भाकृअनुप
ICAR

ICAR-National Research Centre
for Makhana, Darbhanga

ANNUAL HIGHLIGHTS 2025-26

Innovative Research for
Sustainable Aquatic Food Systems
for a Better Tomorrow

RESEARCH | INNOVATION | SUSTAINABILITY | PROSPERITY



Science for Resilient Aquatic Agriculture
Innovation for Prosperous Farmers.

PREFACE

It gives me immense pleasure to present the Annual Highlights 2025–26 of ICAR–National Research Centre for Makhana, Darbhanga. The area under makhana cultivation in Bihar has expanded nearly three-fold, during the past decade, underscoring its growing importance as a high-value aquatic crop and a vital source of livelihood. The NRC has played a pivotal role in this transformation through sustained efforts in research, technology development, capacity building, and extension.

The Centre has focused on developing climate-resilient, resource-efficient production systems to address emerging challenges. Research on makhana–fish integration and balanced nutrient management in water chestnut has further demonstrated opportunities to enhance profitability and resource-use efficiency.

Around 1,500 farmers, entrepreneurs, and other stakeholders from across 10 states were trained at NRC during the year, facilitating wider dissemination of improved mechanised technologies.

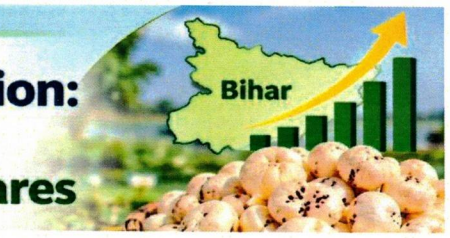
A major thrust during the year was on extension of mechanisation and technological innovation. Significant events, including the National Makhana Mahotsava and Krishi Chaupal, provided platforms for technology demonstration, knowledge exchange, and stakeholder engagement. The visit of the Hon'ble Union Minister for Agriculture and Farmers Welfare further highlighted the growing national importance of makhana research and development.

I sincerely appreciate the dedicated efforts of our scientists and technical personnel, and the support of partner institutions, farmers, and entrepreneurs. I am confident that the Centre will continue to advance scientific excellence and farmer-oriented innovation, with mechanisation as a cornerstone, to drive the sustainable development of makhana and other aquatic crops, while strengthening rural livelihoods. I am sanguine that this document will help various stakeholders gain insights into advances in climate-resilient practices and the sustainable development of makhana and other aquatic crops, while also enhancing their understanding of the challenges faced in this domain.

