COW DUNG BASED ECONOMY: THE FUTURE TECHNOLOGICAL PROSPECTS

Abstract

Cow dung and urine are readily available and reasonably priced renewable bio-resource. Indian farmers rely heavily on cattle's and agriculture for their survival. It's been traditionally used as a mosquito repellent and in fuel. To improve the economic situation of farmers, several items and technologies can be used with cow products. Vermi-compost, bio-fertilizers, and bio-pesticides, among other products that can be made from cow dung and urine, are all very important in agriculture. Cow dung contains variety of microorganism including *C. koseri, K. pneumonia, E. aerogenes*, *E. coli, K. oxytoca, Kluyvera* spp. and *M. morganii* which provides it antifungal, antimicrobial and anti-cancerous properties. In cowpathy, these microbiological characteristics can be used. Additionally, distillate produced from cow urine serve as a bio-enhancer for numerous drugs. The energy needed for microbial growth is provided by cow dung, aiding in the bioremediation of contaminants. Cow urine is a highly effective bio-pesticide that along with neem oil. The future of the cow dung industry is in AI-based contemporary technologies, vermin-composting technology, biogas, compressed biogas, energy production, and smart automation technology for panchgavya production. Thus, farmers must be educated about the advantages of products made from cows apart from only dependency on milk in order to improve their economic situation.

Keywords: Cow Dung, Bio-Enhancer, Bio-Pesticide, Bio-Fertilizer, Vermi-Compost, Panchgavya.

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I. INTRODUCTION

The cow has served as the basis of economy of Indian agriculture. Cow welfare coexists successfully with an agriculture-based economy. Cow dung is an animal byproduct from the bovine; it is undigested remnant of plant materials. It is an affordable and accessible bio-resource. It is a blend of cellulose, lignin, and hemicelluloses. It has minerals like sulfur, nitrogen, potassium, iron, magnesium, copper, cobalt, and manganese. Villagers from India utilize cow dung as fuel and plaster the floors and walls of their homes to insulate them in the winter and summer. Cow dung is utilized in agriculture in India as manure, bio-fertilizer, bio-pesticide, and pest repellant (Gupta et al 2016). In comparison to indigenous Indian cows, the native Indian cow also contains higher amounts of calcium, phosphorus, zinc, and copper (Garg and Mudgal 2007; Randhawa and Kullar 2011). Numerous microbes, including *C. koseri, K. pneumonia, E. aerogenes*, *E. coli, K. oxytoca, Kluyvera* spp. and *M. morganii*, are present in cow manure (Gupta et al 2016; Randhawa and Kullar 2011). These microorganisms from cow manure are utilized to regulate environmental contaminants and energy production. Apart from that cow products are used for agriculture, pesticides, cosmetics and floor cleaner.

II. IMPORTANT TECHNOLOGICAL ADVANCEMENTS AND PRODUCTS THROUGH COW DUNG AND COW URINE (FIGURE 1)

1. **Model based on Machine Learning and Artificial Intelligence (AI):** AI-based model was created to assist donors track their contributions for non-milching. By incorporating stray cows in a circular economy, it offered a solution of stray cows in real-time. It uses machine learning-aided facial recognition technology. When cow stop milking, cow owners typically abandon non-milching cows. These cows get injured, have accidents, and subsist on trash. By using AI-based technology, the donor can provide and track their donations as well as stray animal byproducts such as cakes, compost, incense sticks, and other derivatives of cow dung. Additionally, cow dung can be used to create biogas and biofertilizer generation facilities for additional financial gain (Kedia et al 2022).

2. **Vermi-Composting Technology:** Vermi-composting is reorganized as an environmentally beneficial process for bioconversion of organic solid wastes produced by agricultural, industry, rural and urban areas that are acting as a reservoir for environmental pollutants. It is made from the residue left over from the distillation process from biogas as well as mixture of herbs and urine. Poring the mixture into composting pits after mixing with cow urine results in superior quality vermi-compost with increased essential micronutrients. Cattle dung is essential for mineralization, nutrient recovery, earthworm and microbial activity and the creation of vermin-fertilizer in the vermin-composting of organic wastes. The earthworm excretory pellets known as "vermicasts" can improve soil health and control the soil's texture (Yuvaraj et al 2021).

