Bio-Based Chemicals and Enzymes

Mains: *GS III – Economy| Agriculture| Science and Technology*

Why in News?

Recently the bio-based chemical concept is gaining importance in relation to sustainable practices.

What is Bio-based chemicals?

- **Bio-based Chemicals** – They are industrial chemicals produced using biological feedstocks like sugarcane, corn, starch, or biomass residues, often through fermentation or enzymatic processes.
    - **Examples** include organic acids (such as lactic acid), bio-alcohols, solvents, surfactants, and intermediates used in plastics, cosmetics, and pharmaceuticals.
- **Enzymes** – They are biological catalysts widely used in detergents, food processing, pharmaceuticals, textiles, pulp and paper, and increasingly in biomanufacturing.
- Enzymes often work at lower temperatures and pressures, reducing energy use and emissions.

Why does India need such chemicals?

- **Potential** – India has strong fundamentals for scaling bio-based chemicals and enzymes:
    - A large agricultural base,
    - Deep expertise in fermentation from pharmaceuticals and vaccines,
    - A growing manufacturing sector.
- **Creation of new market** – Expanding this space could reduce import dependence on petrochemicals, create new markets for agricultural produce, and position India as a competitive supplier of sustainable industrial inputs.
    - **For example**, India imported roughly $479.8 million worth of acetic acid in 2023.

Where does India stand today?

- **Bio E3 policy** – India has prioritised bio-based chemicals and enzymes as a priority area under the Department of Biotechnology's BioE3 policy.
- **Bio-based segment** – In the bio-based chemicals segment, companies such as Praj Industries and Godrej Industries are leading.
- **Other firms** – Godavari Biorefineries are pioneering ethanol-based, bio-derived chemicals in India, while Jubilant Ingrevia produces "acetyls" intermediates (for

example, acetic anhydride/ethyl acetate).
- Emerging companies such as StringBio are using novel microbial strategies to develop such chemicals.
- **Indian enzymes market** – It is consolidated in nature with top players accounting for more than 75% of the market share.
- Companies such as Novozymes India, DuPont, DSM, Advance Enzyme Technologies, BASF SE, and Ultreze Enzymes Private Limited are key players in the Indian market.

What are other countries doing?

- **The EU Bioeconomy Strategy and Action Plan** – It provides coordinated support for bio-based chemicals as part of circular bioeconomy goals.
- It links industrial transformation to climate goals, waste reduction, and sustainable growth.
- **U.S** – The USDA BioPreferred Program mandates federal procurement preference for certified bio-based products, including chemicals and enzymes, creating early markets for producers.
- **China** – The bioeconomy development plans explicitly prioritise high-value bio-based chemicals and enzyme technologies as strategic sectors.
- **Japan** – The priority projects funded through METI/NARO integrate bio-based chemical research with manufacturing readiness.

What are the risks?

- **Cost Issues** – A key risk in developing the bio-based chemicals sector is the comparative cost of bio-based products relative to petrochemical alternatives.
- While this cost disadvantage may be temporary and limited to early stages of scale-up, it nonetheless creates a significant entry barrier for private investment.
- **Feedstock Infrastructure** – A second risk relates to the availability of reliable feedstocks and supporting infrastructure required to produce different categories of bio-based chemicals at scale.
- **Market adoption** — Specifically, whether bio-based chemicals can seamlessly substitute existing inputs in manufacturing pipelines and whether downstream manufacturers are willing to switch, even when costs are comparable.

What lies ahead?

- Scaling shared biomanufacturing infrastructure — such as biofoundries, pilot plants, and demonstration facilities under BioE3 — can reduce capital risk for firms.
- Clear standards, certification, and procurement policies can help create build investor confidence.

Reference

[The Hindu| Bio-based Chemicals]



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