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RESEARCH ARTICLE

ROLE OF NATIONAL RICE RESEARCH INSTITUTE (NRRI) IN AGRICULTURAL DEVELOPMENT

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ABSTRACT

Rice and wheat production hold paramount importance in India due to their critical role in ensuring the nation's food security, contributing significantly to the dietary needs and economic sustenance of its population. The rice-wheat cropping system (RWCS) is the predominant agricultural practice in South Asia, covering an extensive area in the Indo-Gangetic Plains, and is vital for producing over 70% of the country's total grain output, which is essential for meeting the food requirements of its vast population. This system not only supports the livelihoods of millions but also accounts for a substantial portion of India's GDP, emphasizing agriculture's central role in the economy. India's position as the second-largest producer of both rice and wheat globally underscores the significance of these crops in its agricultural landscape. Rice and wheat together form the backbone of India's food security system, contributing to a large extent of the total food grain production and ensuring a stable food supply for the nation. The cultivation of these crops is crucial for sustaining the livelihoods of a significant portion of the Indian population, with more than 50% relying on agriculture for their nutritional needs. Moreover, the RWCS is instrumental in addressing the challenges posed by a growing population and shrinking agricultural resources. The adoption of resource conservation technologies (RCTs) and precision farming within this system is aimed at enhancing productivity and sustainability, thereby securing food and environmental security for the future. The strategic importance of rice and wheat in India's agricultural exports further highlights their role in the nation's economy, making their production not just a matter of national security but also of economic advancement. In a nutshell, rice and wheat production is crucial in India due to its significant contribution to food security, economic stability, and the livelihoods of a vast majority of its population, while also playing a key role in addressing future challenges of food and environmental sustainability. In this background, for rice production in our country, an institution is carrying major responsibilities; the institute is Indian Rice Research Institute (NRRI). Gaining knowledge about what are the purposes, objectives, origin, location, goal, vision, mission, opportunities, thrust areas of research, salient achievements, various divisions under this institute, regional stations, KVKs, HRD activities, recent achievements, released varieties, agril. implements, and NRRI technologies ready for commercialization were the major aspire of this present study. Govt. should give more care and emphasis on several activities of this Institution and will assist to remove the challenges upto a great extent whatever the Institution is facing which will ultimately reflect of agricultural production which will secure country' food requirement.

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INTRODUCTION

The majority of India's poor (some 770 million people or about 70 percent) are found in rural areas. India's food security depends on producing cereal crops, as well as increasing its production of fruits, vegetables and milk to meet the demands of a growing population with rising incomes. Rice is one of the most cultivated grain crops in India as well as in Asian countries.

It is a staple food in India. India is the second largest producer of Rice next to China. This crop is grown mainly in tropical and rain fed areas. Rice is the most important food crop of India covering about one-fourth of the total cropped area and providing food to about half of the Indian population. In India rice is grown in 43.86 million ha, the production level is 104.80 million tones and the productivity is about 2390 kg/ha (Agricultural Statistics at a glance-2015).

It is grown under diverse soil and climatic conditions the productivity level of rice is low compared to the productivity levels of many countries in the world. Also about 90 % of the cultivated land belongs to Marginal, Small and Medium farmers which is another constrain in increasing the productivity of rice in the country. It is, therefore, there is ample scope to increase the productivity of rice in the country. The highest productivity is 6710 kg per ha of China followed by Vietnam (5573 kg /ha), Indonesia (5152 kg/ha), Bangladesh (4375 kg/ha) etc. There are improved technologies and various interventions which could be adapted to increase the productivity in the country. Cultivation of hybrid rice has potential to increase the productivity and needs to be promoted. There are many institutions in India those are the background stakeholders of country's rice production. The most important one is National Rice Research Institute (NRRI) which is working continuously, consistently, collaboratively and silently. To know the several efforts and role of this prestigious and renowned Institution is the main concern of this present study.

The National Rice Research Institute has been established since 1966 under Indian Council of Agricultural Research (ICAR) but it was setup on April 23, 1946 at Bidhyadharpur, Cuttack, Odisha with an experimental farm land of 60 hectares. India's National Rice Research Institute (NRRI) is an institution dedicated to improving the income and quality of life of rice farmers in the country. NRRI is part of the Indian Council of Agricultural Research (ICAR), which is governed by India's Ministry of Agriculture and Farmers Welfare. NRRI not only played a key role in ushering the country of an ear of green revolution heading to self-sufficiency in food grain supply in about 25 years from its inception, but also brought glory to the nation by providing research support in rice to become the second largest exporter of rice in the world in the recent years.