3. **Direct Combustion Technologies:** Cow dung is major source of fuel in Indian villages. Cow dung is thermally utilized on a big scale in India, where it is used in production of biogas (Alfa et al 2014; Zahid et al 2017). Globally, the utilization of biomass as a sustainable energy source has increased recently. Agricultural waste such as cow dung is being used for purpose. Pellets made from cow dung were tested as a possible renewable energy source. Cow dung pellets are source of renewable energy. Biomass could be the

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foundation of the energy sector of the future and various researches presented a idea of using cow dung pellets as a potential source of renewable energy that is accessible everywhere (Alfa et al 2014; Zahid and Surindra 2017; Szymajda et al 2021).

4. **Bioremediation:** According to various studies, cow dung contains a diverse bacteria that are ideal for the microbial degradation of pollutants including *Acinetobacter*, *Bacillus*, *Pseudomonas*, *Serratia* and *Alcaligenes* spp.(Adams et al 2014; Gupta et al 2016; Randhawa and Kullar 2011). According to recent study, microorganisms present in cow dung have ability to break down hydrocarbons in engine oil-contaminated soil. Another study suggested using cow dung in the right dosage can be very useful in biodegradation of water contaminated with motor oil (Umanu et al 2013). A metabolic mechanism for the microbial breakdown of polycyclic aromatic hydrocarbons has also been proposed. Cow dung can provides energy needed for growth of microorganism which leads to the bioremediation of contaminants. *C. stercoreus* which can be isolated from cow dung is able to break down lignocelluloses. It also has ability to break down the antibiotic enrofloxacin (Randhawa and Kullar 2011).

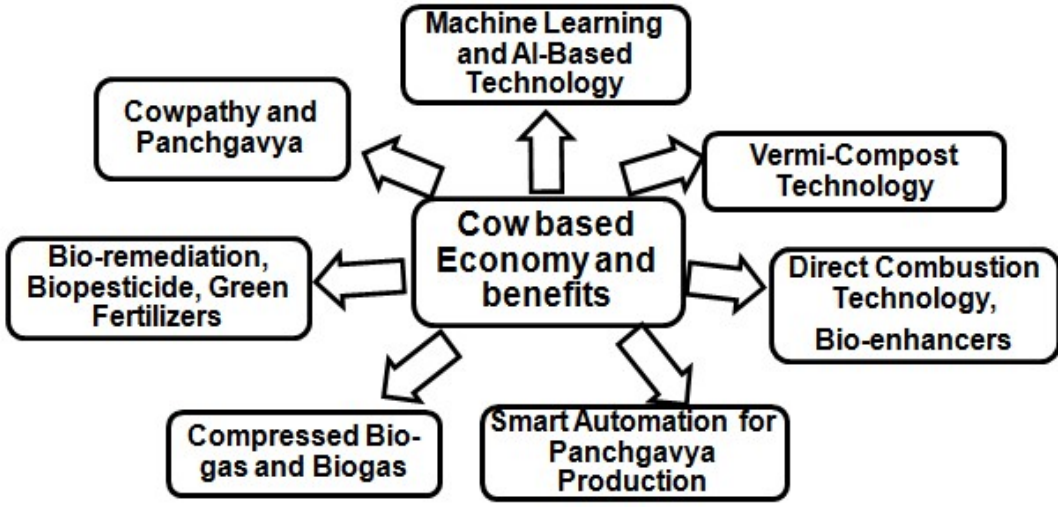

Figure 1: Cow based Economy and Technical Aspects

5. **Bio-Pesticide:** Similar to neem leaves, cow urine is an excellent bio-pesticide. Such bio-pesticides can be used safely, and even their residues don't stay in the food chain for very long. It lacks the negative consequences of chemical insecticides. Neem leaves weigh about 2 kg and are soaked in 10 liters of cow urine with various other veggies. Additionally, a 1:50 ratio may be utilized for spraying. When cow dung and cow urine are combined they work as excellent manure and natural insecticide. The mixture made from neem leaves and cow urine is excellent pesticide and promotes plant development (Dhama et al 2005a; Randhawa and Kullar 2011)