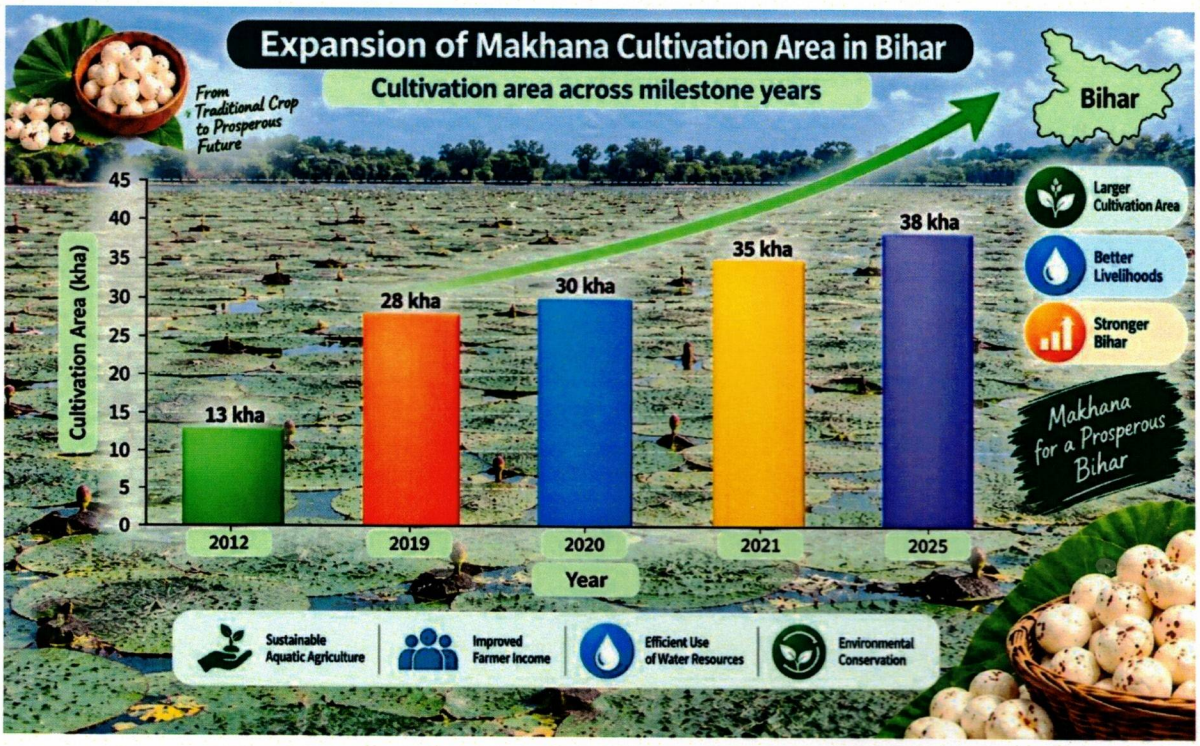
Nachiket

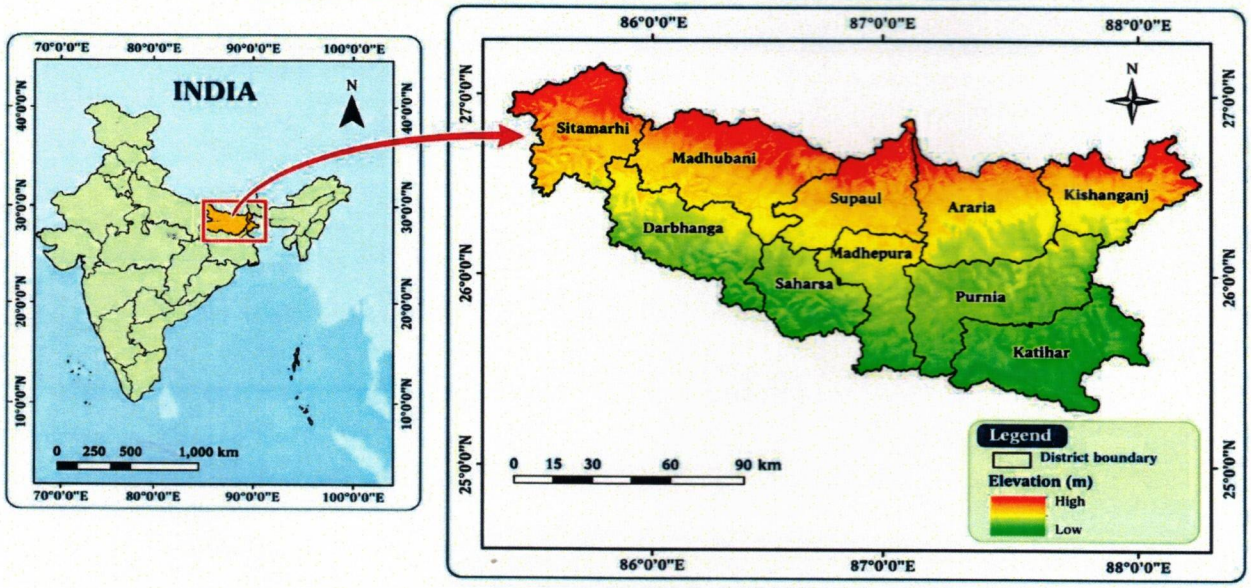
Dr. Nachiket Kotwaliwale
Director
ICAR–National Research Centre for Makhana, Darbhanga

1 Bihar's Makhana Revolution: Cultivation Area Triples to Approach 40,000 Hectares



Driven by sustained farmer adoption, growing market demand, favourable policies, and dedicated research and extension initiatives by ICAR-NRC for Makhana, the area under Makhana cultivation in Bihar expanded remarkably from 13 kha in 2012 to over 38 kha by 2025.

