Cows at the Center of Indian Approach to Sustainable Living and Development

Smrithi Rekha Venkatasubramanian, Founder, Anaadi Foundation, smrithi@anaadi.org
Prajna Cauvery Kotera Pooviah, Program Director, Anaadi CREST, prajna@anaadi.org

Smrithi Rekha Venkatasubramanian
Anaadi Foundation
4/84, Iyvar Malai, Palani Taluk
Tamil Nadu 624621
India
smrithi@anaadi.org
Ph: +919487006160

1. Introduction

In every indigenous or native culture, livestock have played a very significant role in taking care of the physical, social, environmental, and economic well-being of the population. In 2018, a report about the diminished bison population and the impact on native Americans highlighted how the speed at which bisons reduced, significantly impacted the living standards of the natives and the tallest humans were reduced to some of the shortest ones. Studies also reveal that bisons contribute to biodiversity and preservation of certain species of animals that depend on the biodiversity for food and procreation. It is important to note how the 10 million bison population was reduced to 500 in a matter of just 20 years due to rampant human activity. This illustrates how modern life and human aspirations pose a threat to nature and life forms that ensure sustainable living.

The 2030 agenda for Sustainable Development adopted by all members of the United Nations provides a blueprint for peace and prosperity for now and the future. The 17 goals look at various dimensions of sustainability in a comprehensive manner. However, there has been very less focus on looking at indigenous knowledge in achieving the sustainable development goals. While there is a lot of emphasis on technological alternatives that are greener than the existing ones, very less importance has been given to zero-emission or low-cost solutions that come from thousands of years of native wisdom. Ideas like *beun vivir* (meaning living well) that encompass the values and norms of various indigenous traditions across the world and are an alternative to the development-centred approach interest a lot of people; however, they do not occupy the mainstream sustainability discourse (Magni 2017). Though cows have enjoyed a significant status in the Indian society, there has been very little or no focus on how they can help in sustainable development. In this paper, we highlight the central role that cows can play in the Indian society from time immemorial and how they help in creating a sustainable future.

2. Cows in the Indian Tradition

Since the Vedic period, cows have been central to the life of Indians and a deep spiritual connection between man and cows has been highlighted throughout Indian literature. Beyond just milk or economic utility, cows were considered a measure of wealth and prosperity of any kingdom and even determined the social status of individuals. There are numerous references in the Vedas, Purana and Itihasa about the significance of cows.

प्रजापतिर्मह्यमेता रराणो विश्वैर्देवैः पितृभिः संविदानः । शिवाः सतीरुप नो गोष्ठमाकस्तासां वयं प्रजया संसदेम ॥

(Rig veda Samhita 10 – 169 – 4)

May the supreme Lord, complemented by all the Gods, create auspicious and spacious cowsheds for our happiness and populate them with cows and calves. Let us rejoice the cow-wealth and contend by serving those cows.

The Atharvana Veda discusses the importance of cows and cow products as follows:

वशां देवा उपजीवंति वशां मनुष्या उप । वशेदं सर्वं भवतु यावतु सूर्यो विपश्यति ॥

The devas and people live on cow products. Till the sun shines, cows will remain. Everything in the universe is supported by the cow.

The Mahabharata has numerous references to the significance of a cow. In the Markandeya Samasya Parva of the Vana Parva, Maa Sarasvati tells Tarkshya, a brahmana:

वासॊ दत्त्वा चन्द्रमसः स लॊकं; दत्त्वा हिरण्यम अमृतत्वम एति

धेनुं दत्त्व सुव्रतां साधु दॊहां; कल्याणवत साम पलायिनीं च

यावन्ति रॊमाणि भवन्ति तस्यास; तावद वर्षाण्य अश्नुते सवर्गलॊकम

अनड्वाहं सुव्रतं यॊ ददाति; हलस्य वॊड्धारम अनन्तवीर्यम

धुरं धुरं बलवन्तं युवानं; पराप्नॊति लॊकान दश धेनुदस्य

"Those who donate cattle attain the supreme world. By donating bulls, one roams in the world of the sun. By giving garments, one goes to the world of the moon. By giving gold, one attains the immortals. If one gives away a good cow that is easily milked and gives birth to fine calves, one that does not stray, one lives for as many years in heaven as there are countable body hairs on his person. One who donates a strong, young and skilled bull that has infinite strength, and is capable of carrying burdens and drawing a plough, obtains the world that is obtained by donating ten cows." (Debroy B, 2015)[1]

The ancient Indian epics including *Ramayana and Mahabharata* are filled with insights and stories on the protection of cows. *Gosha yatras* (yatra is a journey) were undertaken to take a census of cows in the kingdom. It is described in the Gosha yatra parva of the Mahabharata as to how the Kauravas took a large army of people to inspect the cows. The cows were numbered, classified according to their age and stages of growth. Be it the Bhagavata or Mahabharata, the number of cows owned by the kings is mentioned in large numbers. Hence, we see that cows have played a very significant role in the Indian society since ancient times and their protection and well-being was of paramount importance.