6. **Electricity Generation:** Microbial Fuel Cells transform biodegradable materials into power by using microorganisms as a biocatalyst. Natural cow dung produces more open circuit voltage than sterile cow dung. For this electrogenic properties of five bacteria's were studied (Shiv K et al 2012). Another study concluded that microbial fuel cells offer

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cleaner technology and the potential to use bacteria from cow dung for electricity generation (Siddique et al 2018).\

7. **Cow Dung Houses with Antibacterial Properties:** Cow dung is best natural disinfectant cow dung it has anti-bacterial properties. It is not unusual to discover a house's entire floor covered in some fresh cow dung paste in any typical Indian village. *Mycobacterium vacca*-a common bacteria found in cow dung. It stimulates neurons in the brain that make serotonin, a neurotransmitter involved in emotions of well-being and happiness (Malan-Muller S et al 2018).

8. **Production of Panchagavya through Smart Automation:** A unit was created for the production of panchagavya through automated system. It includes an automated mechanism for producing panchagavya. In these system sensors for pH, moisture, temperature, and pressure were integrated. The device automates the entire procedure using an ATmega 328 microcontroller. (Sumathi and Mohamed-Abdullah J 2022).

9. **Mosquito Repellent based Village Economy:** Chemical mosquito repellents include hazardous substances that are bad for human health. Herbal mosquito repellents made from cow dung are based on Indian traditional methods. They have relatively low production costs as well. Due to its herbal properties, it does not lead to any respiratory problems when inhaled. Numerous studies have attempted to maximize the therapeutic properties. According to Indian philosophy, cow excrement is extremely sacred since it is believed to be the home of the Goddess of Wealth, *Gomay Vaste Laxmi*. Through the production of this product, youth can generate employment, and farmers can be benefited financially (Dhama et al 2005a; Sharma et al 2017).

10. **Green Fertilizer made from Cow Dung Could Transform Big Agriculture:** Cow dung is one of the best known natural agriculture fertilizer or organic manure. It has tremendous importance in Indian cultures. According to Indian vedic system, food that we eat is interconnected with our physical being as well as mental consciousness. Organic farming is one the key activities. Therefore, purity of food determines the wellbeing of the society. Cow dung is natural organic fertilizer its importance decreased when farmers started utilizing chemical fertilizers. However, as chemicals have many hazardous effects, use of cow dung in organic farming has gained importance. Cow dung cakes is an excellent fertilizer with N:P:K and organic manure used for all type of plants (Gupta et 2016).

11. **As Fuel:** In rural places, cow dung is utilized as fuel. Compared to electric ovens, it is still regarded as an excellent fuel for baking potatoes. As per tradition temperature caused by the combustion of cow dung gas only rises to a certain point, keeping the food's nutrients from degrading. Its smoke also kills hazardous microorganisms of the air at the same time. In many parts of India and other developing countries, in mountain regions and villages dried cow dung cakes are used for cooking. In India traditionally, they are called as **Upla** or **Kanda**. They are alternative of wood used for cooking.

12. **Bio-Enhancer:** Bio-enhancing is one of its many properties of cow urine. Distilled cow urine is commonly used as an alternative to anti-bacterial and anti-cancer medicine. Cow urine mixture with antibiotics is used in the prevention of microorganisms. CSIR Indian

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scientists are working on various medicinal properties of cow urine and other panchgavya products in different laboratories. They are making efforts for various types of prevention and treatments in the field of medical department in the form of Panchgavya products. As a bioenhancer, cow urine distillate works better than cow urine and enhances the efficiency of antifungal, antibacterial, and anticancer drugs. Additionally, it makes zinc and the bovine serum albumin-conjugated gonadotropin-releasing hormone more active. Rifampicin, an antibiotic used to treat tuberculosis, can be bio-enhanced by cow urine. Additionally, the transfer of antibiotics, tetracycline, and ampicillin is improved by cow urine distillate (Randhawa GK 2010).