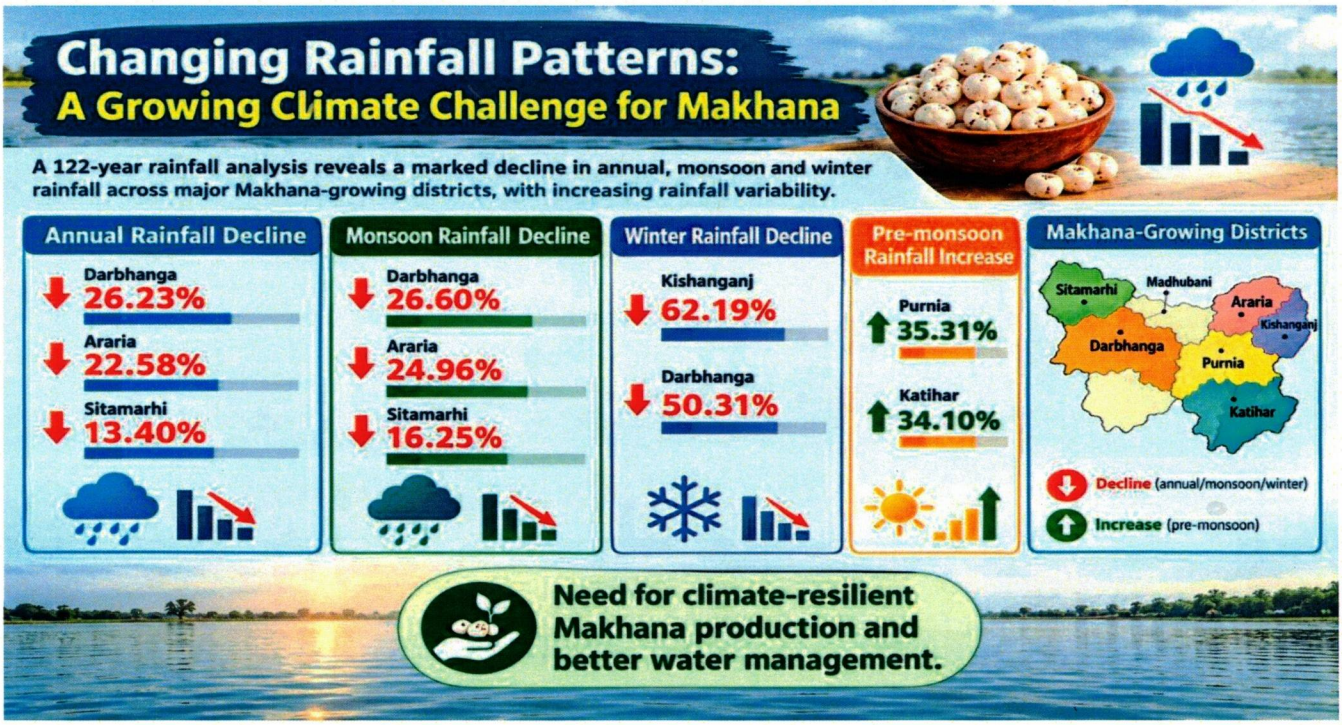


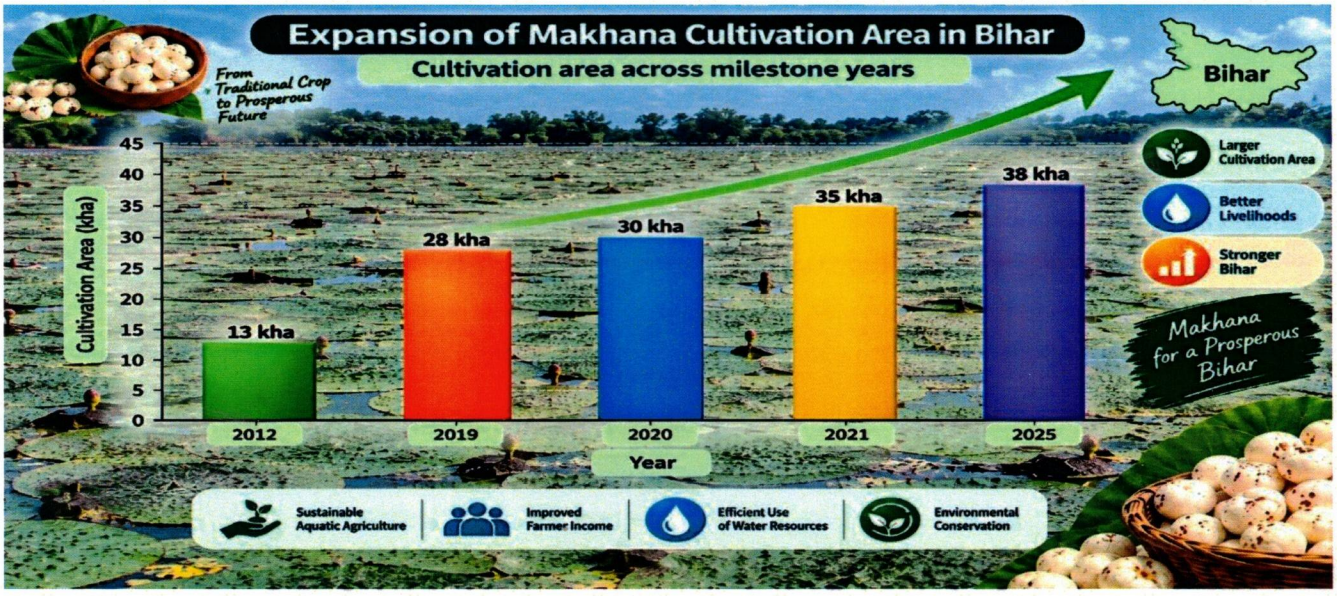


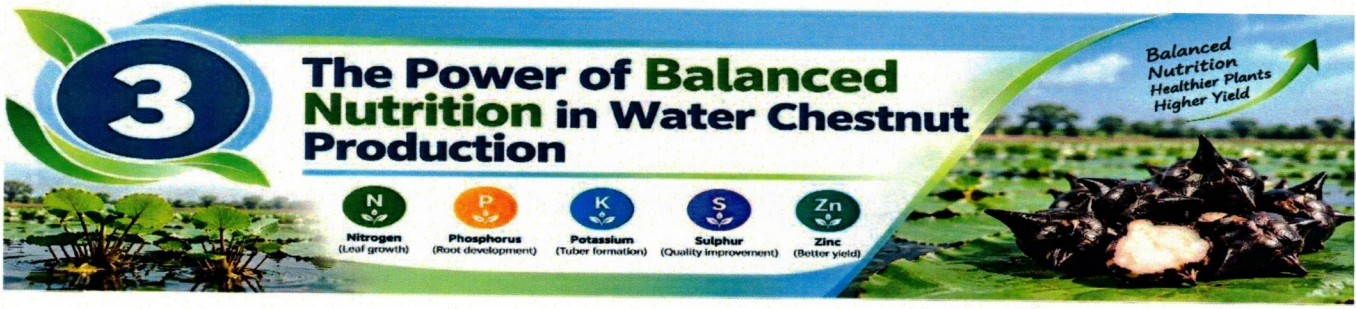
Geographical location of the Makhana growing wetland districts of Bihar

2 Rainfall Deficit Threaten Bihar's Makhana Belt, Demanding Urgent Water-Smart Interventions

Amid a century-scale decline in annual, monsoon, and winter rainfall across core districts like Darbhanga and Araria alongside rising pre-monsoon volatility, expanding climate risks pose severe moisture deficits for aquatic crops, making targeted water-harvesting infrastructure, field-level water management, and resilient production regimes imperative to safeguard future yields.

