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Technological Gap Analysis: A Case Study of Anand, Gujarat

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ABSTRACT

Background: Indian Dairy Industry is vital to the growth of rural economy of India and employing good dairy farming practices is a sustainable approach to achieving this goal. Good dairy farming practices, according to FAO, are about implementation of effective and suitable practices on dairy farms so that the intended use of dairy products and by-products could be achieved while ensuring the farm business remains economically viable. The aim of the present study was to analyze the technological gap in adoption of good dairy farming practices among dairy farmers.

Methods: Anand district was selected purposively. For the estimation of technological gap, six major components of dairy farming *viz*, animal health, hygienic milking, animal nutrition, animal welfare, environmental and socio-economic management practices of animals were used.

Result: The study results indicate that nearly three-fifths of the respondents exhibited a medium level of overall technological gap in good dairy farming practices, followed by 27 per cent of respondents showing a low level of technological gap. Comprehensive awareness and training programs should be crafted to educate farmers about the importance and implementation of effective dairy farming practices, with a focus on animal health, hygienic milking, nutrition, welfare, environmental management and socio-economic aspects. Strengthening of extension services, financial incentives and formulation of regulatory frameworks is crucial in bridging the technological gap in good dairy farming practices.

Key words: Adoption, Dairy farmers, Good dairy Farming practices, Technological gap.

INTRODUCTION

Dairy, in India, is the representation of empowerment, equity and inclusivity where milk is considered as the symbol of collectivization and diversity (Dash *et al.,* 2020). Blessed with largest dairy base and producing 24 per cent of milk globally (PIB, 2023), India is capable of creating income for its growing population from the sector. However, the large dairy base is a matter of concern for efficient resource allocation and its effective utilization (Brown *et al.,* 2022; Senthilkumar, 2018). Therefore, it is very much essential to identify quality breed supported by better feed management practices, to run a dairy farm efficiently in the interest of the producers (Mariammal, 2018). Moreover, cleanliness, hygienic practices, effective floor space, disease (Bafanda *et al.,* 2018) and labour management plays a critical role in safe milk production (Panda and Samanta, 2018) that ultimately create value for money.

Success of dairy development in India is the outcome of white revolution (1970) and Amul pattern of cooperative marketing model (Chawla, 2011) through which technology like artificial insemination was transferred regularly for breed improvement supported by milk production and its effective disposal across the country. Further, different farm or enterprise is supported and nurtured through other technological interventions, such as RFID Technology, Modern Sensor technology, Automatic milking system, Automatic feeding machine and many others. On the other hand, adoption of technology at the dairy farm level throughout the nation requires an ongoing awareness campaign using various extension tools, particularly Krishi Vigyan Kendra.

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Gap is difference between “what is desired” and “what is actual”. The disparity between the optimal allocation and integration of resources and the current level of allocation is identified by gap analysis with an aim to find the difference between policymakers and milk producers (Gurund and Jaishi, 2018). The technological gap in good dairy farming practices refers to the disparity between excellent dairy livestock techniques as defined by the Food and Agriculture Organization (FAO, 2011) and dairy farmers’ level of adoption of good dairy farming practices. Implementation of sound dairy practices to ensure production of safe and good quality dairy products, is the primary aim of good agricultural practices. Technological gap and right dairy management becomes apparent due to the inaccessibility of information and challenges in its effective execution. As a result, producer may struggle to comprehend recommen

dations and the actual modus operandi of dairy farm (Chinchmalatpure *et al.,* 2017). It was observed that more than half of the dairy producers in India were unable to manage dairy farm practices properly, resulting in inefficiency and poor income from their enterprise (Chinch malatpure *et al.,* 2017). In a country like India where more than 70 percent of population resides in rural sector (Kapur, 2019) and more than 85 per cent of farmers own less than 2 ha of land and, with about 75 per cent depending on dairy farming (Kumar *et al.,* 2018), implementing proper dairy management practices is crucial to lift them out of paucity and poverty. It also contributes to India's socioeconomic development (Prajapati, 2021). Technological gap analysis in dairy farm management practices will serve as a solution to address the existing challenges. Effective dissemination of information is necessary to make dairy more inclusive in coming future which has the potential to control malnutrition, undernutrition and hypoproteinemia conditions in the lactovegetarian country like India.

