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Modernizing dairy operations: A comprehensive case study of mechanization in Bhopal farms

M. KUMAR*

Agricultural Mechanization Division, ICAR-Central Institute Agricultural Engineering, Bhopal-462038 (Madhya Pradesh)

**Corresponding author's email id: dreamweaver.manoj@gmail.com*

ABSTRACT: Mechanization stands as a viable solution to address the challenges of workforce scarcity in agriculture and allied sectors. It not only alleviates the labor-intensive nature of tasks but also enhances the efficiency and timeliness of various operations within these domains. This phenomenon extends to the dairy sector, where developed countries exhibit a high degree of mechanization due to the presence of large-scale dairy farms and a shortage of labor. In contrast, dairy mechanization in India lags behind developed nations, primarily attributed to the smaller size of dairy farms. However, there is a noticeable shift in India, particularly in the vicinity of urban areas, with an increasing trend in the size of dairy farms. Consequently, the Indian dairy sector is poised to encounter workforce shortages in the near future. In light of this, a survey was conducted on dairy farms around Bhopal to assess the feasibility of mechanization, and the findings are presented in this study.

Key words: Dairy farm, city, mechanization, outskirts

India possesses the world's largest livestock population, with approximately 109.9 million of buffalo population and 192.5 million of the cattle population (Anonymous, 2019). The milk output's value reached Rs. 9,31,969 crore in 2020-21 (Anonymous, 2022). At the conclusion of the Eleventh Plan 2019, the country's total annual milk production stood at 127.9 million tonnes, with an anticipated demand of 180 million tonnes by 2020 (Anonymous, 2020). Milk production during 2020-21 and 2021-22 is 209.96 million tonnes and 221.06 million tonnes respectively showing an annual growth of 5.29%. The per capita availability of milk is around 444 grams/day in 2021-22 (Anonymous, 2023).

Milk production predominantly serves as a supplementary occupation for small-scale landholders or those without land. In IFCN's 2013 database reports an average dairy farm size ranging from 2 to 18 in India as of 2011. Comparatively, the average size of dairy farms in developed countries exceeds 300 cows. Analytically, larger farms demonstrate lower production costs. Despite small dairy farms achieving higher revenue per hundred weight of milk sold, the cost advantages associated

with larger sizes enable significant profitability for large farms, whereas most small farms struggle to generate sufficient earnings for capital replacement (MacDonald *et al.*, 2007).

In India, farmers and young entrepreneurs are increasingly viewing dairy farming as a business venture, with herd sizes expanding in the outskirts of cities. Typically, in smaller dairies, various operations are carried out by family members of the dairy farmer. As the dairy size grows, so does the need for additional workforce. Anticipating a future shortage of labor across various sectors, including the dairy industry, concerns arise. Mechanization emerges as a viable solution for operating large dairy farms. In India, there is a noticeable trend of increasing dairy farm sizes, especially in the vicinity of urban areas. Through mechanization, dairy farm owners can effectively manage larger farms with the same workforce. The advent of mechanization in dairy farming has significantly transformed agricultural practices, enhancing efficiency and productivity. This research paper delves into the specific context of dairy farms in Bhopal, examining the intricacies of mechanization adoption and its impact on operations. Bhopal, situated in the heart

of India, represents a dynamic agricultural landscape where traditional practices intersect with emerging technologies. This case study aims to explore the current state of mechanization in dairy farms in and around Bhopal, shedding light on the prevailing practices, challenges faced by farmers, and the potential for technological advancements to drive sustainable growth in this vital sector. As the dairy industry undergoes a paradigm shift towards modernization, understanding the nuances of mechanization in a localized setting like Bhopal holds valuable insights for agricultural development strategies and the broader national dairy sector.

MATERIALS AND METHODS

The eight dairy farms were visited in Bhopal city and nearby areas in 2016. The information of dairy farm such as animal type, number of animal, number of person working in the dairy, feed type, time for feeding and milking, feed amount, milk production per animal, dairy structure and Mechanization in dairy were collected. These dairies located in surrounding of Bhopal and in Bhopal. The dairy of more than 40 animals were selected for survey.