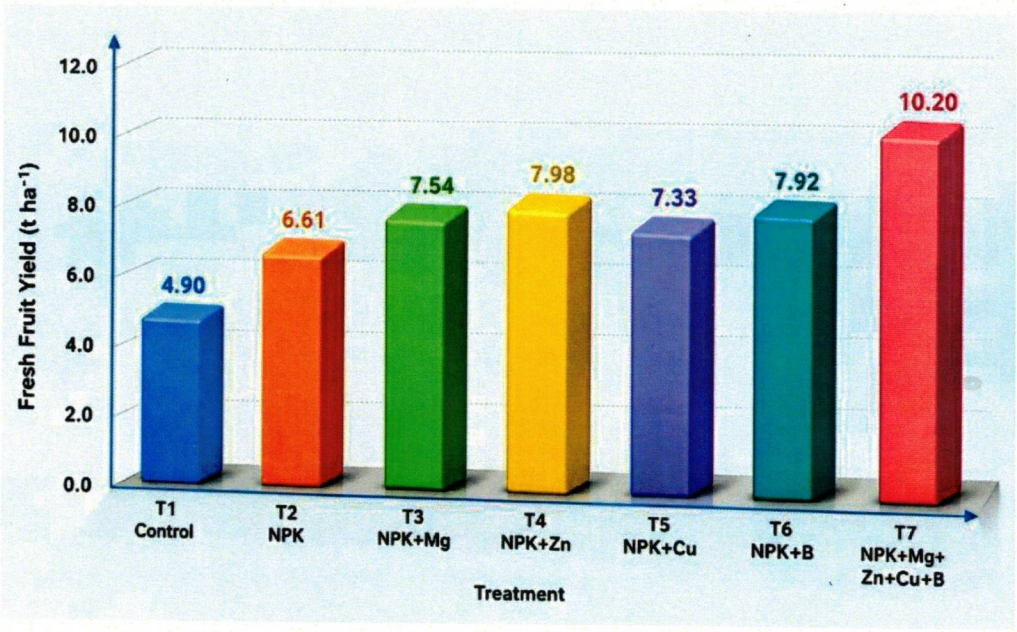


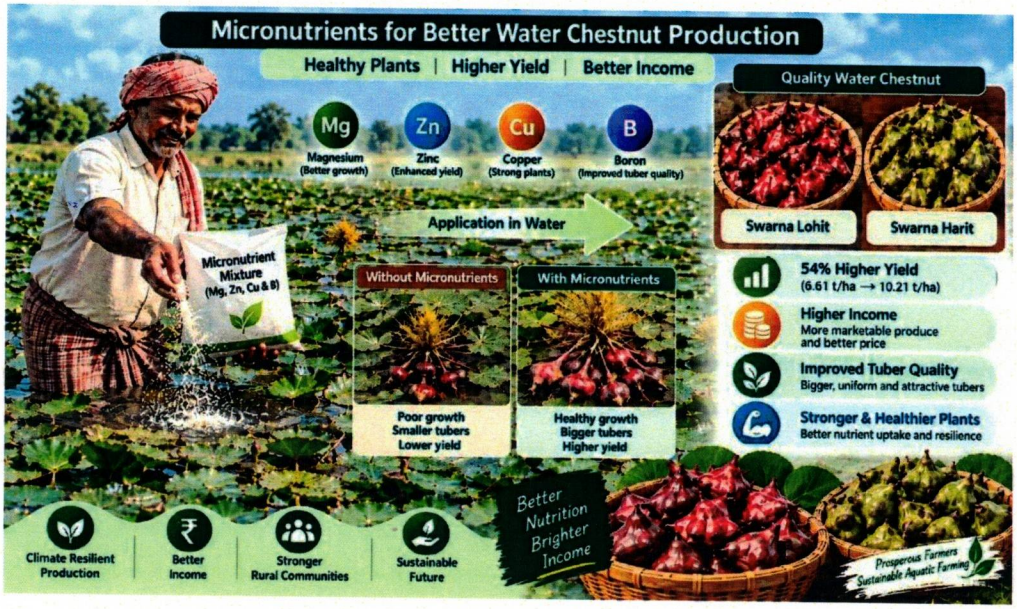


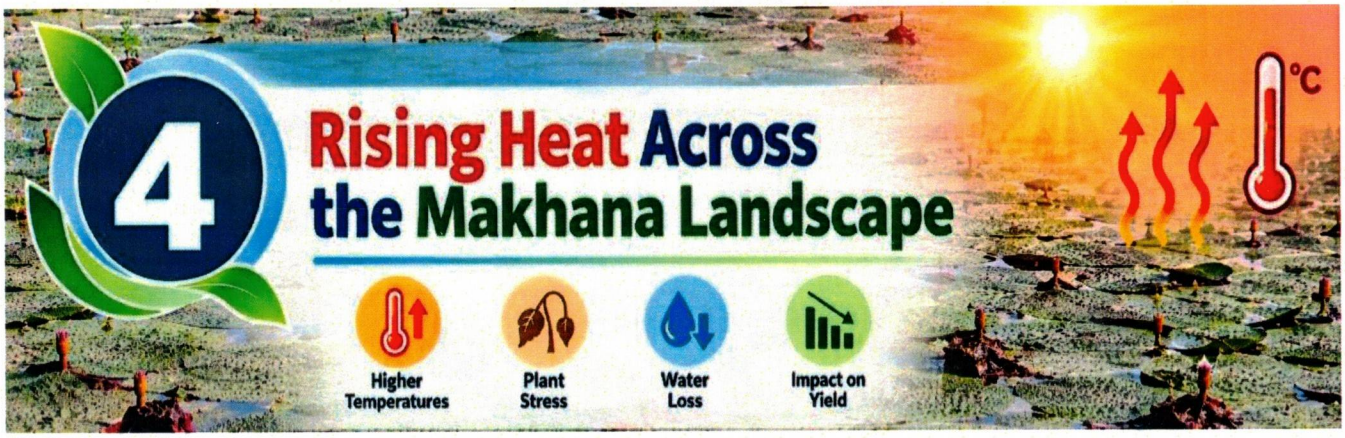


Integrating secondary and micronutrients (Mg, Zn, Cu, and B) with primary NPK addresses critical nutritional limitations, delivering a 54% yield enhancement (from 6.61 t/ha to 10.21 t/ha) over standard farmer practice of NPK alone.

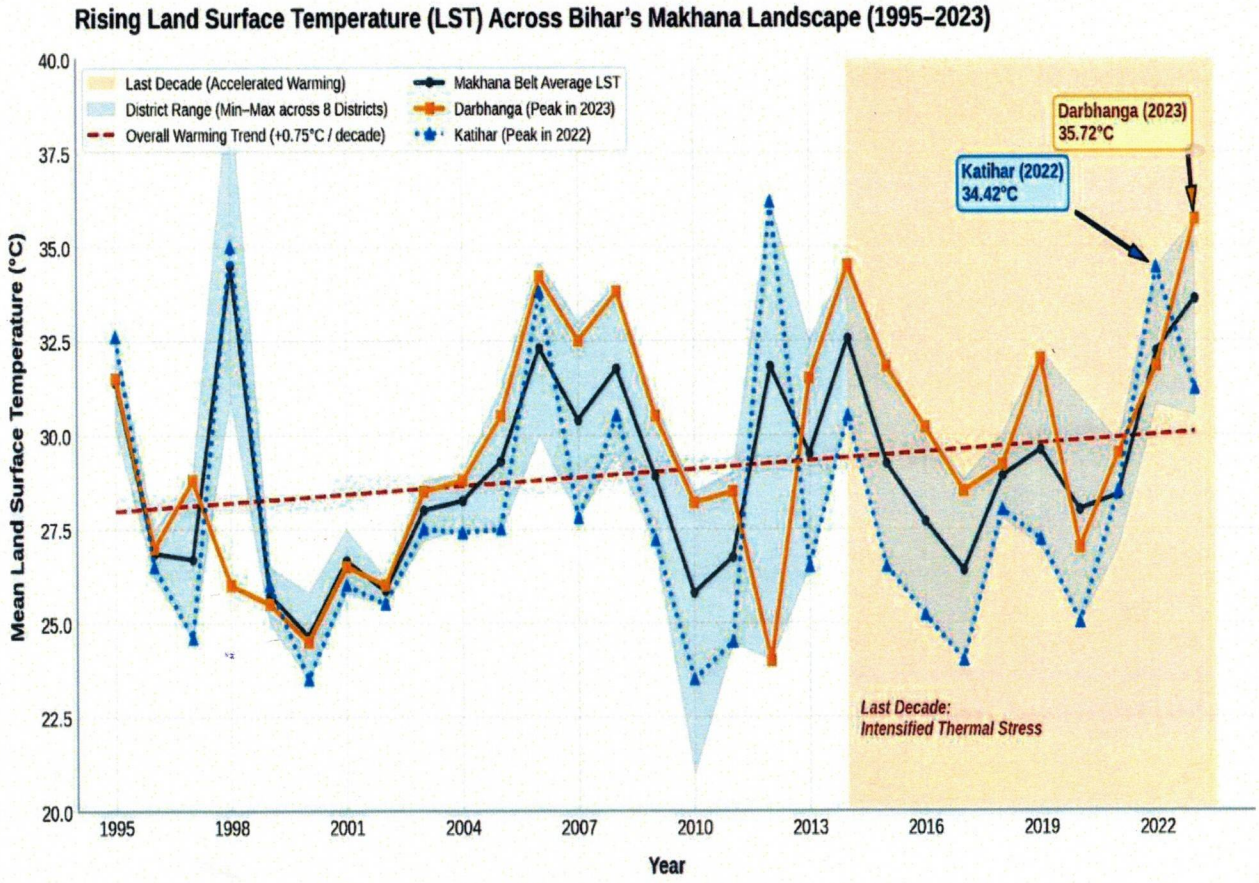
Effect of Secondary and Micronutrients on Water Chestnut Yield



