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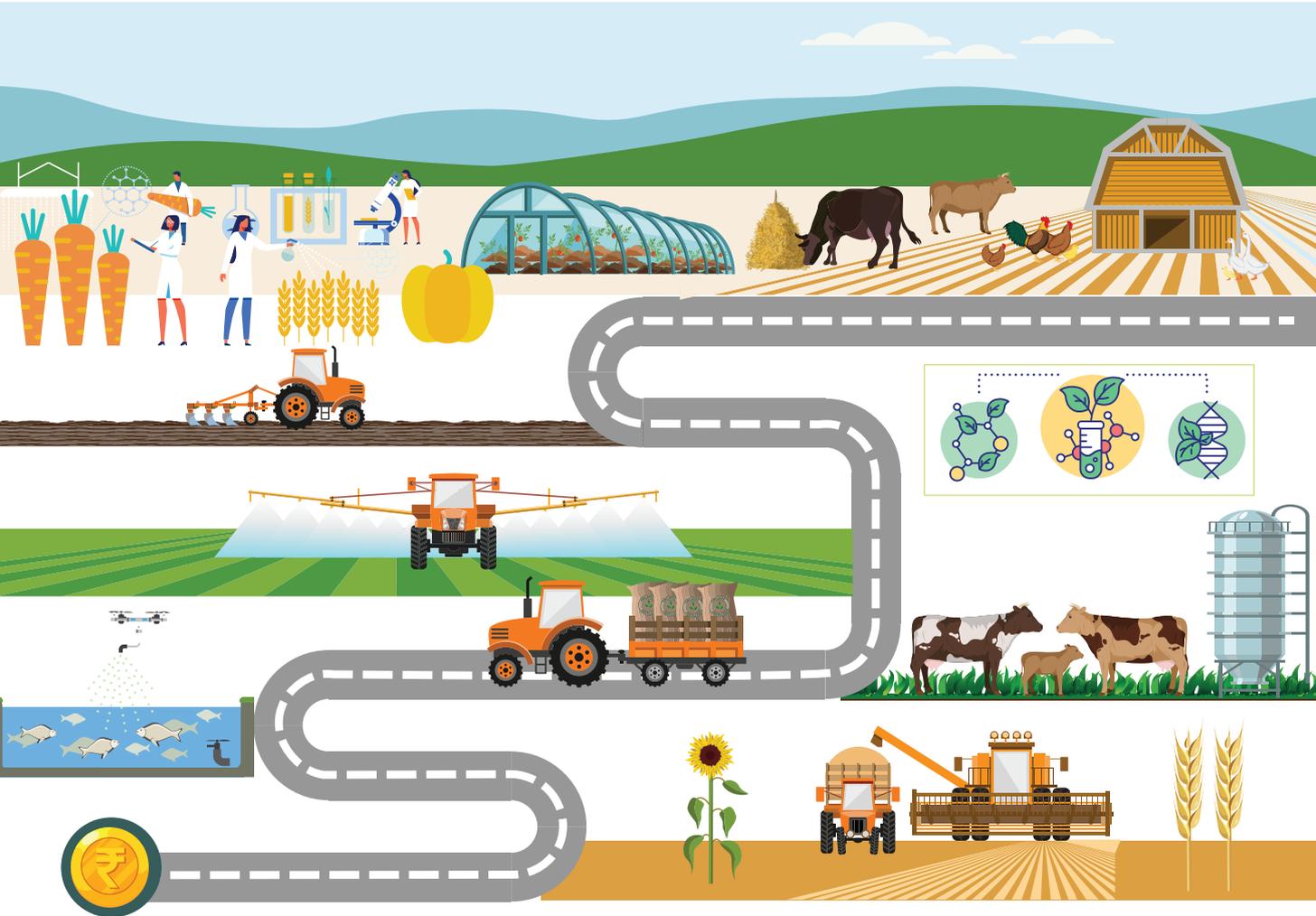
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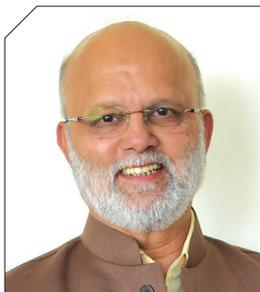
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Indian Agriculture: Way Forward



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Farm to fuel: Bioenergy as clean source of energy

As one of the world's fastest growing economies, India has been seeing rapid industrialization in the past few years. The country is also experiencing an influx of migration with people relocating from villages to cities for employment and education opportunities. Industrialization and urbanization have therefore led to ever-growing energy needs, making India the third largest primary consumer of energy.

Today, India's energy mix is dominated by conventional sources mainly derived from fossil fuels. The country imports 80 per cent of crude oil, thus making it dependent on external resources while incurring high foreign expenditure.

The pursuit of ever-rising energy demands driven by growth is damaging planet earth irrevocably, leading to concerns over the evils of climate change and global warming. The country needs to strike the right ecological balance for sustainable growth. India's existing CO₂ emissions hover around 2.29 billion tonnes. As a signatory at the UN Climate Change Conference, bioenergy will help India fulfill its COP21 Paris Summit obligations to bring down carbon emission by 30-35 per cent.

This is where bioenergy plays a significant role in optimizing India's overall energy portfolio.

What are biofuels?

Biofuel is a fuel that is derived from agri-residue

that can be readily replenished. Biofuel is a source of renewable energy, unlike fossil fuels such as petroleum, coal, and natural gas.

