Biochar and its Application

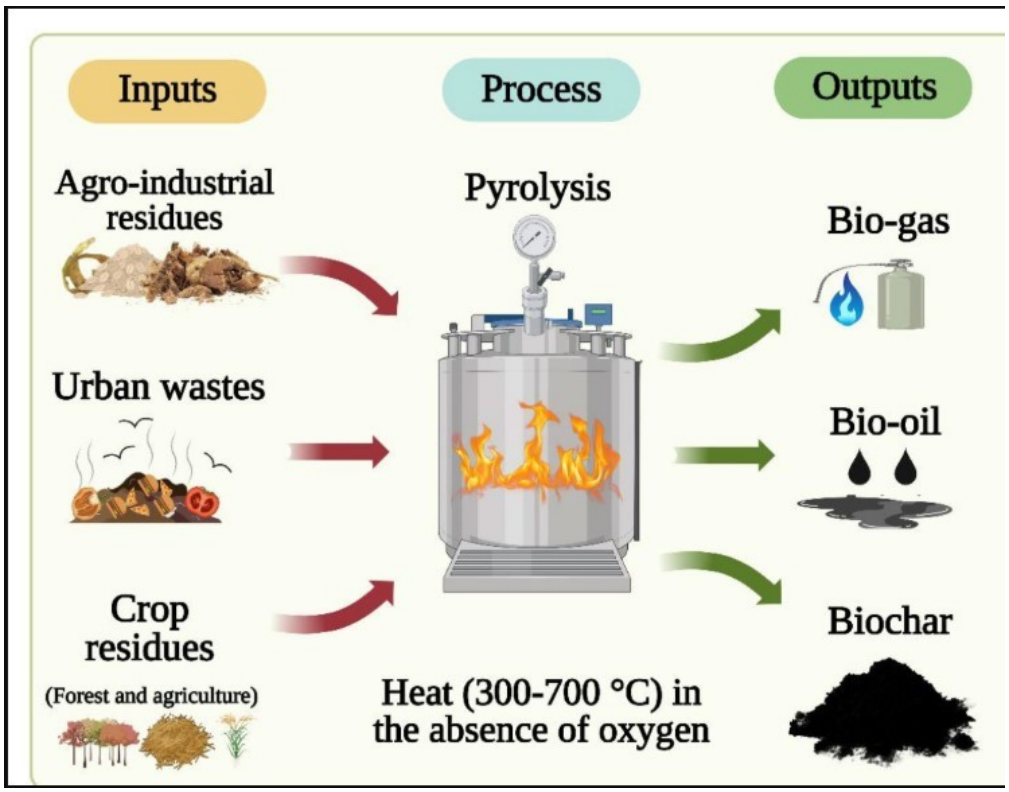
Mains: ***GS III – Environment pollution and degradation.***

Why in News?

Indian carbon market set to be launched in 2026 and CO2 removal technologies such as biochar are expected to play a crucial role.

What is biochar?

- **Biochar** – It is a type of charcoal rich in carbon and is produced from agricultural residue and organic municipal solid waste.



