DAILY CURRENT AFFAIRS 04-01-2025

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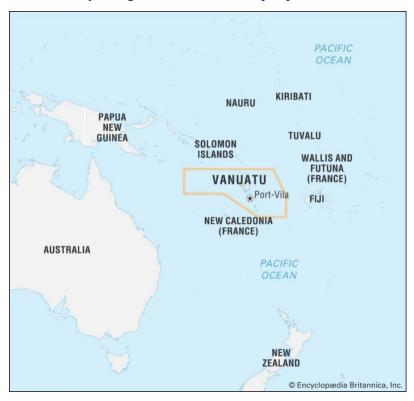5. Pesticide Degrading Bacteria

Vanuatu Island

Syllabus: GS-1: World Geography

Context:

➢ India announces $500,000 for quake-hit Vanuatu island.

Vanuatu Island – Overview

➢ **Location**: South Pacific Ocean, part of Melanesia.

➢ **Geography**: An archipelago of 83 islands.

➢ **Capital**: Port Vila.

➢ **Geological Features**: Located along the Pacific Ring of Fire, with volcanic activity and earthquakes being common.

➢ **Economy**: Relies on agriculture, fishing, tourism, and offshore financial services.

➢ **Climate**: Tropical, prone to cyclones.

➢ **Population**: Primarily indigenous Ni-Vanuatu people.

Reasons for Earthquakes in Vanuatu

➢ **Tectonic Plate Interaction**:

- o Vanuatu lies at the convergent boundary of the **Australian Plate** and the **Pacific Plate**.

- o Subduction of the Australian Plate under the Pacific Plate leads to intense seismic activity.

- ➤ **Pacific Ring of Fire**:

  - o Being part of this zone makes Vanuatu prone to frequent earthquakes and volcanic eruptions.

- ➤ **Subduction Zone**:

  - o The **New Hebrides Trench** near Vanuatu is an active subduction zone where tectonic stress accumulates and releases as earthquakes.

- ➤ **Volcanic Activity**:

  - o Presence of multiple active volcanoes in and around Vanuatu contributes to ground movements.

- ➤ **Seafloor Spreading and Faults**:

  - o Seafloor spreading and faults in nearby oceanic ridges amplify tectonic disturbances.

Key Implications

- ➤ **Disaster Risk**: High vulnerability to tsunamis and infrastructure damage.

- ➤ **Adaptation Measures**: Implementation of resilient infrastructure and disaster preparedness programs are critical for mitigating impacts.

UDISE+

Syllabus: GS-2: Social Justice – Education.

Context:

- ➤ A total of 24.8 crore students enrolled in the academic year 2023-24, Unified District Information System for Education Plus (UDISE+) report.

Key Findings from UDISE+ Report (2023-24)

- ➤ **Total Enrolment**:

  - o **2023-24**: 24.8 crore students.

  - o Compared to the last four years (around 26 crore), there is a drop of over 1 crore students.

o **2018-19**: 26.02 crore students (peak enrolment).

➢ **Recent Trends**:

  o **2022-23**: Enrolment dropped to 25.18 crore.

  o **2023-24**: Further decline by **6% (1.22 crore students)** compared to 2018-19.

Reasons for Variations in Data

➢ **Changes in Data Collection System**:

  o Introduction of a revitalized **UDISE+ ecosystem** in 2022-23.

  o Captures data on over 60 fields per student.

  o Voluntary collection of **Aadhaar details** for uniqueness.

  o Introduction of **unique Educational ID (EID)** for each student.

➢ **Data Verification Improvements**:

  o Online data uploading with **inbuilt validation checks**.

  o Verification at block, district, and state levels to ensure data reliability.

  o Efforts to remove **duplicate/ghost entries** for accurate beneficiary identification.

State-Wise Decline in Enrolments

➢ **Bihar**:

  o 2018-19: 2.49 crore students → 2023-24: 2.13 crore students.

  o **Drop**: Over 35.65 lakh students.

➢ **Uttar Pradesh**:

  o 2018-19: 4.44 crore students → 2023-24: 4.16 crore students.

  o **Drop**: 28.26 lakh students.

➢ **Maharashtra**:

  o 2018-19: 2.32 crore students → 2023-24: 2.13 crore students.

  o **Drop**: 18.55 lakh students.

Gender-Wise Enrolment Trends

➢ **Boys**:

  o 2018-19: 13.53 crore → 2023-24: 12.87 crore.

  o **Decrease**: 4.87%.

- ➢ **Girls**:
    - o 2018-19: 12.49 crore → 2023-24: 11.93 crore.
    - o **Decrease**: 4.48%.

Unique Features of UDISE+ Ecosystem

- ➢ **Student and Teacher Identification**:
    - o Introduction of **Aadhaar-based and EID-based verification**.
    - o Accurate credentials to eliminate duplicate or ghost entries.
    - o Better targeting of government schemes like:
        - ▪ **Samagra Shiksha Abhiyan**.
        - ▪ **PM POSHAN Scheme**.
        - ▪ **National Scholarship Scheme**.
- ➢ **Savings and Benefits**:
    - o Efficient benefit transfers.
    - o Potential for significant savings for the government.