Anand district in Gujarat, India, holds paramount importance, particularly since the inception of Operations flood which propelled the Amul brand to flourish as the fastest growing dairy brand across the world. Anand Milk Union Limited (Amul) is the umbrella brand and one of the milk unions of Gujarat Cooperative Milk Marketing Society (GCMMF) situated at Anand. NDDB (National Dairy Development Board) and NCDFI (National Cooperative Dairy Federations of India) are also headquartered in Anand which have been providing policy support to the milk unions and federations continuously for over 50 years. The cooperative sector, that targets small and marginal farmers, has encountered challenges in reaching everyone due to various operational issues such as in timely payments, dairy milk procurement and governance. This has paved the way for the emergence of private players and many other dairy marketing structures across the nation. The contract farming model of NESTLE targets large dairy farmers at NCR region of Delhi, signals expansion opportunities in other parts of India (Shah, 2021). Other regional players like Milk Mantra and Milk Mist have demonstrated success in their respective regions where dairy cooperatives have struggled to thrive well.

Under this background, it is important to understand technological gap in dairy sector at Anand district of Gujarat. This study targets large dairy producers, assuming their higher level of education, awareness, more marketed surplus and better management practices in Anand district, Gujarat. Any gaps identified through the study could serve as solutions for other dairy practitioners and could be replicated and disseminated across the nation, similar to the cooperative structure established after the Operations flood.

MATERIALS AND METHODS

Anand district is known as the milk capital of India and as Charotar (land of prosperity) looking into the overall agro-dairy based production and enterprises across the districts. The district is situated between 72.15" -73.18" East (Longitude) to 22.07"- 23.29" North (Latitude) on the World Map with 2951 sq.km geographical area, Anand is located near the Gulf of Cambay in Central Gujarat. Proximity to Ahmedabad, Vadodara, Bharuch and Gandhinagar districts has made the district an important key center in Gujarat. Besides that, advent of Delhi-Mumbai express corridor and bullet train like projects make this district a strategic location in coming future.

Besides that, Anand district is also linked to other academic and dairy institutions like NDDB, NCDFI, Anand Agricultural University, Sardar Patel University, DMPAR (ICAR-Directorate of Medicinal and Aromatic Plants Research), IWMI (International Water Management Institute), IRMA (Institute of Rural Management) and many more, within a circumference of 10 km (max). By promoting a culture of knowledge sharing, this network helps achieve the national goal of Vishwaguru as seen from a variety of perspectives and methods.

A good number of large dairy farms are located throughout the district. After discussion with dairy farmers, academia, scientists and other interrelated personnel in the sector, it was decided to do technological gap analysis in dairy farming by putting a cap of 50 as herd capacity. A total 26 dairy farms were observed in the districts for the study purpose, resembling a census approach within specific categories.

For technological gap analysis[1], animal health, animal feeding, hygienic milking, animal welfare, environment and socio-economic management practices were considered.

The variables of the study were considered as per the criteria of FAO (2011) good dairy farming practices adopted for the dairy farming.

Frequency and percentage were calculated and a simple comparison was conducted. The technological gap in the adoption of good dairy farming practices refers to the disparity between dairy animals' good practices and dairy farmers' adoption of those same good practices. The responses of the respondents were taken against each of the practices on a two-point continuum representing adoption and not adoption with scores of 1 and 0 respectively. The technological gap was measured with the help of technological gap index developed by 'All India Co-ordinated Research Programme in Extension', I.A.R.I., New Delhi (Anonymous, 1979). The formula adopted for measuring technological gap index is as under:

$$\text{Technogial gap index} = \frac{R - A}{R} \times 100$$

[1]The technological gap in the adoption of good dairy farming practices refers to the disparity between dairy animals' good practices and dairy farmers' adoption of those same good practices

Where,
R= Recommended practices.
A= Practice actually adopted by farmers.