13. **Biogas:** Non-renewable energy resources like coal, oil, and gases are fast depleting as a result of growing human needs. Methane, which is produced by animal waste to a degree of 55–65%, has a global warming effect on the earth that is 21 times greater than that of carbon dioxide. The organisms involved in the creation of biogas are referred to as methanogens, hydrolysers, and acetogens. The hydrolytic stage of the synthesis of biogas involves extracellular hydrolytic enzymes, particularly cellulase, xylanase, amylase, protease, and lipase, which are excreted by bacteria. Biogas, a mixture of several gases produced by anaerobic fermentation of organic materials from methanogenic bacteria. It is primarily consists of methane (50-65%) and CO_2 (25-45%). The production of biogas during the winter months in hilly places is reduced by 70% because mesophilic bacteria cannot survive in psychrophilic temperature ranges (Gupta et al 2016). Bio gas is used to power internal combustion engines. Cow dung remnants from the engine can be utilized to make manure that is great fertilizer for crops (Rui et al 2018).

Table 1: Bacteria's and Temperature Range for Biogas Production

Bacteria's	*Pseudomonas* sp., *Azotobacter* sp, Purple sulphur or purplenon-sulphur bacteria, *E. coli, Bacillus* sp., *Pseudomonas* sp., *Staphylococcus* sp. and *Proteus* sp.
Thermal Range	Mesophilic (32–38 °C) Thermophilic (50–55 °C)

14. **Compressed Bio-Gas:** In India, compressed biogas will be particularly useful for need of large population and small land area. Lots of organic trash is generated in India. We can avoid putting this material in landfills if we use it to generate electricity. Biogas processing technology has already been developed in India. Using cutting-edge technology, compressed biogas can match the performance of compressed natural gas. Methane makes up 60% of biogas, and CO_2 makes up 40%. This is equivalent to the CNG's pure composition following processing. Power plants and automobiles may both run on this compressed biogas.

15. **Health Management of Humans:** Cow dung has antibacterial and disease-preventing qualities. The bacterium that causes sickness and putrefaction is eliminated by it.

- **Panchgavya:** It is an ayurvedic cure consists of five (pancha) cow products (gavya)-milk, curd, ghee, dung and urine. It can be used to make a variety of herbal medications and is thought to be able to treat a wide range of diseases (Pathak and Kumar 2003; Jarald et al 2008). In Ayurveda, Panchagavya is especially

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significant. It has medicinal properties that combat a number of illnesses and conditions. To this, mixtures of several herb varieties may be added. Like other medical systems like homeopathy and allopathy, this one is called “cowpathy”. According to Ayurveda, utilizing Panchgavya can treat both physical and mental disorders. It is effective in treatment of broad range of illnesses, including the flu, allergies, colds, cough, asthma, gastrointestinal tract disorders, heart problem, skin infections, tuberculosis, chickenpox, leprosy, and numerous other bacterial and viral infections. (Dhama et al 2005b; Jain et al 2010). Utilizing Panchagavya regularly helps the body rid itself of harmful toxins. Additionally, panchgavya's effect on the central nervous system's ability to regulate pain, muscular tone, and spontaneous motor activity has been established in albino rats (Paliwal et al 2013). Panchgavya-derived products make great organic fertilizers, manures, biogas, fuel, and biopesticides, among other things.

- **Cowpathy:** Ayurvedic ingredients derived from indigenous cows are the basis of the treatment known as "cowpathy." According to the ancient Ayurvedic literature (Vir Charak Samhita, Sushrut Samhita, and Gad Nigrah), prime products from indigenous cows have a variety of pharmacological uses, including the treatment of leucoderma, hyperlipidemia, arthritis, asthma etc (Dhama et al 2013; Bajaj et al 2022). Many Ayurvedic practitioners use cow urine for treatments. However, much of the scientific information is lacking in this regards, due to batch to batch fluctuation, seasonal changes, urine collection time and its effect, the impact of feed, and differences/similarities between the urine of other cattle (Bajaj et al 2022).

- **Anti Fungal Properties:** According to some studies, the antifungal component in cow dung inhibits the development of coprophilous fungus (Dhama et al 2013). In cow dung *Eupenicillium bovifimosum* creates chemicals that resemble patulodine and have strong antigungal properties (Lehr et al. 2006). Cow dung microorganisms K4 have antibacterial activity against *E. coli* (Teo and Teoh 2011). The effects of live *M. vaccae* administration on mice's anxiety levels and ability to learn were also assessed and it produced positive results (Matthews and Jenks 2013). According to these researches, cow dung may be a valuable source of microorganisms that could potentially lead to new antibacterial compounds.

