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India's Genome-Edited Rice Breakthrough: A Model for Climate-Smart Agriculture in the Global South

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India has become the first country in the world to develop genome-edited rice varieties using CRISPR-Cas (Clustered Regularly Interspaced Short Palindromic Repeats and CRISPR-associated proteins) technology. This landmark technology development offers a replicable model for the Global South, where the dual challenges of food insecurity and climate stress demand transformative agricultural solutions. The two new rice varieties, DRR Rice 100 (Kamala) and Pusa DST Rice 1 represent a significant advance in sustainable crop improvement. "These varieties have been developed by the Indian Council of Agricultural Research–Indian Institute of Rice Research (ICAR-IIRR), Hyderabad, and the ICAR–Indian Agricultural Research Institute (ICAR-IARI), New Delhi, using precise genome-editing techniques without introducing any foreign DNA , ensuring both biosafety and consumer acceptability.

These genome-edited varieties are the result of focused research initiated under the National Agricultural Science Fund by the Indian Council of Agricultural Research (ICAR). DRR Rice 100 was developed by ICAR-IIRR, Hyderabad, using the popular Samba Mahsuri variety. It offers early maturity, increased grains per panicle, and strong stalks, all while maintaining grain quality. The variety matures about 20 days earlier than conventional varieties, helping to conserve water, reduce methane emissions, and improve input efficiency. Pusa DST Rice 1, developed by ICAR-IARI, New Delhi, is based on the MTU 1010 variety and shows exceptional adaptability to saline and alkaline soils, increasing yields substantially in these challenging conditions.

Together, the two varieties promise a 19 percent increase in yield, a 20 percent reduction in greenhouse gas emissions, and savings of approximately 7,500 million cubic meters of irrigation water. These traits are especially important for the Global South, where agriculture must adapt to shrinking water availability and rising climate risks while still ensuring food security. In addition to technical performance, these varieties are designed for wide agroecological suitability. They are intended for cultivation across multiple agro-climatic zones and dryland regions, including states in southern, central, and eastern India and regions in Sub-Saharan Africa, Southeast Asia, and parts of Latin America.

India's genome-editing initiative has been supported by strong political will, strategic investment, and biosafety regulations that allow the use of site-directed nucleases (SDN 1 and SDN 2) in crop improvement. The broader policy framework also promotes the "Minus 5, Plus 10" strategy, which aims to reduce rice cultivation area by five million hectares while increasing production by ten million tons. In 2023–24, the Government of India allocated ₹5 billion (USD 60 million) to support genome-editing research across multiple crops including rice, oilseeds, and pulses. These policy enablers can serve as a reference for other Global South countries seeking to harness biotechnology for public-good agricultural innovation. This scientific advancement holds significant relevance for countries across Africa, Asia, and Latin America, where agriculture is increasingly threatened by climate variability, soil degradation, and water scarcity.

India's leadership in genome-edited rice development underscores the transformative potential of science-based, equity-driven innovation. The initiative illustrates the value of a strong regulatory system, a commitment to smallholder inclusion, and alignment with global goals such as Sustainable Development Goal 2-Zero Hunger and climate action. The emphasis on biosafety, affordability, and scalability further strengthens the relevance of these innovations for countries across the Global South. The genome-edited rice initiative aligns with broader goals of increasing crop productivity, conserving resources, reducing the climate footprint of agriculture, and improving farmer incomes. With rising demand for resilient crop varieties in water-scarce and saline-prone regions, these innovations offer new pathways for achieving sustainable food systems in the Global South. As DAKSHIN promotes knowledge exchange and cooperation across developing countries, India's genome-edited rice success story stands as a compelling example of how public research, policy alignment, and climate responsiveness can together drive agricultural

transformation. The development and deployment of these varieties underscore the critical role of South-led innovation in addressing the shared challenges of food and environmental security.