RESULTS AND DISCUSSION

Good animal health practices

As highlighted in Table 1, all the respondents in the study area adopted to manage animal diseases that can affect public health (zoonotic diseases[2]) and well connected with veterinarians and pharmaceutical agencies for taking any remedial measures and medicines. It is in line with the findings of Tewari *et al.* (2018) who found that majority of the dairy farmers were availing health care services through veterinary hospital or dispensary. This could be attributed to the presence of Amul, which offers treatment and extension services at the grass root level.

Respondents were also aware about selection of breed (84.62%) and identification of animals that help them to maintain the records (84.61%) for further care and management. About 88.46 per cent of respondents purchased healthy animals only from known sources and 84.62 per cent of respondents adopted selection of breeds and animals well suited to the local environment and farming system.

In case of using of identification system, it was observed that 88.46 per cent of respondents recognize animals from birth to death. About 76.92 per cent of respondents adopted immediate care practice of sick animals and follow-up; may be due to accessible health facilities from Amul and other government dispensaries near to the dairy farm. However, major technological gap was found in case of regular health check-up of animals for sign of disease (23 responds), isolating sick animals (14 responds) and vaccination of all animals as recommended schedule (15 responds) in good animal health practices. It is in line with the findings of Sood *et al.* 2020, Shakya *et al.,* 2019. It might be due to unawareness regarding subclinical symptoms[3] of the disease at the respondent level, which

Table 1: Technological gap in adoption of good animal health practices. (n=26)

Items	Frequency	Percentage (%)
Selection of breeds and animals well suited to the local environment and farming system	22	84.62
Vaccination of all animals as recommendedschedule	15	57.69
Purchase of healthy animals from known source and following quarantine measures for new animals to be added in the herd.	23	88.46
Using an identification system that allows all animals to be identified individually from birth to death (tagging the animals for identify)	23	88.46
Regular health check- up for signs of disease	6	23.08
Immediate care of sick animals and follow-up	20	76.92
Isolating sick animals	14	53.85
Maintenance of records for all management/health care profile	22	84.61
Manage animal diseases that can affect publichealth (zoonosis)	26	100.00
Use of quality medicinefromcertified pharmacies as per recommended dosages	26	100.00
Using only veterinary medicines as prescribed by veterinarians	26	100.00

Table 2: Technological gap in adoption of good hygienic milking practices. (n=26)

Items	Frequency	Percentage (%)
Segregate milk drawn from sick or under treatment animals for appropriate disposal	20	76.92
Maintaining clean housing and milking area	9	34.62
Ensuring basic hygiene measure for milking	11	42.31
Ensuring milking utensils are cleaned before and after milking	26	100.00
Ensuring disinfection of storage area after each milking	25	96.15
Ensuring milk is cooled or delivered for processing within the specified time	26	100.00
Ensure clean milk storage area	24	92.31
Arranging adequate milk storing containers	26	100.00

[1]Zoonotic diseases are infections that are spread between people and animals
[1]Subclinical diseases are conditions where the disease is identifiable with laboratory testing or imaging, but have no outward signs or symptoms

necessitates further technological interventions through public private partnership.

Good hygienic milking practices

As evident from the Table 2, majority (100%) of respondents have adopted practices to ensure use of cleaned milking utensils before and after milking, to ensure milk was cooled or delivered for processing within the specified time and to arrange adequate milk storing containers for good hygienic milking practices. As dairy cooperative society was near to respondent farmers, which ensures a reliable and steady source of income, through proper disposal pattern to the milk unions, respondents adhered to the clean milking practices and were attentive to the possible wastages resulting from irresponsible management of milk. This is evident in their clean milk storage practices, with 96.15 per cent of respondents disinfecting the storage area after each milking and 92.31 per cent ensuring the milk storage area remains clean. Less than half of respondents (42.31 %) have fulfilled the basic hygiene measures in clean milk production which is another area of concern in the study area. Again, the milking parlour was also not maintained properly by many respondents (65.38%) in the study area. There are clear-cut discrepancies in the method of milking and the environment of milking among dairy farmers. This could be controlled properly through dissemination of information *via* different extension machineries, thus making the beneficiaries more scientific and astute in clean milk production.

