International Journal of CO-OPERATIVE ACCOUNTING AND MANAGEMENT, 2024
VOLUME 7, ISSUE 2
DOI: 10.36830/IJCAM.202408

Cooperative Synergy: Unleashing the Power of Dairy Cooperatives in Achieving Sustainable Development Goals

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Abstract: The study presents the general concept of cooperatives, with a particular emphasis on dairy cooperatives, emphasizing their role in fostering collaboration, inclusion, and social growth. It emphasizes the significance of cooperatives in achieving various Sustainable Development Goals (SDGs). The study aimed to explore the intricate relationship between dairy cooperatives, using the case of "AmulFed Dairy of India" as an example, and their role in advancing the SDGs. The study adopted an exploratory case study approach to collect data and gain a comprehensive understanding of the AmulFed's contributions to the SDGs. The primary finding of the study is that dairy cooperatives, as represented by AmulFed Dairy, are closely aligned with all seventeen SDGs. Finally, the study recognizes and commends AmulFed for its consistent dedication to achieving prosperity, equity, and sustainability within the dairy sector and among its participants. This study emphasizes the critical role of dairy cooperatives in furthering sustainable development and demonstrates their positive influence across multiple dimensions of societal well-being.

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Keywords: AMUL, Cooperatives, Dairy, India, Sustainable Development Goals

1. Introduction

The world we live in is marked by diverse challenges. Around 656.4 million people worldwide live in extreme poverty, meaning they survive on less than $1.90 per day (Lakner et al., 2022). When it comes to 'inequality', people round the globe are witnessing disparities in terms of both income and wealth, with wealth inequality being particularly pronounced. Approximately 10% of the worldwide population receives 52% of global earnings, while the poorest 50% of the population earns only 8.5%. Furthermore, ownership is even more concentrated. Half of the global population owns only 2% of global wealth, whereas 10% of the global population controls 76% of total global wealth (Chancel et al., 2022). The overall health disparity round the globe in terms of access to healthcare, child mortality, maternal health, malnutrition and disease prevalence is a matter of grave concern.

Similar is the case of global education disparity. According to the UNESCO Report, 2022, in low-income countries, out of school rate for lower secondary level, upper-secondary level is as high as 39 per cent and 61 per cent respectively. While talking about the high-incomes countries, 3% of the students are out of school at lower secondary level compared to 8 per cent in upper secondary level. In low-income countries, 65% of girls between the age of 15 and 17 are not in school. People globally are facing problems in terms of access to clean water and sanitation. According to UNICEF data (2023), about 2.2 billion people lack access to safely managed water services. As many as 115 million people in the world still collect drinking water directly from rivers, lakes, and other surface water sources. The findings show stark differences, with the poorest and those residing in remote areas having the lowest likelihood of using a basic service. In the majority of nations, women and girls continue to bear the burden of collecting water.

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The condition of environmental degradation is also similar. According to the reports of 'The World Counts (2023)', annually, around 55 billion tons of fossil energy, minerals, metals, and biomass are extracted from the Earth. Based on the present deforestation rate, it is projected that around 5-10% of tropical forest species will become extinct with each successive decade. On an hourly basis, about 1,692 acres of arable land are undergoing desertification. The effect of climate change is also visible: Earth's temperature has risen by an average of 0.14° Fahrenheit (0.08° Celsius) per decade since 1880, or about 2° F in total. The above stark statistics leave out the further complications of regional wars, the criminal networks trafficking people and drugs and engaging in enslavement. Often corruption at state levels and the misuse of the latest technological innovations for disinformation and manipulation add further dimensions to this multifactored global crisis. All these factors add emphasis and urgency for global cooperation to address these issues.

1.1 United Nation's Sustainable Development Goals

The holistic term 'Sustainable Development' focuses on intergenerational equity of resources for meeting present as well as future needs (Brundtland Report, 1987); improving quality of life without compromising environmental sustainability or harming the prospects for future generations (Murphy, 2006); and development that meets current needs and goals without jeopardising future ones (Daly, 1990; Pearce et al., 1989). According to UN secretary-general Antonio Guterres, 'sustainable development', fundamentally, emphasizes upholding human rights, ensuring peace and security. He focused on leaving no one behind, by reducing inequalities within as well as between nations, reaching those most at risk, and bolstering our resolve to prevent conflict and maintain peace (Voinea, 2018). Thus, it will be fully justified to recognise sustainable development as the concept which seeks to achieve a balance between social equity, economic growth and environmental well-being by adoption of a sustainable package of practices in all aspects of development.

The year '2015' witnessed a vigorous, inclusive and comprehensive call for sustainable development in the form of the United Nations' Sustainable Development Goals (SDGs). It was also known as the 'Global Goals', as they were a universal call to end poverty, safeguard the planet, and ensure that all people enjoy peace and prosperity by 2030 (Odey et al., 2021). SDGs are an ambitious plan inclusive of 17 goals and 169 targets related to poverty, food, health, education, women, water, energy, economy, infrastructure, inequality, habitation, consumption, climate, marine ecosystems, institutions for peace, and sustainable development (Carreira et al., 2017). The SDGs have a set deadline of 2030, so they are even called 'AGENDA-2030'.

1.2 India and Sustainable Development Goals

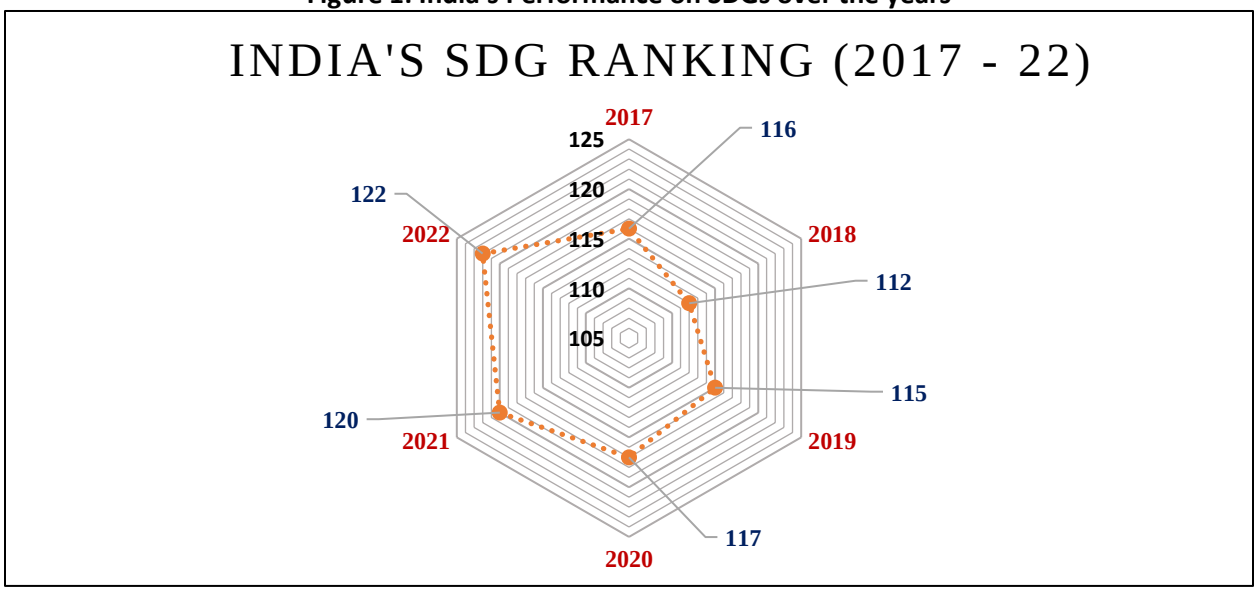
On one hand, 'India' happens to be the world's largest democracy with a federal parliamentary system, fifth largest economy globally, expected to rise to the third position in near future (Economic Survey, 2022-23), emerging market and an active influencer of international affairs. However, on the other hand India faces many social, economic, and environmental challenges such as low per capita income, poverty, hunger, energy security, water security, increasing population, sanitation, poor health care, depleting natural resources and climate change (Bansal et al., 2020, Singh & Rahman, 2021). India was one of the 193 United Nations member states to adopt the SDGs and commit itself as a stakeholder to meet the 2030 agenda for sustainable development (Singh & Rahman, 2021). India has been instrumental in the formation of the SDGs, and the country's national development objectives are reflected in SDGs (NITI Aayog, 2017).

