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Editorial

Animal farming for 'Food and Fuel'

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Livestock is an important sub-sector of Indian agricultural economy which plays a multifaceted role in providing lively hood support to the rural population and food security. The contribution of livestock sector to the agriculture output has significantly increased from 1.8% (1950) to 29.35% in the year 2021 [14]. In India, 18 million people are employed in livestock sector. In the last decade, the socio-economic mobility of people has initiated a dietary diversification from cereal based to protein rich food. From the year 2009 to 2019, there was 16.6% reduction in the consumption of cereals while there was an increase of 25.4% in the consumption of milk, meat, fish and eggs, reiterating the economic principle as income rise, demand tend to shift towards protein rich foods [13]. The livestock sector is gradually getting transformed from traditional to commercial and beyond, which is happening currently. From the perspective of increasing production in 80's and 90's, the current perspective is productivity, quality, choice and value addition [1].

Last 70 years has seen unprecedented change in the dairy sector of India. From a milk deficient country in the year 1950, producing a meagre 17 million tonnes of milk, India has transformed into the world's largest producer of milk, producing a bulk volume of 209.96 million tonnes in the year 2020-21, accounting for 17.6% of the total global output [14].

As of 2020, India also is the top country by the number of cattle and buffaloes in the world accounting for 33.33% of the world's cattle and buffaloes possessing 305.4 million animals [20]. Though this is a matter of pride, this is also a matter of concern as ruminants are one of the major source of anthropogenic methane emission and also suffer from the after effects of climatic change. Methane is stated to be one of the major greenhouse gases responsible for stratospheric ozone depletion and also 25 times more potent in terms of heat trapping. Livestock and climate change are interdependent and linked through a complex mechanism where adversity of one affects the other one in many ways [2].

Climate change and its impact on livestock sector

The impact of climate change is visible all over the world but South Asia appears to be most vulnerable region. The situation in India is more alarming as rural economy is primarily dependent on crop-livestock production systems. Climate change and its extreme weather events such as drought, flood, and long heat waves has been adversely affecting crop and livestock productivity thereby endangering the food security of the country. Temperature affects the critical factors for livestock production, such as water availability, animal production, reproduction and health, forage quantity and quality [18]. Temperature increase will increase the lignin and cell wall components in plants which reduce digestibility and degradation rates, leading to a decrease in nutrient availability for livestock and increased emission of methane [17].

Climate change enhances the introduction and invasion of disease agents by altering biological variables. Climatic change affects the host distribution, density, disease emergence and the animal-human interface. A pathogen may find access to new territories and turn more aggressive [3]. Climate change is leading to increased incidence of zoonotic disease affecting public health

with emerging disease like Avian flu, Swine flu, Nipha virus, Corona viral disease etc. Yet uncertainties about the future disease trends under changing scenario remain uncertain and undisclosed [10].

Climatic variables tend to increase animal's water consumption which might increase to three fold. Meanwhile, the livestock sector contributes 14.5% of global greenhouse gas emissions, driving further climatic change [13].

Animal farming for fuel

All animal farming activity can produce fuel in terms of biogas from animal excreta and biodiesel from animal fats. The world is on a quest for energy, the premier source of which is now petroleum. Developing alternate source will carry the flames of progress to the future [19]. Energy is the most fundamental requirement of every nation as it progress through the ladder of development. India with 16% of the world's population could boast of only 0.5% of the world's oil reserves. The estimated crude oil import cost comes to about 10% of the country's Gross Domestic Product [14]. With the Indian economy poised for a robust growth of 9 to 9.5% per annum, energy security would remain vulnerable until alternative fuels to supplement conventional fuels are developed based on indigenously available feed stocks. The Indian bio-fuel policy 2019, proposed 10 per cent reduction in the import of crude oil in four years' time. Renewable energy is a major source for fighting climate change [2]. In bio-fuels, the country has a ray of hope. Development and utilization of new indigenous bio-mass feedstock and development of next generation of more efficient bio-fuel conversion technologies are the need of the hour. In this context, animal farming for fuel offers new scope as it contributes to the national energy security by producing 'wealth from waste', following the four basic principles of waste management i.e., REDUCE, REUSE, RECYCLE and RECOVER [6].

