



NRRI

*Pioneering Excellence
in Rice Research*

"Innovating for Sustainable Agriculture and Food Security"



ICAR-National Rice Research Institute
Cuttack 753 006, Odisha



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सचिव (डेयर) एवं महानिदेशक (आईसीएआर)
Secretary (DARE) &
Director General (ICAR)

भारत सरकार
कृषि अनुसंधान और शिक्षा विभाग एवं
भारतीय कृषि अनुसंधान परिषद
कृषि एवं किसान कल्याण मंत्रालय, कृषि भवन, नई दिल्ली-110 001

GOVERNMENT OF INDIA
DEPARTMENT OF AGRICULTURAL RESEARCH AND EDUCATION (DARE)
AND
INDIAN COUNCIL OF AGRICULTURAL RESEARCH (ICAR)
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Foreword

It is with immense pride and satisfaction that I pen down this preface for the portfolio document of the ICAR-National Rice Research Institute (NRRI), Cuttack. As the Director General of the Indian Council of Agricultural Research (ICAR), I am privileged to witness the remarkable journey and invaluable contributions of NRRI towards transforming India's agricultural landscape, particularly in the domain of rice science. The vision of NRRI resonates deeply with the overarching goals of the Indian agricultural sector. To ensure sustainable food and nutritional security and equitable prosperity through rice science is not merely a goal; it is a commitment to the welfare of our nation. The legacy of NRRI speaks volumes about its pivotal role in India's agricultural history. From playing a transformative role in the green revolution to developing varieties and technologies to fulfil the evolving needs of Indian farmers, the institute has been a cradle of innovation and progress.

The landmark discoveries detailed in this document showcase NRRI's commitment to pushing the boundaries of rice science. From the pioneering Indica-Japonica hybridization program to the identification of germplasm harbouring genes crucial for resistance to diseases and tolerance to submergence, NRRI showed its consistent commitment to addressing contemporary challenges and ensuring food security. The impact of NRRI's work is profound in the statistics presented – 180 released rice varieties cultivated by thousands of farm households and the global reach of NRRI's rice varieties in countries such as Australia, Malaysia, and beyond. The development of the country's first protein-packed rice varieties underscores NRRI's dedication to addressing not just food security but also nutritional needs. One of the pressing challenges of modern agriculture is to address the issue of climate change. NRRI has significantly contributed to developing climate-smart varieties that are genetically better equipped to tolerate submergence, salinity, and drought. Multiple-stress-tolerant varieties developed by NRRI are being well accepted by farmers, as evidenced by the increasing areas under cultivation. NRRI's unique strengths, as enumerated, demonstrate its commitment to innovation, technology dissemination, and fostering collaborations. The institute's facilities, equipped with state-of-the-art laboratories and cutting-edge tools, speak to its prowess in research and development. The emphasis on genome editing, diverse germplasm collections, and agribusiness development through the ABI centre showcases a holistic approach to agricultural advancement.

The dedication of NRRI extends beyond research facilities to outreach and education. The institute's role as the lead institute for the IARI University Cuttack Hub is commendable, providing a platform for teaching and research in agriculture. The engagement with students through various institutes reflects NRRI's commitment to nurturing the next generation of agricultural leaders. The dedicated workforce of NRRI, comprising scientists, technical staff, and administrative personnel, forms the backbone of the institute. Their efforts, coupled with rich linkages with international and national organizations, industry, FPOs, and NGOs, highlight NRRI's collaborative approach to addressing complex agricultural challenges. In conclusion, the ICAR-NRRI portfolio document encapsulates a journey of dedication, innovation, and impact. As we navigate the challenges of the future, NRRI's legacy and ongoing contributions serve as a beacon of inspiration for the entire agricultural community. I commend the institute for its unwavering commitment to ensuring food and nutritional security, and I am confident that this document will stand as a testament to NRRI's role in shaping the future of Indian agriculture.

(Himanshu Pathak)



Mandate

Generation of technology through applied research for sustainable increase in productivity and income from rice and rice-based cropping/farming systems in all the ecosystems.

Development of technology for integrated pest disease and nutrient management for various farming situations.

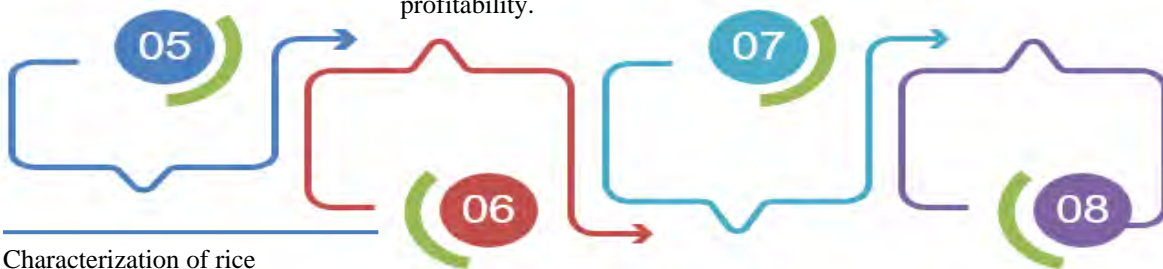
Conduct basic, applied and adaptive research on crop improvement and resource management for increasing and stabilizing rice productivity in all ecologies with special emphasis on rainfed ecosystems and related abiotic stresses.



Collection, evaluation, conservation and exchange of rice germplasm and distribution of improved plant materials.

Maintain database on rice ecology, ecosystems, farming situations and comprehensive rice statistics for the country as a whole in relation to their potential productivity and profitability.




Collect and maintain information on all aspects of rice and rice-based cropping and farming systems in the country.