RESULTS AND DISCUSSION

Details of Dairy

Out of 8 dairies 6 dairies were buffalo based and whereas two dairy is cow based. These buffalo were belongs generally Murrah breeds. The dairy farm no. 1, No. 2, No. 3, No. 4, No. 5 and No. 6 having 70, 40, 300, 130, 250 buffalos and farm no. 6 and No. 7 having 100 and 50 cows of local breed. Dairy farmers are using different types of feeds for the animals in that they are generally using straw, Binola/

khali (cotton seed oil cake or cotton oil cake), channa Churi, Channa Chilkha (Husk of Chickpea), chapd (bran), green fodder, additives etc. The feed details of different dairies are given in Table 1.

Dairy structure

The dairy structure constitutes a fundamental element in the mechanization of dairy operations. While these dairy structures vary, a majority feature concrete structures with farm sheds, either with or without trusses. Although the structures are predominantly face-in type (head-to-head arrangement), they exhibit differences in various aspects (Fig. 2). The survey reveals that most dairies have a main structure (Fig. 2a) with 2-4 rows of face-in type arrangement (Fig. 2b, Fig. 2c, and Fig. 2f). Some dairies extend the main structure by creating a single row, as depicted in Fig. 2d. In Bhopal, the prevalent dairy structures are face-in type, with a few featuring face-out/tail-to-tail arrangements (Fig. 2e and Fig. 2). Among the surveyed dairies, only one had provisions for tractor movement between the dairy structures (Fig. 2g), albeit with a face-out arrangement (Fig. 2h).

Feeding practices

In general, in these dairies feed is dispensing two times a day. The details of feeding of different dairies are given in Table 2.

Feed quantity

In Bhopal Dairies the feed quantity of lactating animal and dry animal were different. The details of feed quantity in dairies are given in Table 3.

Dairy mechanization

In these dairies, power chaff cutters are the

Table 1: Feed details of different dairies

Farm no.	No. of animals	Feed type
1	70 buffalo + 10 calf	Straw, Binola (cotton seed oil cake or cotton oil cake), channa Churi, Channa Chilkha, chapd (bran), yeast, green fodder (chari and cabbage leaves)
2	40 buffalo	NA
3	300 buffalo	NA
4	130 buffalo + 26 calf	Straw, Binola (cotton seed oil cake or cotton oil cake), channa Churi, Channa Chilkha, chapd (bran), yeast, green fodder (chari and cabbage leaves), mineral powder
5	250 buffalo + 50 calf	Bhusa, kutti, Dana (khali, channa churi, chapad, paddy, corn), salt, additives
6&7	150 cows local breed	Bhusa, dana (channa churi, chapad, kapila pashu ahara), hara chari



(a) Concrete structure, tin shed with feed alley in middle of the rows (face in)



(b) Concrete structure, tin shed with feed alley in middle of the rows (face in)



(c) Concrete structure, temporary roof with feed alley in middle of the rows (face in)



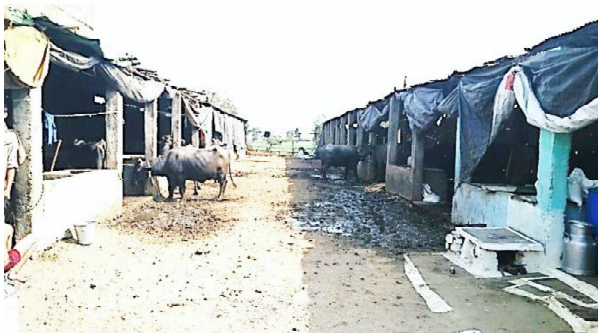
(d) Concrete structure, tin shed with feed alley in end of the row (face out)



(e) Concrete structure with feed arrangement at outer side



(f) Concrete structure with feed alley in middle of the row



(g) Concrete structure with temporary roof with feed alley at outer side and movement space for tractor in between two rows



(h) Inner view of one side of dairy structure with feed alley at outer side and movement space for tractor in between two rows

Fig. 1: Different dairy structure used in Bhopal for dairy animals

predominant machines in use. Some dairies utilize grinders, but none of them employ milking machines. Past experiences with milking machines revealed an issue of blood contamination in the milk, leading to the discontinuation of this technology in their dairies.