2.1 Native Cow Breeds

At one point in time, there were 111 breeds of native cattle in India. Currently the National Bureau of Animal Genetic Resources lists 41 breeds. Focusing on milk yield alone has led to the decline in native breeds - Bos Indicus - and increase in Jersey cows in India. Laugesen and Elliott (2003) found correlations between the consumption of A1 milk (produced by the foreign breeds) and Ischaemic Heart Disease (IHD) in 20 affluent countries. They found that intensive cattle breeding may have caused some genetic variations in humans over a period of time. However, a lot of studies that emerged after this

[1] Bibek Debroy, "The Mahabharata, 10 Vols," *Gurgaon: Penguin*, 2015.

have negated the harmful effects of A1 milk. Though the debate remains, one cannot ignore the benefits of A2 milk that comes through practice.

2.2 Cows in Indian Medicine

Ayurvedic therapies rely on Bhasma, where metals, minerals and animal products are calcinated in crucibles with the help of cow-dung cakes. Bhasma breaks down heavy metals in the body thereby making them beneficial for therapy. Cow urine is known for its excellent anti-microbial properties and a preparation called *ark* is known to have anti-diabetic properties (Sachdev et al, 2012).

3. Cow-centric Sustainability

Sustainable development has become an immediate necessity as the world is facing challenges along multiple dimensions. These range from poverty to lack of jobs to CO_2 emissions.

• More than 8% of the world's population lives in poverty and more than 700 million people encounter severe food insecurity[2].

• When it comes to global emissions, the agriculture sector is on the top. The major causes include enteric fermentation, manure left behind on soil and crop burning. About 70 billion[3] animals are raised annually for human consumption, and this process releases huge amounts of methane.

• 39% of global energy related carbon emission is due to buildings (Abergel et al, 2017).

Several of these challenges can be combated when cows or livestock are placed at the core of sustainable living. In this section, we shall explore the various aspects of cow-centric sustainability.

3.1 Renewable Energy

3.1.1 Biogas

Cow dung can be used to meet several of our energy and fuel needs. Cow dung can be collected, fed into a digestor tank and decomposed by bacteria in the absence of oxygen (anaerobic). The decomposition process produces biogas, which is a natural and renewable gas consisting of 55-75% methane, 30-45% carbon dioxide and 2-8% water vapour and traces of hydrogen (Muthu et al, 2017). The process also produces a digestate, which can be used as compost or biofertiliser. Biogas possesses chemical energy, and hence it can be used as cooking fuel, or burnt in a gas engine generator to produce electricity. The electricity can be used both domestically and commercially, since it can be made in small and large scale.

The energy content of biogas mainly comes from the hydrocarbon methane. Cattle dung is ideal as the biogas source because cows have highly efficient methanogenic bacteria (bacteria that produce methane as a metabolic by-product in anaerobic conditions) in their stomachs which are ejected along with the dung. Hence, the need to introduce external cultures for methanogenesis is reduced (Narayan et al, 2018).

3.1.2 Small and large scale energy sufficiency

Given India's huge rural population and the need for fuel for various human activities, livestock produced biomass for energy has a significant potential. About 2600 million tons of

[2] Katayama, Roy and Wadhwa, Divyanshi. "Half of the World's Poor Live in Just 5 Countries."(2019). https://blogs.worldbank.org/opendata/half-world-s-poor-live-just-5-countries.

[3] Compassion In World Farming (CIWF). Strategic Plan 2013–2017 for Kinder, Fairer Farming Worldwide; CIWF: Surrey, UK, 2013; pp. 1–19.

livestock dung generated per year can yield close to 300,000 million m3 of biogas (Kaur et al, 2017). There are several success stories of people and organizations who ventured into building biogas technology and benefited themselves as well as the local population around them. SKG Sangha, a non-profit organisation started in 1993 and based in Karnataka, have built more than 160,000 biogas units in India over the last 27 years[4]. They are based in Karnataka and have benefited the rural populations in the state, who relied mainly on fuelwood for cooking. In 2007, they were given the Ashden Award (also known as the "green Oscar" for sustainable energy pioneers) in recognition of their achievement of building biogas plants for a large number of households in order to replace fuelwood.

