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Environment and pollution management in dairy sector: A case study of dairy cooperatives of Gujarat

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Abstract

India is the world's largest milk producing country. Its milk Production for the year 187.7 million tonnes which is around 20% of the world milk production. There are around 16.5 million dairy farmers registered with around 1,85,903 Village Dairy cooperatives in the country. Majority of the milk producers belong to small and marginal category with only 2 to 5 animal holding. The leading milk producing states are – Uttar Pradesh, Andhra Pradesh, Madhya Pradesh, Rajasthan and Gujarat. The NDDDB has already implemented the National Dairy Plan (NDP-I), Dairy Entrepreneurship Development Schemes, Dairy Infrastructure Development scheme (DIDF), AHIDF etc.

The Dairy sector affects the environment in terms of Animal husbandry activity mostly by production of methane, Dairy Processing operations, large Effluents, huge use of Electricity and fuel energy for Heating and Cooling Operations, Large use of Water in dairy operations, and so on.

However, the Indian Dairy Sector, spearheaded by the Gujarat Dairy Cooperatives under the leadership of Gujarat Cooperative Milk Marketing Federation (GCMMF) and support from NDDDB, has been able to effectively mitigate the environmental problems through hard work, dedication, innovation and determination. Some of their initiatives include – Plantation, Rural Sanitation, Bio-CNG production, Use of Solar Energy, Innovations in the Energy efficient equipment and processes, Process Control and by small innovations (kaizen), etc. Their efforts have been recognized nationally and internationally by way of receiving awards and appreciation and also led to cost savings and ultimately benefitted milk producers by increasing their incomes.

Keywords: Amul green initiatives, Gujarat dairy cooperatives plantation, solar energy, bio-CNG by dairy plants, energy conservation

1. Introduction

India is the world's largest milk producing country. Its milk Production for the year 2020-21 stood at a mammoth 209.96 million tonnes which is around 20% of the world milk production. There are around 16.5 million dairy farmers registered with around 1,85,903 Village Dairy cooperatives in the country. Majority of the milk producers belong to small and marginal category with only 2 to 5 animal holding. The leading milk producing states are – Uttar Pradesh, Andhra Pradesh, Madhya Pradesh, Rajasthan and Gujarat. The demand of milk and milk products in the country is also increasing and in order to meet the expected rise in demand, the NDDDB has already implemented the National Dairy Plan (NDP-I). Recognising the increasing importance of dairy sector in accelerating the agricultural GDP and also as an initiative to double the farmer's income, the government has also announced support schemes in the form of Dairy Entrepreneurship Development Schemes, Dairy Infrastructure Development scheme (DIDF), and a few schemes to promote organic farming. Since the 1970s, the contribution of the livestock sector to India's agricultural gross domestic product (AgGDP) has been increasing, and this represents one of the most significant changes in the structure of India's agricultural economy.

2. Objective of the study

India is the world's largest milk producing country. Its milk Production for the year 187.7 million tonnes which is around 20% of the world milk production. The Dairy sector affects the environment in terms of Animal husbandry activity mostly by production of methane, Dairy Processing operations, large Effluents, huge use of Electricity and fuel energy for Heating and Cooling Operations, Large use of Water in dairy operations, and so on.

The Dairy sector has responded by use of Solar energy, Bio-CNG, Dairy plants, Micro-ATMs, Dairy Apps to increase its performance.

The objective of the present study is to study the Environment and Pollution Management in Dairy Sector by taking a case study of Gujarat state's Dairy cooperatives.

3. Research Methodology

The data for the research study was collected from secondary sources including the Annual reports, Websites, published articles, etc. The data was collected mainly for the Dairy Cooperatives of Gujarat state which is represented by Amul. The data was organized in various parts of the Dairy value chain and it was analysed in light of its contribution towards efficiency of Dairy Sector.