Challenges and Observations

- ➢ The UDISE+ 2022-23 data is **not strictly comparable** with previous years due to enhanced verification methods.
- ➢ Dropout rates and enrolment indicators require careful analysis in light of system changes.

Conclusion

The decline in student enrolment highlights the need for deeper analysis of socio-economic factors, educational policies, and implementation gaps. The revamped UDISE+ system, while improving data accuracy, presents new challenges in interpreting trends over time.

Duopoly in UPI Ecosystem

Syllabus: GS-3: Indian Economy – Payment Systems.

Context:

- ➢ UPI duopoly's rise and market vulnerabilities.

Overview

- ➢ **UPI Ecosystem Growth**:
    - o Accounts for 80% of digital transactions in India.
    - o Over ₹20.60 lakh crore in transactions in August 2024.
- ➢ **India's Challenges**:
    - o Low digital literacy.
    - o Historical reliance on cash.

Key Success Factor: Public Trust

- ➢ UPI has fostered trust through resilience, reliability, and openness to innovation.
- ➢ Current penetration: 30% of the population, leaving 70% as an untapped market.

Challenges to UPI's Expansion

1. Market Concentration

- ➢ Two dominant players:
    - o PhonePe: 48.36% market share.
    - o Google Pay: 37.3% market share.
    - o Combined control: Over 85% of the market.
- ➢ Paytm: Third-largest with only 7.2% share.

2. Risks of Market Duopoly

- ➢ **Systemic Vulnerability**:
    - o Over-reliance on two apps creates single points of failure.
    - o Potential ripple effects across the financial system if services fail.
- ➢ **Reduced Competition**:
    - o High barriers to entry for new players.
    - o Dominant players leverage their scale for cross-selling financial products.
    - o Lack of incentives for innovation among existing players.
- ➢ **Foreign Dominance**:
    - o PhonePe (Walmart-owned) and Google Pay (Google-owned).
    - o Concerns:
        - ▪ Data protection.

- ▪ Potential backdoor access to sensitive user information.

Regulatory Efforts and Limitations

- ➢ **NPCI's Market Cap Directive (2020)**:
  - o Capped TPAP market share at 30%.
  - o Implementation deadline repeatedly extended.
  - o As of 2024, PhonePe and Google Pay maintain dominant positions.
- ➢ **Proposed Changes**:
  - o Possible increase of the market cap to 40%.
  - o Extensions and increased caps could further consolidate the duopoly.

The Way Forward

1. Promoting Indian TPAPs

- ➢ Encourage the growth of Indian players to balance market dynamics.
- ➢ Support smaller players with fair competition and innovation incentives.

2. Maintaining Public Trust

- ➢ Implement and enforce market cap regulations.
- ➢ Build failsafe mechanisms to address systemic vulnerabilities.

3. Driving Innovation

- ➢ Develop diverse service offerings and app designs to engage the untapped 70% of the population.

Conclusion

- ➢ UPI has the potential to sustain its transformative role in digital payments.
- ➢ Addressing market risks and fostering a competitive environment are crucial for its future growth and inclusivity.

Market Structures: Definitions and Examples

Market Structure	Definition	Examples
Monopoly	A market dominated by a single seller with no close substitutes for its product.	Indian Railways (passenger rail services in India), Microsoft (Windows OS in earlier years).
Duopoly	A market dominated by two major sellers, leading to limited	PhonePe and Google Pay in the UPI ecosystem, Airbus and Boeing in the

Market Structure	Definition	Examples
	competition.	aircraft manufacturing industry.
Oligopoly	A market dominated by a few large sellers, each influencing the market.	Telecom sector in India (Airtel, Jio, Vodafone Idea), Automobile industry.
Perfect Competition	A market with many sellers offering identical products, with no single seller influencing the price.	Agricultural markets (e.g., wheat, rice).
Monopolistic Competition	A market with many sellers offering similar but slightly differentiated products.	Fast food chains (McDonald's, Burger King), Clothing brands (Zara, H&M).

Gravitational Waves

Syllabus: GS-3: Science and Technology – Space science.

Context:

➢ Astronomers build galaxy-sized 'detector' to map universe's vibrations.

Gravitational Waves and the MeerKAT Pulsar Timing Array

Gravitational Waves: An Overview

➢ **Definition**: Ripples in the fabric of space and time caused by massive, dense objects orbiting or colliding with each other.

➢ **Sources**:

　　o Supermassive black holes at galaxy centers.

　　o Collisions and mergers of galaxies.

➢ **Significance**:

　　o Provide insights into the universe's structure and history.

　　o Enable the study of black holes and other massive cosmic phenomena.