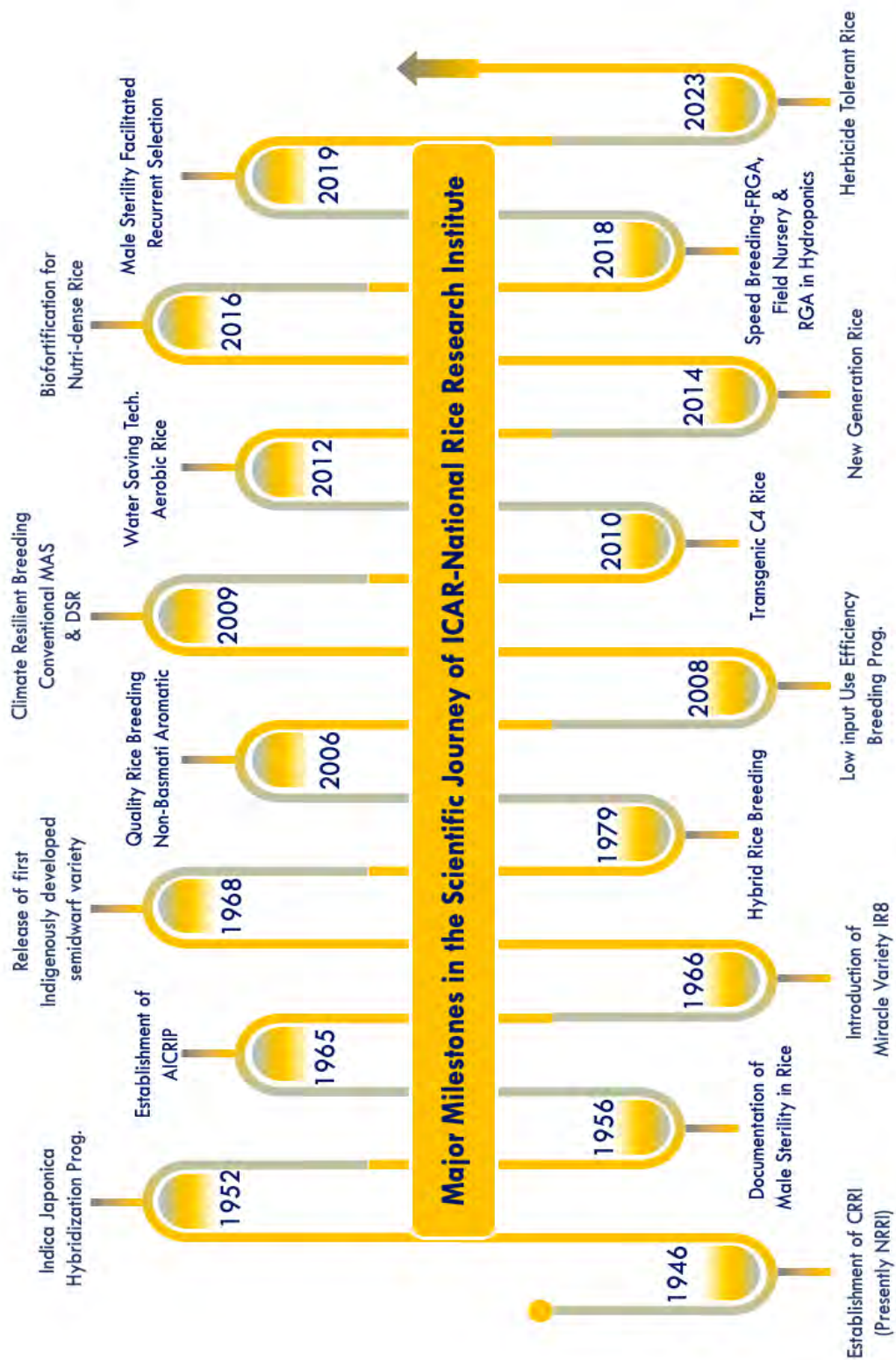


Characterization of rice environment in the country; evaluation of physical, biological, social-economic and institutional constraints to rice production under different agro-ecological conditions & in farmer situations and develop remedial measures for their amelioration.

Impart training to rice research workers, trainers and subject matter/extension specialists on improved rice production and rice-based cropping and farming systems.

Goal

<p>To ensure sustainable food and nutritional security and equitable prosperity of our nation through rice science.</p>  <p>VISION</p>	<p>To ensure food and nutritional security of the present and future generations of the rice producers and consumers.</p>  <p>GOAL</p>	<p>To develop and disseminate eco-friendly technologies to enhance productivity, profitability and sustainability of rice cultivation.</p>  <p>MISSION</p>
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Our Legacy

Seeds of Green Revolution were first sown in the field of CRRI



NRRI has played a transformative role in India's journey, turning the tide from insufficiency to self-sufficiency in food grain production.



NRRI has received recognition from the National Academy for Agricultural Sciences (NAAS), New Delhi for its significant contributions to the Green Revolution.



The World Food Prize laureate **Prof. MS Swaminathan** started his career journey at CRRI in 1954, working on the Indica-Japonica Hybridization Program.

Breeding for fertilizer responsiveness started in 1952 by **Dr. Krishnaswamy Ramiah**, Founding Director of CRRI. This program is considered one of the founding steps toward the Green Revolution



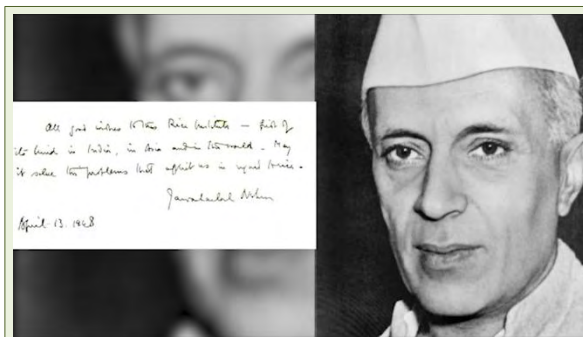
Former NRRI Director, **Dr. Trilochan Mohapatra**, held the prestigious positions of Secretary, DARE, and Director General of ICAR from 2016 to 2022.

Dr. Himanshu Pathak, the former Director of NRRI, has taken on the responsibilities of Secretary, DARE, and Director General of ICAR from 2022.

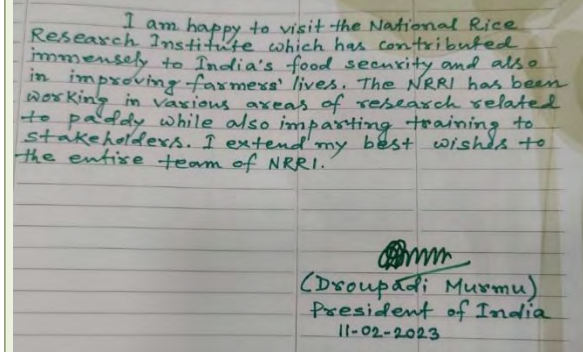




In 2021, NRRI celebrated its remarkable 75-year journey of serving our nation. Established in 1946 amidst the backdrop of the Bengal famine, NRRI has persistently dedicated itself to the cause of enhancing food security in India.