4. Result and Discussion

4.1 The Environmental Pollution a Dairy sector

The Dairy sector affects the environment adversely in the following ways:-

i) Milk Production stage (Animal husbandry activity)

In the milk production activity a lot of undesirable effect is observed in the environment. India has a huge population of Milch animals. As per the 2019 livestock census data, there were 192.5 million Cattle and 109.9 million Buffaloes in the country. In India, in 1999, the average milk productivity per cow was 1014 kg/year which was below the global average of 2017 kg/year (FAO, 2002) ^[14]. The milch animals in their daily biological routine and throughout their lifecycle create environmental pollution. In addition, livestock produce greenhouse gases. The IPCC (Intergovernmental Panel on Climate Change) has estimated that agriculture (including not only livestock, but also food crop, biofuel and other production) accounted for about 10 to 12 percent of global anthropogenic greenhouse gas emissions (expressed as 100-year carbon dioxide equivalents) in 2005 [and in 2010. Cows produce some 570 million cubic metres of methane per day, that accounts for from 35 to 40% of the overall methane emissions of the planet. Livestock is responsible for 65% of all human-related emissions of the powerful and long-lived greenhouse gas nitrous oxide. As a result, ways of mitigating animal husbandry's environmental impact are being studied. Strategies include using biogas from manure.

Enteric fermentation accounts for the methane generated during the digestive process of ruminants -although non-ruminants species also produce methane when digesting, the amount is much lower. Feed quality is closely correlated with enteric emissions. Poorly digestible rations, i.e. highly fibrous ingredients, yield higher enteric methane emissions. Manure acts as a source of both methane and nitrous oxide. Methane is released during anaerobic decomposition of organic matter. Nitrous oxide is mainly generated during manure ammonia decomposition. Different manure management systems (MMS) can lead to different emission levels. In general terms, methane emissions are higher when manure is stored and treated in liquid systems (lagoons or ponds), while dry MMS such as dry lot or solid systems tend to favor nitrous oxide emissions.

There are several emissions related to feed production. Carbon dioxide emissions arise from expansion of feed crops and pastures into natural areas such as forests, from manufacture of fertilizers and pesticides for feed crops and from feed transportation and processing. Nitrous oxide

emissions are caused by the use of nitrogenous fertilizers and by direct application of manure both in pastures and crop fields. Enteric fermentation accounts for 44 percent of total sector's emissions, with about 3.5 gigatonnes CO₂-eq. Feed production is the second largest source of emissions, with 3.3 gigatonnes CO₂-eq or about 41 percent of total emissions. Manure management is responsible for almost 10 percent of the total, or 0.8 gigatonnes CO₂-eq. Also, the farmers make improper use of fertilizers (N, P, K), herbicides, and pesticides consumed for agriculture in India for the Feed and Fodder cultivation.

ii) Dairy Processing operations

The dairy processing is a highly Energy Intensive activity. It involves operations like heating (and many times upto high range in case of Powder manufacturing) and Cooling or refrigeration (in order to maintain cold chain). Hence, efficiency in energy usage is of utmost importance for dairy sector. At VDSC nowadays there are full time running Bulk Milk Coolers (BMC) which also require energy.

iii) Large quantity of Dairy Effluent

A dairy processing plant typically uses 2 to 3 litres (or even upto 4 litres) of milk for processing just 1 litre of procured milk. This puts a heavy energy costs first in lifting the water from below the ground reservoir and secondly the effluent generated is also very large quantity. The high level of Effluent causes again cost and energy loss for the dairy as it has to treat the effluent as per the pollution control Board standards. All dairies need to invest in Effluent Treatment Plants (ETP).