Over the years, India has vociferously advocated and worked towards attaining the different SDGs. India has maintained approximate constancy in the overall SDG Index and Ranking over the years as represented in Figure 1. Indian government through its implementing agency 'National Institution for Transforming India' (NITI Aayog) and evaluation agency 'The Ministry of Statistics and Programme Implementation' (MOSPI) are carrying out a mapping of all SDGs and government sponsored schemes running parallel to these SDGs for their grass-root implementation. Some significant positive shifts made by India over the years with the SDGs functional have been described below.

- **SDG 1: No Poverty** - Over the years, India has made considerable progress in decreasing poverty. According to the World Bank (2021), India's poverty rate has dropped from 21.6% in 2011 to 9.7% in 2019.

- **SDG 2: Zero Hunger** - India has made progress in reducing hunger and improving food security. The Global Hunger Index (GHI) score for India has improved from 38.9 in 2000 to 27.2 in 2021. It should be noted here that a lower score in the index indicates lower hunger levels (Von Grebmer et al., 2021).
- **SDG 3: Good Health and Well-being** –
  - ✓ Under-five mortality rate decreased from 126 per 1,000 live births in 1990 to 34 per 1,000 live births in 2019 (UNDP, 2020).
  - ✓ Maternal mortality ratio declined from 556 deaths per 100,000 live births in 1990 to 113 deaths per 100,000 live births in 2016 (World Bank, 2021).
- **SDG 4: Quality Education** - The literacy rate in India increased from 64.8% in 2001 to 74.04% in 2011 and further to 77.70% in 2021 (National Statistical Office of India, 2021).
- **SDG 5: Gender Equality** - The percentage of seats held by women in the national parliament (Lok Sabha) increased from 4.4% in 1990 to 14.4% in 2020 (World Bank, 2021).
- **SDG 7: Affordable and Clean Energy** - India's total installed renewable energy capacity reached around 98 gigawatts (GW) as of 2021, accounting for nearly 24% of the country's total installed capacity (Ministry of New and Renewable Energy, Government of India, 2021).
- **SDG 11: Sustainable Cities and Communities** - The Smart Cities Mission aims to develop 100 smart cities across India. The mission focuses on aspects like efficient energy use, sustainable transport, and improved livability (UN-Habitat. MoHUA, GoI. 2023).

Figure 1: India's Performance on SDGs over the years



Source: SDG Index Report, UN, 2017 -2022

Though India is progressing well in all the aspects of SDGs, but still India has a long way to go. There are a few reports which certainly give an idea about volume of work the country has to do. According to National Annual Rural Sanitation Survey, 2019-20, conducted by Independent Verification Agency (IVA) under the World Bank support project to the *Swachh Bharat Mission* Grameen (SBM-G), only 64.9 per cent of rural population have access to improved sanitation facilities. About 15 per cent of the rural population doesn't have safe, functional and hygienic toilets, 10 per cent of Indian villages are not 'Open Defecation Free'. Similarly, the NITI Aayog's Composite Water Management Index (2019) reported that the states of Maharashtra, Gujarat, Karnataka, Jharkhand, Andhra Pradesh and Rajasthan, Uttar Pradesh, Punjab, Delhi, Bengaluru, and Chennai have been facing serious Water scarcity since 2018. India is experiencing an acute water challenge, the country has per capita water availability close to or lower than 1000m3, which is just the threshold amount described by the 'Falkenmark Index'.

According to the Annual Status of Education Report (ASER), 2019, 25% of youngsters in rural India are still unable to read simple text proficiently even after four years of schooling. India is one of the world's largest emitters of greenhouse gases and faces numerous environmental challenges, including air pollution, deforestation, and water pollution (Chopra, 2016). All the 1.4 billion population of India are living in areas where the annual average level of particulate pollution exceeds the World Health Organization guideline. About 94 percent of them reside in areas where the air quality exceeds India's own standard. A quarter of India's population is exposed to pollution levels not seen in any other nation, and 248 million residents of northern India are projected to lose more than eight years of life expectancy if pollution levels continue (Greenstone & Fan, 2020). India was ranked 140 out of the 189 countries, indicating significant gender disparities in areas such as education, health, and economic participation (The Gender Inequality Index, 2020). According to the National Crime Records Bureau, about 405,861 crimes against women were reported in 2019, highlighting the persisting challenges of gender-based violence.

The Global Nutrition Report, 2021 highlighted that there has been no significant improvement in areas of anaemia, under-5 wasting, adult male and female obesity and adult male and female diabetes. There has been a 15% increase in deaths due to poor diet in India since 2010. The report points out the loophole in India's public distribution system (PDS) even though the PDS aims to distribute essential commodities to the marginalized population at subsidized rates to ensure food security for all. India's PDS faces persistent problems like fake supply of ration cards leaving the poor out, selling the commodities on the open market, not supplying permitted amounts of food grains by the fair price shops, replacing good quality food grains with cheap varieties, etc.

1.3 The Present Status of Cooperatives in India

A cooperative is defined as an autonomous association of people united voluntarily to meet their common economic, social and cultural needs and aspirations through jointly-owned and democratically-controlled enterprises (ICA, 1995). Cooperatives around the globe have one billion members, provide 100 million jobs and the top 300 cooperatives are worth 1.6 trillion-dollars, equivalent to the 9th largest economy in the world. Cooperatives are highly relevant and important in the realization of the SDGs as they offer an opportunity to mobilise the poorest of the community. Being member service driven rather than having their performance measured by Return of Capital Employed (ROCE), their economic model is able to address the disparity in ownership at the global level and contribute to sustainable economic growth, social development and environmental responsibility.

According to the United Nations, cooperatives, in their purpose and operation, are naturally sustainable organizations. They can be considered as a business that is encouraged to implement the 2030 Agenda for Sustainable Development. The 2030 agenda for sustainable development explicitly recognizes co-operative enterprises as important players within the private sector to achieve the SDGs (Gicheru, 2016). The International Cooperative Alliance (ICA) has identified targets within the 17 SDGs of most relevance to co-operatives and grouped them into main action areas: eradicating poverty, improving access to basic goods and services, and protecting the environment and building a more sustainable food system (Iyer, 2020).

Cooperatives contribute to a sustainable future with their inclusiveness and transparent accountability for achieving the SDGs. They support the United Nations in the implementation of the SDGs, creating the framework for sustainable business practices at all levels- economic, social and environmental. Several initiatives as well as activities have been undertaken by cooperatives from local to global levels in the fields of agriculture, manufacturing, banking, industry, consumption, technology, etc., for contributing to the SDGs in many diverse and unique ways (Gicheru, 2016). The following contributions are made by cooperatives at a global level: sustainable economic growth and starting of ventures to reduce poverty; food security through sustainable agriculture and food fortification to end hunger (Schwettmann, 2014); health management for good health (Leviten, 2009)**;** educational projects to ensure quality education; and promotion of diversity for gender equality (Lafont & Ribeiro-Soriano, 2023). Cooperatives have been instrumental in ensuring sustainable use of water and sea water desalination to ensure sanitation for all (Deane & Mac Domhnaill, 2021), sustainable investments for economic growth (Brief, 2015).

The case of the cooperative development of India's Dairy Industry

India today is the largest producer of milk in the world, contributing about twenty-three per cent of milk produced worldwide, but India's position during 1950s and 1960s was drastically different. India was a milk deficit nation and

was dependent on imports for meeting its requirements. The annual compound growth rate in milk production during the first decade after independence was 1.64%, which declined to 1.15% during the 1960s. In 1950-51, per capita consumption of milk in the country was only 124 grams per day. By 1970, this figure had dropped to 107 grams per day, one of the lowest in the world and well below the minimum recommended nutritional standards. India's dairy industry was struggling to survive. This evolution in India's dairy scenario can be augmented to the stellar role played by the dairy cooperative.