Pandit Jawaharlal Nehru visited us twice: April 13, 1948 and January 3, 1962



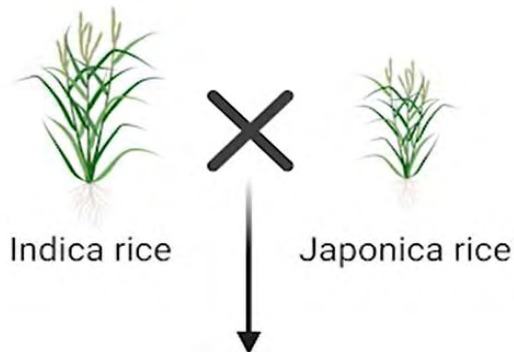
Landmark discovery

First Indica-Japonica Rice Hybridization Program

FAO-sponsored Indica X Japonica Rice hybridization program was carried out at CRRI, Cuttack.



Indica-Japonica Hybridization Program



Landmark Jeypore Botanical Survey (JBS)

From 1955 to 1959, NRRI conducted the groundbreaking Jeypore Botanical Survey (JBS), the inaugural initiative of its kind, collecting 1745 traditional rice cultivars and 150 wild rice genotypes. This initiative garnered global attention from biosystematics, geneticists, and conservationists. Subsequently, the Jeypore tract was identified as a secondary center of origin for cultivated rice.



27,000 km²



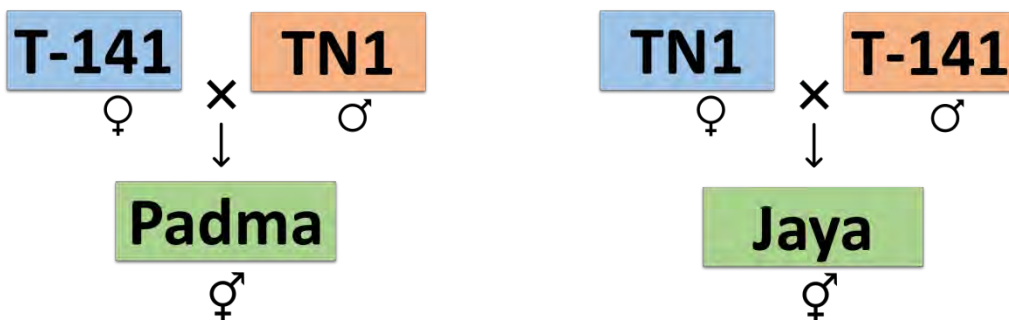
1,745 Local cultivars



150 wild rice

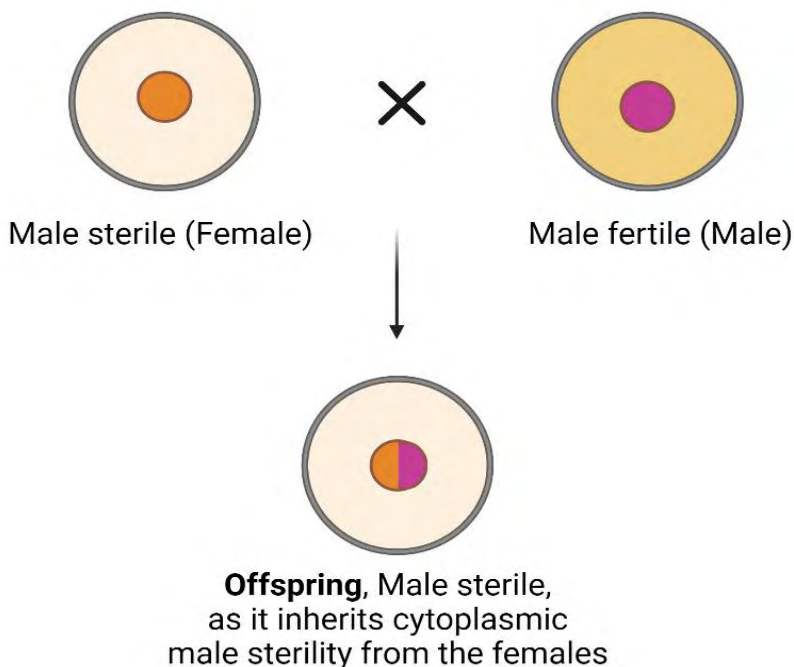
Country's First Semi-dwarf High Yielding Rice Variety

In 1968, NRRI achieved a milestone by introducing Padma, the country's first semidwarf, high-yielding, and input-responsive variety, derived from the T-141 x TN1 cross. Subsequently, a reciprocal cross of TN1 x T-141 at NRRI resulted in the release of Jaya from DRR, Hyderabad



New Source of Cytoplasmic Male Sterility

NRRI identified a new source of Cytoplasmic male sterility in 1990. This CMS has tremendous impact in hybrid rice breeding.

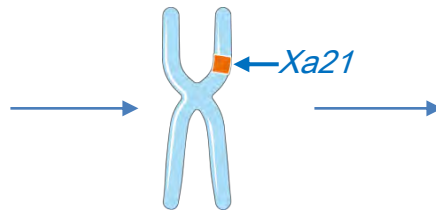


Donor Plant for Bacterial Blight Resistance Gene *Xa21*

NRRI scientists have identified *Oryza longistaminata* as the genetic source of *Xa21*, a crucial gene that provides strong resistance to bacterial blight disease. This gene has been extensively utilized in breeding rice with bacterial blight tolerance.



Oryza longistaminata



Xa21-introgressed Rice cultivars

Donor Plant for 'Flood-proof' Gene *Sub1*

Scientists at NRRI, Cuttack, discovered the exceptional submergence tolerance of the rice landrace FR13A, leading to the identification of the *SUB1* gene. This foundational research has enabled the global transfer of the *SUB1* gene to various rice varieties, contributing to the development of flood-resistant rice.