Purpose:- The purpose of the NRRI is to improve the income and quality of life of rice farmers in India as well as extending helping hand for national development. The scientists at NRRI have many research results to their credit in various disciplines of rice research, including: Biochemistry, Blue green algae, Entomology, Food technology, Plant breeding and genetics, Physiology, etc. The purpose of this article is to bring NRRI's efforts and activities on more limelight. The Institute is silently, continuously and consistently working for betterment of people of nation. The main intension of this study is to inform every unit of our Indian society to identify who is their real annadata (Rice provider) beyond farmers.

Origin:-The outbreak of devastating epiphytotic brown spot disease of rice (*Helminthosporium* spp) in the then Bengal province (the areas of which are now in the state of West Bengal and Bangladesh) in 1942 resulted in a serious shortage of rice. Added to this, the failure of civil administration to cope with such a disastrous situation culminated in what was called the Great Bengal Famine of 1943. With this background, the Central Government, in the year 1944, decided to intensify research on all aspects of rice crop. In the following year, the Government decided to establish a Central Institute for Rice Research and this led to establishment of the Central Rice Research Institute (CRRI) on April 23, 1946 at Bidyadharpur, Cuttack, Odisha with an experimental farm land of 60 hectares provided by the Government of Odisha. Dr. K Ramiah, an eminent rice breeder, was its founder Director. Subsequently, in 1966, the administrative control of the Institute was transferred to the Indian Council of Agricultural Research (ICAR). The Institute was renamed as ICAR-National Rice Research Institute (NRRI) in the year 2015. ICAR-NRRI is one of the institutes of ICAR under Crop Science Division. The Institute has three research stations, at Hazaribag, Jharkhand for carrying out rice research on rainfed upland ecologies; at Gerua, Assam for carrying out rice research on flood prone rainfed lowland ecologies; and at Naira, Andhra Pradesh for carrying out rice research on coastal saline ecologies. Two Krishi Vigyan Kendras (KVKs) also function under the administrative control of ICAR-NRRI. These are located at Santhapur, Cuttack, Odisha and Jainagar, Koderma, Jharkhand.

Location: The Institute is located at Cuttack in the state of Odisha (20.5°N, 86°E) and has an elevation of 23.5 m above mean sea level (MSL). The annual rainfall at Cuttack is about 1500 mm and is received mostly during June to October (**Kharif** or wet season). Minimal rainfall is received between November to May (**Rabi** or dry season) from south west monsoon. The Institute is located on the Cuttack-Paradeep State highway, about 35 Kms away from the Biju Patnaik Airport, Bhubaneswar and about 7 Kms from the Cuttack Railway Station. The National Rice Research Institute (NRRI) is located near Bidyadharpur village on the Cuttack-Paradip Road, Odisha. It is one of the premier national research institutes under the Indian Council of Agricultural Research (ICAR). The purpose of the NRRI is to improve the income and quality of life of rice farmers in India. The scientists at NRRI have many research results to their credit in various disciplines of rice research, including: Biochemistry, Blue green algae, Entomology, Food technology, Plant breeding and genetics, Physiology, etc.

Site:-The site occupies approximately 250 acres (1.0 km2). Many of the scientists are housed on the campus, which includes a co-operative store, co-operative dairy, and a CGHS dispensary. There is also a hostel and in-transit accommodation.

Organization:-The research institute is divided into various departments, each headed by a Departmental Head. After the implementation of the Gajendragadkar Commission report, working conditions (in terms of pay) improved greatly for the research scientists. Most of the scientists stay in houses in the campus.

Name change of NRRI: - Due to outbreak of devastating brown spot disease of rice in 1942 resulted in a serious shortage of rice and brought the Great Bengal Famine of 1943. With this background, the Central Government, in the year 1944 established a Central Institute for Rice Research and this led to establishment of the Central Rice Research Institute (CRRI) on April 23, 1946 at Bidyadharpur, Cuttack, Odisha. Subsequently, in 1966, the administrative control of the Institute was transferred to the Indian Council of Agricultural Research (ICAR). The Institute was renamed as ICAR-National Rice Research Institute (NRRI) in the year 2015. Before the name of NRRI, ICAR was attached because, it is under the control of ICAR and an effort to bring all ICAR institutes under an umbrella.

Photo

Goal: To ensure food and nutritional security of the present and future generations of the rice producers and consumers.

Vision: To ensure sustainable food and nutritional security and equitable prosperity of our Nation through rice science.

Mission: To develop and disseminate eco-friendly technologies to enhance productivity, profitability and sustainability of rice cultivation.

Mandate

- 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.
- Generation of appropriate technology through applied research for sustainable increase in productivity and income from rice and rice-based cropping/farming systems in all the ecosystems in view of decline in per capita availability of land.
- Collection, evaluation, conservation and exchange of rice germplasm and distribution of improved plant materials to different national and regional research centres.
- Development of technology for integrated pest disease and nutrient management for various farming situations.
- 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.
- 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.
- Impart training to rice research workers, trainers and subject matter/extension specialists on improved rice production and rice-based cropping and farming systems.
- Collect and maintain information on all aspects of rice and rice-based cropping and farming systems in the country.