India, under the leadership of late Prime Minister Lal Bahadur Shastri, established National Dairy Development Board in 1965 with a mandate to support the creation of the 'Anand Pattern' of dairy cooperatives across the country through the Operation Flood (OF) programme, which was to be implemented in phases. The 'Anand Pattern' generally known as Anand Milk Union Limited (AMUL) is essentially a cooperative structure comprising village-level Dairy Cooperative Societies, which promote district-level unions, which in turn promote state-level marketing federations. Operation Flood was implemented in the following phases:

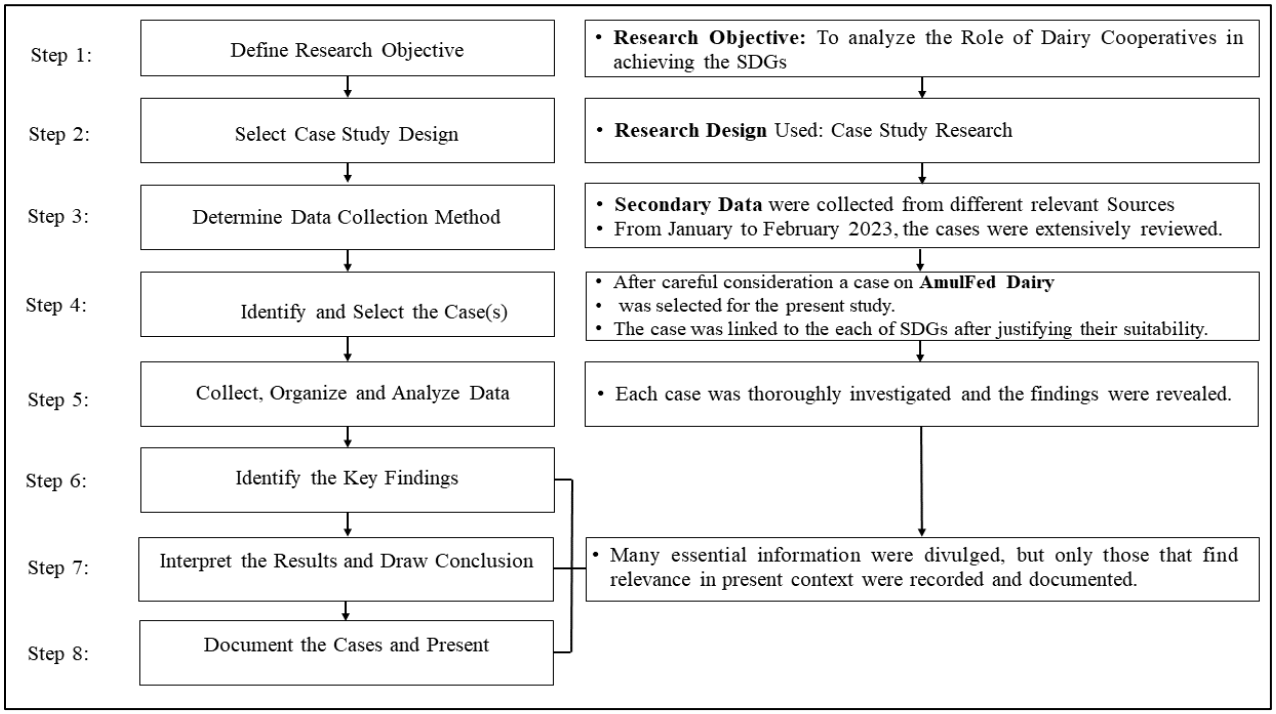
- Phase I (1970–1980) was financed by the sale of skimmed milk powder and butter oil donated by the European Union (then the European Economic Community) through the World Food Programme.
- Phase II (1981–1985) increased the number of milk sheds from 18 to 136; urban markets expanded the outlets for milk to 290. By the end of 1985, a self-sustaining system of 43,000 village cooperatives with 4,250,000 milk producers had been covered.
- Phase III (1985–1996) enabled dairy cooperatives to expand and strengthen the infrastructure required to procure and market increasing volumes of milk. This phase added 30,000 new dairy cooperatives, which led to a total of 73,000.

Milk production of India in 1950-51 was merely 17 million tonnes (MT), which with the efforts of these cooperatives has increased to 210 million tonnes in 2020-21. Today, world milk production is growing at the rate of two per cent, whereas in India, its growth rate is more than six per cent. The per capita availability of milk in India is much higher than the world average. In three decades (the 1980s, 1990s and 2000s), the daily milk consumption in the country rose from a low of 107 grams per person in 1970 to 427 grams per person in 2020-21 as against the world average of 322 grams per day during 2021.

2. Methodology

The present investigation uses 'case study' research design to probe the role played by the dairy cooperatives in realizing the SDGs through the lens of 'AmulFed Dairy', a unit of the "Gujarat Cooperative Milk Marketing Federation Ltd. (GCMMF)". The case study method involves in-depth exploration of a phenomena, event, individual, group, or organisation in its real-life setting. It seeks to comprehend the case and gather rich, thorough data from numerous sources. Case studies use qualitative methods including interviews, observations, and document analysis to investigate complicated occurrences and build theories (Yin, 2018; Flyvbjerg, 2011; Baxter & Jack, 2008; Stake,1995). Case study research method is appropriate to use, when the researcher is probing 'why' or 'how' type of questions and the phenomenon to be studied is in real-life context (Grauer, 2012). The complete methodology followed is shown in the form of a flow chart (Figure 2). For data collection, 'document analysis' approach was used.

Figure 2: Flow Chart Showing Case-Study Methodology



Followed: authors' own depiction adapted from Yin (2018).

3. Results and Discussion

This section illustrates the case of the 'AmulFed Dairy', a unit of the "Gujarat Cooperative Milk Marketing Federation Ltd. (GCMMF)" and depicts how dairy farmers at a grassroots level became active agents in the process of their own development and empowerment. In doing so, the study contributes to the ongoing research on dairy cooperatives' role in achieving SDGs in India.

Background

The innovative and inspiring dairy cooperative model started in 1946 as a symbol of protest against the middlemen in Anand, Gujarat. The cooperative, which started initially as Kaira District Cooperative Milk Producers Union Ltd, led by Pioneers like Morarji Desai and Tribhuvan Das moved strength by strength under the guidance of Dr. Verghese Kurien, the Milk Man and Father of White Revolution in India. The AMUL model was instrumental in bringing white revolution in India with its three-tier structure. The "Amul girl" campaign, was a successful advertising and marketing tactic that improved brand recognition for AMUL. The cooperative's growth, diversification into different dairy products, and international recognition was in response to its success in the holistic transformation of communities.

AmulFed Dairy Gandhinagar, a division of the GCMMF, commenced its operations in September 1994 with the capability to process 1 million litres of milk daily. Over time, AmulFed Dairy, Gandhinagar has undergone full automation and evolved into a versatile manufacturing facility producing various goods. Presently, it boasts a milk processing capacity of over 6 million litres daily. This achievement positions it as one of the largest dairy plants in Asia, processing such a substantial volume of milk and transforming it into an array of value-added dairy items at a single site. AmulFed Dairy's primary objectives include receiving "Excess Milk" from the Member Union Dairies of Gujarat and providing wholesome and nutritious milk products in Ahmedabad and the adjacent regions. These successes demonstrate the importance of co-operation between co-operatives in achieving progressive change and improvements for small producers, their families and communities.

