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Rare electron localization in semiconductors

Researchers have unveiled a rare type of electron localization phenomenon in semiconductors

- **Semiconductors** – These are materials with electrical properties lying between conductors and insulators.
- **Anderson Localization** - It is an intriguing phenomenon in solid-state physics proposed by American theoretical physicist P W Anderson.
- **Theory** - Localization of elementary quasiparticles like electrons, photons, and phonons in disordered and amorphous semiconductors occurs when doping and impurities lead to the absence of conduction in metals or semiconductors.

  Doping is the process of adding impurities to intrinsic semiconductors to alter their properties. Normally Trivalent and Pentavalent elements are used to dope Silicon and Germanium.

- **Anderson transition** - As a result of doping and impurities, the electrons that otherwise used to travel from a region of high potential to one of low potential in a conducting material, become confused and roam around the doped or the impurity centers.
- **Quasi classical Anderson transition** – It proposed that potential fluctuations caused by random distributions of charged dopants could also induce a metal-insulator transition.
- **No experimental evidence** - Despite decades of effort, direct experimental verification of this phenomenon has remained elusive.
- **Recent Discovery** - Researchers at Bengaluru's Jawaharlal Nehru Centre for Advanced Scientific Research (JNCASR) have used oxygen and magnesium as random dopants to demonstrate a quasiclassical Anderson transition phenomena.
- **Percolative metal-insulator transition** - It created a fluctuation electrical potential leading to bubbles of electrons inside the parent material.

- During the transition, the structure remain the same but electronically there is a transition.
- **Benefits** - Such an electronic transition semiconductors could open pathways for their utilization in various applications, including lasers, optical modulators, photoconductors, spintronic devices, and photorefractive dynamic holographic media.
- **Efficient semiconductors** - Potential fluctuations can be a novel tool to alter semiconducting properties in materials to create more efficient semiconductors.

References

PIB | Rare electron localization phenomena in Semiconductors

Dhangars

A large group of Dhangars recently marched to the office of the subdivisional officer in Khamgaon of Maharashtra's Buldhana district, demanding a "grazing corridor" for their sheep and goats.

- **Dhangars** – They are ***community of shepherds*** classified as a nomadic tribe ***(Vimukta Jati and Nomadic Tribes***) in Maharashtra.
- At the central level classification, they are categorised as Other Backward Classes (***OBC***).
- **Other names** – They are known by other names such as ***Dhangad Golla and Kuruba*** elsewhere.
- **Population** - The second-largest community in the State after the Marathas, constituting ***9% or 1.5 crore of the State's population*** as per the 2011 Census.
- **Spread** - Dhangars live in the central plateau of Maharashtra during the monsoon season.
- Besides Maharashtra, they live in Gujarat, Karnataka, and Andhra Pradesh.
- **Livelihood** - Traditionally they are shepherds, cowherds, buffalo keepers, blanket and wool weavers, butchers and farmers.
- They sow dry crop of 'bajra' in deccan during the monsoon season and let their flock and herds graze here.
- **Migration** - By October they reap the harvest and move to Konkan–a fertile Agricultural region.
- The Konkan peasants welcome them to manure and fertilise their fields for

the ‘rabi crop.
- They stay here till the monsoon arrives and then move on to the dry plateau carrying with them the rice given by the Konkans.
- **Grazing Prohibition** - Indian Forest Act, 1927 prohibits cattle grazing, and pronounces a penalty of up to ₹500 in addition to compensation for damage done to the forest.
- **Forest Rights Act** - Scheduled Tribes (ST) and Other Traditional Forest Dwellers (Recognition of Forest Rights) Act, 2006 permits traditional activities such as grazing.
- Dhangars, who come under the nomadic tribe’s category, do not get benefitted under the act.
- **Demand** – They have been demanding Scheduled Tribe (ST) status and “grazing corridors” for the recognition of their right to graze along their traditional routes.

References

1. The Hindu | Dhangars in search of legal pastures
2. Indian Express | Who are the Dhangars of Maharashtra

INS Arighaat

The 2nd Arihant-Class submarine ‘INS Arighaat’ was recently commissioned into the Indian Navy at Visakhapatnam.

- **INS Arighat or S-3-** It is the ***2nd Ship Submersible Ballistic Nuclear (SSBN)*** submarine in its class.

  The Arihant class submarines are named after a Sanskrit word meaning the “Destroyer of the Enemy”.

- **Aim -** To ***boost deterrence and establish strategic balance.***
- It is a ***nuclear triad***, the capability to launch nuclear weapons from land, air, and sea.
- **Manufactured by-** Shipbuilding Centre (SBC), Visakhapatnam.
- **Size-** The submarine is approximately 112 meters long, weighs around 6,000 tonnes.
- **Power-** It has a nuclear reactor enabling speeds of ***12-15 knots*** on the surface and 20-24 knots when submerged.

