anaerobic environment, where the starch is changed to acids. The acidic environment kills most of the microorganisms and preserves the fodder. While highlighting the important points for quality silage making, she stressed on ideal stage of harvesting for silage making and further advocated to harvest the crop when the nutrient contents remained at their peak stage with maximum dry matter accumulation. Generally, a crop with 30-35 per cent dry matter conserves into high quality silage and the deviation may result

in poor quality product. Low dry matter content may result in low dry matter silage which is bulky, thus reducing the feed intake and also nutrient loss during ensiling. It also increases the risk of bacterial and fungal incidence. Harvesting too late can cause a low nutritive value of silage because of poor starch and fibre digestibility leading to low palatability, which may reduce dry matter intake.

While emphasizing on the methodology of silage making, the importance of silo structure and its dimensions needs to be properly checked to ensure the proper fermentation of fodder during the process of ensiling. She suggested starting with the first step of the digging of a pit. The size of the pit generally depends upon the number of animals along with the availability of fodder. On average, one cubic meter pit can accommodate roughly 5–6 quintals of green fodder.

Dr. Jaspal Singh Hundal, Principal Scientist, Animal Nutrition Department, Guru Angad Dev Veterinary and Animal Sciences University, Ludhiana discussed about the nutritional value of the parent crop in silage making. Along with this, he briefed about the importance of silage testing which not only establishes the quality of silage, but also ensures the success of ensiling process. Further, testing can be used as objective basis for costing silage and assist in budgeting and formulation of diets. The major determinants of silage quality are water soluble sugar content, buffering capacity and ideal dry matter (DM) content of parent fodder in addition to optimum managerial skills like chop length, quick and tight packing, sealing, management during storage and feed out, etc. The water soluble sugar content of forage should be 2-3% (fresh basis) with buffering capacity of <300 mEq/kg DM. The maize and sorghum are most suitable crops for silage making. The ideal DM content of fodder is 30-35% at the time of ensiling because it strongly influences the type of fermentation. The silage additives like fermentation stimulants, fermentation inhibitors, aerobic spoilage inhibitors, nutrients etc. add value to enhance the silage quality.



Testing of silage include mainly sensory (colour, aroma) and chemical evaluation. The colour of good quality silage for maize, cereals and other grass silages is light green to green. If colour of silage is very dark to dark olive, it indicate wilted legumes, silage with limited fermentation whereas if brown to dark brown it means overheating and inadequate compaction or aerobic spoilage. The aroma of good quality silage should be mild, pleasantly acidic with sour milk or natural yogurt smell. However, sometimes sweet, fruity alcoholic aroma (yeasts fermentation), sour vinegar smell (poor fermentation), rancid butter, putrid aroma (clostridial fermentation) or strong tobacco or caramel smell with flavour of burnt sugar (heat-damaged silage) may be observed which represents unpleasant conditions for final product.

The quality of parent forage and optimum management is required to determine silage quality. Sensory and lab evaluation are important to assess silage quality and to formulate total mixed ration for animals to maximize performance. Laboratory analysis of silage is more reliable method to establish its quality. At present there are only three silage testing labs at Punjab Agriculture University, Guru Angad Dev Veterinary and Animal Sciences University, and Milked (Verka) lab in Ludhiana. Accordingly, the pH of silage should be 3.8-4.2, lactic acid >4%, acetic acid 1-3% and butyric acid <0.13% on 2-3 % on fresh basis. The ammonical nitrogen is the



best indicator of silage fermentation and to ensure good quality good quality silage, it should be less than 10% total nitrogen. Further, silage should be free from molds, yeasts, clostridial bacteria and other unwanted organisms.

Ms. Ravdeep Kaur, Team Leader from Agriculture Infrastructure Fund (AIF) Punjab PMU Team appraised the audience about implementation of AIF Scheme in Punjab. The state currently stands at 11th position across 35 states and UTs participating in the implementation of this scheme. It's noteworthy that over the past ten months, the pace of AIF scheme a steep rise has been witnessed with the receipt of more than 1600 till date during the current year as against the 268 applications during the 2021-22. So far, investment worth more than 2300 crore has been attracted from nearly 1600 projects. The loan amount sanctioned in Punjab through AIF scheme has increased from Rs.144 crores to Rs. 485 crores in the past ten months. The leading districts availing the benefits include Sangrur, Patiala, and Mansa, accounting for nearly one third of the total sanctioned loan from the entire state. Agriculture Infrastructure Fund Scheme gives golden opportunity to Cooperative Societies to create the requisite infrastructure by availing loan at mere 1% interest rate. So far, 232 applications with loan amount of worth Rs.24.59 crores have been distributed for developing infrastructural facilities including Cold Rooms & Cold Stores, Primary Processing Centers, Custom Hiring Centers, Warehouses and Solar Panel and other agriculture infrastructures. Some unique projects such as Production and Export unit of Flower Seeds, Silage and Baling plants, Drones in Agriculture, Banana Ripening Chambers, etc. have also been sanctioned. This scheme is also playing a vital role in enhancing the pace of crop diversification in the state. Significant efforts have been put forth for increasing the scheme outreach through state level conference, district level seminars, social media promotion, generation of WhatsApp helpline number, etc.



