GENOME EDIT IN INDIA: SCIENCE & TECHNOLOGY

NEWS: Genome-edited seeds to mark beginning of second green revolution: Chouhan

WHAT'S IN THE NEWS?

India launched two genome-edited rice varieties—DRR Dhan 100 and Pusa DST Rice 1—offering higher yields, faster maturity, and climate resilience using CRISPR and SDN1 technologies. These varieties aim to boost food security while reducing water use and methane emissions without introducing foreign DNA.

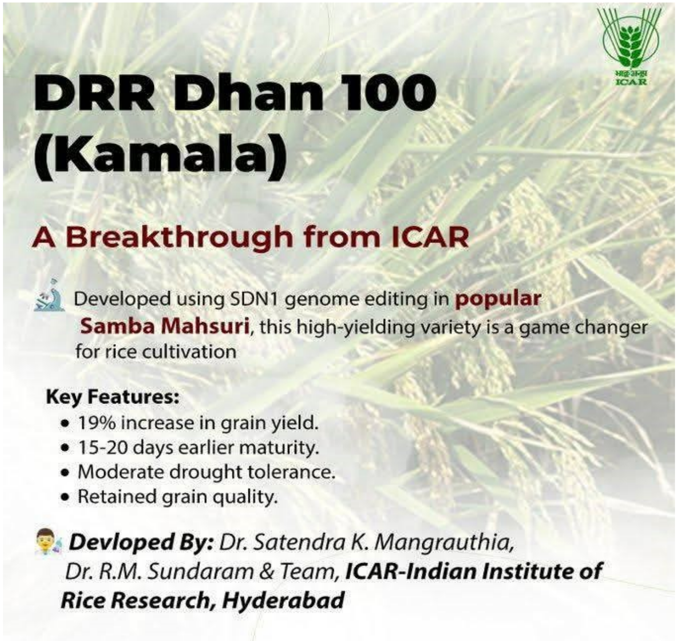
Context: Launch of Genome-Edited Rice Varieties in India

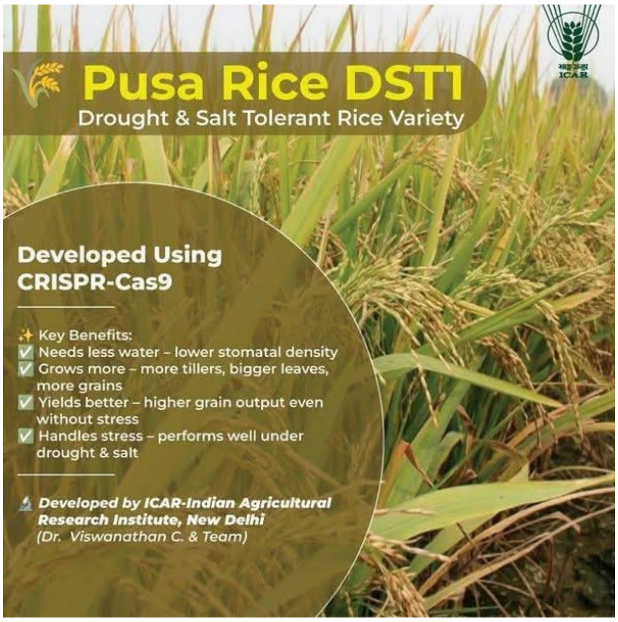
- Recently, the **Union Agriculture Minister** announced the launch of **two genome-edited rice varieties** developed by **ICAR**.
- This follows the **2023–24 Union Budget** allocation of **₹500 crore** for promoting genome editing in agricultural crops.
- India is the **second-largest rice producer** globally after China.

What are Genome-Edited Seeds?

- Genome-edited seeds are developed by making **precise changes to a plant's own DNA** without adding foreign genetic material.
- Technologies like **CRISPR-Cas9** are used to **enhance specific traits** such as yield, stress tolerance, and maturity.
- They are different from **Genetically Modified Organisms (GMOs)** which often involve **insertion of foreign DNA**.
- Genome editing mimics natural mutations and is **more precise, faster, and safer** than traditional breeding.