OPPORTUNITIES:-The National Rice Research Institute (NRRI), Cuttack, Odisha offers opportunities for research and training to students at Post-graduate (PG) level. The research and trainings are coordinated by the Human Resource Development (HRD) Cell of the Institute as per guidelines, which are in full conformity with that of the ICAR and are uniform across entire ICAR system. The students registered in M.Sc./M.Tech. or equivalent degree programs of State Agricultural Universities (SAUs) and the UGC recognized Universities/Deemed Universities/ Organizations recognized by Technical Education Councils /equivalent recognized organizations offering PG courses are eligible for the research and training. Selection of students is based on academic merit. NRRI offers HRD research and training provides opportunities in the disciplines of Agricultural Chemistry, Agricultural Chemicals, Agricultural Economics Agricultural Engineering, Agricultural Statistics, Agricultural Extension, Agronomy, Biochemistry, Biotechnology, Bioinformatics, Botany, Economic Botany, Entomology, Environmental Sciences, Fisheries, Food technology, Genetics, Genomics, Microbiology, Life Sciences, Molecular Breeding, Nematology, Plant Breeding, Plant Pathology, Plant Physiology, Seed Technology, Soil Microbiology, Soil Science, Zoology; and related disciplines covering various aspects of rice research. The Institute can include other disciplines, if deemed appropriate. M.Sc. dissertation: The students registered for M.Sc. /M.Tech. or equivalent degree in recognized educational organizations are allowed to undertake research in two sessions i.e., during July-December (Session I) and January-June (Session II) every year, for which the applications are accepted during January to March and July to September, respectively as per the notification at NRRI official website. Training: The students registered for M.Sc. /M.Tech. or equivalent degree in recognized educational organizations are allowed to undertake training for one month to 6 months duration.

THRUST AREAS OF RESEARCH

- To breed resilient high yielding rice varieties suitable for drought-prone rainfed uplands
- To strategize management options for sustainable rice production under direct seeded rainfed ecology
- To evolve rice based farming systems for drought prone rainfed ecology
- To develop biotic stress management strategies for rainfed upland rice
- Strengthening the breeding strategy to evolve suitable *Sali* varieties with tolerant to flood.

- Development of short duration varieties with blast resistance and cold tolerance for *Boro* season.
- Evolution of HYV as pre-flood *Ahu* and post-flood *Sali* situations.
- Development of flood resistant rice varieties for lowland, semi-deep and deep water conditions.
- Development of appropriate integrated insect pest and disease management strategies.
- Development of strategies to avoid crop submergence through suitable cultural practices for both intermediate and semi-deep conditions.

SALIENT ACHIEVEMENTS

- Variety developed:
- For favorable uplands:Vandana, Anjali, CR Dhan 40, Purna& CR Dhan 103
- For unfavorable uplands:Sadabahar, Sahbhagidhan&GangavatiAgeti
- For drought-prone shallow lowlands: Hazaridhan, Abhishek & IR 64-Drt1
- Improved drought tolerance through Marker-assisted backcross breedingof rice varieties:
- For upland: Anjali & Vandana
- For medium land: IR64Sub1
- Standardized direct seeding technology for unfavorable and favorable uplands
- Seed invigoration techniques giving a head start to rice over weeds
- Early post emergence herbicides for weed control
- Blast resistance in two HYVs improved through introgression of major R genes. (Pi2 into Vandana and Pi9into BPT 5204).
- HPR/chemicals/cultural practices to manage blast, brown spot and false smut
- IPM strategy for upland rice
- Incubation methods for phosphetic fertilizers to improve P efficiency
- Utilization of beneficial soil microflora to enhance P uptake with special reference to ArbuscularMycorhiza Fungi (AMF)
- Combinations of inter – and sequence crops for different moisture regimes
- Released rice variety 'Chandrama' as *Boro* and *Sali* for Assam.
- Released aromatic high yielding rice variety 'CR Dhan 909' as *Sali* crop for Assam, Bihar, Maharashtra and UP for irrigated and rainfed lowland ecology.
- Rice breeding materials viz., deep water rice lines, breeding materials for *Boro* seoason on pipeline.
- Rice varieties 'Naveen' have been identified suitable as pre-flood *Ahu* crop and 'Abhishek' as post-flood *Sali* rice crop.
- Continual maintenance of over 830 Eastern Indian rice germplasm.
- Integrated rice-fish-horti farming system producing 18.1 t/ha of REY (rice equivalent yield) per annum with employment generation of 412 man days ha^{-1} have been developed.
- Optimum time of sowing of seeds for *Boro* rice has been ascertained.
- Rice-rapeseed system was identified to provide higher net return, production efficiency and B:C ratio as compared to rice-lentil or rice-linseed systems.
- Geographical distribution of rice *tungro* disease has been mapped in parts of Assam and Tripura. Survey revealed that leaf blast/neck blast is the major disease in Boro and Ahu while BLB, Sheath blight, sheath rot and blast occur predominantly during Sali season and management practices evolved and recommended.
- Use of pheromone traps @ 20/ha recorded the lowest incidence of dead heart (3.45%) and white ear head (2.01%).
- Late transplanting of winter paddy in first fortnight of September recorded the highest incidence of rice stem borer and leaf folder.