- **Armament-** It can carry 10-12, K-15 nuclear-tipped submarine-launched ballistic missiles (SLBMs) with a range of ***about 750 km***.
- It is equipped with ***4 vertical launch tubes*** for missile launches.
- **Stealth and Deterrence-** Nuclear-powered submarines like INS Arighat are stealthier, can dive deeper, and stay submerged longer, boosting India's deterrence and strengthening its nuclear triad

INS Aridaman or S4 *nuclear-powered submarine with longer-range ballistic missiles (over 3,000 km), is under construction.*

Ship Submersible Ballistic Nuclear (SSBN)
• A Ship Submersible Ballistic Nuclear (SSBN) is a type of nuclear-powered submarine that is designed to carry and launch ballistic missiles. • SSBNs are primarily used as deterrents and are not usually used for attack submarines. They are considered a dependable platform for a second-strike against a nuclear attack. • **Ship Submersible-** Refers to the submarine's ability to operate underwater, making it less detectable and more difficult to target compared to surface ships. • **Ballistic-** Indicates that the submarine carries ballistic missiles, which are long-range missiles that are launched from the submarine and follow a predetermined trajectory to strike targets, typically carrying nuclear warheads. • **Nuclear-** It has two aspects - The submarine is powered by a nuclear reactor, giving it the ability to remain submerged for long periods and travel great distances without needing to surface. - The ballistic missiles it carries are usually armed with nuclear warheads. • SSBNs are a key component of a nation's nuclear triad, which typically includes land-based missiles, air-delivered nuclear weapons, and sea-based nuclear capabilities.

References

1. The Hindu | INS Arighaat
2. Deccan Herald | India's second nuclear submarine

NITI Aayog's Report on Edible Oils and Atmanirbharta

Recently, NITI Aayog released a report titled "Pathways and Strategies for Accelerating Growth in Edible Oils Towards the Goal of Atmanirbharta".

- **Outline-** The report outlines strategic interventions aimed at increasing India's domestic edible oil production by a significant ***43.5 million tonnes (MT).***
- This ambitious goal seeks to bridge the import gap and move the country towards self-sufficiency in edible oils.

Key Highlights

- **Surge in edible oil consumption-** The Per capita consumption of edible oil in India has risen to 19.7 kg/year.
- In 2022-23, India imported 16.5 million tonnes (MT) of edible oils, with domestic production fulfilling only ***40-45% of the requirements.***
- **Projected growth and demand-** Under a Business-As-Usual (BAU) scenario, domestic supply is expected to reach 16 MT by 2030 and 26.7 MT by 2047.

  Business-As-Usual (BAU) scenario is a scenario for future patterns of activity assumes that there will be no significant change in people's attitudes and priorities, or no major changes in technology, economics, or policies.

- Demand forecasts vary based on different approaches, with potential gaps of up to 29.5 MT by 2030 and ***40 MT by 2047*** under high consumption scenarios.
- **Strategic interventions for self-sufficiency** - The proposed strategy is structured across 3 key pillars
  - **Crop Retention and Diversification** – It involves retention of crops whereas involves adding new crops or cropping systems to a farm.
  - **Horizontal Expansion-** Horizontal expansion in agriculture is the practice of cultivating crops on flat land, typically in large outdoor fields or plots.
  - It increases the cultivation area for oilseeds, utilizing rice fallow lands and wastelands for crops like palm.
  - **Vertical expansion-** Vertical farming is a method of growing crops in layers, rather than on a single surface, to produce more food in less space.
  - It enhances yields through improved farming practices, better-quality seeds, and advanced production technologies.
- **State-wise quadrant approach-** Identifies state clusters for targeted interventions based on cultivation area and yield

    - High Area-High Yield (HA-HY)
    - High Area-Low Yield (HA-LY)
    - Low Area-High Yield (LA-HY)
    - Low Area-Low Yield (LA-LY)
- **Potential gains-** Strategic interventions could increase domestic production by 43.5 MT, potentially bridging the import gap and achieving self-sufficiency.
- Specific strategies include utilizing rice fallow areas, improving yield gaps in oilseeds, and expanding palm oil cultivation.
- **Recommendations-** Emphasizes the need for ***robust systems, public-private partnerships***, and a dynamic trade policy to support growth.
- Public awareness and consumption could encourage domestic oilseed consumption and awareness of dietary guidelines.
- The report suggests a focused and rigorous implementation of the recommended strategies to meet future demands and achieve self-sufficiency by 2030 and beyond.

Reference

PIB | NITI Aayog's Report on Edible Oils and Atmanirbharta

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