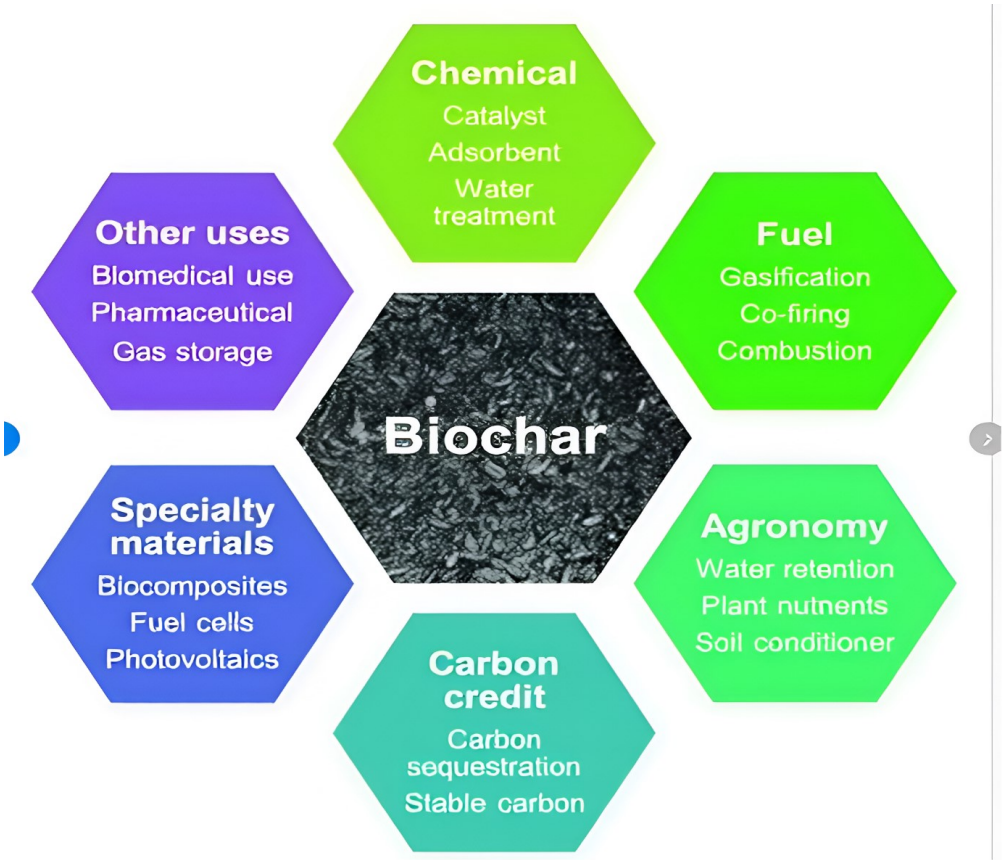
- **Potential of India** – India generates over 600 million metric tonnes of agricultural residue and over 60 million tonnes of municipal solid waste every year.

A significant ***portion of waste is burnt openly or dumped in***

***landfills**, leading to air pollution from particulate matter and greenhouse gases such as methane, nitrous oxide, and CO2.*

What are the potential applications of biochar?

- **Agriculture –** It can improve water retention, particularly in semi-dry and nutrient-depleted soils.



- It can also enhance soil organic carbon, helping restore degraded soils.
- **Tool for climate goals** – It offers a science-backed multisectoral pathway for India to achieve its climate and development goals.
- **Electricity generation** – Byproducts of biochar production, such as syngas (20-30 million tonnes) and bio-oil (24-40 million tonnes), can generate additional electricity and fuels.
- **Building material** – It can be explored as a low-carbon alternative to building materials.
- Adding 2-5% of biochar to concrete can improve mechanical strength, increase heat resistance by 20%.
- **Waste water treatment** –It offers a low-cost and effective option to reduce pollution.
- A kilogram of biochar, along with other substances, can treat 200-500 litres of wastewater.

India *generates more than 70 billion litres of wastewater every day, of which 72% is left untreated.*