VARIOUS DIVISIONS UNDER NRRI

Crop Improvement Division:-The Crop Improvement Division is engaged in basic, strategic and applied research for genetic improvement of rice besides knowledge generation on relevant aspects. Scientists from the disciplines of Economic Botany & Plant Genetic Resources, Genetics & Plant Breeding and Agricultural Biotechnology are involved in multidisciplinary research in collaboration with scientists from other Divisions of the institute. Besides the in-house research projects, the researchers of the Division are also involved in various national and international collaborative external funded research projects. The division undertakes research on varietal improvement through various means along with research on taxonomy, plant genetic resources, classical genetics, cytogenetics, mutagenesis, in-vitro culture, bioinformatics, genomics etc. of rice. Molecular marker assisted breeding has now become an integral part of crop Improvement programme of the division. Eleven different research projects under the programme "Genetic improvement of rice for enhancing yield, quality and climate resilience" are undertaken by the Division. Till date, 125 pureline varieties and 03 hybrids have been released (out of which 80 were released by Central Variety Release Committee and 48 by different State Variety Release Committees) for different rice ecologies of India. Nucleus and breeder seed of the released varieties are produced for all the released varieties as per the indent received from the Department of Agriculture and Cooperation, Government of India.

Crop Production Division:-The Crop Production Divisionis engaged primarily in applied, strategic and basic research on effective and eco-friendly utilization of natural resources like soil, water, nutrient, labour, etc. Division also focuses on managing abiotic and biotic stresses for sustainability, productivity and profitability of rice production system. Divisional scientists from various disciplines such as Agronomy, Soil Science, Microbiology and Agricultural Engineering are involved in interdisciplinary research, training and extension activities in collaboration with scientists of otherdivisions of the institute and other organisations as well. Division is also involved in various national and international collaborative externally funded research and developmental projects. The division undertakes research on enhancing resource use efficiency with special emphasis on water and nutrients, resource conservation technology on rice and rice based systems,weed management, exploration of microbial technology for enhancement of

production and productivity in rice and rice based systems. The division is also involved in designing, developing and evaluating rice based farming system for enhancing profitability and ensuring livelihood support. Design and development of farm machinery for small farmers, value addition and post-harvest technology,etc. is also a major area of research. Climate resilient agricultural technologies, greenhouse gas emission-mitigation and ecosystem service estimation have now become an integral part of research programme of the division. Till date more than 40 crop production technologies and more than 25 farm machineries for different ecologies have been developed and validated by the division.

Crop Protection Division:-The Crop Protection Division is conducting applied, strategic and basic research on integrated management of rice pest to improve productivity, quality and profitability from rice cultivation. Scientists from the disciplines of Entomology, Pathology, Nematology and Agricultural Chemicals are involved in multidisciplinary research in collaboration with scientists from other divisions of the institute to generate basic and advance knowledge on relevant aspects. Besides in-house research projects, the researchers of the division are also involved in various national and international funded research projects. The division is engaged in different aspects of rice protection sciences, e.g. exploration of new sources of resistance for insect pest and diseases of rice, bio-ecology of rice insect pest and diseases for climate smart protection strategies; bio-intensive approaches for pest management in rice and optimization of chemical pesticide-use for management of rice pest in different ecosystems. Major thrust has been given on multiple pest resistance genotypes, pest modelling and forecasting, tri- trophic interaction of rice, pest and predators/parasites under climate change, novel molecules and formulations for eco-friendly pest management and stored grain pest management. The work on host plant resistance and its mechanism, bio-ecology and epidemiology of rice pest, integrated pest management has been recognized worldwide. The division is also involved in designing, validating and popularizing pest and ecology based IPM modules for the farmers to ensure profitability.