4.2 Gujarat dairy Cooperatives noteworthy initiatives

Gujarat is a leading milk producing state and has contributed significantly in the overall success of the dairy sector of the country. Milk production in the state has increased from 4.4 million tonnes in the year 1994 to 12.2624 million tonnes in the year 2015-16. The state contributes to around 8% of milk production in the country. The per capita availability of milk in Gujarat is impressive 506 gms/day. According to the 19th livestock census -2012 All India Report, Gujarat had 9984 thousand cattle and 10386 thousand buffalo population, which comes to around 5.23% and 9.55% of cattle and buffalo population of the country. The GCMMF is the apex organization of the Dairy Cooperatives of Gujarat. The State has been a pioneer in organizing dairy cooperatives and GCMMF success has not only been emulated in India but serves as a model for rest of the World. It include more than 36 lakhs village milk producers who are registered with around 18,545 Village Dairy Cooperative Societies (VDSC) at the village level affiliated to 18 District Cooperative Milk Producers' Unions at the District level and GCMMF at the State level. More than 70% of milk producers are small, marginal farmers and landless labourers and include a sizeable population of tribal folk and people belonging to the scheduled castes

a) Establishment of bio-CNG plant by Amul dairy

The Kaira District Co-operative Milk Producers Union Limited popularly known as Amul Dairy has become the first in India's food industry to start a fully automated bio-CNG generation and bottling plant to utilize energy from its plant's waste. Earlier, the dairy union used to flare the biogas into the atmosphere by burning it. While burning raw biogas some

elements like carbon dioxide and hydrogen sulphide used to get released into atmosphere harming the environment. As part of its green initiative, Amul decided to reutilize the biogas and adopted medium pressure swing adsorption (MPSA) technology to convert biogas into bio-CNG. Amul is the first in the dairy sector as also the food industry of the country to design, install and commission such a technology along with our Ahmedabad-based technical partner Atmos Power Private Limited". For every litre of milk that is processed at the dairy, one litre water (two million litre a day) is used for chemical cleaning of plant and machinery. This water has residual milk solids which earlier emitted 2,500 cubic metre of methane per day with 60 to 65% purity. Now, the raw biogas from digesters is first collected in double membrane raw biogas balloon having capacity 1,000 cubic metre. From raw biogas balloon, it is transferred for purification. MPSA tower is used for further purification and then passed to surge tank for storage of purified bio-CNG having more 93 percent of methane content. From surge tank, it is transferred and stored into another double membrane purified biogas balloon having capacity 1000 cubic metre. Finally, it is compressed and filled into cylinders for use.

Also there is a Biogas Generation Banas Dairy at Palanpur The Biogas Generation is 200 m³/day with reactor volume of 3000 m³. The reactor MOC is concrete with the pump recirculation and double membrane roof. The Biogas is upgraded from 55% methane to 96% methane using PSA system. The Pressure swing absorption is a 2-stage purification process. The purified methane is stored in cascades and supplied to the dispenser unit which is installed for supply Bio CNG to the trucks / vehicles.

b) Establishment of world's first solar cooperative at Gujarat's Dhundi village

The unrelenting heat of the summer afternoon sends us scurrying for cover under a large tree as we reach Dhundi village in Gujarat's Kheda district. It is a spacious thatched hut with mud walls and floors smeared with cow-dung. There are people winnowing and sifting grain, buffaloes chewing cud. Adjacent to the hut is a two-bigha field lush with bajra and maize crop. And conspicuous amid all the green are gleaming, evenly-spaced, ground-mounted solar panels. Chawda is a solar farmer. The blazing sun that's making us wilt brings a smile to his face — to him it means power, copious water, and income. Exactly two years after the launch of the world's first solar irrigation cooperative here, the Dhundi Saur Urja Utpadak Sahakari Mandali or DSUUSM, nine farmers, including Chawda, have become successful solar entrepreneurs: they harvest solar energy as they would a remunerative crop. They irrigate their fields using solar pumps, and they earn by selling surplus power to the Madhya Gujarat Vij Company Ltd., and by selling water to other farmers in the area. The International Water Management Institute (IWMI), which launched the project in 2016, is based in Anand, the home of famous cooperative brand Amul. The world's first solar cooperative movement has transformed lives here — farmers buy water from these entrepreneurs at half the rate they paid when they used diesel pumps. In a typical field there are 36 solar panels with a combined capacity of 10.8 kW are installed. The power generated one can draw all the groundwater he needs, and he gets to sell the surplus. Everyday, one can sell up to 50 kWh of solar energy for approximately ₹ 7 per unit. When Chawda invested ₹ 54,000 two years ago for solar panels, pumps and a micro-

grid, it pinched his budget, but he was excited about the experiment, he says. And it has paid off. His income has jumped from ₹ 30,000 a year to ₹ 1,30,000 today, a cool ₹ 1 lakh more from selling electricity and water.