FR13A



SUB1A gene



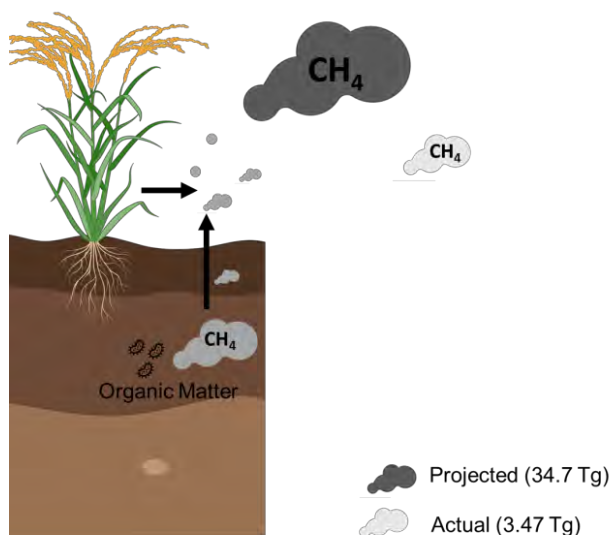
(-) *SUB1A*

(+) *SUB1A*

Flood-proof cultivars

Rice Field's Actual Impact on Greenhouse Gas Emissions

NRRI collaborated with NPL, New Delhi, and IARI, New Delhi, to reevaluate rice's role in greenhouse gas emissions. The study, in 1996, found that rice contributed around 3.47 Tg/year to methane emissions, a significant deviation from the earlier projected estimate of 34.7 Tg/year by other agencies in 1996. The scientific community subsequently accepted the emissions values reported by ICAR-NRRI in 1996.



Bringing Green Revolution to Eastern India (BGREI)

Initiated in 2010-11, the BGREI mega program by the Government of India aimed to enhance agricultural production sustainably in seven Eastern Indian states: Assam, Bihar, Chhattisgarh, Jharkhand, Odisha, Eastern Uttar Pradesh, and West Bengal. NRRI provided the lead technological support to the states to implement BGREI.

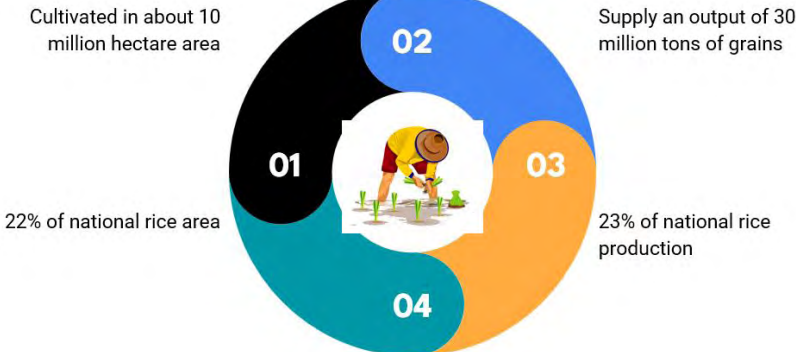
BGREI states have made significant progress in the improvement of production and productivity of rice, the constraints limiting the productivity of “rice-based cropping systems” in eastern India.





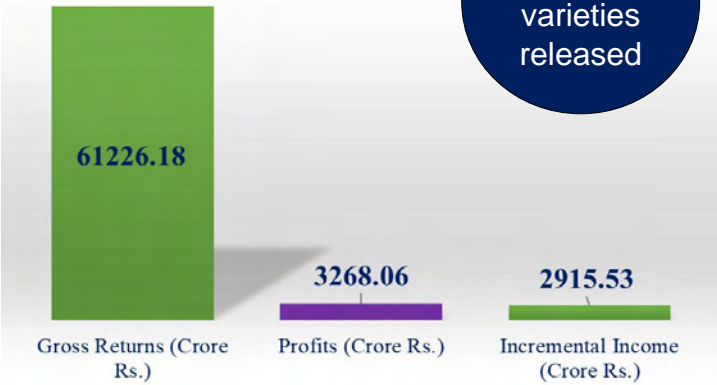
Our Impact

NRRI Rice Varieties



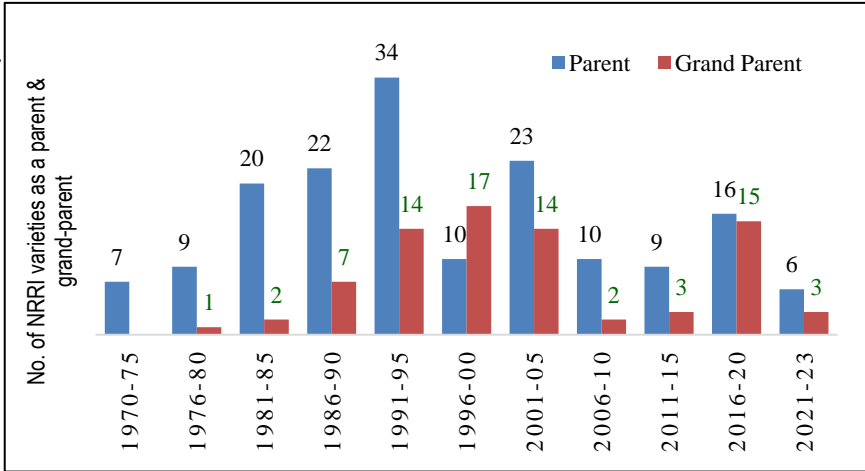
179
varieties released

NRRI Rice varieties are cultivated by 106 thousand farm households and 9.18 million beneficiaries.



The Cascading Impact of NRRI: A Pedigree Analysis Showcase!

Rice breeders from other institutes utilized over 54 NRRI varieties as either male or female parents, collectively contributing to the development of 166 popular rice varieties in the country. Post-1975, NRRI varieties were used as grandparents in developing 78 rice varieties nationwide. Cumulatively, NRRI's dynamic portfolio has left an indelible mark, playing a vital role as parents or grandparents in the creation of 244 rice varieties across India.



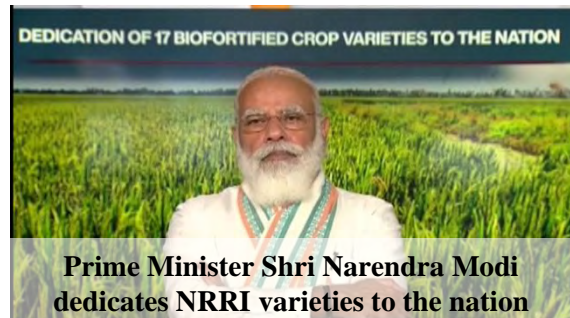
Impact of NRRI: Beyond the Boundary

NRRI's rice varieties have been used to develop 78 rice varieties in other countries. NRRI released Circna in Australia, Malinja and Mahsuri in Malaysia, and ADT27 in Tamilnadu. These four along with other NRRI varieties, as parents, have given rise to many varieties abroad.



A Pioneer in Producing Biofortified Nutrient-dense Rice

As a step toward eradicating malnutrition, we came up with healthier and protein-packed rice varieties. NRRI developed the country's first-ever High Protein Rice Variety!