Crop Physiology and Biochemistry:-The Division of Crop Physiology and Biochemistry consists of Biochemistry and Physiology disciplines. It has identified several rice germplasm with higher protein and micronutrient content in the past and contributed to development of high protein and high zinc rice varieties from NRRI. Several germplasm with tolerance to drought, submergence, salinity, high temperature, low light and those with multiple abiotic stress tolerance have been identified and evaluated, some of which are already in use for developing abiotic stress tolerant varieties. The research program of the Division is aimed at identifying and developing rice varieties with desirable grain and nutritional quality traits, tolerance to various abiotic stresses and improving photosynthetic efficiency of rice keeping in view the changing climate scenario with emphasis on the following:

- Evaluating the rice germplasm for physico-chemical grain quality traits, protein and micronutrient content and their bioavailability, specialty rices including low glycemic index rice, aromatic rice and pigmented rice, *and* value addition
- Identifying rice germplasm with single/multiple abiotic stress (submergence, salinity, drought, low light, high temperature tolerance with specific traits and improving the photosynthetic efficiency of rice through traditional and biotechnological approaches involving introduction of C4 traits from other crop plants and glycolate metabolism genes from *E. coli.*

Social Science Division: The division of social sciences comprising of scientists from the field of Agricultural Extension, Agricultural Economics and Agricultural statistics under takes broadly the socio-economic research pertaining to rice development. Characterization of resources, socio-economic and institutional constraint analysis, creation and maintenance of database are the major research activities. Besides, the division is engaged in capacity building of stakeholders, dissemination of rice production technologies through publications, advisory services, exhibition, workshop, interface, special days etc. Findings emanating from the various research projects have been used in developing policies, programmes, models and approaches for sustainable rice production.

REGIONAL STATIONS

ICAR-NRRI-Central Rainfed Upland Rice Research Station (CRURRS)Hazaribag, Jharkhand:-Central Rainfed Upland Rice Research Station (CRURRS) was established in Hazaribag of Jharkhand state in 1980 with specific mandate of catering to the need of improved technology for enhancing rice based agricultural productivity of rainfed uplands which covers about 13.5% rice growing area of India. Rainfed uplands are mostly located in the eastern parts of the country covering the states of Bihar, Jharkhand, Odisha, West Bengal, Assam, parts of Madhya Pradesh and Uttar Pradesh. Rainfed uplands in India are characterized by aerobic to semi aerobic soils conditions, absence of surface water accumulation, dependence on monsoon having erratic distribution, plain to slopping topography. These characters make the target ecology very much prone to unpredictable drought situations at various crop growth phases and a few biotic stresses, of which some of them are accentuated under drought stress.

ICAR-NRRI-Regional Rainfed Lowland Rice Research Station (RRLRRS) Gerua, Assam:-Rice contributes 95% of the total food grain production in the state of Assam and cultivated in three main seasons, viz. Ahu (February-March to June-July), Sali (June-July to November-December) and Boro (November-December to April-May). Of these three seasons, Sali occupies more area, which is flood prone. More than 23 districts suffers from flood chronically, which affects the productivity of rice severely and shrink total production of the state. In order to develop suitable high yielding varieties and production technology, specially for flood prone lowlands of Assam, the state government had requested the Indian Council of Agricultural Research (ICAR), New Delhi to consider establishing a sub-station of National Rice Research Institute (NRRI) in Assam to assist the state's efforts on rice research, as NRRI plays a pivotal role in rice research of the country. This issue was considered by the ICAR and a Regional Rain-fed Lowland Rice Research Station (RRLRRS) as a sub-station under ICAR-NRRI was established on September 15, 1997 at the site of Field Trial

Station of Department of Agriculture (12.5 ha) located in Gerua in the Hajo circle of the Kamrup district of Assam.

ICAR-NRRI-Regional Coastal Rice Research Station (RCRRS)

Naira, Srikakulam, Andhra Pradesh: ICAR-National Rice Research Institute, Cuttack has initiated steps to establish its Regional Station (Coastal Regional Rice Research Station) in the campus of one of its constituent College of Agriculture (Acharya NG Ranga Agricultural University (ANGRAU), Naira in Srikakulam district of Andhra Pradesh, to cater to the needs of the rice growers of coastal regions based on the approval of XII Plan EFC.This will be the third regional station of ICAR-NRRI. Looking to the research in the fragile coastal ecology with high frequency of flood and drought, the Regional Station in Naira (AP) will focus on the rice research for rainfed coastal ecosystem.

KRISHI VIGYAN KENDRA (KVK), SANTHAPUR:- The Krishi Vigyan Kendra Cuttack was established at Santhapur Farm as per the sanction of ICAR vide letter No. 3-2/92 , dt. 26.5.1992 and is officially functioning from 14th Nov 1992. The KVK Cuttack, Santhapur is functioning under ICAR-National Rice Research Institute, Cuttack with the financial assistance from ICAR, Govt. of India since 1992 with a view to propagate latest technology in the agrarian sector among the farmers of the district to improve the socio-economic status.