Dr. Navjot Singh Brar, Subject Matter Specialist (Agronomy), Krishi Vigyan Kendra, SAS Nagar, Punjab talked about sustainable agronomic practices in raising the fodder crops. He highlighted that spring maize is the best suited crop used for silage making in Northern India. The entire process of silage-making, from sowing of crop to ensiling, is strategically well-fitted and seasonal one starting from Mid-February to end August. Majority of dairy farmers starts sowing of spring maize for silage making in end of February after harvesting of toria/oats/vegetable pea/potato. This February sown crop is harvested and ensiled in end of May. Approximately, 30% of farmers go for post-wheat sowing and ensiling is done in July. This summer maize crop always runs a risk of rain and machine scarcity.

In order to sustain the yield and quality of green fodder for silage production, farmers must adopt scientific cultivation practices and ensure timely sowing of maize. He also briefed about the importance of recommended varieties, time and method of sowing, rational fertilizer use, weed management and water management. To reduce evapo-transpirational losses in spring maize, Dr. Brar advocated the need of installing drip irrigation in spring maize and urged the farmers to avail similar benefits under micro-irrigation scheme. He emphasized the need of soil testing based plant nutrition, managing

the weeds through integrated weed management. For better control of fall army worm in spring maize, recommended insecticides and their application technology was explained to ensure production of insecticide residue free fodder. Furthermore, the importance of timely harvesting to ensure better quality fodder with high nutritional quality and low fiber content was narrated. He also shared his expressions of quality analysis reports of different silage samples collected from various commercial dairy farms in Punjab.

He further emphasized the need of promotion of winter cereals (wheat, barley, oat) for silage making in order to decrease the whole dependency on spring maize. At last he urged the farmers to adopt recommended varieties, stick to time of sowing, go for integrated nutrient and weed management, adopt drip irrigation, follow instructions for scientific management of fall army worm, harvest the crop at proper stage and construct silos with proper dimensions in order to produce quality silage.

Dr. Harinder Singh, Consultant, Excellent Enterprises Pvt. limited (Company involved in commercial silage production since 1997) mentioned that India is feeding the largest cattle population in the world, the majority are under-fed, malnourished and non-performing, while others are fed with nutritionally imbalanced and unprocessed feeds. At the same time, during few days or weeks of the year, there remain the problem of overfeeding (in some areas) as an excess of fodders, straws in the fields and under feeding (in most areas) when there is no harvest, or drought, floods, rains etc. The absence of value addition of fodder industry and commercial processing of fodders add woes to the growth of dairying in India, but can revolutionize it through preservation of green fodders as silages. He further emphasized that lack of coordination among industry-farmers-institutes for better outputs starting from seed-sowing to post-harvesting, processing, value-addition, matching-machinery, R&D services, marketing aids etc. Farmers experienced about 70% of their expenses on feed contribute of the total economics of dairy farming, to tilt the balance as '*babu rail mein-babu jail mein*'.

- To achieve profitability & overcome challenges of handling, transportation, storage, enrichment and value-addition
- To serve the animals with more even and economical feeding recipes, round the year without being affected by excess-deficient regimens due to drought, floods, crop failure, insect manifestation, etc
- To make available enriched fodders, straws at all the time at farmers' door step without affected by market fluctuation
- Recent price fluctuations in feed ingredients (soybean, binolla, mustard, maize etc) have forced the common dairy farmer to look for more viable, nutritious, economical feed alternates/ingredients & silage, hays, TMR's, enriched straws has emerged as the only and best choice before him.



