Nano Fertiliser

Source: FE

Why in News?

Indian Farmers Fertiliser Cooperative (IFFCO) is setting up its **first overseas nano fertiliser plant** in **Brazil** through a joint venture, following successful exports to over **40 countries**, including the **US**, **Brazil**, and **Nepal.**

- It will be located in **Curitiba (Parana, Brazil)** with an **annual production capacity of 4.5 million litres.**

Note

- **Brazil**, a major producer of **corn, soybean, sugarcane**, and **coffee**, has seen a **20% cut in urea and DAP usage**, a **10% yield increase** in corn and soybean, and a **7% rise** in sugarcane output with the use of **Indian nano fertilisers**.
    - As a result, **Brazilian farmers** are increasingly interested in **boosting productivity** while **reducing fertilizer use.**

What is Nano Fertiliser?

- **About:** Fertilisers coated with **nanomaterials** (particles ranging from **1 to 100 nanometres**) are known as **nanofertilisers**.
    - These nanomaterials enable the **controlled release of nutrients**, improving their **availability to plants over a longer period.**
- **Nanomaterial Components:**
    - **Inorganic Materials:** Metal Oxides (e.g., **Zinc oxide (ZnO), titanium dioxide (TiO2))**, **Silica Nanoparticles** and **Hydroxyapatite Nanohybrids**.
    - **Organic Materials: Chitosan** (**natural biopolymer** derived from **chitin** found in **crustacean exoskeletons**), Carbon-based Nanomaterials (e.g., **carbon nanotubes (CNTs)**, **fullerenes**, and fullerols).
- **Types of Nanofertilizers:**
    - **Nanoscale Coating Fertilisers:** It uses **nanoparticle coatings** for **controlled nutrient release**.
    - **Nanoscale Additive Fertilisers:** It binds nutrients to **nano-sized adsorbents** for **gradual availability**.
    - **Nanoporous Materials:** It enables **slow nutrient release**, enhancing **plant absorption.**
- **Nano Fertiliser Adoption in India: Nano Urea** (2021) and **Nano DAP** (2023) are witnessing steady adoption, with **FY25 sales** reaching **26.5 million bottles** of Nano Urea Plus and **9.7 million bottles** of Nano DAP.
    - **IFFCO** also plans to launch **Nano Zinc** and **Nano Copper**.
- **Need of Nano Fertilisers in India:** India's heavy subsidies on conventional fertilisers (from **0.6%** in FY14 to **0.9%** in FY23 % of GDP), have led to a **Rs 1.67 trillion subsidy burden** in 2025–26, straining public finances.

    - **Nano fertilisers** offer a sustainable solution by **reducing import dependency** (e.g., DAP) and delivering nutrients more efficiently—**500 ml Nano Urea equals 45 kg conventional urea**—boosting efficiency.
- **Challenges with Nano Fertiliser Adoption:**
    - **Limited Farmer Awareness: Skepticism and resistance** from farmers used to traditional methods hinder adoption of nano fertilisers.
    - **Inconsistent Results:** A **Department of Fertilizers audit** reported **25–50% variation** in nitrogen savings, raising scientific skepticism about nano urea's quality and effectiveness.
    - **Food Chain Risks: Nanoparticles** may **bioaccumulate** in plants, posing risks to the **food chain**, **human health**, and the **environment**.

Indian Farmers Fertiliser Cooperative (IFFCO)

- **IFFCO**, established in **1967** and headquartered in **New Delhi**, is one of the **largest cooperatives in the world**. It began with just **57 member cooperatives** and has grown into a network of over **36,000 Indian cooperatives**, serving more than **50 million farmers**.
- Wholly **owned by Indian cooperatives**, IFFCO operates **five fertiliser plants** and over **20 state offices** across India.
    - It has also expanded globally through **joint ventures** such as **JIFCO (Jordan)**, **KIT (Dubai)**, **OMIFCO (Oman)**, and **ICS (Senegal)**.
- While its core focus remains on **fertiliser production and marketing**, IFFCO has also diversified into sectors like **general insurance** and **rural telecommunications.**

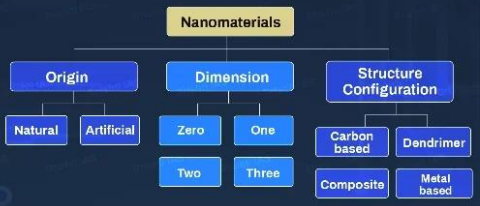
Nanotechnology and Nanomaterials

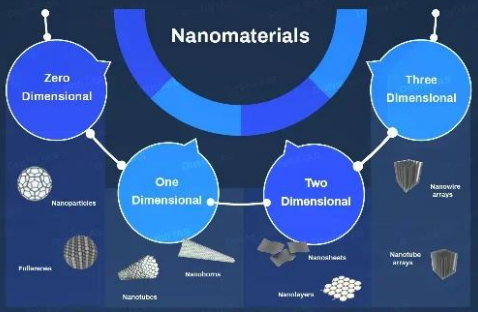
Nanotechnology is the branch of science and engineering focused on manipulating matter at the atomic and molecular scale (dimensions ≤ 100 nanometers).

Nanomaterials

Materials with at least one dimension ≤ 100 nm

- Classification:





- Properties:
  - **Mechanical Strength:** Higher durability and lightweight – ideal for aerospace and automotive
  - **Quantum Confinement:** Alters electronic properties at nanoscale – enhances semiconductor performance and display technologies
  - **Increased Surface Area:** Enhanced catalytic properties – ideal for chemical reactions and environmental cleanup
  - **Magnetic Properties:** Exhibits superparamagnetism – useful in data storage

Nanotechnology

Nanotechnology in India – Evolution

Chintamani Nagesa Ramachandra Rao is regarded as the father of Indian nanotechnology.

- **9th Five-Year Plan (1998-2002):** Introduced nanomaterials into India's strategic science goals
- **10th FYP (2002-07):** Launched National Nanoscience and Nanotechnology Initiative (NSTI)
  - **Nano Science and Technology Mission (NSTM) (2007)** pushed nanotechnology into mission-mode R&D
- **12th FYP (2012-17):** Phase-II of NSTM
- **Institute of Nano Science and Technology (INST):** Estd. 2013

Challenges	Way Forward
• Safety & toxicity • Efficient mass-production • Inadequate regulatory frameworks • High production expenses • IPR related legal complexities	• Prioritising R&D and fostering international collaboration • Rigorous testing of nanomaterials to assess their potential toxicity • Develop comprehensive regulatory frameworks + ethical guidelines

UPSC Civil Services Examination, Previous Year Question (PYQ)

Q. With reference to chemical fertilizers in India, consider the following statements: (2020)

1. At present, the retail price of chemical fertilizers is market-driven and not administered by the Government.
2. Ammonia, which is an input of urea, is produced from natural gas.
3. Sulphur, which is a raw material for phosphoric acid fertilizer, is a by-product of oil refineries.

Which of the statements given above is/are correct?

(a) 1 only

(b) 2 and 3 only

(c) 2 only

(d) 1, 2 and 3

Ans: (b)