Two brothers Aditya and Amit from Haryana built their own biogas plant, named the Amrit Fertiliser Plant[5], powered by a gaushala (cow shed) of 1200 cows that no longer produce milk. The biogas plant was primarily built to supply electricity to their ancestral steel factory and cut down on their electricity bill. Their plant not only produces enough electricity to power their steel factory, but also the biofertilisers from the biogas plant have benefited several local farmers, who were able to practice organic farming at just 10% of the cost of conventional organic farming. The brothers were also able to increase their income by 50%. The self-funded biogas plant spans 5,500 square feet, has so far used 36,500 tonnes of cow dung to produce 18,25,000 kWh of electricity and delivered around 73,000 tonnes of fertilisers to more than 1,000 local farmers. Use of the biofertiliser reduces water requirement for farming and therefore also reduces the demand for water.

3.1.3 Energy for transportation

Biogas can also be enriched with Methane up to 95% to be used as a transportation fuel and as an alternative to fossil fuel. It has been estimated that using biogas as vehicle fuel can reduce greenhouse gas emissions in the transportation sector between 60 - 80% when compared to fossil-based fuels like gasoline and diesel[6]. Shri Krishna Gaushala, located at Ghaziabad is a pilot unit that demonstrates biogas enrichment and bottling technology and is a joint venture by the Ministry of New and Renewable Energy, Govt of India and IIT Delhi. The Gaushala has around 1000 cows and the unit has 3 biogas plants, fed by 5 tonnes of cow dung. The biogas produced is purified and bottled with a Biogas Purification & Bottling Unit and used as vehicle fuel.

3.1.4 Energy from a cow - the numbers

For cooking: A single cow gives about 9–15 kg of dung per day. Cow dung from 3-5 cows can produce 1.5 - 2 m^3 (metre cube) of biogas per day. So one can say that on average, we get 10 kg of dung per day from a single cow, and therefore 4 cows give 40 kg of dung which can be used to produce 1.5 m^3 of biogas per day (the conservative lower limit) (Gupta et al, 2017). The energy content or the average calorific value of biogas is about 22 - 24.5 MJ/m^3 (million joules per metre cube)[7]. Therefore, 1.5 m^3 of biogas equals at least 33 MJ of energy, which is equal to 7882 kcal. According to the Advisory Board on Energy, the minimum requirement for cooking in India is 620 kcal per person per day, or 3100 kcal for a family of five, which is more than sufficiently met by the daily biogas production (Ravindranath and Ramakrishna, 1997).

[4] "SKG Sangha," accessed May 6, 2020, http://www.skgsangha.org/.

[5] "These Two Brothers from a Village in Haryana Are Converting Cow Dung into Biogas to Power Their Factory," accessed May 6, 2020, https://yourstory.com/socialstory/2019/09/biogas-plant-amrit-fertilisers-electricity-farmers-haryana.

[6] IRENA, "Biogas for Road Vehicles Technologu Brief," *IREA International Renewable Energy Agency*, 2017, https://www.irena.org/publications/2017/Mar/Biogas-for-road-vehicles-Technology-brief.

[7] Muthu et al., "Production of Biogas from Wastes Blended with CowDung for Electricity Generation-A Case Study."

For electricity: In order to determine the energy that can be usefully converted to electricity, accounting for various mechanical and thermal losses during energy conversion in the power plant, the efficiency has to be considered. The efficiency is generally found to be about 35%. Therefore, 35% of 33MJ, the total energy of biogas, amounts to 11.5 MJ, which is equal to 3.2 kWh of electricity per day. (joules, kilocalories and kilowatt hours are all units of energy that are interconvertible). The estimated value of 3.2 kWh is corroborated by an experimental study done by Akpojaro et al (2019) who built and tested a small-scale biogas generation plant. Their results show that 2.88 kWh of electricity can be generated using 1.56 m^3 of biogas generated from 40 kg of cow dung. This translates to 96 kWh of electricity per month which meets the monthly electricity consumption of an average Indian household. According to the Center for Policy Research and Prayas (an energy group), in 2014 an electrified Indian household consumed on average about 90 kWh of electricity per month; enough to run 4 tube-lights, 4 ceiling fans, a television, a small refrigerator, and small kitchen appliances with typical usage hours and efficiency levels in India[8].