KRISHI VIGYAN KENDRA (KVK), JAINAGAR :- For improving livelihood of the farmers' their knowledge and skill development on improved agricultural technologies is most important which is imparted through trainings by KVKs. KVK, Koderma was established by Indian Council of Agricultural Research (ICAR) in the year 2005 under the administrative control of ICAR - National Rice Research Institute (Cuttack) to cater to such needs with the broad objective of intensifying transfer of technology to the practicing farmers, farm women, rural youths and extension functionaries. The government of Jharkhand allotted 25 acres of land to the ICAR in Jainagar block of Koderma district for establishing this KVK.

HUMAN RESOURCE DEVELOPMENT (HRD)

GUIDELINES FOR HUMAN RESOURCE DEVELOPMENT (HRD) PROGRAMME: The National Rice Research Institute (NRRI), Cuttack, Odisha offers opportunities for research and training to students at post-graduate (PG) level. The research and trainings are coordinated by the Human Resource Development (HRD)Cell of the Instituteas per guidelines, which are in full conformity with that of the ICAR and are uniform across entire ICAR-Agriculture University (AU) System and applicable only to those institutions where a Memorandum of Understanding (MOU) exists between ICAR Research Institutes and the University/Deemed to be University (DU) seeking collaboration. Such Universities/ DU may be within National Agricultural Research System (NARS) which includes Agriculture Universities (AU) and DU of ICAR or outside NARS (Central/ State Govt./ Public Sector funded institutions/ State Universities/ PSU/ Autonomous bodies/ Statutory Corporations/ Private Universities or Institutions). ICAR research Institutes are expected to ensure that the MOU promotes the major function of the Institute/laboratories.

Human Resource Development Cell:-The work related to human resource development at NRRI is administered by a HRD Cell. There is a Human Resource Development Committee consisting of all Heads of Divisions as members, one of them being nominated as Chairman by the Director, and an HRD Coordinator (a scientist of the Institute nominated by the Director), who acts as Member Secretary of the Committee. The term of the Coordinator is for three years, which may be extended by the competent authority.

Objectives of HRD program at NRRI:-The objective of HRD programme is to develop a new generation of rice researchers for India and abroad. The program provides an excellent opportunity for students to work in the emerging areas of rice research in their post graduate and doctoral programme, guided by leading rice scientists. Researchers have the liberty to use the data generated during the work done by them for submission of Masters/Doctoral thesis to a recognized University as per terms and condition laid down in this document.

Disciplines for HRD:-NRRI offers HRD research and training provides opportunities in the disciplines of Agricultural Chemistry, Agricultural Chemicals, Agricultural Economics Agricultural Engineering, Agricultural Statistics, Agricultural Extension, Agronomy, Biochemistry, Biotechnology, Bioinformatics, Botany, Economic Botany, Entomology, Environmental Sciences, Fisheries, Food technology, Genetics, Genomics, Microbiology, Life Sciences, Molecular Breeding, Nematology, Plant Breeding, Plant Pathology, Plant Physiology, Seed Technology, Soil Microbiology, Soil Science, Zoology; and related disciplines covering various aspects of rice research. The Institute can include other disciplines, if deemed appropriate.

Application for HRD training:-The candidates fulfilling the terms and conditions may apply to the Director, NRRI, Cuttack – 753 006, Odisha as per the notification on the NRRI website with complete bio-data indicating discipline, subject preference and copies of the relevant documents i.e., certificates of date of birth, high school, 10+2, graduation and post-graduation degrees. The candidates applying for M.Sc./M.Tech./equivalent degree will pay an amount of Rs.500/- as application fee.

RECENT ACHIEVEMENTS OF ICAR-NRRI, CUTTACK

- A high protein rice variety, CR Dhan 310 was developed through introgression of high protein content in a popular high yielding variety 'Naveen' and released by CVRC as the first high protein rice variety in the country with an average grain yield of 4.5 t/ha and protein content of 10.2%. The variety is suitable for irrigated ecosystem in both wet and dry season. High protein lines in 'Swarna (MTU 7029)' background have also been developed and are being evaluated.
- CR Dhan-701 (CRHR-32) was the first long duration hybrid developed in this Institute to be released in the country that has got potential to replace the popular varieties like Swarna, Savitri and Pooja with maturity duration of 142 days. The hybrid performed well in

Odisha, Bihar, Gujarat and Tamil Nadu with grain yield of 6.5 t/ha in wet and 7.5 t/ha in dry season. The variety is suitable for shallow lowland condition and having tolerance to stagnant water (30 cm) for 10-15 days at tillering stage, moderately resistance to RTD, Sheath blight and GLH. It has medium slender translucent grains with good HRR, intermediate amylose content (25.61%) and good cooking/eating quality.