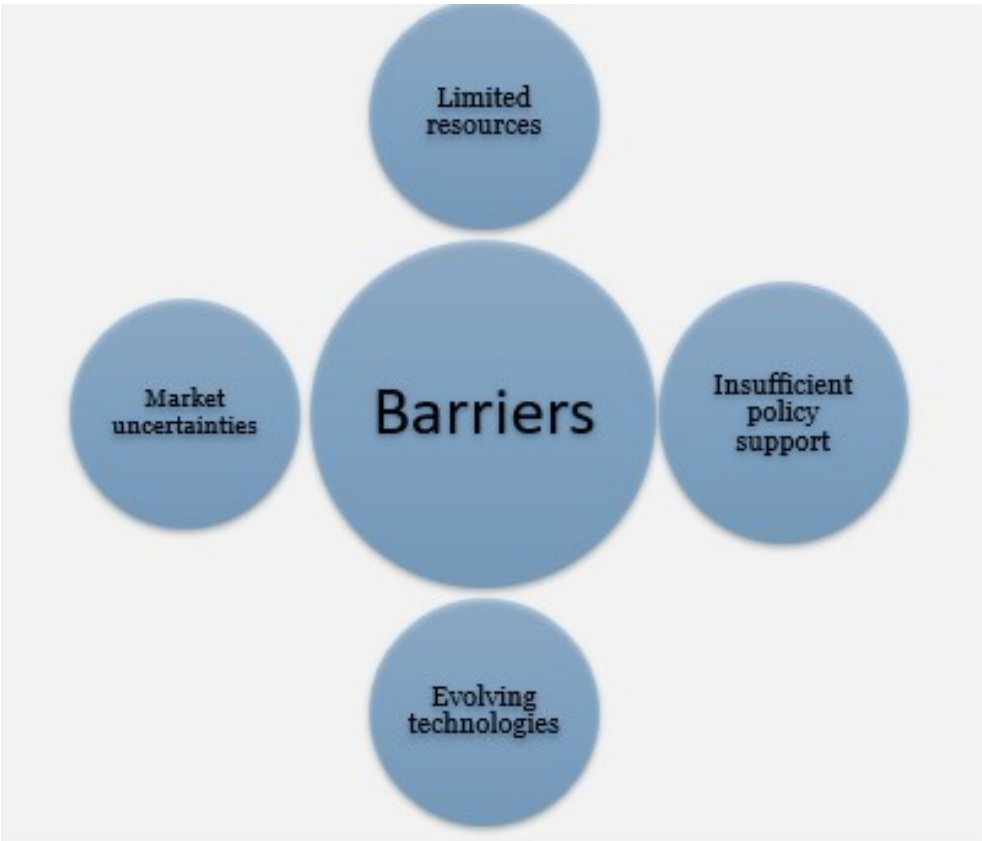
- **Lowers coal demand** – Utilising syngas could generate around 8-13 TWh of power, equivalent to 0.5-0.7% of India's annual electricity generation, replacing 0.4-0.7 million tonnes of coal per year.
- **Reduces import** – Bio-oil can likewise potentially offset 12-19 million tonnes (or 8%) of diesel or kerosene production annually.
- It leads to lower crude oil imports and reducing more than 2% of India's total fossil-fuel-based emissions.
- **Source of Income** – Indian carbon market *will generate additional income for investors and farmers* through carbon credits.
- **Employment opportunity** – It has the potential to *create approximately 5.2 lakh rural jobs, linking climate action* with inclusive economic development.

Biochar as a Carbon Sink

• By using 30% to 50% of surplus waste, India *can produce 15-26 million tonnes of biochar* and *remove 0.1 gigatonnes of CO2-equivalent annually.*
• This, in turn, can abate nitrous oxide emissions by 30-50%.
• Notably, nitrous oxide is a greenhouse gas with 273-times the warming potential of CO2, making its mitigation a crucial benefit of biochar.
• **In soil** – It can hold carbon in the soil for 100-1,000 years due to its strong and stable characteristics, making it an effective long-term carbon sink.
• In carbon capture applications, modified biochar can adsorb CO_2 from industrial exhaust gases.
• **In building material** – It capture 115 kg of CO_2 per cubic metre, making building materials a stable carbon sink.

What hinders biochar's application?

- **Less efficient** – Its carbon removal efficiency is currently lower than that of conventional methods.
- **Remains underrepresented** - The absence of standardised feedstock markets and consistent carbon accounting methods, undermines investor confidence.
- **Limited awareness** – Less cognizance among stakeholders, weak monitoring, reporting, and verification frameworks hinders the progress.
- **Lack of coordination** – Areas such as agriculture, energy, and climate policy lack coordination among them.



What measures can be taken?

- **Research and development** – R&D is essential to create region-specific feedstock standards and *to optimise biomass utilisation rates based on agro-climatic zones and crop types*.
- **Integration into various plans** – Biochar should be systematically integrated into existing and upcoming frameworks.
- This includes crop *residue management schemes, bioenergy initiatives* in both urban and rural contexts.
- It also include state-level climate strategies under the State Action Plans on Climate Change.
- **Acknowledgement** – Recognizing biochar as a verifiable carbon removal pathway within the Indian market is crucial.
- **Village level Deployment** – Biochar *production equipment at the villages* should be setup and can be operated by trained people.
- **Benefit analysis and integration** – It *should be systematically integrated into policy and market frameworks* to fully realise its potential.

What lies ahead?

- Participation and support from multiple stakeholders could truly serve as a scalable pathway for negative emissions across sectors.
- Viable business models could be developed for large-scale adoption and utilization of the technology.

Reference

The Hindu| Biochar and its Potential