CR
DHAN
310


CR
DHAN
311

CR
DHAN
315

CR
DHAN
411

- Cultivate NRRI's biofortified rice varieties

1.5 lakhs Indian Farmer



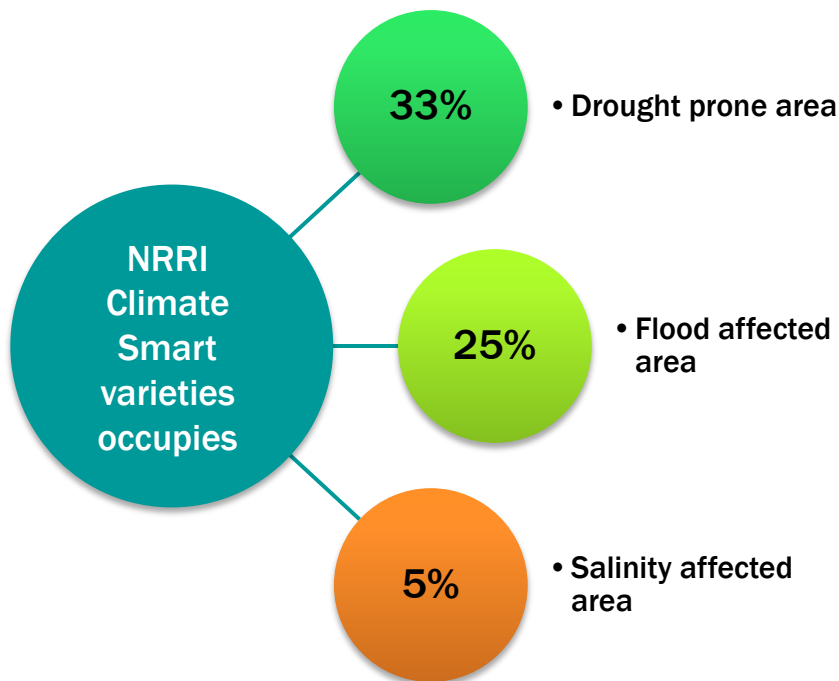
- Have access to biofortified rice

2.53 lakh Indian Children

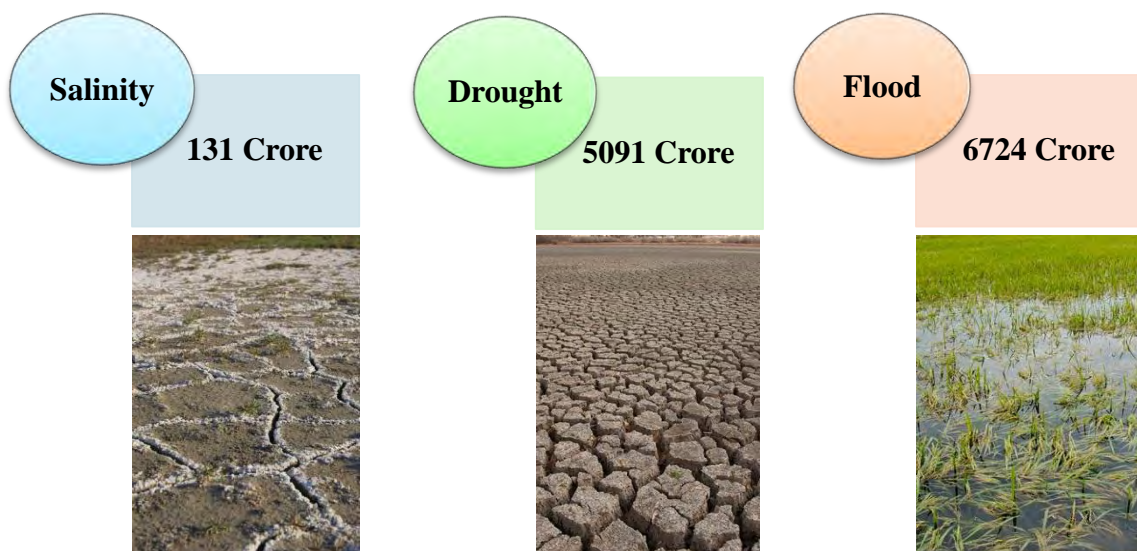


Climate-smart Varieties

"NRRI's climate-smart varieties stand strong against drought, sail through flash floods, and defy salinity.



Economic advantage of NRRI's Climate Smart varieties



Biotic Stress Tolerant Varieties

NRRI's Biotic stress-tolerant rice varieties enhance food security by reducing crop losses due to pests and diseases.



Bacterial Leaf Blight

- CR Dhan 326
- CR Dhan 800
- Improved Lalat &
- Improved Tapaswini



Rice Blast

- CR Dhan 107



Brown Plant Hopper

- CR Dhan 317 &
- CR Dhan 805



Gall Midge

- Samlei

0.68 t/ha



Yield Resilience

2.51 million Tonnes



Production Resilience

Rs. 5124 Crore



Economic Resilience

Massive Outreach to Farmers

Unlocking success through Massive Outreach strategies designed to connect with our primary stakeholders, Farmers.

**Reached
>30,000
Farmers over
the last 5 years**



Supplying Germplasm

NRRI spreads the seeds of innovation nationwide, supplying unique rice germplasm for Research and Development, cultivating a brighter future for Indian agriculture.

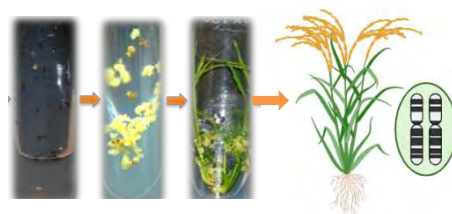


23017
accessions
supplied over
last 5 years.

Our Unique Strengths

Doubled Haploid (DH) Technology

NRRI's Patented Doubled Haploid (DH) Tech: Redefining Research and Breeding! We lead and share our cutting-edge expertise with other institutes. We released five DH varieties with diverse traits.



Genome Editing



NRRI excels in genome editing. The institute possesses expertise in both conventional CRISPR-Cas9 and advanced tools such as Base editing and Prime Editing. NRRI Scientists have already developed novel editing tools and edited rice lines to enhance yield.

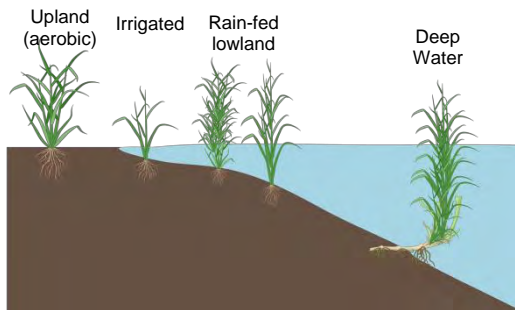
Oryza Garden

NRRI *Oryza* Garden has 23 species from the *Oryza* genus, representing all genome types.