The crude oil price has been increasing and fluctuating causing geopolitical instabilities around the world, which prompted the government of India to decontrol the petrol prices. Ever since, the petroleum prices had been increasing steadily. With the onset of the Russian war, the crude has hit the all-time high of 118.42 $. Therefore, the time is ripe to explore the possibilities of 'animal farming for alternate fuel'.

Bio-diesel production from animal slaughter waste

Bio-diesel is an alternate fuel, which is produced from vegetable oil and animal fats that can be used in all diesel engines which reduces vehicular pollution considerably. Bio-diesel can be used in all diesel engines at 20 per cent blending level (B20). In the engine it reduces the total fuel consumption and brake specific fuel consumption, while it increases the mechanical efficiency and brake thermal efficiency [11]. The biodiesel lead to less engine wear, a quieter engine and better fuel economy. The better lubricating qualities of bio-diesel prevents the overheating of engine.

The blending of biodiesel at 20%, substantially reduce the engine emissions as proved by significantly lower smoke levels of 47.14 %. This is due to the high Cetane value of animal fat bio-diesel which has shorter ignition delays, providing more time for fuel combustion, leading to more efficiency and less exhaust emission [9].

Rendering

Among the different bio-secure and sanitary disposal methods, dry rendering is an excellent way to recycle animal slaughter waste. The end products are carcass meal and oil/fat. Carcass meal can be used as protein powder for pets and fishes and also as an excellent bio-fertilizer.

The average yield of protein powder was 35% of the weight of the slaughter waste loaded into the cooker and the yield of oil was10% of the weight of the slaughter waste [7].

Biodiesel production

Biodiesel production from animal fat/Oil is gaining prominence as this renewable fuel is produced from in-edible oil without any competition for food. It is a two-step reaction, acid catalyzed esterification of the FFA portion of oil followed by the base catalyzed transesterfication of the triglyceride with standardized methanol molar ratio, catalyst concentration, reaction temperature and reaction time to obtain maximum biodiesel yield of 92%. Heterogeneous catalyst was standardized for transesterification of rendered chicken oil, which could reduce the processing cost and it absorbs water leading to better quality bio-diesel [8].

Bio-CNG from animal waste

The production of biogas from animal waste to replace LPG has gained priority form consumer point. It solves a major problem of

non-availability of cooking gas at affordable price to the common man. At the same time this also utilise animal dung a potential pollutant, for renewable energy generation *vis-à-vis* the production of organic manure for organic farming [5]. Biogas contains 60% methane, 30% carbon dioxide, 5% hydrogen, 1% nitrogen, 0.3% water vapour and hydrogen sulphide in traces [15].

Compressed natural gas (CNG) production

Natural gas is 100% methane and 60% of biogas is methane. This process comprises of scrubbing out the contaminants in the biogas to produce pure methane and then compressing at high pressure of 200 bar to form CNG which can be used as a fuel for automobiles and for cooking. The CNG bottling plants consists of a high-pressure compressor, and cascade of storage cylinders. Dried and purified gas goes into the suction of high pressure compressor, where it compress the gas to desired working pressure (~200 Bar) and fill into the storage cylinder [16]. This cylinder can be used to run vehicles and also as a replacement for LPG. This project will also address the shortage of organic fertilizer for organic farming [4].

Future perspectives

Bio-diesel production technology provides opportunity to produce highly valued bio-fuel from dead animal, birds and slaughter waste, which can improve the engine efficiency and reduce vehicular pollution considerably. Simultaneously, this technology can also solve the major problem of unscientific disposal of dead birds and slaughter waste which is prevalent in developing countries, leading to severe environmental pollution.

As such, animal production in the future may orient towards "Animals for food and fuel" which would revolutionize this sector leading to greater financial viability, production of renewable energy and environmental protection. Pigs and poultry would lead this sector because of their excellent attributes such as prolificacy, short generation interval and quick body weight gain for slaughter. Fat less pork at a premium price is gaining consumer acceptance phenomenally. This provides the separated fat to be converted to biodiesel economically. Thus development and utilization of new bio-mass feed stocks for the production of bio-fuel and development of next generation of more efficient bio-fuel conversion technologies awaits the future.

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