The Two New Genome-Edited Rice Varieties





1. DRR DHAN 100 (KAMALA)

- **Developed by**: ICAR–Indian Institute of Rice Research (IIRR), Hyderabad.
- **Technology Used**: CRISPR-Cas9 genome editing targeting **CKX2 (Gn1a)** gene.
- **Parent Variety**: Samba Mahsuri (BPT 5204).
- **Features**:
  - Higher grain yield.
  - Early maturity.
  - Improved drought tolerance.

2. PUSA DST RICE 1

- **Developed by**: ICAR–Indian Agricultural Research Institute (IARI), New Delhi.
- **Based on**: MTU 1010 fine grain variety.
- **Technology Used**: SDN1 genome editing technique targeting the **DST gene**.
- **Features**:
  - High resilience to drought, salinity, and alkaline soil conditions.

Benefits of These Varieties

- **Higher Productivity**: Up to **30% increase in yield per hectare**.
- **Faster Maturity**: Harvest possible **15–20 days earlier** than traditional varieties.
- **Water Efficiency**: Require less irrigation water, leading to:
    - **7,500 million cubic meters of water savings**, equivalent to three irrigation cycles.
- **Environmental Benefits**:
    - Lower **methane emissions** from paddy fields by **20% (32,000 tons)**.
    - Reduce area under rice cultivation by 5 million hectares while increasing production by 10 million tons.
- **Climate Resilience**: Enhanced tolerance to **drought, heat, and soil salinity**, making them fit for climate-smart agriculture.

Importance of Genome Editing in Agriculture

- **Precision Agriculture**: Allows targeted improvement of crop traits without random mutations.
- **Time Efficiency**: Accelerates the crop development cycle compared to conventional breeding.
- **Nutritional Enhancement**: Potential to improve micronutrient content and shelf life.
- **Food Security**: Helps ensure sustainable and resilient food production amid climate change.
- **Export Potential**: Higher quality grains with resilience traits can boost India's rice exports.

About Paddy (Rice Cultivation in India)

- **Season**: Primarily a **Kharif crop** (monsoon season).
- **Contribution**: Accounts for **40% of India's foodgrain production**.
- **Top Producing States**:
    - **West Bengal, Uttar Pradesh, Punjab, Odisha, Andhra Pradesh, Telangana, Tamil Nadu, Chhattisgarh, Bihar, Assam**.

Regulatory Framework in India

- **Legal Exemption for Genome-Edited Plants**:

- Plants developed using **SDN1 and SDN2** methods are **exempted from strict regulations** under **Rules 7–11 of the EPA, 1989**.
- These are **not regulated by the Genetic Engineering Appraisal Committee (GEAC)**.
- This has **cleared the path for faster approval and deployment** of genome-edited crops in India.

Genome-Edited Seeds vs Genetically Modified Crops

Feature	Genome-Edited Seeds	Genetically Modified (GM) Crops
Genetic Material Modification	Edits plant's own genes precisely	Adds foreign genes from other species
Foreign DNA	Absent in final product (especially SDN1/SDN2)	Present – foreign DNA is introduced
Precision	Highly targeted and accurate	Insertion is often random and unpredictable
Natural Mimicry	Mimics natural mutations	Creates unnatural genetic combinations
Regulation	Less stringent (if no foreign DNA)	Strict regulatory scrutiny under GEAC
Traits	Yield, stress tolerance, shelf life, nutritional content	Herbicide tolerance, insect resistance (e.g., Bt crops)
Technology	CRISPR-Cas9, TALENs, ZFNs	Agrobacterium, gene guns
Examples in India	DRR Dhan 100 (Kamala), Pusa DST Rice 1	Bt Cotton

Conclusion and Way Forward

- The launch of **DRR Dhan 100 and Pusa DST Rice 1** represents a **milestone in Indian agricultural biotechnology**.
- These varieties align with national goals of **doubling farmers' income**, **reducing emissions**, and **enhancing food security**.
- India should continue to **invest in genome editing**, streamline **regulations**, and **expand research** to other crops like wheat, pulses, and oilseeds.
- Public awareness and **farmers' training** on genome-edited seeds will be key to ensuring **adoption and trust**.
- Genome editing is a **game-changer for climate-smart and sustainable agriculture** in India.

Source: **https://www.thehindu.com/news/national/genome-edited-seeds-to-mark-beginning-of-second-green-revolution-chouhan/article69538185.ece**