c) Establishment of solar cooperative at Mujkuva village in Anand District

Mujkuva Saur Urja Utpadak Sahakari Mandali Limited. The sun is shining a little brighter for the farmers of Mujkuva village of Anklav taluka, nearly 17 km away from Anand, Gujarat. A group of 11 farmers in the village have turned their backs on conventional electricity and have taken up solar to irrigate their farms. This initiative, taken under Mujkuva Solar Pump Irrigators' Cooperative Enterprise (SPICE), was launched by Prime Minister Narendra Modi on September 30, 2018. As many as 11 farmers in the village are using the solar energy to pump out borewell water to irrigate their farms. Most of them are irrigating for one to two hours a day, leaving behind surplus to be sold at ₹ 3.24 per unit. With this, every farmer is expected to earn around ₹ 6,000 per month. Moreover, there will be no electricity bill too. Prior to this, any farmer had been shelling out around ₹ 2,000 per month as electricity bill," Labubhai Patel, secretary of Mujkuva Saur Urja Utpadak Sahakari Mandali Limited told Mercom.

The mandali that was formed with the help from the National Dairy Development Board (NDDB), headquartered in Anand, is selling the surplus to Madhya Gujarat Vij Company Limited (MGVCL), a state-owned power distribution company. The farmers are currently using 15 HP water pump and the energy being generated from the 150 kW solar panel is around 90 to 100 units per day. This project has also put an end to villagers many sleepless nights. As per existing policy, the village gets electricity for one week during day (around eight hours), followed by one week during nights for eight hours. So, while we could irrigate our farms during the day for one week, the next week required us to stay up at night.

d) Establishing Bio gas plants at Mujkuva village

Till two years ago, a majority of Mujkuva's 600-odd households, owning two-three buffaloes each, depended predominantly on dairying. The dung produced by the animals 15-20 kg by adults and 10-12 kg by calves — was stored in an open space, locally known as ukeda, for later use as fuel and manure. Open composting, apart from not capturing the true economic value of dung, is also a source of greenhouse gas (GHG) emission.

In late-2017, NDDB organised 40 women dairy farmers from Mujkuva to form a self-help group (SHG) by the name of 'Jai Ambe'. Each member got a new-generation bio-gas plant with prefabricated digester installed at their home. A household bio-gas plant mixes raw dung and water in equal portion. The mixed dung gets decomposed in an anaerobic digester and produces bio-gas and slurry. It was envisaged that slurry obtained from these plants would be sold to the SHG, which would, then, convert it into nutrient-fortified bio-organic fertiliser. The plants were set up with the support of the National Biogas and Manure Management Programme (NBMMP). Implemented by the Union Ministry of New and Renewable Energy, it offers 40% subsidy on the project cost. The NDDB has so far set up roughly 1,000 bio-gas plants across 12 states under its National Dairy Plan and is targeting a total of 10,000 in the next five years. It is planning to expand the Mujkuva model to other villages, while leveraging the existing network of dairy cooperatives to market its bio-

inputs to farmers in different regions. Under the NBMMP scheme, more than 1.25 lakh biogas plants have been installed during 2016-17 to 2018-19, with a target of 76,000 fixed for the current fiscal itself. Apart from boosting dairy farmers' income, the programme is expected to lead to more scientific handling of animal dung. Converting dung into renewable energy will also prevent emission of methane, a key GHG, into the atmosphere.

e) Plantation programmes

The Village Dairy Cooperative Societies of Gujarat as a mark of respect for our nation decided to conduct such event on every Independence Day and accepted 15th August (Independence Day) as a "Green Revolution Day by Afforestation to Protect Mother Earth from Pollution, Climate change and Global Warming".