AmulFed Dairy and SDGs: Quantifiable measures taken by the cooperative

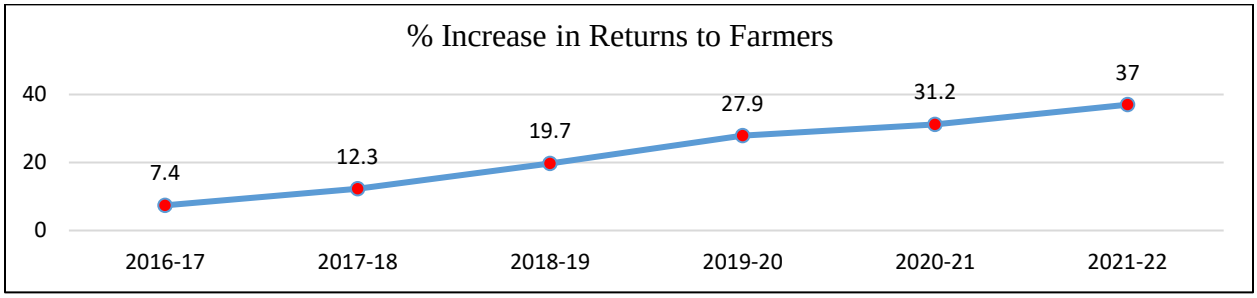
SDG 1: No Poverty

"Amul" provide rural livelihood by accepting milk from all 16.6 million milk producers of India and about 3.6 million milk producers from Gujarat. The depiction in Table 1 represents data only from Gujarat. Amul's operations were steady from 2016 to 2021, covering 20 districts and working with over 34.56 lakh [one lakh is equal to 100,000] milk producing farmers who poured milk to about 18,559 village cooperative societies. Notably, the amount of milk received each day increased steadily, demonstrating the cooperative's expansion from 152.71 lakh kg/day in 2016–17 to 215.96 lakh kg/day in 2020–21.

Table 1: Impact of AMUL on Rural Livelihood of Gujarat State of India

Year	No of Districts Served	No. of Village Producers Served (Lakhs)	No. of Village Cooperative Societies	Volume of Milk Receipt(Lakh Kg/day)
2016-17	20	34.56	17307	152.71
2017-18	20	34.56	18554	168.3
2018-19	20	36.16	18559	200.42
2019-20	20	36.36	18562	185.29
2020-21	20	36.37	18565	215.96

Figure 3: % Increase in Returns to Farmers (Considering 2015-16 % return as baseline)



From the above graph (Figure 3), we conclude that there has been a significant improvement in return to farmers, ranging from 7.4% in 2016-17 to 37 % in 2021-22. In addition, the cooperative provides gainful employment to about 925 employees and around 1,490 workers. Thus, we can conclude that Amul works to eradicate poverty in line with SDG 1 by promoting sustainable development, increasing incomes, and fostering economic opportunity through cooperative structures.

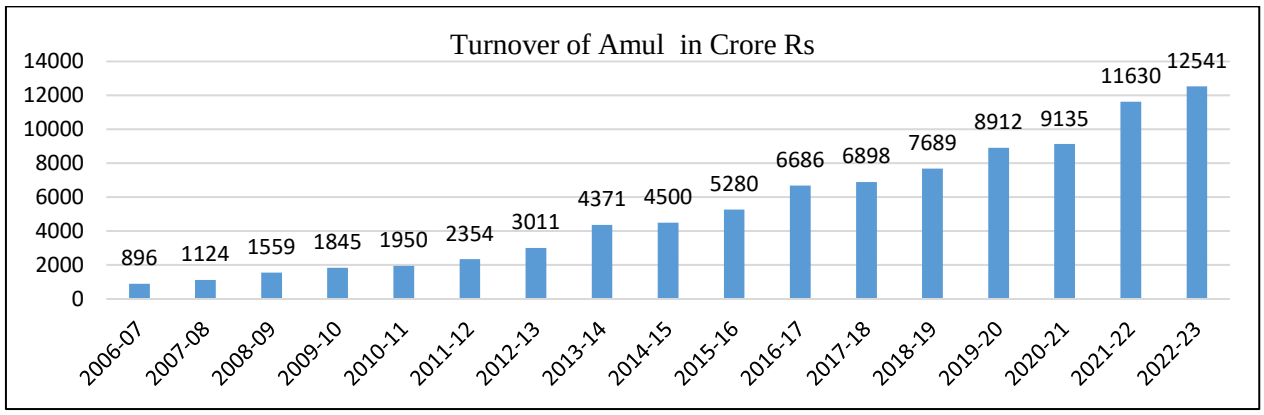
SDG 2: Zero Hunger

Amul has been instrumental in reducing hunger among the people directly and indirectly. The following measures have been taken that suggest and support the above statement:

- AmulFed Dairy is engaged in essential service business using its 236 outlets.
- AmulFed Dairy successfully managed significant raw milk inflow and met market demand during the COVID-19 pandemic in 2020 and 2021, adhering to regulatory norms.
- Amul offered free lunch, snacks, hostel facilities, medical compensation and hardship allowances to their workers during COVID times.

- The annual turnover, depicted in Figure 4, is also, being a co-operative (i.e., a business that distributes its surpluses to its members), a direct plausible indirect measure of hunger reduction in the participating communities. Rising turnover signifies a lift in dairy productivity, growing nutritional needs in a sustainable way.

Figure 4: Year – Wise Turnover of AMUL in Crore Rupees [one crore is equal to 10 million]



SDG 3: Good Health and Well Being

- Amul has launched a product line designed for nurturing health and providing their customers with nutrition. These product lines are:
  - ✓ **Probiotic Products Range** – Probiotic Buttermilk, Prolife Lassi, Amul Flaavyo (Yogurt), Frozen Yoghurt, Probiotic Chocobar ice-cream
  - ✓ **Camel Milk based Products Range** -- they help manage diabetes, provide immunity, promote growth and development, improve blood circulation and promote the cardio-vascular health.
  - ✓ Lactose Free Milk
  - ✓ **Milk with Goodness of Ayurveda** - Fortified with the nutrition of milk and memory boosting Bhrahmi, Sankhapushpi, Tulsi, Ashwagandha and other herbs.
- AmulFed Dairy Health, Safety and Well-being Policy is committed to provide a safe and healthy work environment. The total fatal accident, lost-time injuries frequency rate and occupational illness frequency rate for direct employees for three consecutive years (2020 -2022) has been zero.

SDG 4: Quality Education

- **Amul Vidya Bhawan** – Establishment of schools and provision of quality education and vocational training to underprivileged children of dairy farmers in rural areas.
- On the occasion of National Milk Day Celebration, AMUL organized various activities in schools like sports activities, quiz competitions, Drawing Competition, Essay Writing & Extempore Competition.

SDG 5: Gender Equality

Women employees are assigned equal roles and responsibilities vis-à-vis men employees. 116 female employees are discharging their duties in critical operations.

SDG 6: Clean Water and Sanitation

- Amul plants since its inception have maintained “Zero Liquid Discharge” plants.
- Amul has been working in the direction of water stewardship by following the principles of water recharge, reuse and recycle.
- For water recharge, a water harvesting plant has been installed at AMULFED office at Ahmedabad inclusive of a total of eleven number of recharge wells. This initiative resulted in 23 per cent of ground water drawl.
- A total of 700 kilos of water is recycled per day of which 20 per cent recycled water is used of total water consumption.

- Milk condensate generated by plant operations is reused, constituting 40 per cent of total water consumption.

SDG 7: Affordable and Clean Energy

- Amul has explored the use of renewable energy in the form of solar rooftop solutions. In 2019, the cooperative joined hands with 'Waaree Energies' (a leading solar PV manufacturer) for the panel installation works. The twelve-month performance of the installation has been depicted below in the form of Table 2.