Open Discussions

Sardar Satpal Singh Toor, a landless farmer from village Swadi Kalan, Ludhiana shared brief account of his experience about silage making. He is managing a dairy farm of 62 milch animals in which the fodder requirement

is fulfilled by spring maize silage making. Looking at the success of this technology and foresee opportunity, he started silage making in 2017 by sowing spring maize on about 20 acres of land taken on lease basis. He added that silage making ensured round the year quality fodder availability and decreased the cost of production. With this technology, there is a saving in labour costs involved in daily harvesting, transportation and chopping of fodder and only 3-4 labours are sufficient to manage the whole farm. He further experienced that the Pit/Bunker silage of high quality, with better yield and low wastage, can be ensured with farm management from seed to harvest.

Mr. Toor critically pointed out constraints in silage production and storage. There were issues in handling at all levels from harvesting to packing and then transporting to other places due to its bulkiness. Silage quality also deteriorates quickly once opened; hence it cannot be transported for long distances. However, one can keep the silage bales in the open without much loss in quality. The cost of silage has been increased by 25-33% (INR 1.5-2/kg), depending upon the size of bales, but it has opened the avenues of “Silage Baling” as an industry. Though bale packing is entirely mechanized work right from harvesting to ensiling, and the entire process is very fast, and less labour-dependent but require huge capital investment initially. He urged the government officials and policy planners to provide subsidy for infrastructure development and for raising of fodder crop for silage making to meet up the demand incentives requirement of their cattle at lower cost.

In last, an elaborated open discussion was organized between the participating stakeholder’s deliberating on issues and prospects in the dairy sector along with their potential solutions. Various queries and issues raised by the Subject Matter Specialists (SMS) of the KVKs and officials from GADVASU, PAU as well farmers which were promptly taken care by the experts and panelists.

At the end, **Mr. Sarbjeet Singh** proposed the vote of thanks to the expert panel and participants.

Key Reflections and Policy Recommendations

1. Conservation of forages to meet the demand in deficit

Fodder scarcity is mostly observed in dry periods and during floods. Conserved forages which are nutritionally rich and can be prepared by low cost methods like silage are to be promoted among the farmers.

2. Promotion of scientific cultivation of fodder crops

Green fodder is the raw material used for silage making and it is primary determinant of silage quality. Spring maize is the major crop used for silage making in Northern India and it is very important to adopt scientific practices for its cultivation. There is need to promote scientific fodder crop production through improved agronomic practices and quality seed production. The farmers should be made aware about the adoption of proper cropping systems to ensure the sowing of spring maize on time. There is also concern of high water consumption by the maize crop that can be managed through the use of smart irrigation practices. Along with this efforts should also be made for promotion of winter cereals (wheat, barley, oat) for silage making in order to decrease the sole dependency on spring maize.

3. Research and development initiatives

Presently research initiatives have been mainly focused towards cultivation of green fodder in irrigated areas only, but there is need to promote the research and development programme towards dry land or partially irrigated areas. For this, coordination among industry-farmers-institutes for better outputs starting from seed-sowing to post-harvesting, processing, value-addition, matching-machinery, R&D services, marketing aids etc. is the need of time.

4. Quality silage production

The quality of silage is a real concern for the farmers as there is a lack

of trust of balers among the farmers. It has been found that poor quality maize; maize stalks without pods, early cutting, or late-cut maize are also ensiled. The testing facilities at various levels will ensure the production of quality silage, which will ultimately benefit the stakeholders in the value chain. It can also be taken up as an entrepreneurial activity by providing desirable funding through various governments schemes and programmes.

5. Capacity building of farmers and extension functionaries

There is need to strengthen and develop trained manpower in latest technologies in terms of both animal health as well as management aspects. Need based capacity building programmes must also be organized for fodder growers to keep them abreast with latest technical know-how.

6. Promotion of fodder production as an entrepreneurial activity

The Government should provide technologies and financial support to fodder based enterprises such as fodder bank, seed production, and equipment and machinery development. The movement of quality fodder in various forms along the different borders and geographies will create employment opportunities both directly and indirectly. Thus creation of such kind of businesses will create buffer storage and build confidence among farmers to expand or scale up their enterprises.

7. Government initiatives and policy framework

Capital subsidy for establishment of Hay/Silage/Fodder Block/TMR plants on machinery and equipment for fodder processing and storage should be introduced at larger scale. There should be provision of subsidy to the farmers for the development of infrastructure required for silage making and also on inputs required for the raising of fodder crop for silage making.

8. Marketing and storage of silage bales

Production of silage bales is limited to months of May-June, and the

silage bailers have to wait till January for selling purpose. It is observed that the availability of bales at nearby places or low transport cost is deciding factors for marketing and availability. There is a need for the availability of bales at the multiple location or options of selling through the conventional dealer network to boost the local consumption of bales.





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