It showcases the full spectrum of genome diversity!



All Ecology and All-season Breeding



Within our digitally managed NRRI Farms, we boast state-of-the-art facilities tailored for breeding crops across diverse rice ecologies and throughout every season. NRRI extends off-season nursery facilities to researchers from across the country.

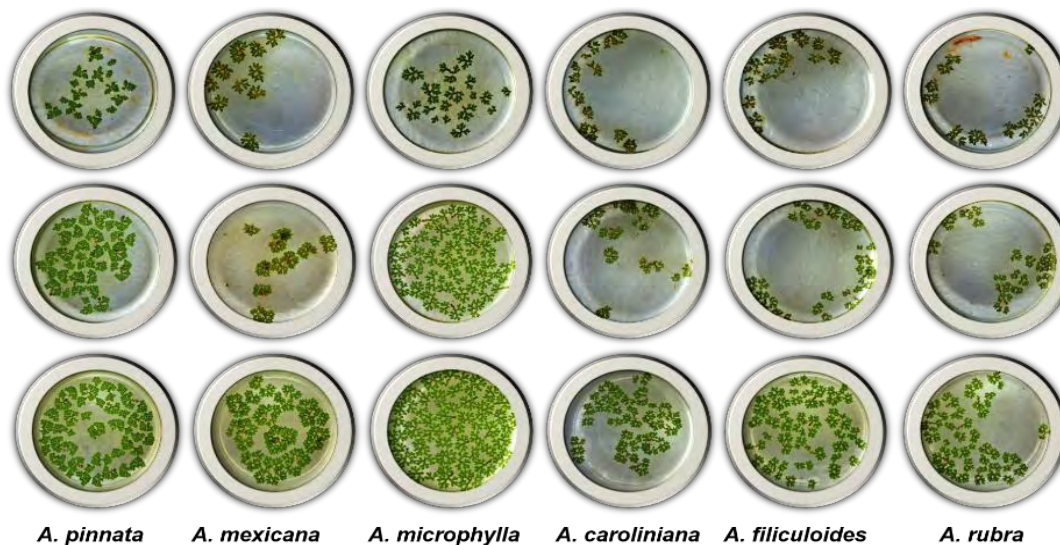
Gene Bank

The NRRI gene bank safeguards over 38,000 rice germplasms, ensuring a reservoir for future needs. Among them, we cherish unique germplasm, including collection from the Jeypore tract in Orissa - a recognized center of rice origin. Additionally, we proudly house a set of the Assam Rice Collection.



Natural Nitrogen-fixing Fertilizing Solution

We curate a diverse collection of 102 strains encompassing all six recognized species of Azolla. NRRI facilitates the distribution of these strains to both farmers and researchers.



Agribusiness Incubation Centre (ABI)

NRRI's ABI center fosters agripreneurs in rice ecosystems, driving technology commercialization and offering vital training in agribusiness management. It serves as a dynamic interface connecting farmers, banks, universities, venture capitalists, and various stakeholders for holistic agribusiness development.



Long-duration Rice Hybrids



The majority of the rice hybrids available in the market are in early to medium duration group. NRRI proudly notified three long-duration hybrids, CR Dhan 701, CR Dhan 702 and CR Dhan 703 with more than 15% yield superiority of same duration inbreds.

In total, NRRI commercialized six heterotic hybrids for different ecologies and states.

First non-basmati Herbicide-tolerant Rice

NRRI introduced India's maiden non-basmati herbicide-tolerant rice variety, CR Dhan 807, tolerant to Imazethapyr herbicide and drought. This variety holds the promise of lowering cultivation costs by 25-30% through efficient weed management.



54 years and continuing: Long Term experiment

Started in 1969, a long-term fertilizer experiment is still being carried out at NRRI, assessing soil properties, crop productivity, and responses to various nutrient inputs. These experiments inform strategies for responsible fertilizer use, soil quality enhancement, and the long-term environmental impact of these practices.

1969

Long-term fertilizer experiment

IARI-Cuttack Hub

NRRI is the lead institute for IARI University Cuttack Hub for teaching B.Sc (Ag), M.Sc, and Ph.D. NRRI is assisted by 8 sister institutes from nearby regions. Students will be enrolled through CUET/NTA.

IARI-Cuttack Hub: Nodal and Satellite Institutes



NRRI-HRD Cell

Year - 2014-2022

- MSc 226
- Summer Training 42
- PhD 46

Year - 2014-2022

- NRRI Estd. 1946
- 12 MOU

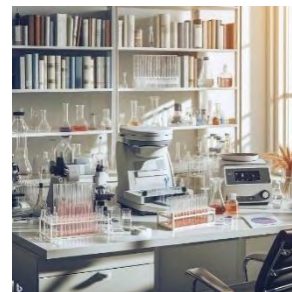
- ➔ Central Universities
- ➔ State Agricultural Universities

- ➔ Private Universities
- ➔ Basic Universities

Our Facilities

State-of-the-art Laboratories

NRRI boasts state-of-the-art laboratory facilities for cutting-edge research. Our team of scientists leverages all modern technologies and tools to advance rice crop design, production, and protection. Our facilities include a C4-photosynthesis laboratory, DH and Genome editing laboratories, SNP array technology, a Biocontrol laboratory, a Rice quality laboratory, and fully-equipped food processing units, among other essential resources.

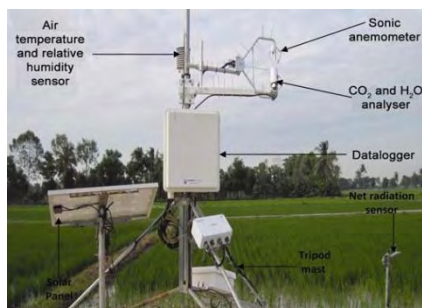


Transmission Electron Microscope

We possess a state-of-the-art Transmission Electron Microscopy facility with a resolving power of up to 0.2 nanometers. This instrument employs electron beams to magnify structures by a factor of up to 10 million, providing unprecedented insights into objects at the nanoscale.

NRRI Biofertilizer Unit

NRRI's Biofertilizer Unit boasts the capability to manufacture up to 50,000 liters annually. Our objective is to nurture and empower 20 aspiring entrepreneurs, supporting them in establishing businesses centered around biofertilizers.