Table 2: Year Wise Performance of Solar Roof Top Installation at AMUL

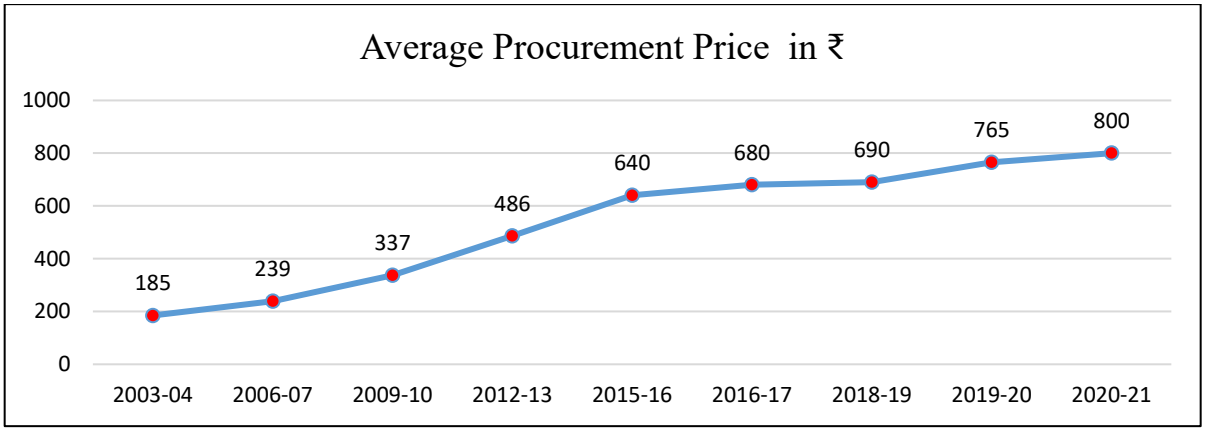
Year	Technology (Electrical)	Type of Energy	Total Installed Capacity (Kwp)	Total Generation (Million Kwh)	% Overall Electricity Energy
2018-19	Solar Roof Top	Solar	520	0.36	0.55
2019-20			1000	1.15	1.72
2020-21			1000	1.68	2.19
2021-22			1000	1.64	1.92
2022-23			1000	1.48	2.36

Note: Kwp – Kilowatt Peak, Kwh – Kilowatt hour

SDG 8: Decent Work and Economic Growth

- Figure 5 depicts Amul's average procurement price paid to milk producers pouring in their facilities have increased over the years ensuring a decent return to about 16.6 million milk producers.

Figure 5: Average Procurement Price Paid by AMUL to the General Milk Producers



- Talking about the economic growth of the cooperative, Amul has worked on a number of economic growth indicators:
  - ✓ **Product Manufacturing by Amul**

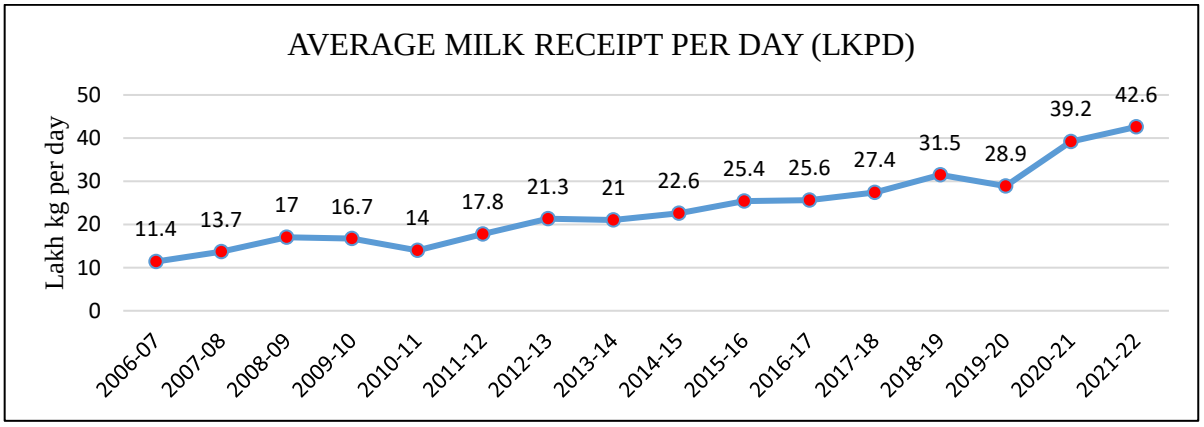
    Table 3 depicts the production patterns from 2019-20 to 2022-23 of the cooperative. Amul increased Ultra Heat Treatment (UHT) milk production from 1,899 to 2,502 lakh liters from 2019 to 2023, while milk pouch packing rose from 4,346.9 to 4,521.8 lakh liters in the same time frame. Ice cream production ranged from 17,574 to 19,721 kiloliters and fermented product output from 4,220 to 20,405 metric tons (MT). Milk powder production increased from 47,819 to 85,470 metric tons. Above indicators are the evidence of over the year economic growth of the cooperative.

Table 3: Year Wise Growth in Product Manufacturing by Amul

Year	Milk Pouch Packing (Lakh litres)	UHT Milk (Lakh Litres)	Fermented Products (MT)	Ice cream (kl)	Powder (MT)
2019-20	4346.9	1899	4220	17574	47819
2020-21	4521.8	1967	4223	10266	77689
2021-22	4494.8	2344	14227	14296	85470
2022-23	4497.51	2502	20405	19721	42569

- ✓ **Average Milk Receipts Per Day by Amul**
  Figure 6 shows the average milk receipt per day in Lakh Kilogram per day (LKPD) from 2006-07 to 2021-22. This statistic shows how much milk Amul receives every day. Starting at 11.4 LKPD in 2006-07 which gradually rose to 42.6 LKPD in 2021-22.

Figure 6: Average Milk Receipt Per Day by Amul



- ✓ Other Parameters like Turnover, Increase in Farmer's share in the Amul's income, and product line development have already been discussed in above SDGs.

SDG 9: Industry, Innovation and Infrastructure

- **Innovative Infrastructures Installed by Amul**
  - ✓ Segregation of high and low chilled water temperature requirements resulted in reduction in power consumption by about 700,000 kWh/annum.
  - ✓ Installation of new cooling tower in powder plant. Eliminating tail tank pump and reduction in power consumption by 60,000 kWh/annum.
  - ✓ Installation of paddle dryer for drying of Effluent Treatment Plant sludge, resulting in generation of solid fuel of 1 Ton/day. Potential reduction in annual fuel consumption is 160 metric tonnes of oil equivalent.
  - ✓ Installation of Ghee barrel melting tunnel resulting in reduction in steam consumption by 320 MT per annum and fuel saving of 24,000 standard cubic meters (SCM)/annum.
- **Digitalization** of the plant and work of Amul.
- **Innovative Product line development** as discussed in above SDG 3.

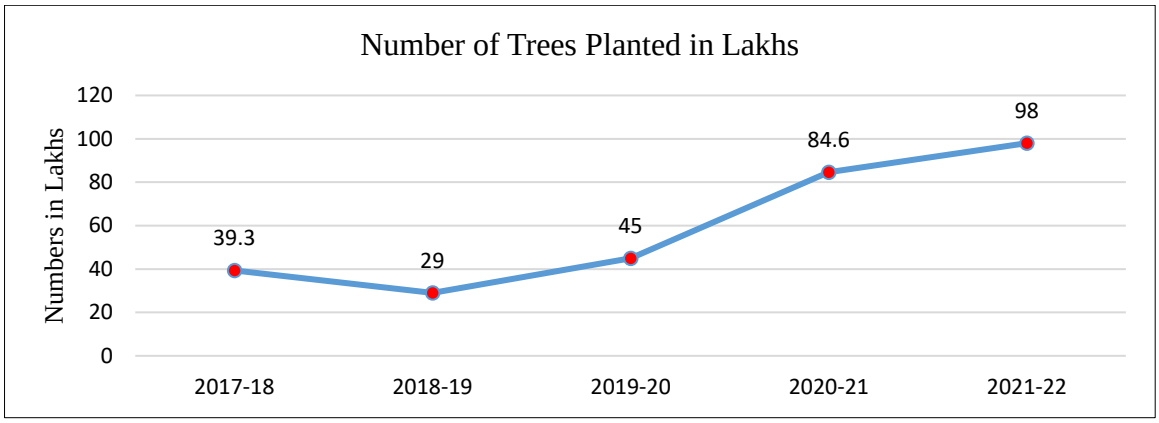
SDG 10: Reduce Inequalities

- Equality in opportunity, treatment, and wages for both male and female employees, and milk producers.

SDG 11: Sustainable Cities and Communities

- Mass Tree Plantation Drive is facilitated by Amul on Independence Day each year. This important initiative taken by the cooperative is helping to offset carbon emissions and provide a healthier environment. Figure 7 depicts the number of trees planted by Amul over the year.

