



General Studies-3; Topic: Science and Technology- developments and their applications and effects in everyday life.

Synthetic biology

What is Synthetic Biology

- Synthetic biology refers to the science of using genetic sequencing, editing, and modification to create unnatural organisms or organic molecules that can function in living systems.
- Synthetic biology enables scientists to design and synthesise new sequences of DNA from scratch.

Applications of Synthetic Biology

- Synthetic biology has applications in various fields from **developing synthetic organisms** for vaccination to **creating natural products** in a lab.
- In the pharmaceutical industry, synthetic biology can be used to make natural compounds such as artemisinin used for the treatment of malaria and Car T cell therapy for cancer treatment.
- It is starting to be used in the fashion industry as well.
- Some companies are exploring the possibility of dyeing jeans without producing hazardous waste.
- Companies using it to deliver fixed nitrogen to plants instead of using fertilisers, engineering microbes to create food additives or brew proteins.

Security Implications

- The exponential technologies have unforeseen **national and global security implications**.
- In 2014, the U.S. Department of Defense categorised **synthetic biology as one of the six 'disruptive basic research areas'**.
- There are many risks associated with the technology which must be addressed before it becomes widely accessible.

- There is the possibility of **deliberate misuse**.
- **Accidental leaks** of experimental pathogens are another concern.
- There has been very little focus on threats emanating from biological sources.
- A well-planned attack using highly infectious pathogens synthetically engineered in a lab could be disastrous.

Concerns / Challenges

- Unlike the nuclear domain, the **fields of synthetic biology are not regulated internationally** despite growing military interest in synthetic biology applications and their potential misuse.
- Very little has been done by the international community about 'weapon of mass destruction' (WMD) capability of bio-weapons.
- When it comes to bio-weapons, all we have is the **Biological and Toxin Weapons Convention (BTWC) of 1972** with no implementing body.
- The outcomes of bio-defence research could potentially be used to create bio-weapons.

India's Position

- **India has multiple institutions dealing with biosafety and biosecurity threats** but there is no coordination among them.
- Implementation of biosafety guidelines is the responsibility of the Science and Technology Ministry and the Environment Ministry.
- However, labs dealing with biological research are set up under the Indian Council of Medical Research and the Indian Council of Agricultural Research, which are under the Ministries of Health and Agriculture, respectively.
- The **multiplicity of bodies and ministers makes coordination difficult**.
- Given the **rising risk of diseases of zoonotic origin**, the traditional ministry-wise separation might not be useful.
- An important question is whether India, with its porous borders, is prepared for defending against pathogens or dangerous biological organisms or agents arriving from abroad.
- COVID-19 should serve as a wake-up call.

Way Forward

- There is a need to carefully review, especially in the wake of the pandemic, the biosecurity systems in place where such technologies are in use.
- Pandemics have also highlighted that the traditional distinction at the international institutional level between biological weapons and diseases may not be useful anymore.
- There needs to be more conversation between health specialists and bio-weapons/defence specialists.
- There is a need to address the thin line between biotechnology research and bio-weapons research, and consider international measures for monitoring and verification.
- There is also a need to look at the benefits of the products and the risk it poses to biodiversity.
- Best practices and standards must be woven into operational biological protocols to combat these threats.
- A draft foresight paper on synthetic biology released by the Department of Biotechnology has stressed the need for a national policy that can consolidate India's stand on the issue.