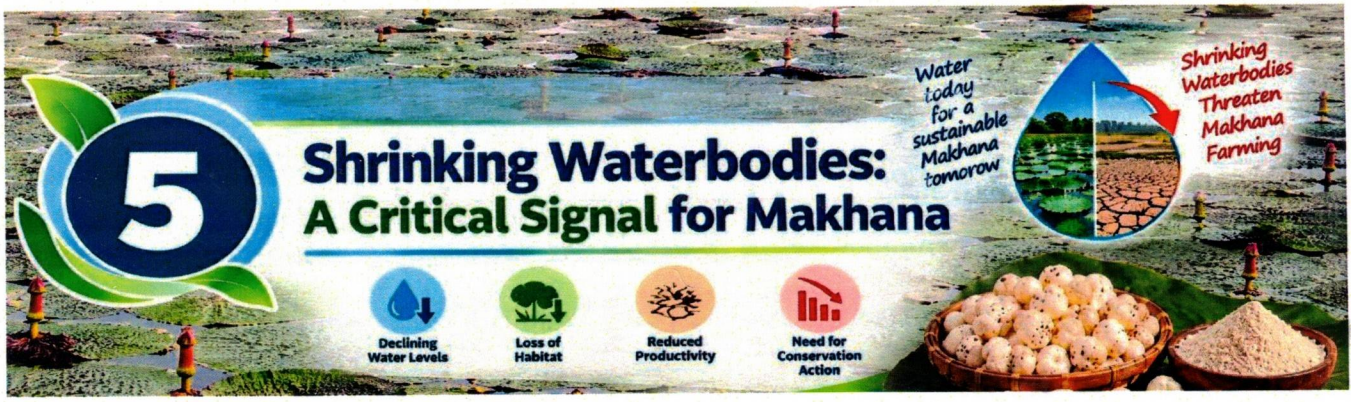




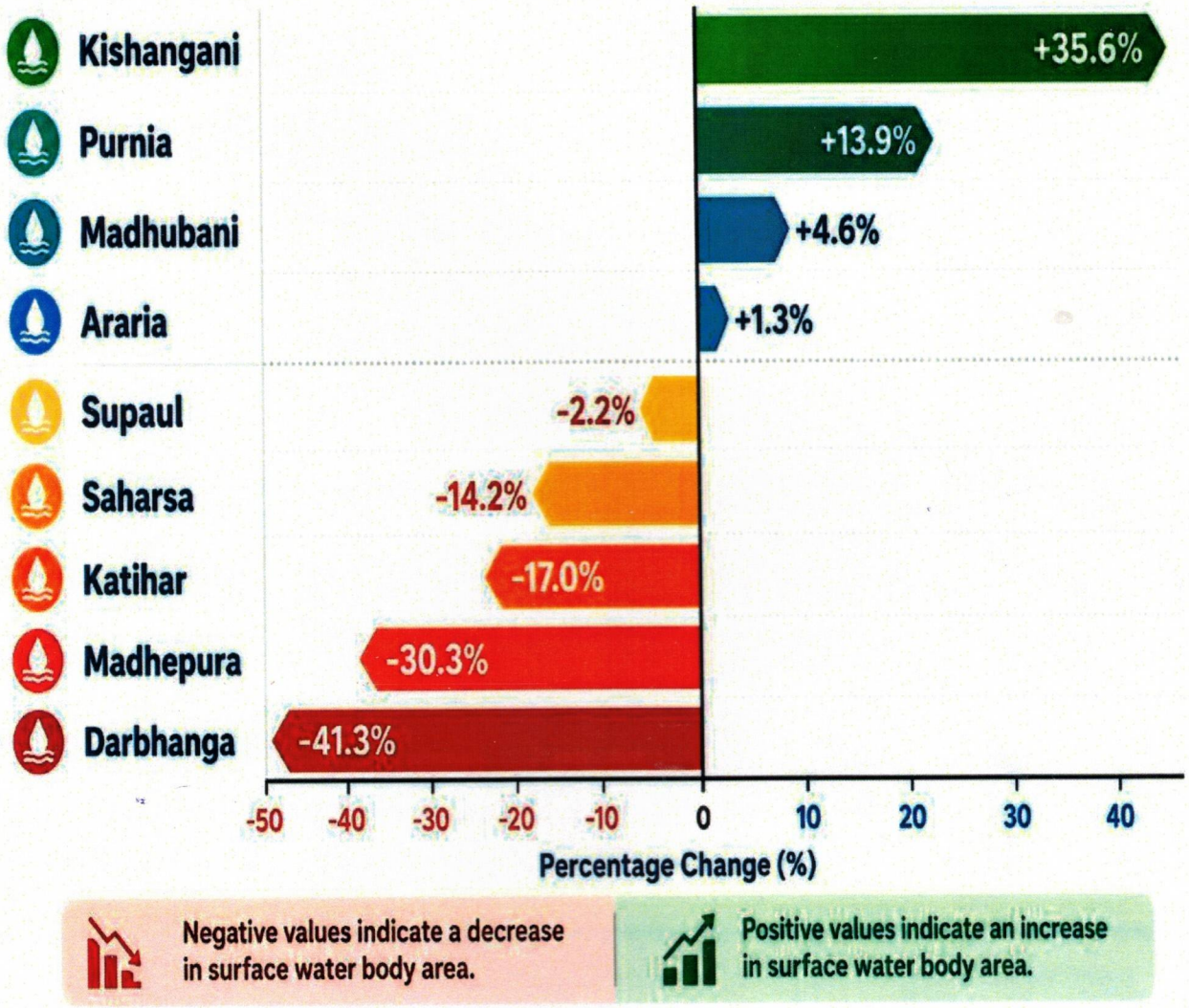
Satellite-based analysis (1995–2024) shows a progressive rise in mean annual Land Surface Temperature (LST) across the major Makhana-growing districts, particularly during the last decade. Rising surface temperatures may accelerate water loss from wetlands and influence waterbody extent, potentially affecting the growing environment and productivity of Makhana. This necessitates integration of temperature, rainfall and waterbody dynamics into climate-resilient Makhana production strategies.