In the transportation sector, biofuel is one of the largest sources of renewable energy in use today. Derived from agricultural resources, biomass can be in liquid, or gaseous form.



1. Liquid: Bioethanol, Biodiesel, Biojet fuel

2. Gaseous: Compressed Biogas (CBG)

Ethanol is the most widely used form of biofuel in liquid form where it is blended with gasoline. Among gaseous form of biofuels, compressed biogas is the most preferred.

Biofuel as environmental, economic and social enabler

As an environmental enabler: Climate change is affecting monsoon patterns, and consequently, the agriculture economy. Uninhibited industrialization is having a detrimental impact on ecological balance. Increasing traffic and associated rise in pollution levels, and the burning of agricultural waste, (as evident in the recent brown clouding in northern India) are adversely affecting air quality and is a health hazard.

Biofuels are carbon neutral and therefore combat these issues. Moreover, biofuels are renewable and cleaner in nature and are available as captive feedstock in farms, and emit lesser toxic greenhouse gases.

As an economic enabler: Being captive in nature, biofuels facilitate energy security. They also help reduce the country's high import bill

and foreign exchange payout for crude oil. To that extent, they also help mitigate the spikes in pricing of crude oil in volatile situations caused by a mismatch in demand and supply.

As a social enabler: The exodus from rural areas in the pursuit of education and employment is putting additional stress on already stretched urban infrastructure. India has to strive for inclusive growth especially in the rural sector for it to realise its ambition of reaching a five trillion-dollar economy mark in five years. This is where biofuels can play a vital role in stepping up the rural economy.

Bioenergy offers an alternative revenue stream to farmers by way of using agri residue to generate fuel ethanol. This can de-risk them from uncertainties in weather and crop pricing. Since ethanol plants are in rural areas, close to availability of feedstock, they provide employment opportunities to the farming community. Additionally, they also present entrepreneurship opportunities to rural youth in creating a robust eco system by way of feedstock supply chain.

Various technologies for producing biofuel

Biofuels can be derived from sugar and starch-



based feedstock and various technologies are available based on them.

a. 1G Technologies: First generation biofuels, also known as conventional biofuels, are made from sugary feedstock (sugarcane juice, syrup, B heavy molasses, C molasses), starchy feedstock (grains like sweet sorghum, corn, etc.) or vegetable oil. First generation biofuels are produced through well-established technologies and processes like fermentation, distillation and transesterification.

b. 2G Technologies: For India to fulfil its 10 per cent (ethanol blending mandate) EBM, it must look beyond 1G technology solutions due to limitations in feedstock availability, etc.

There is availability of 2G technology for lignocellulosic feedstock like wheat straw, paddy straw, rice straw and various other agricultural residue.

The 2nd Generation bio-ethanol technology converts agri waste into fuel grade ethanol. This alternate solution helps farmers earn from stubble that is otherwise burnt, become an additional source of revenue besides farming and create employment opportunities through collection of agri waste and managing supply chain of feedstocks.

The 2G integrated smart bio refineries based on 'enfinity' technology process multiple feedstock/ biomass like corn and sugarcane residue, rice or wheat straw, various lignocellulosic biomass. They produce fuel grade ethanol, bio chemicals, bio CNG, liquid CO₂, bio fertilizers and power which is exported to the grid.

c. Compressed Biogas: Agri waste can be used as a raw material or feedstock to produce not just biofuel such as ethanol, but also compressed bio-gas (CBG) which can complement compressed natural gas (CNG). Indigenously developed cutting edge technology solutions that help convert agri-waste into CBG have been developed which unlike fossil fuels, are carbon neutral and therefore do not contribute to GHG emissions.

Concept of a biorefinery

Just like a petrochemical refinery transforms and refines crude oil into more useful products such as petroleum naphtha, gasoline, diesel fuel, jet fuel, etc., a BIO- refinery converts biomass to biofuels, biochemicals

and other beneficial products.

Several advanced technologies to convert agri-waste into valuable products in the form of biofuels and bio chemicals have been developed.

India's first integrated bio-refinery demonstration plant was based on the proprietary platform technology - "enfinity" for manufacturing ethanol from a variety of agri-waste. The 1 MLPA capacity 2G bio-refinery demonstration plant is in operation for over three years. It is capable of processing a variety of agri-residue like rice and wheat straw, cotton stalk, bagasse, cane trash, corn cobs & stover, etc.

Renewable chemicals

Multi feedstock help produce a variety of fuels. Advanced refineries can generate not only biofuels but also renewable chemicals from 1G and 2G sources.

Renewable chemicals are another segment that has huge potential in the coming future. At Praj Matrix the R&D centre, scientists are developing different renewable and oleochemicals such as Furfural, Xylitol, Hyaluronic Acid, Vitamin E etc. These renewable chemicals find applications in growing industrial segments such as health and wellness, cosmetics, nutraceuticals.

Challenges in achieving the potential of biofuels

Setting up a robust ecosystem for the smooth functioning of supply chain management of biofuel feedstock is still work in progress. Securing funding at various stages of the project lifecycle is a challenge, and various statutory clearances and permissions take longer than expected.

There is a need to create awareness and educate farmers about supplying agri residue for advanced biofuel projects. The government may consider making available suitable biomass aggregation machinery and announcing a minimum support price (MSP) for agri residue which will address the feedstock concern.

Conclusion

Biofuels are poised to play a critical role in India's energy basket. Being an economic, social and environmental enabler, biofuels have the potential to make definitive contributions in ushering India's bio-economy. **AS**