For biofertiliser: A biogas plant not only serves the fuel and electricity needs but also supplies rich fertilizer at very low cost to farmers. A farmer's family having 4 cows would get 40 kg of cow dung, which becomes the fertile digestate after biogas production. In a year, this would amount to 13.9 tons (1 ton = 1000 kg) of biofertiliser per year. An average farmer has land of about 5 hectares, and he needs 135 kg of fertiliser per hectare, or 675 kg for 5 hectares, which is again more than sufficiently met by the amount of digestate produced from the biogas plant. The remaining 13.2 tons can be sold or exported for additional income (Sharma 2011).

It is clear that biogas technology based on cows has numerous benefits. It is a renewable source of energy that leads to energy sufficiency, as it meets primary energy needs both at the household level and for sustainable development at the industrial and national levels. It leads to freedom from the need to import oil and reduces a huge financial burden on the government. Farmers are liberated from the need to purchase chemical fertilisers, which degrade the soil, lower, the yield gradually and put them in debt and suffering. Biofertilisers from biogas plants are obtained at a very low cost and enrich and restore soil fertility, while reducing the water demand. This ends their cycle of sorrow and also gives them additional income from the sale of surplus fertiliser. Moreover, the easy availability of biofertiliser at cheap rates will create a widespread trend towards purchasing them, encouraging organic farming and discouraging the use the chemical fertilizers. This would replenish the soils, reduce the pollution of water bodies due to chemical fertilisers and positively impact the health of the ecosystem and humans. The use of biogas also prevents cutting down of trees for fuel. The biogas plants can be fully operated by women; thus it leads to technological empowerment and training of rural women and encourages women entrepreneurs. It would create a new generation of eco-conscious entrepreneurs who aspire to disseminate and implement sustainable technologies in India.

3.2 Soil Rejuvenation

Food and agriculture systems are closely linked to planetary and human health. Chemical-based industrial agriculture which strips the soil of nutrients is not only the leading cause of land degradation posing a serious threat to food security amidst a rising global population, but is also having severe implications on public health and accelerating climate change Gupta 2019). With scientific research strengthening the connections between pesticide exposure and a wide range of diseases (Owens et al, 2010) there is an urgent need to adopt or re-adopt sustainable agricultural practices that nourish the soil and in turn, human health.

Cows have been central to the Indian system of sustainable and regenerative agriculture, as cow dung and cow urine have been used traditionally in the preparation of a wide range of

[8] "Trends in India's Residential Electricity Consumption | Centre for Policy Research," accessed May 6, 2020, https://www.cprindia.org/news/6519.

liquid manures and formulations that promote plant growth, boost plant immunity, improve soil health and increase crop productivity and yield. Surapala's Vrikshayurveda, a text on the science of plant life deals with various aspects of plant physiology, propagation, pathology, treatment and soil types. The text has numerous references to the application of cow dung to plants during different stages of growth (Ratnakaram, 2003). Krishi Parashara, an ancient manual of agriculture, highlights the importance of producing manure from cow dung to achieve good yields, along with the process of preparation.

The indigenous Indian cow dung contains 24 different minerals like nitrogen, potassium, etc that benefit soil nutrition directly and has rich microbial diversity consisting of different species of bacteria, protozoa, archaea and yeast that are critical for soil nutrient cycling and cycling of major elements such as Nitrogen, Phosphorus and Carbon (Gupta et al, 2016, Nishanth et al, 2010).

Several cow dung and cow urine based biofertilizer formulations such as panchagavya, jeevamruta, amrit sanjeevani and beejamrita are used by farmers during different stages of plant growth, and each is found to have unique beneficial functions. Studies have been conducted to study the efficiency of these formulations on the performance of different crops and their capability to protect the plants from different diseases.

Beejamrita is largely used to treat seeds before sowing. A comparative study on the effect of beejamrita on seed germination of pea showed that it was most effective for seed treatment as it resulted in a 92% germination rate compared to 56% in control.

Panchagavya is a popularly fermented formulation used as a biostimulant and plant growth promoter (Sharma et al, 2019). It is prepared with five central ingredients derived from the cow - cow dung, cow urine, milk, curd and ghee - in decreasing proportions along with other components such as ripe bananas which act as a substrate for microorganisms and jaggery which accelerates the fermentation process. It is applied at 3% concentration after 21 days and research findings recorded the NPK content (0.97, 0.92 and 0.65% respectively) of panchagavya at a maximum on the 21st day after preparation. Foliar application of panchagavya to chilli plants produced the highest plant height, early 50% flowering, highest number of flowers, number of fruit and highest yield per hectare of chilli (Mudiganti Ram et al, 2015). Panchagavya was also found to contain Azotobacter, Azospirillum and phosphobacteria in addition to microorganisms that improve pest resistance and disease resistance in plants and finds application as a biopesticide (Naresh et al, 2018).