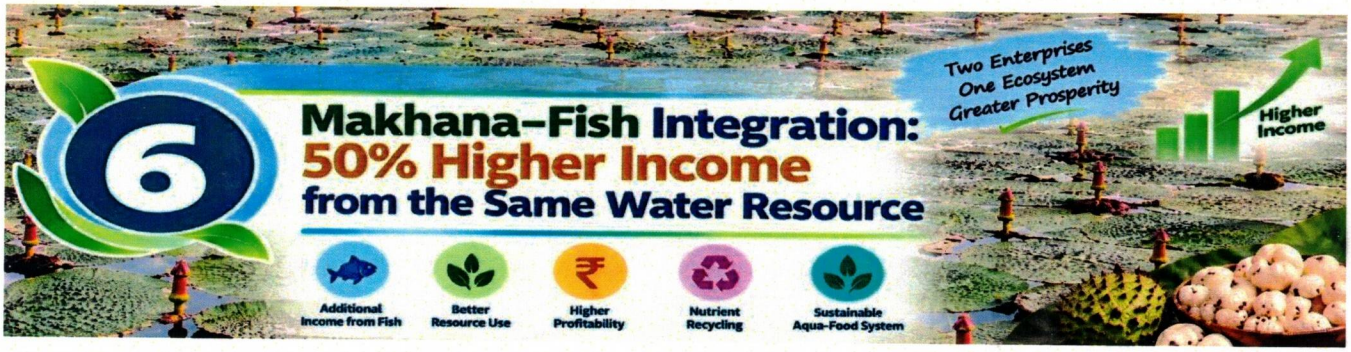
Rising Land Surface Temperature across Bihar's Makhana landscape



A 30-year post-monsoon assessment reveals post-monsoon waterbodies have shrunk sharply across traditional hubs like Darbhanga (−41.3%) and Madhepura (−30.3%), severely threatening core aquatic habitats despite localized gains in eastern districts. This mounting habitat loss imperils future Makhana productivity, making urgent wetland conservation and sustainable water management imperative.

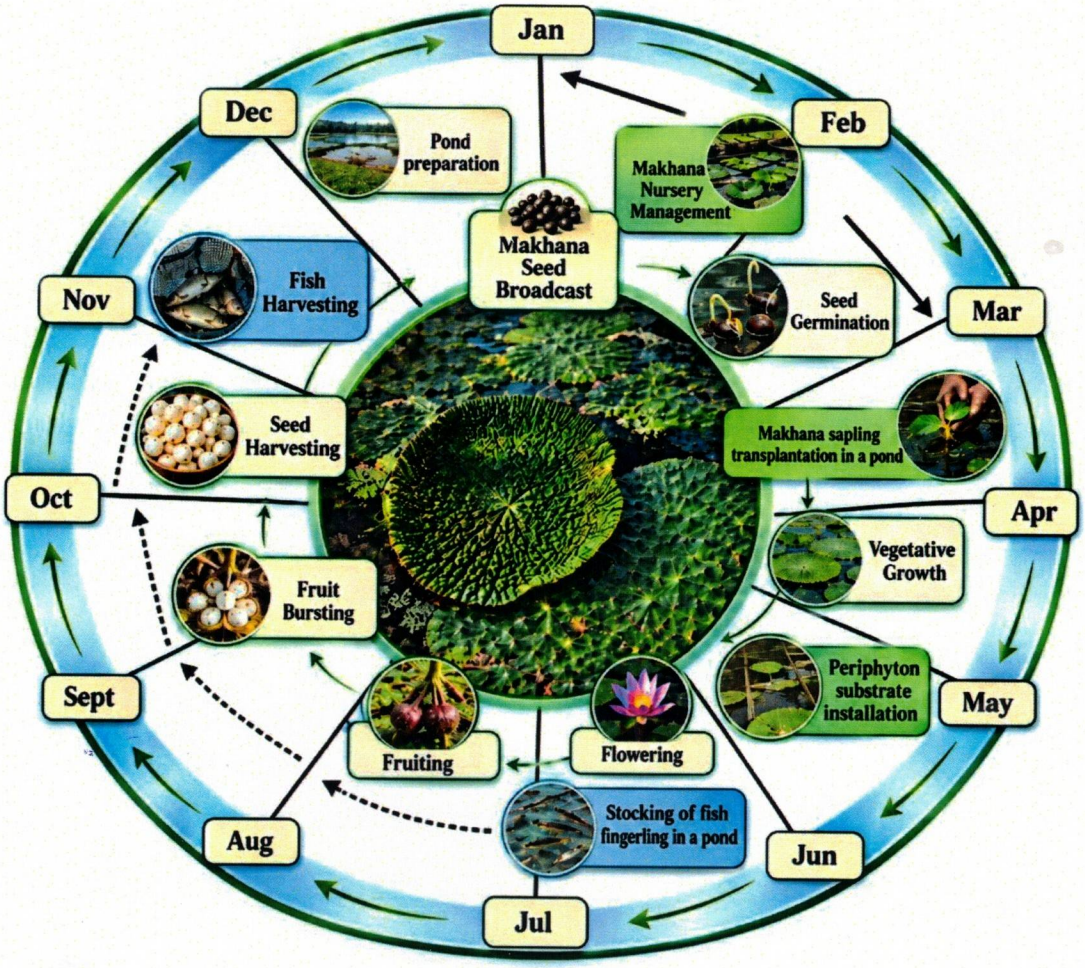


Percent change of surface water body area in Makhana growing districts (1995-2024)