First tree plantation programme (15th August, 2007) was carried out on "one member, One tree" basis. Second tree plantation programme (15th August, 2008) in which around 52.74 lakhs tree were planted was conducted on "one member three tree" basis. There from, in last thirteen years, milk producers of GCMMF planted around 733 lakhs tree saplings across Gujarat. By doing so, milk producers of Gujarat Dairy Cooperatives have shown their concern, awareness and commitment for betterment of environment.

It has been estimated that when one tree is cut, in monetary terms there is loss of Rs. 33 lakhs (Oxygen worth of Rs. 5.3 lakhs, Land Fertility of Rs. 6.4 lakhs, Rs. 10.5 lakh for reduction of pollution of atmosphere and Rs. 5.3 lakh towards Flowers / Fruits and habitation to birds - animals). But the benefits that accrue to mankind when a tree is planted cannot be measured in money and is priceless. Sapling, often, results in a tree.

f) Rural Sanitation programmes

AMUL was awarded by Aaj Tak for health and sanitation work in Gujarat on 27th Aug 2013. In 2010 Amul, with the help of the National Housing Bank, piloted the safe sanitation programme by constructing 5000 safe sanitation systems in selected villages. Later, the demand for household sanitation systems increased so Amul had to extend its operation. Amul Dairy has launched a novel scheme for total rural sanitation and set a target for itself whereby not a single milk producer will attend to nature's call in the open. The Dairy with the support of District Rural Development Agency (DRDA) will provide interest free loans to its milk producers in Anand and Kheda districts to set up 'Pucca' toilet blocks, which will not only help women milk producers avoid embarrassment but will also ensure hygiene. 'In five years' time, dairy wishes to achieve the target of providing 100 percent toilet facilities in all villages where Amul has a milk society. The mission is not just about bringing a cultural change by imbibing good habits among milk producers but also targeted towards encouraging hygienic practices in the milk supply chain. Amul has prepared a model low-cost toilet block that costs Rs. 11,500 per unit. While DRDA will support this initiative through subsidy ranging between Rs. 4500 and Rs. 4600 for BPL/APL families, Amul will provide its members an interest free loan worth Rs. 4300 returnable in four years' time. A member can pay up this loan by getting Rs.100 per month deducted from his/her bill.

g) The Launch of Ethno Veterinary Medicine

NDDB also extended the support to the pilot project on

bovine mastitis control in Sabarkantha Milk Union, for a further period of 18 months from October 2016 to March 2018 (Phase-II) by increasing the number of milk societies covered from 50 to 100 and, adding new components like Ethno-Veterinary Medicine (EVM) with the aim to reduce the use of antibiotics and, thereby its residues in milk. In addition, this will also help the farmers in reducing treatment costs significantly since EVM uses household ingredients that are usually available in the farmer's house

h) Awards and Recognition

The GCMMF has received various awards such as "Green Globe Foundation Award in the manufacturing category at the Delhi Sustainability Development Summit in 2012 organized by TERI and United Nations Environment Project. This effort to provide green cover to the earth was also acknowledged when the state level apex body of Gujarat Dairy Cooperatives - GCMMF received seven successive prestigious "SRISHTI's G-Cube Award"-2007, 2008, 2009, 2010, 2011, 2012, 2013 and 2015 for Good Green Governance in the "Service Category". In the year 2014, Amul green movement was honored with the Hercules Category Award by Gujarat Innovation Society.

5. Conclusion

A large number of Indian population is still connected with the rural and agricultural economy. Hence, the dairy and Food processing plants of the country should come up with suitable strategies to curb the environmental pollution and at the same time Increase the farmer's income. A few good and successful initiatives like Bio-CNG plant, Plantation, Solar Cooperatives, etc. can be very helpful in this regard. The producer members of GCMMF have certainly set an example for all the cooperatives and other institutions to turn India green in the era of Global warming and environmental crisis. When 3.6 million dairy farmers of Gujarat have planted 733 lakh trees in just ten years and are planning to plant more trees every year, they are doing an invaluable - truly Amul - service to the society.

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