Science & Technology · GS - III

Discuss several ways in which microorganisms can help in meeting the current fuel shortage.

EXAM YEAR	PAPER	SUBJECT
2023	GS - III	Science & Technology

MARKS	WORD LIMIT
10	~150 words

Answer Hint

Microorganisms can convert renewable biological feedstocks and waste into energy carriers such as biogas, bioethanol, biodiesel and biohydrogen, offering decentralised and potentially cleaner alternatives to fossil fuels.

Model Answer

Introduction

Microorganisms possess metabolic capabilities that can convert biomass and organic waste into useful fuels. Their application in biotechnology can diversify India's energy sources and reduce dependence on fossil fuels.

Body

Major Applications

Biogas: Anaerobic microorganisms decompose cattle dung, sewage and organic waste to produce methane-rich biogas.

Bioethanol: Yeast and other microorganisms ferment sugar- and starch-rich feedstocks into ethanol, which can be blended with petrol.

Biodiesel: Certain microorganisms, particularly microalgae, can accumulate lipids that can be processed into biodiesel.

Biohydrogen: Some bacteria and algae can produce hydrogen through biological processes, offering a potential clean-energy pathway.

Waste-to-energy: Microbial treatment can convert agricultural residues, food waste and wastewater into energy while reducing waste-management burdens.

Second-generation biofuels: Microbial and enzymatic processes can help break down lignocellulosic biomass, reducing dependence on food crops as fuel feedstock.

Advantages

These approaches can utilise waste, reduce greenhouse-gas emissions relative to conventional fossil fuels and support decentralised rural energy systems.

Challenges

High production costs, feedstock availability, technological limitations, land-use concerns and difficulty in scaling some processes remain constraints.

Conclusion

Microbial biotechnology can contribute to India's **energy diversification and circular bioeconomy**. Greater research, efficient conversion technologies and commercially viable production systems are needed for large-scale adoption.

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