Real-time Eddy Covariance for Measuring Greenhouse Gas Emissions

The cutting-edge Real-time eddy covariance system is installed to capture and quantify mass fluxes ($\text{CO}_2/\text{CH}_4/\text{water vapour}$) as well as energy fluxes (latent heat/net radiation/soil heat). This powerful tool enables us to effectively track and manage greenhouse gas emissions within the rice-cropping system, facilitating comprehensive inventory management.

DNA Sequencing Facility

ICAR-NRRI houses a state-of-the-art Sanger sequencing facility for determining nucleotide sequence of DNA (up to ~900 base pairs) with high accuracy. We extend our expertise and cutting-edge facilities with other institutes and agencies.



Speed Breeding for Accelerated Product Delivery

Global climate change has underscored the urgency of increasing genetic gain in crop breeding. This can be achieved by reducing the breeding cycle or generation time. NRRI leads in the domain of field speed breeding for accelerated product delivery. We have standardized field speed breeding protocols capable of reducing flowering time by 30-35 days. NRRI shares the speed breeding facility with collaborators.

Molecular Breeding Facility

NRRI's molecular breeding facilities excel in trait improvement in rice crops. The institute possesses expertise in DNA-based genetic manipulation, marker-assisted selection (MAS), and genomic-assisted selection. We are equipped with SNP-array system.

We have released nine MAS varieties: Lalat MAS, Tapaswini MAS, CR Dhan 800 (*xa5*, *xa13*, and *Xa21*), CR Dhan 801 (*Sub1*, *qDTY 2.1*, and *qDTY 3.1*), CR Dhan 802 (*Sub1*, *qDTY2.1+qDTY3.1*), CR Dhan 803 (*Sub1*), CR Dhan 806 (*Sub1*), CR Dhan 805 (*qBph4.3* and *qBph4.4*), and CR Dhan 807 (*AHAS*) for different sustainability traits.



Phenotyping Facilities

NRRI is equipped with outstanding phenotypic facilities dedicated to the assessment of rice responses to drought, salinity, submergence, and a wide range of rice diseases.

Ammonia Gradient Gas Analysing System (AMANDA)

NRRI's Ammonia Gradient Gas Analyzing System (AMANDA) employs the aerodynamic gradient method to measure ammonia flux. Featuring three strategically positioned denuders and a peristaltic pump, it efficiently traps ammonia in NaHSO₄ stripping solution for precise quantification in the detector.



Open Top Chambers

NRRI houses specialized facilities known as Open-Top Chambers (OTCs), designed to investigate the effects of elevated CO₂ and O₃ levels on plants and soil ecosystems.

C4-Rice Laboratory

NRRI scientists are working on the scientific grand challenge of engineering C₄ traits in rice to enhance photosynthesis and productivity. The C₄ laboratory is equipped with portable photosynthesis system and spectroradiometer.



Biocontrol Laboratory

NRRI's Biocontrol Laboratory addresses the diverse bioagent requirements for effective rice pest management, serving various stakeholders in the rice industry.

State-of-the-art Engineering Facilities Agricultural

NRRI's engineering facilities include a workshop for designing gender-friendly farm equipment, a rice processing unit for milling and value addition, and a post-harvest engineering laboratory for quantifying rice by-products.





Pesticide Residue Laboratory

NRRI's pesticide residue laboratory offers a wide range of capabilities, including the quantification of over 100 pesticides in rice grain, water, and soil. Additionally, it provides insights into pesticide uptake, partitioning, and degradation, as well as qualitative analyses of volatile metabolites, fatty acids, amino acids, 2-AP levels, and aroma profiles.

Insectarium

NRRI's Insectarium is a state-of-the-art facility utilized for the production of a vast array of live insects, including the yellow stem borer, leaf folder, and brown planthopper, available to researchers around the clock for various entomological studies. The Insectarium's controlled chambers facilitate studies on insect biology, life tables, and host-plant relationships. It also hosts beneficial insects that help control harmful and weedy insect populations.



Rainout Shelters and Climate Control Green Houses

We maintain three rainout shelters designed for experiments requiring protection from unexpected rain events, along with two climate-controlled greenhouses for genetic engineering and genome editing experiments.

Auditorium and Meeting Facilities

The MKCG Platinum Jubilee Auditorium at NRRI is equipped with 500 comfortable seats and two fully furnished meeting rooms. Furthermore, NRRI offers the K. Ramiah conference room, accommodating up to 150 attendees, a mini auditorium with space for 100 individuals, and an additional three meeting rooms.



NRRI Maintains Rich Biodiversity

Throughout the year, NRRI's fields thrive with rich biodiversity, showcasing the harmonious coexistence of various flora and fauna. Recent estimates indicate that the NRRI campus is home to 76 bird species and 18 different animal species.