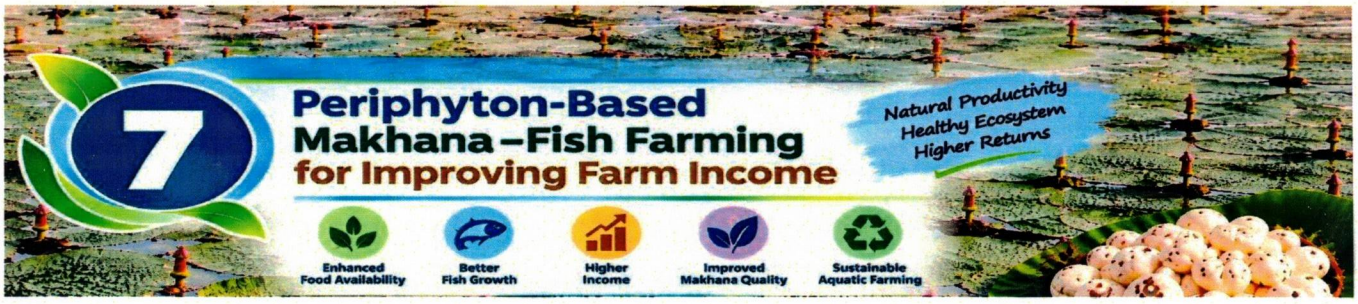


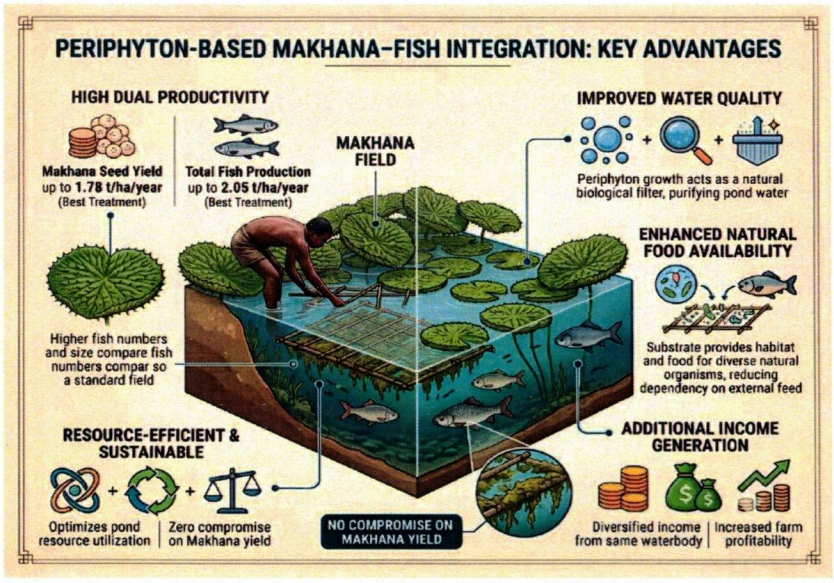
Integrating Makhana with fish culture substantially elevates farm profitability, boosting net returns by over 50% from ₹1.79 lakh/ha to ₹2.74 lakh/ha.

- Combined Yield: 1.55 t/ha of Makhana seed alongside 1.48 t/ha of fish.
- Compatible Species: Catla and Rohu
- Core Benefit: sustainable, resource-efficient model that strengthens farmer income, land productivity, and nutritional security.



Synchronized Timeline of Makhana Phenology and Integrated Fish Culture: Nursery Management (Jan–Mar) through Fingerling Stocking to Harvest (Jun–Oct).





Periphyton substrate frames enhanc natural live feed and water quality yielding up to 1.78 t/ha Makhana see and 2.05 t/ha fish. This maximizes pon productivity and farmer income fron the same water footprint withou compromising crop yield.



Developed an eco-friendly, resistance-conscious Singhara beetle management strategy integrating biopesticides, botanicals and selective insecticides.