Time and Man Power required for milking and feed preparation

The primary time and effort invested in dairy operations revolve around feed preparation, dispensing, and cleaning. In India, feeding practices typically involve a combination of chopped straw, chopped green fodder, and concentrate. Dairies commonly feed animals with either soaked chopped straw mixed with concentrate or provide dry, unchopped fodder to the animals (Singh, 2013). Table 4 presents the observed points based on the survey.

Mechanization and gaps

Indian dairies have the potential for mechanization, enabling fewer workers to manage a greater number of dairy animals. However, the implementation of mechanization is crucial in various aspects such as milking, feed preparation, feed delivery, and cleaning. In the survey of dairy farms in the surroundings of Bhopal, a prevalent observation is the low level of mechanization, with dairy farmers commonly using power chaff cutters and grinders for feed preparation. Notably, milking machines are not widely adopted by these farmers. The majority of these dairies feature a main structure with a head-to-head (face-in) arrangement, which has been extended over time as dairy businesses flourished. However, the extensions of dairy structures are not conducive to mechanization.

Several mechanized options, such as tractor operated

Table 2: Feeding practice details of different dairies

Farm no.	Man power	Feeding Frequency
1	8-10	2
2	NA	NA
3	NA	NA
4	10	2
5	16	2
6&7	NA	2 (concentrate) + multiple time (green fodder)

Table 4: Man power requirement for different operation in dairy

Operation	Man power requirement
Feed mixing and dispensing	One man required 1 h time to mix and dispense feed for 10 animals per day
Milking time	One person required 2 h for milking 12 animals in one time.
Feed type	Concentrate soaked in water 2-3 h before feeding

Total Mixed Ration (TMR) wagons, stationary electric motor-driven TMR wagons, milking machines, and dung cleaning machines, are available in the Indian market. For feeding systems, adopting a tractor-trailed TMR wagon in Indian dairies can reduce dependence on electricity. The incorporation of dairy mechanization allows the existing workforce to efficiently manage a larger number of dairy animals, ultimately leading to increased profitability. However, the current form of surveyed dairy farms, particularly those with a head-to-head arrangement, poses challenges for the use of tractor-driven TMR wagons due to limited space. Therefore, it is recommended for new dairy farmers who will construct their dairy farm in future to construct dairy farms with proper structures (Fig. 2) that facilitate the harnessing of benefits from a mechanized dairy farm.

Table 3: Feeding practice details of different dairies

Farm no.	Feeding amount for lactating animal/day	Feeding amount for dry animal/day
1	5 kg bhusa + 3.5 kg concentrate	Less amount concentrate
2	NA	NA
3	NA	NA
4	10 kg bhusa + 5 kg concentrate + 10 kg green fodder	Less amount concentrate
5	2.5 kg bhusa + equal to milk concentrate (wet) + 2 kg green fodder	2.5 kg bhusa + 3-4 kg concentrate (wet) + 2 kg green fodder
6&7	10 kg bhusa + 5 kg concentrate	Only bhusa



Fig. 2: A typical structure of dairy farm suitable for dairy mechanization at ICAR-NDRI Karnal

CONCLUSION

The surveyed dairy farms exhibit a notably low level of mechanization, with dairy farmers primarily utilizing chaff cutters and fodder grinders. Typically, one person oversees the activities for approximately 10 animals in these dairies, including feed preparation, dispensing, milking, and cleaning the dairy farm floor—operations that are both labor-intensive and time-consuming. While dairy workers are unfamiliar with feed mixing, dispensing, and cleaning machines/setups, whereas they have previously employed milking machines. Past encounters with milking machines, however, resulted in issues such as blood contamination in the milk, prompting the discontinuation of this technology in their dairies. The potential for increased mechanization exists if new dairy farms are planned systematically in Bhopal and its outskirts. Furthermore, there is a need for awareness among dairy farmers regarding the use of these basic dairy farm machines to maximize the benefits of dairy farm mechanization.

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