- Cultivation of rice as direct seeded crop in a non-puddled soil with suitable varieties and supplemental irrigation releases very less green-house gas from aerobic situation and water consumption can be reduced by more than one third of irrigated rice field. Aerobic rice varieties i.e. CR Dhan 200 (Pyari), CR Dhan 201, CR Dhan 202, CR Dhan 203 (Sachala), CR Dhan 205 and CR Dhan 206 (Gopinath) developed in this institute with maturity duration of 110-115 days.
- Albinoshoot regeneration was the most annoying problem encountered in case of indica rice at the time of androgenesis. To tackle the problem, a protocol has been standardized for high frequency of green shoot regeneration free from albinos and a patent has been filed (Application No. 1355/KOL2015).
- A urea briquette applicator mounted on conoweeder developed to apply urea briquettes simultaneously with weeding operation. It consists of two cones, one float, one briquette hopper, briquette delivery control system and one handle fitted in the frame. The working of applicator is similar to conoweeder in which the operator has to push the weeder and at same time at some interval push the clutch fitted on the handle to place one or two urea briquettes at a time.
- A power operated single row dry land weeder capable of inter row weeding in paddy crop was developed by ICAR-NRRI, Cuttack. The weeder consisted of engine, blades assembly (L shape blades) and transmission system. The rotating blades cut the weeds and also give forward motion to machine. At the forward speed of 1.28 km/h the field capacity of the weeder is 0.025 ha/h with weeding efficiency of 62.5%. The weeder eliminates the drudgery involved in weeding operation with reduced cost of operation.
- A five panel customized leaf colour chart (CLCC) for nitrogen (N) management in rice for different ecologies is developed by ICAR-NRRI on the basis of spectral evaluation of leaves of hundreds of high yielding varieties (HYVs) and local cultivars grown in eastern India under different levels of N applications.It is a cheap and easy to use handy tool provided with a folder having N application schedule. By using this, farmers can adjust the N application to actual crop demand, achieve higher yields and increase nitrogen use efficiency. The instructions of CLCC are available in English, Hindi and Odia in simple language which can be easily followed by the farmers. CLCC is commercialized and is being manufactured by a Chennai based Company at the rate of Rs. 110 per CLCC.

RELEASED VARIETIES:-High Yielding Rice Varieties and Hybrids were developed at NRRI. Rice is grown under varying eco-systems on a range of soils under varying climatic and hydrological conditions ranging from waterlogged and poorly drained to well drained situations. Rice is also grown in different ecologies from irrigated to upland, rain-fed lowland, deep water and very deep or tidal wetland ecologies. Upland rice is grown in around 6.0 million ha of well-drained soil where the moisture stress and blast are the major constraints and productivity is around 1t/ha. Mostly early maturing varieties of 80 to 110 days duration are grown, depending upon the rainfall pattern and soil topography. Rainfed lowland rice is grown in around 13.0 million ha, mostly in eastern India, where soil moisture is available for longer period and rice varieties of 140-145 days duration to photosensitive types harvested from mid-November to mid-December are grown. The water depth varies in rain-fed lowlands and it can be shallow up to 25cm, and medium deep waterlogged up to 50cm. Deep water rice is grown in areas where water depth is more than 50cm up to 2 meter and around 4 million has area is under cultivation in Eastern India with an average productivity of 0.8 t/ha. Most of the deep water rice area is now being under boro and dry season rice due to low productivity of deep water rice. Rice is also grown in Coastal wetlands where tidal water fluctuates as per Moon cycle and period of day. Soil salinity is a problem in areas near the creeks in wet season and in dry season rice. In India more than 1200 varieties were released for cultivation suitable different ecosystems and out of them 128 varieties (23 Upland, 9 Aerobic, 45 Irrigated, 2 Boro, 23 Shallow lowland, 14 Semi deep water, 6 Deep water, 6 Coastal saline) have been contributed from NRRI, Cuttack. The varieties released by Central Varietal Release Committee (CVRC) have wider adaptability as they are recommended for more than one state.

Inbred High Yielding Varieties:

- Pooja (CR-629- 256)
- Naveen (CR 749-20- 2)
- Varshadhan (CRLC 899)
- Swarna Sub-1 (CR 2539-1)

Popular and recent NRRI Rice Varieties for Different Ecologies

Upland Ecology

Vandana (RR 167-982):
Kamesh (CR Dhan 40)
Shabhagidhan (IR 74371-70-1-1-CRR-1):
Satyabhama (CR 2340-11):

Aerobic rice

Pyari (CR Dhan 200)
CR Dhan 201(CR2721-81-3-IR83380-B-B-124-1):
CR Dhan 202 (CR2715-13-IR84899-B-154):