- **Cow Urine Therapy:** Cow urine has therapeutic properties, such as its antibacterial, and antifungal effects. Cow urine increases tolerance against the mcf-7 human body cancer cell line (Gupta et al 2016). There are 24 different salts in cow urine, which is used to treat numerous illnesses. 95% of cow urine is water, 2.5% is urea, 2.5% is minerals, harmones, and enzymes. Iron, calcium, phosphorus, salts, carbonic acids, potash, nitrogen, ammonia and lactose present in it. Amino acids and cytokines present in cow urine boost immunity. Drug-resistant bacteria, viruses, and illnesses like cancer are all killed by cow urine. It is beneficial for treating conditions including the flu, sinusitis, allergies, arthritis, snake bites, chicken pox, constipation, fever, obesity, baldness, edema, hepatitis, leprosy, gastric ulcers, burning, fatigue, fever, and Parkinson's illnesses (Gupta et al 2016).

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The description of Panchagavya is as follows;

- **Milk:** Cow milk, according to Ayurveda, offers nourishment that cannot be found in any other food. Cow's milk, which is one of the essential nutrients to strengthen ojas—the vital energy that controls our immunity, vigor, and happiness—nourishes all bodily functions after being correctly digested. The good-fat milk produced by Indian Cow A-2 contains -casein protein, which supports the nervous and gastrointestinal systems. This milk is the reverse of the Jersey cow's A-1 milk. When compared to buffalo milk, it has fewer calories, lower cholesterol, and higher levels of micronutrients like vitamin. It also contains more moisture, carotene, thiamine, vitamin C, riboflavin, sodium, and potassium.

- **Curd:** The byproduct of cow's milk is curd. All of the top Ayurvedic doctors, including Charaka and Susukhata, have written about the advantages and qualities of curd. Curd can treat a variety of illnesses. It is regarded as a tonic and protects against early aging. Patients who suffer from diarrhoea and nausea can get relief from curd, and it is also helpful for chronic gastric and particular colitis. Cow's milk curd is regarded as an anti-inflammatory and blood cleanser. It helps with gall diseases and blood-related issues if taken with sugar. In gastrointestinal issues, it is helpful. Since ancient times, curd has been combined with cumin, black salt, and sugar. Whey butter has a very little amount of milk fat.

- **Ghee:** Cow ghee enhances mental wellness, and resistance to infection. It has cholesterol-lowering and immune-stimulating properties. Cow ghee improves memory function. Cow ghee enhances digestion and benefits vision. It delays the onset of old age. You can make a micronutrient supplement by combining non-fat cow's milk, vitamins, honey, and cow's ghee.

III. CONCLUSION AND CURRENT PROSPECTIVE

Cows are mostly raised in India for milk production due to the economic benefits to farmers. Non-milching cows are not economic beneficial to farmers. Generally, these cows are sold to slaughterhouses or abandoned as strays. Because of their low literacy, most farmers are unaware of the benefits of cow urine and manure. It is necessary to protect cattle’s as an effort is being made through AI-Based technology. Cow dung also pollutes roadways and grounds. Very large amount of urine (5-6liters) and cow dung (8-10kg) is produced per cow on an average. The benefits of cow’s product should be known to the farmers. Farmers believe that cow dung and urine are sources of pollution and of no use but most of them are unaware it can be used as bio-pesticides, bio-fertilizers, and panchgavya. From cow dung electricity and biogas can be produced. Electricity may be made from cow manure. Cow dung is regarded very important because of its multiple used in the areas of agriculture, energy resources, environmental protection, and medicine. Cow dung functions as an antibiotic, fungicide, and antiseptic must be utilized in cowpathy. After composting, cow dung contains a lot of nitrogen. Insects found in plants also perish when exposed to cow manure and cow urine. Therefore, the usage of cow-based products is where the future of India's agricultural economy lies.

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