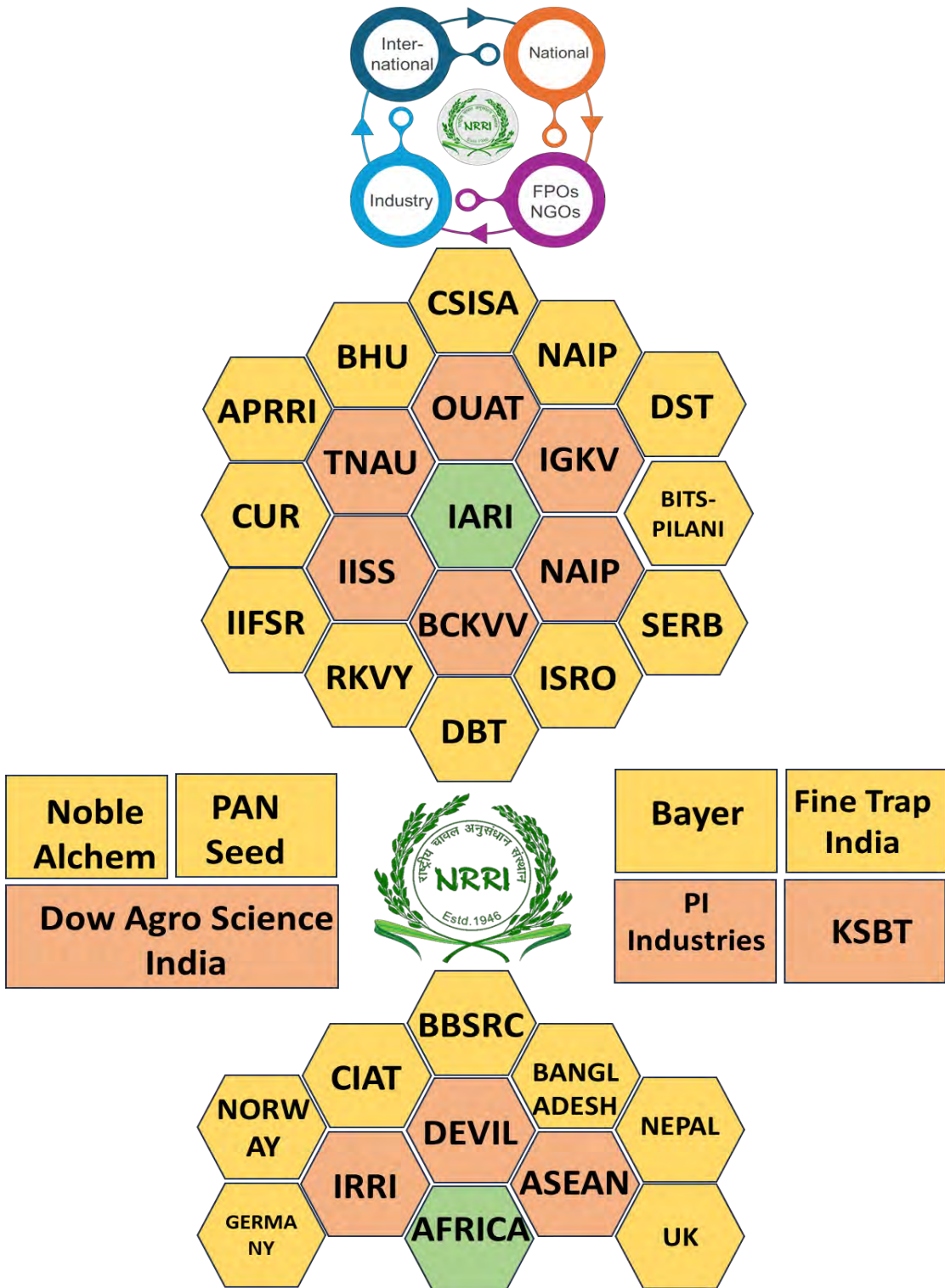
Wild Rice-In Situ Conservation (Mitsuaki Tanabe-MOMI-2000)



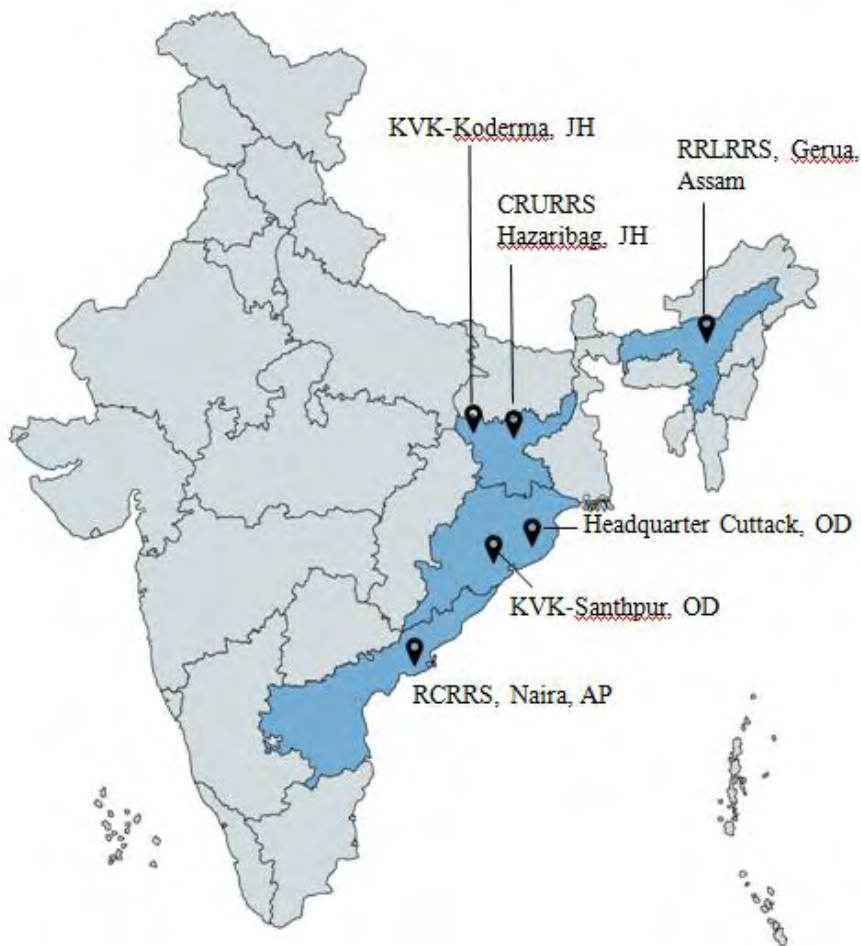
The sculpture, known as “**Momi**” symbolizes the sprouting seed of wild rice, weighs 4.5 tons, and was presented by Japanese sculptor Mr. Mitsuaki Tanabe to ICAR-National Rice Research Institute, Cuttack, to raise awareness about wild rice conservation. Similar sculptures have been installed in IRRI, Philippines, FAO, Rome, PTRRC, Thailand; NTMFA, Taichung, and ZPM, China.



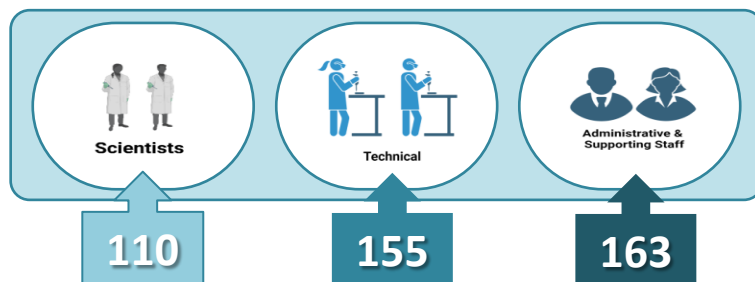
Strong National and International Linkages



Location of Regional Stations and KVKs



Workforce



Contact:

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Phone: 0671-2367757; Fax: 0671-2367663, Email: director.nrri@icar.gov.in

Visit us at: <https://www.icar-nrri.in>