Application of cow manure to soil is found to significantly increase Soil Organic Carbon (SOC) which improves soil structure and improves the performance of vital ecosystem functions such as soil carbon storage, water retention and aeration. Soils are the largest terrestrial ecosystem and act as both carbon sources and sinks (Hao et al, 2003). Sustainable land management practices using cow manure to improve the soil carbon sequestration has the potential to be a powerful climate change mitigation tool.

In addition to the innumerable benefits to soil health and plant health, cow dung is locally available, easy to convert into manure and cheap. This reduces the financial burden on farmers by eliminating their need to buy expensive chemical fertilizers that come at a huge cost to their own health and well-being and degrade their farmland in the long run.

Cow-based agriculture can ensure the richness and fertility of soils, which form the foundation of a sustainable food system.

3.3 Eco-Construction

Concrete is the most consumed resource on the planet, after water. Cement, the key ingredient in concrete, has shaped much of our built environment – our houses, buildings, bridges, roads and dams. However, its carbon footprint is massive. The cement

industry is one of the primary producers of the greenhouse gas CO_2 and accounts for about 8% of the world's CO_2 emissions. Concrete also damages the topsoil, the most fertile layer of the earth rich in microbes. The hard surface of concrete contributes to surface run-off that leads to soil erosion, water pollution and flooding. Concrete and cement production is highly centralized, and also capital and energy intensive. Hence modern construction has become a very expensive activity. Even after construction, maintaining the buildings (heating, cooling, lighting, etc) is very energy intensive. Construction and buildings together account for 39% of the CO_2 emissions according to the Global Status Report of 2017 by the UN Environment and the International Energy Agency (Abergel and Dulac, 2017).

The simplest and oldest earth-based building technique is cob, which is an amalgamation of soil (dug for the foundation), clay, cow dung and straw. The proportion depends on the type of soil in the local region. Cob is a great thermal mass, which means that it stores heat energy and releases it very slowly, thus maintaining a constant interior temperature even with large temperature swings outside. It keeps the interior of the building cool in summer and warm in winter. Construction with cob therefore makes the building energy-efficient. Adobe is another earth-based construction technique. Adobe is made from sand, clay, and water, together with fibrous materials like straw and cow dung, which is shaped into bricks using frames and sun-dried.

3.3.1 Cow dung as soil stabilizer

Cow dung is an important ingredient in the construction material because it acts as a good binder and a thermal insulator. The fibres present in cow dung also prevent cracking. Modern scientific studies show that cow dung functions as a soil stabilizer. A soil stabilizer is a material that improves the durability of the soil by increasing its strength and resistance to water. In an investigation on the use of cow dung as a soil stabilizer in the construction of Adobe bricks, bricks with different cow dung – soil ratios were tested for compressive strength, permeability, erosion and cracking. The results showed that the ratio of 1:4 (cow dung: soil) had the highest compressive strength and resistance to erosion. The ratio 1:5 had the highest resistance to water permeability. Furthermore, there was minimum cracking in all the treatments (Scholwin et al, 1992).

In another research study, the effects of cow dung on microstructural changes in Adobe bricks were investigated by the method of X-ray diffraction, thermal gravimetric analyses and scanning electronic microscopy (Millogo et al, 2016) It was found that cow dung reacts with kaolinite and fine quartz to produce insoluble silicate amine, which glues the isolated soil particles together. Also, it was observed that the significant presence of fibers in cow dung prevents the propagation of cracks in the brick and reinforces the material, leading to a homogeneous Adobe microstructure. There was a significant improvement in the water resistance of the bricks, making Adobe stabilized by cow dung an advantageous building material for wet climates.

3.3.2 Floor Plaster

Cow dung is traditionally used in floor plastering. Cow dung contains 3-5 crores of useful microbes. It has anti-fungal properties and repels insects (Sathasivam et al, 2010). A paste of mud and cow dung is usually applied to floors and serves to disinfect the floor. Cow urine is also used as an additive for plastering floors owing to its anti-fungal property. It prevents the growth of harmful fungi on the walls and floors. Cow urine is also an extremely good sealant for earthen floors. Cow urine is used for sealing the top surface of the finish, preventing crack formation.

4. Conclusion

Thus, we see that is not surprising that the Indian tradition has given so much importance to cows. Cows helped to lead self-reliant, self-sustaining and fulfilling lives. Harnessing the

potential of cow-based products beyond dairy products, can help boost the economy and ecology of developing nations and can bring self-sufficiency. A cow-centric approach to sustainable development is much needed.

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