Good animal nutrition practices

Feeding is another area of possible technological interventions as highlighted in Table 3. All of the respondents (100%) have ensured that chemicals are used appropriately on pastures and forage crops and observed with holding periods. Similarly, all the respondents utilized only permitted chemicals for treating animal feeds or components of animal feeds and observed holding periods. The adoption was 96.15 per cent among the respondents to ensure that proper care was taken while handling chemicals and feed stuffs. About 92.31 per cent of the respondents have ensured that appropriate storage conditions were met to avoid feed spoilage or contamination. In addition, 88.46 percent of respondents have made it a habit to keep track of all feed and feed ingredients supplied on the farm. About 80.77 per cent of farmers have adopted the practice to plan and execute farm input management activities for feed, fodder and medicines as well as ensured sufficient supply of clean and fresh water for animals. Only 34.62 per cent of respondents have adopted the practice to fulfill the nutritional requirements of animals through feed and fodder as most of the respondents didn't take it seriously and just fed the animals with unbalanced and less nutritional feed-fodder mixture. Major technological gap was found in case of ensuring the nutritional requirements of animals through feed and fodder in good animal nutrition practices.

Table 3: Technological gap in adoption of good animal nutrition practices. (n=26)

Items	Frequency	Percentage (%)
Planning and execution of farm input management activities for feed, fodder andmedicines	21	80.77
Ensuring a sufficient supply of clean and freshwater	21	80.77
Ensuring the nutritional requirements of animals are met through (feed and fodder)	9	34.62
Proper care was taken while handling chemicals and feed stuffs	25	96.15
Ensuring chemicals are used appropriately on pastures and forage crops and observe withholding periods	26	100.00
Using only approved chemicals for treatment of animal feeds or components of animal feeds andobserve with holding periods	26	100.00
Ensuring appropriate storage conditions to avoidfeed spoilage or contamination	24	92.31
Rejection of mouldy or sub-standard feed	26	100.00
Keeping records of all feed or feed ingredientsreceived on the farm	23	88.46

Table 4: Technological gap in adoption of good animal welfare practices. (n=26)

Items	Frequency	Percentage (%)
Preventing animals from eating toxic plants and other harmful substances	26	100.00
Providing adequate suitable space and clean bedding	9	34.62
Protecting animals from adverse weather conditions	23	88.46
Providing housed animals with adequate ventilation	14	53.85
Do not adopt procedures and practices that causeunnecessary pain	26	100.00
Providing suitable flooring and footing inhousing and animal traffic areas	14	53.85

Table 5: Technological gap in adoption of good environmental practices. (n=26)

Items	Frequency	Percentage (%)
Using farm inputs such as water and nutrientseffectively	19	73.08
Minimization of the production of environmentalpollutants from dairy farming	25	96.15
Implementation of practices to reduce, reuse orrecycle farm waste as appropriate	15	57.69
Disposal of waste to minimize environmental impacts	20	76.92
Using appropriate agricultural chemicals and veterinary medicine to avoid contamination of the local environment	25	96.15
Ensuring the overall application of the dairyoperation so that for high quality food is harvested	24	92.31

Table 6: Technological gap in adoption of good socio-economic management. (n=26)

Items	Frequency	Percentage (%)
Implementation of sustainable work practices	18	69.23
Employ labors based on national laws and practice	26	100.00
Have appropriate procedures and equipment inplace for undertaking dairy farming tasks	23	88.46
Ensuring the farm working environment complieswith relevant occupational health and safety requirements	24	92.31
Plan ahead to manage financial risks	20	76.92

Good animal welfare practices

As it was observed from Table 4 that in case of good animal welfare practices, all (100%) of the respondents have adopted practice to prevent animals from eating toxic plants and other harmful substances whereas no respondents have adopted any procedures and practices that cause unnecessary pain to animals. It is an area where respondents must be aware of veterinary ethics, code and conduct to keep the animals in their premises. Majority (88.46 per cent) of the respondents have adopted practice to protect animals from adverse weather conditions. About 53.85 per cent of the respondents have adopted both practices to provide adequate ventilation as well as to provide suitable flooring and footing in housing and animal traffic areas. Still, there is a great scope of improvement in this area to provide the animals clean house and suitable flooring space as these are fundamental factors impacting clean milk production. Similarly, there is significant scope of improvement in ensuring clean bedding and suitable space (only 34.62% have adopted). This could be done by commercialization of dairy farming which has potential to impact good animal welfare practices in the study area.