Figure 7: Mass Tree Plantation Drive and number of Trees Planted Over the Years



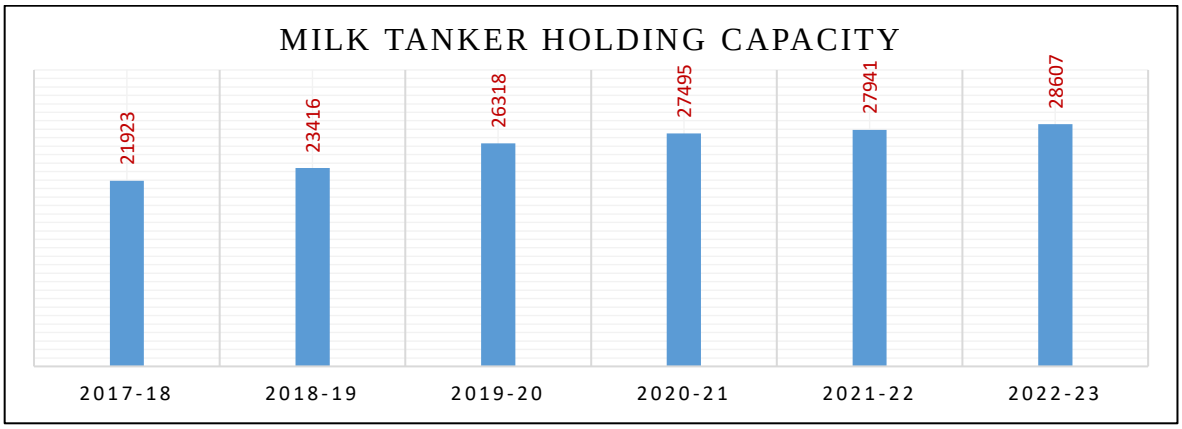
- Other measures are reduction in water usage, water stewardship, reduction in greenhouse gas emissions, etc.

SDG 12: Responsible Consumption and Operations

Amul has been taking appropriate steps towards responsible production/operations and consumption of plants under them. Some of the most important measures to justify the above made statement are discussed below:

- **Efficient Increase in Milk Tanker Capacity**
  Figure 8 represents a steady increase in the annual milk tanker storage capacity of AMUL, from 21,923 in 2017-18 to 28,607 in 2022-23. This gradual increase in the milk tanker holding capacity over the years highlights AMUL's dedication in optimizing dairy operations and its capacity to adapt to increasing milk production.

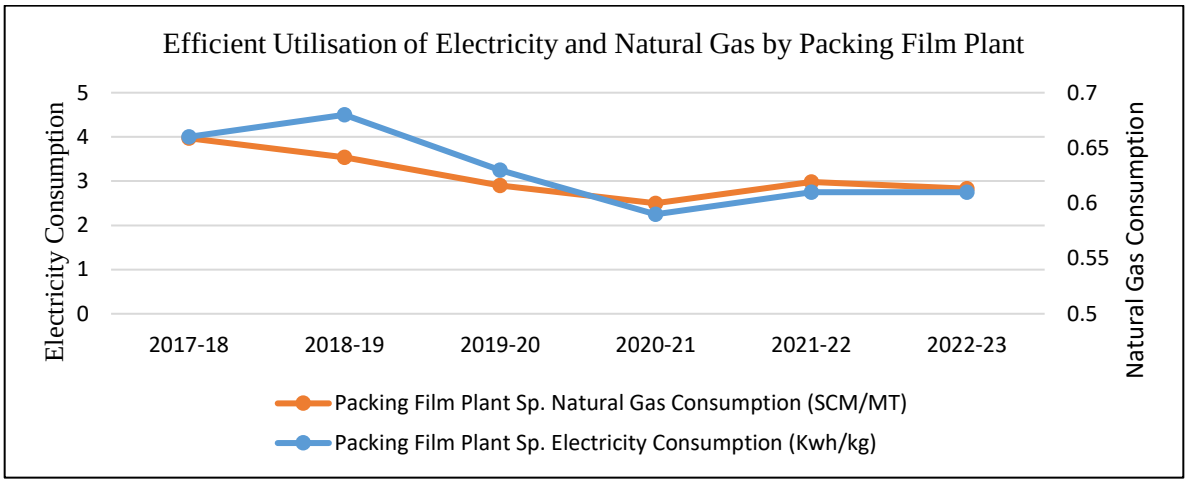
Figure 8: Milk Tanker Holding Capacity of Amul Over the Years



- **Efficient Management of Packing Film Plant**
  Figure 9 plots the details for specific electricity and natural gas consumption per unit for Amul's Packing Film Plant from the financial year 2017-18 to 2022-23. It demonstrates the plant's efforts to improve energy efficiency and its alignment with Sustainable Development Goal 12, which revolves around responsible

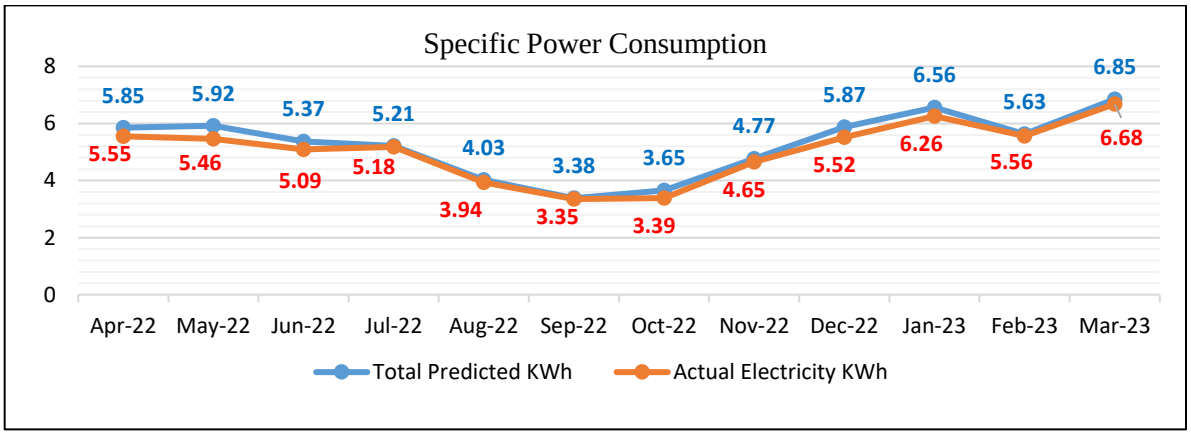
consumption and production. Notably, the graph demonstrates a consistent decline in the consumption of both electricity and natural gas over the years. The decrease in electricity consumption from 0.66 Kwh/kg in 2017-18 to 0.61 Kwh/kg in 2022-23, as well as the decrease in natural gas consumption from 3.97 SCM/MT in 2017-18 to 2.83 SCM/MT in 2022-23, demonstrates the AMUL's sincere efforts to resource efficiency and effective production.

Figure 9: Efficient Utilisation of Electricity and Natural Gas by Packing Film Plant



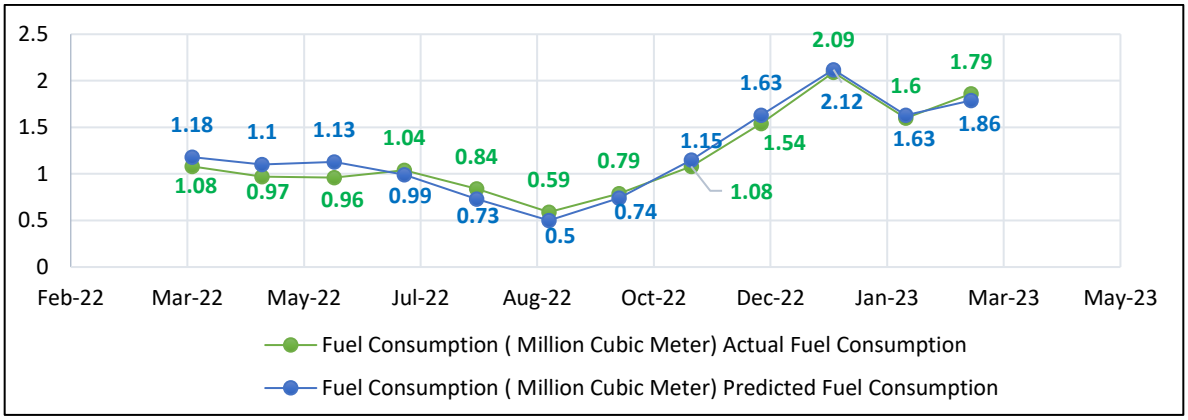
- **Efficient Reduction in Power Consumption**
  Figure 10 compares the total predicted electricity consumption in kWh and actual electricity kWh consumption by Amul Plant from April 2022 to March 2023. It can be seen from the graph that the actual electricity used by the plant is less than the predicted one, thus directly adhering to SDG 12 which focuses on responsible consumption and production.