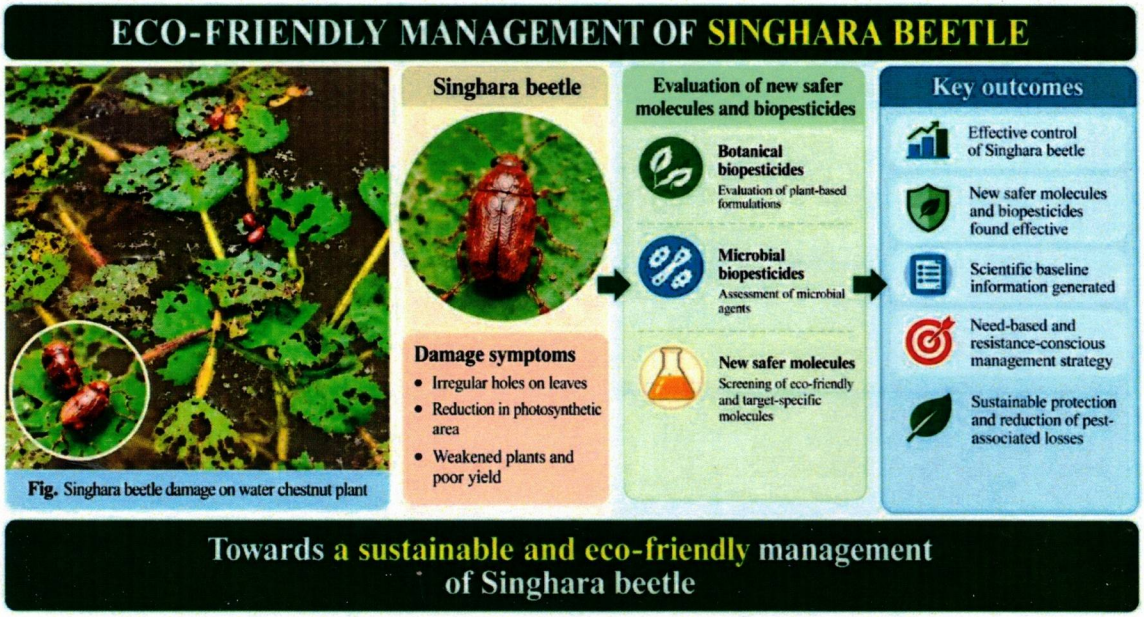
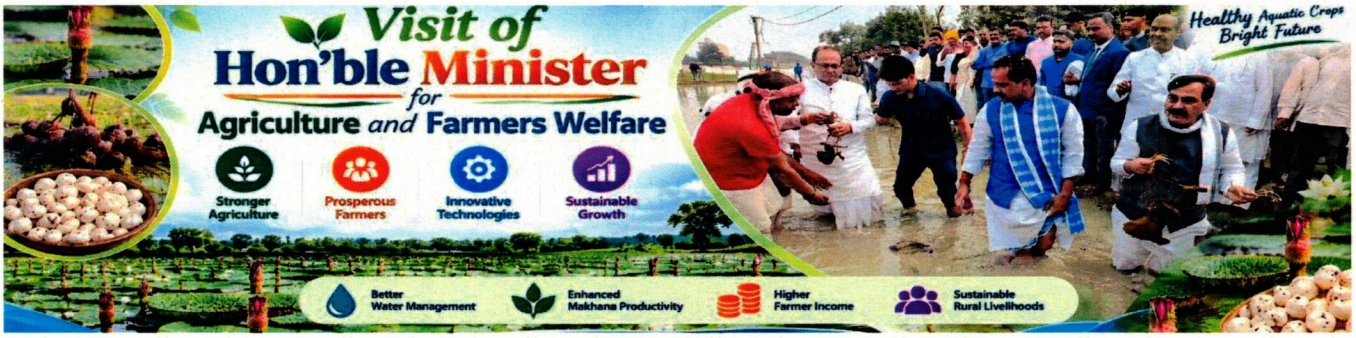


Fig. Singhara beetle damage on water chestnut plant

Major Events, Outreach and Capacity Building

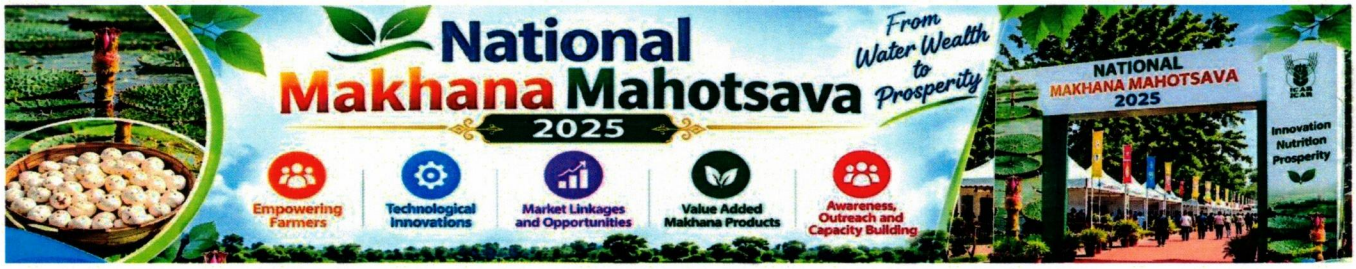




Hon'ble Union Agriculture Minister Shri Shivraj Singh Chouhan Ji visited ICAR-NRC Makhana, Darbhanga on 23 February 2025, where he inspected research facilities, engaged with over 1,200 growers during Kisan Samvad, planted seedlings, called for farmer-led inputs in shaping the proposed Makhana Board, and urged scientists to develop a thornless variety for easier cultivation.



Hon'ble Agriculture Minister Planting Makhana at ICAR-NRCM Farm



The National Makhana Mahotsava 2025, organized by ICAR-NRCM with CIPHET and ITC Ltd. on 7 October 2025, convened 750+ farmers and entrepreneurs to showcase processing innovations and chart a Viksit Bharat roadmap for the sector. The event also finalized strategic MoUs with SKUAST Kashmir and ITC Ltd. to strengthen research, value addition, and market development

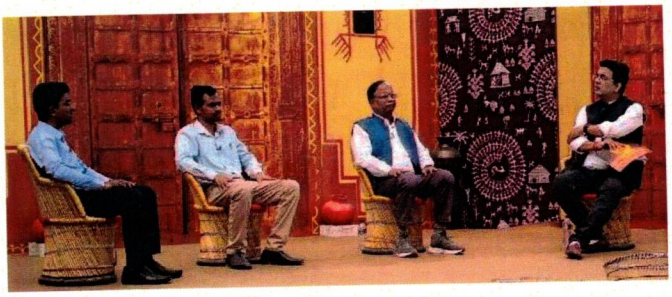


Krishi Chaupal:

Empowering Makhana Farmers & Entrepreneurs



Broadcast by DD Kisan on 12 April 2025, Krishi Chaupal convened over 125 growers and entrepreneurs with leading experts to advance scientific cultivation, processing, mechanization, and market linkages across the Makhana value chain.



Experts Including the Director, NRC-M on the Set of Krishi Chaupal





A state-of-the-art Makhana Processing-cum-Quality Testing Laboratory and renovated office building were inaugurated at ICAR-NRCM, Darbhanga on 3 June 2025 by Dr. S. N. Jha, DDG (Agricultural Engineering), ICAR, alongside Director Dr. Nachiket Kotwaliwale. This facility strengthens post-harvest research, mechanization, and quality assurance to boost processing efficiency and empower farmers and entrepreneurs across the sector.



In 2025, ICAR–NRC for Makhana trained over 1,500 farmers and entrepreneurs across nearly 10 Indian states, advancing scientific production, mechanization, and value addition to strengthen the Makhana value chain nationwide.


भाकृअनुप
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