Good environmental practices

It is depicted from the Table 5 that majority (96.15%) of respondents have adopted both the practices of minimization of the production of environmental pollutants from dairy farming as well as to use appropriate agricultural chemicals and veterinary medicine to avoid contamination of the local environment. Most of the respondents (92.31%) have ensured the overall application of the dairy operations to get high quality food. About 76.92 per cent of respondents have adopted disposal of waste to minimize environmental impacts and 73.08 per cent of respondents have also adopted the practice to use farm inputs such as water and nutrients effectively. Slightly more than half (57.69%) of respondents have adopted implementation of practices to reduce, reuse or recycle farm waste as appropriate, however few farmers still haven't adopted regularity in reducing and recycling of farm waste. Major technological gap was found in case of implementation of practices to reduce, reuse or recycle farm waste as appropriate in good environmental practices.

Table 7: Overall technological gap in good dairy farming practices. (n=26)

Category	Frequency	Percentage
High (<29)	4	15
Medium (29 to 43)	15	58
Low(>43)	7	27

Good socio-economic management

It was observed from the Table 6 that in case of good socio-economic management practices, all the respondents have adopted practice to employ labors based on national laws and practices. About 92.31 per cent of the respondents have adopted practice to ensure the farm working environment complies with relevant occupational health and safety requirements. Majority of the respondents (88.46 per cent and 76.92 per cent, respectively) have implemented both the practices to have proper procedures and equipment in place for completing dairy farming tasks as well as to plan ahead for managing financial risks. About 69.23 per cent of respondents have implemented sustainable work practices, however few respondents haven't adopted sustainable work practice for dairy farming due to their

improper management in several areas (like animal health and safety, hygiene and quality assurance of produce, cleaned and efficient housing, waste management, *etc*.).

Overall technological gap in good dairy farming practices

It is calculated by considering six major components of dairy farming, *viz*; animal health, hygienic milking, animal nutrition, animal welfare, environmental and socio-economic management practices of animals. It is observed from the Table 7 that majority (58%) of respondents had medium level of overall technological gap in good dairy farming practices. Twenty-seven per cent respondents had low level of technological gap and 15 per cent respondents had high level of technological gap in good dairy farming practices. It is found that the technological gap in adoption of good dairy farming practices was medium in overall good dairy farming practices as the respondents have not adopted regular health check-up of animals for sign of disease, maintain clean housing and milking area, ensure the nutritional requirements of animals through feed and fodder, provide adequate suitable space and clean bedding, implementation of practices to reduce, reuse or recycle farm waste as appropriate and implementation of sustainable work practices.

CONCLUSION

The implementation of good dairy farming practices is crucial for sustainable growth of dairy industry, benefitting both dairy farmers and consumers from the economic, social and environmental perspectives. Overall technological gap for good dairy farming practices found medium to low as respondents have not adopted regular health check-up of animals for sign of disease, maintain clean housing and milking area, ensure the nutritional requirements of animals through feed and fodder, provide adequate suitable space and clean bedding, implementation of practices to reduce, reuse or recycle farm waste as appropriate and implementation of sustainable work practices. Maintaining cleanliness and hygiene in all areas of a dairy farm will protect animals from pests, insects and diseases while also improving the quality of the produce. The dairy farmers should develop a habit to observe and check animals regularly in order to keep them safe and healthy, maintain cleanliness and hygiene in all the parts of dairy farm to protect animals from pests, insects and diseases as well as to improve quality of produce and give proper attention to all the on-farm activities (animal health and safety, hygiene and quality assurance of produce, cleaned and efficient housing, waste management, *etc*.) simultaneously to enhance the overall farm performance.

There is a need of comprehensive awareness and training programs so that farmers could understand the importance of effective dairy farming practices. Extension services should be strengthened to provide support and guidance to the farmers and helping them to overcome the barriers. Financial incentives and strong regulatory framework are required to improve the performance of dairy farms. Transfer of knowledge and capacity building programs can be facilitated through collaborative approach of government, dairy cooperatives and non-government organizations.

Conflict of interest

All authors declared that there is no conflict of interest.

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