Figure 10: Efficient Reduction in Power Consumption (Actual vs Predicted)



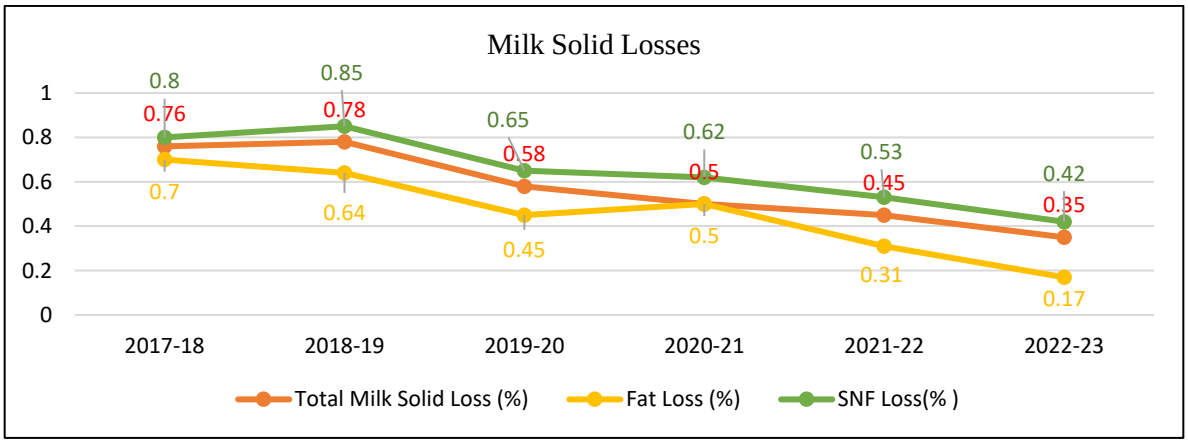
- **Efficient Reduction in Fuel Consumption (Million Fuel Cubic Meter)**
  Figure 11 depicts a comparison between the total predicted fuel consumption and actual electricity consumption in million fuel cubic meter by Amul Plant from April 2022 to March 2023. It can be seen from the graph that the actual fuel consumption by the plant is less than the predicted one. The efficient and effective production and operational management of the cooperative directly adheres to SDG 12 which focuses on responsible consumption and production.

Figure 11: Efficient Reduction in Fuel Consumption (Million Fuel Cubic Meter)



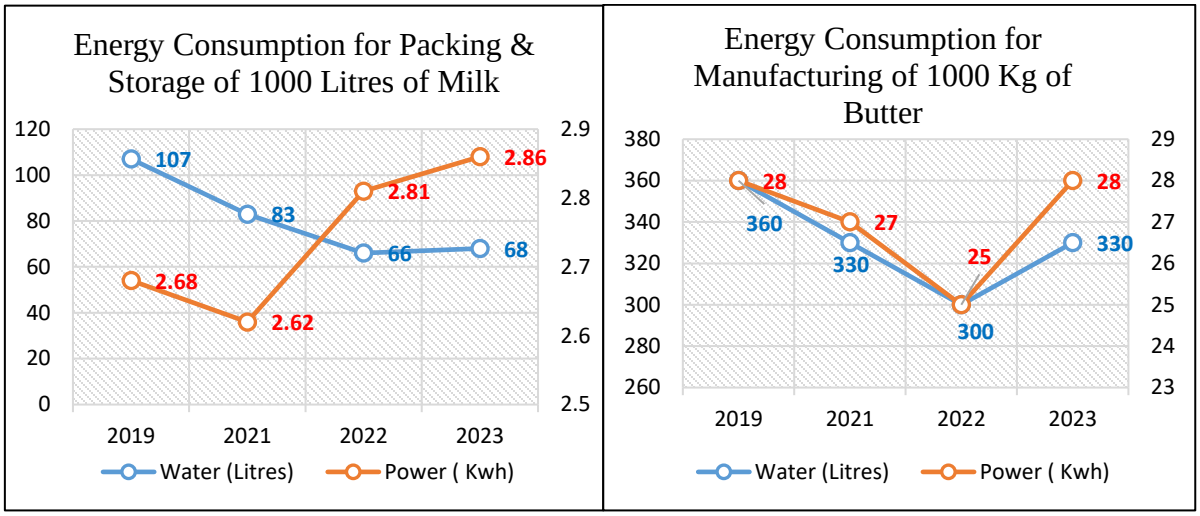
- **Reduction in Milk Solid Losses**
  Efforts to reduce operational wastage are also a significant step towards attaining SDG 12. From Figure 12, it can be concluded that Amul's milk solid losses in terms of total milk solid loss, fat loss, and SNF (Solid-Not-Fat) has seen a significant decline from 2017-18 to 2022-23, highlighting cooperative's efforts to efficiently manage resources and ensure optimum operational utilization complying to 12th Sustainable Development Goal, which focuses on responsible consumption and production. The consistent reduction in milk solid losses across all categories, from 0.76% to 0.35% in total milk solid loss, reflects AMUL's continuous efforts in this direction.

Figure 12: Reduction in Milk Solid Losses Over the Years



- **Specific Utility Consumption**
  Amul's specific utility consumption for the production of its top five products like milk, UHT milk, Ice cream, Butter, and Powder Milk in terms of water, power, steam, chemical has seen some fluctuation. Figure 13 shows that, with the years passing, the utility consumption has declined, thus fulfilling the requirements for SDG 12 "governing responsible consumption and production".

Figure 13: Energy Consumption for the production of product



SDG 13: Climate Action

- **Optimizing Tanker Holding Capacity**
  Amul's effort to increase the milk holding capacity of milk tankers is resulting in reducing CO_2 Emissions. From the Table 4, it can be concluded that, due to increased milk tanker's capacity, the distance travelled mapping same route has significantly reduced from approximately 2 crore kms in 2021-22 to about 1.27 crore kms in 2022-23. Similarly, the total fuel used in the process has also reduced from approximately 57 lakh litres in 2021-22 to 39 lakh litres in 2022-23, thus, enormously reducing the carbon dioxide emitted from the process from approximately 33 lakh Kgs in 2021-22 to 25.5 lakh Kgs in 2022-23. This step taken is consistent with the SDG 12, i.e., Climate Action.

Table 4: CO_2 Emitted Per MT Milk

Year	Total Milk Receipt (MT)	Distance Travelled (Kms)	Total Fuel Used (Litres)	CO2 Emitted (Kg)	CO2 Emitted Per MT Milk
2021- 22	1551865	20010252	5717222	3312139	2.12
2022 - 23	1110721	12739659	3920877	2550033	2.03

- **Energy Efficient Packaging Film Plant**
  Amul is leaving no stone unturned in effectively managing energy in the packing plants. Efforts taken by the cooperative in this line have been described below in the Table 5.

Table 5: Steps Taken Towards Managing Energy Efficient Packaging Film Plant (in metric Tonnes)

Sustainability Efforts in Operations	Reduction in CO2 Emission (MT)
Savings in granules by in house manufacturing of Bottles Closures	430
CAP and Straw Cardboard box reuse	127
Solvent recycling by House Distillation	30
Reuse of Core and Converting Paper into Metal Core	14.8
Increasing Productivity and Reduced unprinted Wastage	5.7
Total Reduction in CO2 Emission (MT)	607.5

- **Steps towards Environment Compliance**
  The data from the Table 6 shows beverage production in millions of packs in two time frames from January 2022 to June 2022 and July 2022 to April 2023. In the first period, 193.9 million beverage packs and plastic straws were manufactured. No paper or compostable straws were used. After a plastic straw ban in July 2022, beverage manufacturing surged to 220.12 million packs without straws. The more environmentally friendly alternatives were 177.24 million paper straws and 42.88 million biodegradable straws.