Discoveries Using Gravitational Wave Detectors

➢ **High-Frequency Gravitational Waves**:

- o Observed since 2015 using Earth-based detectors.
- o Generated by collisions of smaller black holes.

➢ **Low-Frequency Gravitational Waves**:

- o Detected in recent studies using galactic-scale detectors.
- o Indicate the activity of supermassive black holes.

➢ **Gravitational Wave Background**:

- o A cosmic "ocean" of waves caused by galactic mergers throughout history.
- o Likely louder and more active than previously thought.

The MeerKAT Pulsar Timing Array

➢ **Location**: South Africa; part of the MeerKAT radio telescope.

➢ **Significance**:

- o One of the most sensitive radio telescopes globally.
- o Observes pulsars to detect gravitational wave patterns.

➢ **Achievements**:

- o Monitored 83 pulsars over five years.
- o Found a powerful gravitational wave signal and mapped the most detailed cosmic architecture yet.

Role of Pulsars in Detection

➢ **What are Pulsars?**:

- o Extremely dense neutron stars, the size of a city but twice the Sun's mass.
- o Spin rapidly and emit radiation in predictable pulses.

➢ **Detection Mechanism**:

- o Gravitational waves alter the time intervals of pulsar radiation reaching Earth.
- o Observing these variations helps map the gravitational wave background.

Key Findings and Implications

➢ **Hot Spot in the Southern Hemisphere**:

- o Anomalous gravitational wave activity detected.
- o Suggests supermassive black holes as the primary source.

- ➢ **Cosmic Questions Raised**:

  - o More supermassive black holes may exist than predicted.

  - o Raises the possibility of alternative origins, like early universe phenomena post-Big Bang.

- ➢ **Global Collaboration**:

  - o Findings to be validated through the International Pulsar Timing Array collaboration.

Importance for Science and Space Research

- ➢ **Mapping Cosmic Architecture**: Helps understand the structure of the universe.

- ➢ **Insights into Black Holes**:

  - o Expands knowledge about their formation and behavior.

  - o Provides new clues about galaxy mergers.

- ➢ **Future Prospects**:

  - o Refine understanding of gravitational waves.

  - o Explore potential exotic phenomena shaping the universe.

Pesticide Degrading Bacteria

Syllabus: GS-3: Environment and Biodiversity

Context:

- ➢ IIT Bombay researchers have identified bacteria that can consume toxic pollutants in the soil and produce helpful nutrients as a by-product.

Introduction

- ➢ **Issue:** Soil contamination in agriculture is a major problem.

  - o Toxic compounds inhibit seed germination, reduce plant growth and yield, and accumulate in seeds and biomass.

- ➢ **Traditional Solutions:** Chemical treatments and soil removal are expensive and incomplete solutions.

Research Initiative by IIT Bombay

- ➢ **Objective:** Use bacteria to address soil contamination and improve plant health.

- ➤ **Discovery:** Researchers identified bacteria from toxic environments, particularly the genera **Pseudomonas** and **Acinetobacter**.
  - o These bacteria effectively degrade aromatic compounds and act as "natural cleaners."

Functions of Beneficial Bacteria

- ➤ **Pollutant Degradation:**
  - o Break down pollutants into harmless, non-toxic compounds.
  - o Clean contaminated environments efficiently.

- ➤ **Soil Fertility Enhancement:**
  - o Convert insoluble nutrients (phosphorus, potassium) into soluble forms for plant uptake.
  - o Produce **siderophores** to help plants absorb iron in nutrient-limited conditions.

- ➤ **Plant Growth Promotion:**
  - o Produce **Indoleacetic Acid (IAA)**, a plant growth hormone.
  - o Boost crop growth and yield by 45-50% when bacterial mixtures are used.
    - ▪ Crops tested: Wheat, mung bean, spinach, fenugreek, etc.

Combination of Bacterial Strains

- ➤ **Synergy:** Mixtures of bacterial strains combine abilities:
  - o Pollutant breakdown.
  - o Plant growth promotion.
  - o Defense against diseases.

Role in Disease Management

- ➤ **Fungal Diseases:**
  - o Impact 168 crops, causing global crop losses of 10–23% annually.
  - o Bacteria produce substances like **lytic enzymes** and **hydrogen cyanide (HCN)** to inhibit plant pathogenic fungi.
  - o **Advantages over Fungicides:** Eco-friendly and target harmful fungi without affecting the environment or beneficial organisms.

Future Potential and Applications

- ➤ **Challenges for Adoption:**

- o Scaling up technology, testing in diverse environments, and commercializing products.

- ➢ **Future Research Directions:**

  - o Test bacterial benefits under drought and stress conditions.

  - o Develop easy-to-use **bio-formulations** with natural materials for agricultural applications.

Conclusion

- ➢ Beneficial bacteria offer an innovative, sustainable, and eco-friendly solution to address soil contamination, improve crop health, and manage diseases, with promising future applications in agriculture.