Table 6: Increase in Paper and Compostable Straw Used in Millions

Period	Beverages Production (Million Packs)	Plastic Straw Used (Million)	Paper Straw Used (Million)	Compostable Straw Used (Million)
Jan 22 to June 22	193.9	193.9	-	-
July 22 to April 23 (Post ban)	220.12	Nil	177.24	42.88

- **Methane Gas Reuse as Biofuel**
  Amul uses methane as a biofuel. As shown in Table 7, the daily usage of the gas is at 4,200 standard cubic meters (SCM) which is equivalent to 3,018 SCM of natural gas. This biofuel consumption in the form of methane gas accounts for 9% of fuel usage, saving about Rs 141,844 daily and reducing CO2 emissions by 5855 kg.

Table 7: Initiatives for Methane Gas Reuse as Biofuel

Methane Gas Reuse as Biofuel	Amount
Methane Gas used as Biofuel Per Day	4200 SCM
Biogas Equivalent to Natural Gas	3018 SCM
Biofuel used out of Total Fuel Consumption	9%
Cost Benefit per Day	Rs 141,844
Reduction in Kg CO_2 Emissions per Day	5855 kg

- **Green House Gas Emission During Transportation**
  Table 8 depicts reduction in CO_2 emission by monitoring vehicle utilisation in Amul. CO_2 emitted in tonnes for ambient transportation has come down from 3,386 tonnes in January 2023 to 2,083 tonnes in March 2023. For refrigerated transportation, the emission was reduced from 72.51 tonnes in January 2023 to 38.09 tonnes in March 2023.

Table 8: Green House Gas Emission During Transportation

Emission Category	Month	Product Dispatch (MT)	Distance travelled (KMS)	CO_2Emitted (Tonnes)
Ambient Transportation	Jan 23	26973	5205374	3386
	Feb 23	24738	1790862	3320
	March 23	38103	1123397	2083
Refrigerated Transportation	Jan 23	1493	181297	72.51
	Feb 23	1008	158315	63.32
	March 23	1157	95235	38.09

SDG 14: Life Below Water

- Measures like rainwater harvesting taken by Amul can be considered as appropriate for meeting the said SDGs.

SDG 15: Life on Land

- **Solid Waste Management:** Solid Waste generated by AMUL plant as operational losses, being 100% recyclable are sold to Central Pollution Control Board (CPCB), a national agency, and Gujarat Pollution Control Board (GPCB), which are state agency approved vendors.
- **Ethno Veterinary Practices (EVP) Promoted by AMUL**
  - ✓ AMUL has identified the EVP formulations for different types of disease conditions like pyrexia, Mastitis, Foot and Mouth Disease lesions, etc.
  - ✓ AMUL is implementing an EVP program as a part of their routine veterinary services to farmers' doorsteps.
  - ✓ The formulations are distributed in the form of sachets. The impact of the program has been depicted in the Table 9.

Table 9: Impact of Ethno Veterinary Practices Promoted by AMUL

Year	Disease Condition	Cured with EVP	Average Success Rate
Previous Year	44000	37000	84 %
Current Year	13889	11810	85 %

SDG 16: Peace, Justice and Strong Institutions

- AMUL has been a role model in Indian dairy cooperative sector. Under the guidance of National Dairy Development Board, the AMUL model has been replicated pan India. Thus, AMUL can be considered as a 'Strong Institution' as the cooperative ensures inclusiveness of all strata of the society. The cooperative, through transparency in milk collection and disbursement of payment, has been instrumental in promoting justice among its members.

- Further, Gujarat Cooperative Milk Marketing Federation, in order to build a strong institution and ensure peace, prosperity and justice among its member community, provides technical, managerial and marketing support. Some important programs taken by Amul in this direction have been described in Table 10.

Table 10: Important Programs Taken by Amul

S. No.	Program	Description
1	Animal Enumeration	Conducted an animal census in 14,253 village, covering 22.4 lakhs households in Gujarat.
2	Genomic Selection	Genomic Selection is a methodology used for selecting an individual animal for breeding. Memorandum of Understanding with National Dairy Development Board, Gujarat Biotechnology Research Centre, Government of Gujarat, etc., for utilization of their knowledge and skills towards effective implementation of program.
3	Sex- Sorted Semen Technology & Embryo Transfer Technology	Artificial Insemination to increase number of female calves. Embryo transfer technology to increase milk productivity per cattle. Utilisation of 2.2 Lakh Sex-Sorted Semen Doses.
4	Strategic Productivity Enhancement	Strategic Productivity Enhancement Program initiated in 4635 villages, covering 36.3 lakh animals. The Fertility Improvement Program, implemented in 4202 villages covering 3.45 lakh animals.
5	Entrepreneurship Development Program	Young and educated milk producers are trained in commercial dairy farming and management under the Entrepreneurship Development Program. 268 programmes conducted and trained 17499 milk producers.

SDG 17: Partnership for the Goal

- **Responsible Material Outsourcing**
  - ✓ Sourcing laminated paper used for aseptic packing from responsible packaging material suppliers like Tetra Pak and SIG (Signature Eco). Tetra Pak and SIG are registered under AARC (Action Alliance for Recycling Beverage Cartons) and recycle all waste laminates collected from market and convert them into value added products like chipboards, roof plates, pallets.

- ✓ The Kabadiwala and Tetra Pak India collaborated under the program "Mera Carton Meri Zimmedari" (My Carton, My Responsibility) for a mission to not only divert used cartons from landfill to recycling, but also to bring behavioural change and uplift the waste pickers community.

- AmulFed has taken appropriate measures for stakeholder's engagement and creating value for them.

4. Summary

The AmulFed Model, based on the above results, can be appropriately considered as a successful example of dairy cooperatives for achieving the Sustainable Development Goals. The model not only contributes to the "triple bottom line" agenda of sustainable business practice inclusive of social well-being, environmental health and just economy but also complies with the good governance objective of the goals. Their planning, management and operations significantly conform to all seventeen SDGs. The AmulFed work profoundly impacts the life of rural communities and can be an inspiration for all the dairy cooperatives.

Amulfed's collaborative approach with millions of milk producers in India, particularly in Gujarat (Indian State), their efforts to increase milk collection, substantial rise in farmer returns from selling of raw milk to cooperative, and generation of employment opportunities have yielded substantial benefits to the dairy farmers and employees associated to the cooperatives with respect to poverty reduction and rural livelihood.

5. Conclusion

The paper basically illuminates the role of dairy cooperatives in general and of AMULFed in particular in achieving SDGs overall. The case analysis revealed the strength of the dairy cooperatives in making the sector innately sustainable in terms of cooperative values and principles, democratic control, joint ownership and empowering local members and powering communities. The AMUL cooperative model can offer the framework for equitable participatory processes promoting transparency and accountability, collaboration with communities, governments, businesses, and other stakeholders to realize sustainable development.

In addition, the authors urge that the pioneering Amul model be replicated both within India and on a worldwide scale. Other cooperatives in India are working hard to duplicate this concept in its true spirit, with the help of the National Dairy Development Board. State level dairy cooperative brands work in tandem with Amul dairy model. This necessitates government assistance, infrastructural expenditures, and training initiatives to improve dairy farming techniques as well as dairy management and a cooperative-values-led leadership and management culture.

The Amul Model can be applied internationally to alleviate poverty and improve sustainable agriculture in underdeveloped countries. Farmers, governments, and the corporate sector must work together to develop dairy cooperatives that can raise communities out of poverty, provide food security, and contribute to the accomplishment of several SDGs. We can work toward a more egalitarian and sustainable global dairy business by scaling up and replicating the Amul model, thus protecting the small producer and their communities in the face of globalisation and its many accompanying threats.

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