Irrigated ecology

Satabdi (CR 146-7027-224):
Naveen (CR 749-20-2):
Rajalaxmi (CRHR-5):
Ajay (CRHR-7):
Satyakrishna (CR AC 2221-43):
Phalguni (CR Dhan 801):
Improved Lalat (CRMAS 2621-7-1)
Improved Tapaswini (CRMAS 2622-7-6):

Boro/ dry season rice: Chandan (CR - 898):

Shallow lowland ecology

Pooja (CR-629-256):
Swarna Sub-1 (CR AC 2539-1):
Reeta (CR AC 780-1937-1-3):
CR Dhan 300 (CR 2301-5):
CR Dhan 701 (CRHR 32):

Semi Deep/ Water Logged Ecosystem

Sarala (CR 260-77)
Durga (CR 683-123):
Gayatri (CR 210-1018)
Varshadhan (CRLC 899):
CR Dhan 500 (CR 2285-6-6-31):
Jayantidhan (CR Dhan 503):

Coastal Saline Ecosystem

Luna Suvarna (CR LC2096-71-2):
Luna Sampad (CR LC2095-181-1)
Luna Barial (58CR 2092-1-3):
Luna Shankhi (CR 2577-1):

Aromatic Rice

Nua Kalajeera
Nua Dhusara:
Nua Chinikamini:
Purnabhog (CRM 2203-4)
CR Sugandh Dhan 907 (CR 2616-3-3-31):

AGRIL IMPLEMENTS

- Customized Leaf Color Chart (CLCC) for real time Nitrogen (N) management in rice
- Two Row Urea Briquette Applicator
- Three Row Urea Briquette Applicator
- Four Row Urea Briquette Applicator
- Conoweeder with Urea Briquette Applicator
- Simple combo- kit for rapid screening of plant growth promoting bacteria
- Nitrogen fixing liquid bacterial inoculants for rice
- Manual three row seed drill
- NRRI Power tiller operated seed drill for rice and Groundnut
- NRRI Power tiller operated seed drill for rice and pulse
- NRRI four row manual drum seeder (hyperboloid shape)
- NRRI six row manual drum seeder (cylindrical shape)
- NRRI four row manual rice transplanter
- NRRI manual finger weeder
- NRRI manual star cono weeder
- NRRI portable power operated paddy thresher
- NRRI manual rice winnower
- NRRI power rice winnower cum cleaner
- Mini paddy parboiling unit
- Rice husk and Chaff stove

ICAR – NRRI Technologies Ready for Commercialization

- Nanoemulsion of eucalyptus oil: an alternative to synthetic pesticides against storage pests
- Indigenous green silver nano-particles
- Indigenous biobed technology to limit point source pollution
- NRRI Trichocard (T. j) Species: Trichogramma japonicum
- NRRI Trichocard (T. c) Species: Trichogramma chilonis
- NRRI Braconcard (B. h) Species: Bracon hebetor
- Hybrid Rice Ajay (CRHR-7)
- Hybrid Rice Rajalaxmi (CRHR-5)
- Hybrid rice CR Dhan 701 (CRHR-32)
- Rice doubled haploid technology (Satyakrishna)
- High Protein Rice (CR Dhan 310)

CONCLUSION

Agriculture is the base of our country's economy, culture, life, livelihood, industry, planning, development and overall our identity. In a nutshell, agriculture is the soul of Indians and best way known as agriculture is the every culture here. As a seventh largest country in the world, India has vast agricultural land for world's largest populous country (142.86 crores according to 2023 estimation). Gradually shrinking agricultural land and continuously increasing population has thrown a big challenge to agricultural system. Food is the primary need or mother need of human being. In this respect to remove the gap between demand of food and supply or production of food is the main concern of our national government. If any disaster happens in agriculture, Indians will be insecure in availability of food. The outbreak of devastating brown spot disease of rice in the then Bengal province in 1942 resulted in a serious shortage of rice. Added to this, the failure of civil administration to cope with such a disastrous situation culminated in what was called the Great Bengal Famine of 1943. With this background, the Central Government, in the year 1944, decided to intensify research on all aspects of rice crop.

In the following year, the Government decided to establish a Central Institute for Rice Research and this led to establishment of the Central Rice Research Institute (CRRI) on April 23, 1946 at Bidyadharpur, Cuttack, Odisha with an experimental farm land of 60 hectares provided by the Government of Odisha. Dr. K Ramiah, an eminent rice breeder, was its founder Director. Subsequently, in 1966, the administrative control of the Institute was transferred to the Indian Council of Agricultural Research (ICAR). The Institute was renamed as ICAR-National Rice Research Institute (NRRI) in the year 2015. There are several factors responsible for rice production enhancement i.e. High Yielding Varieties Programme (HYVP), green revolution, bringing more areas under rice cultivation, farm mechanization, hybrid rice production , irrigation water availability, sufficient rainfall, proper fertilization, development of definite package of practice, set up NRRI, IPM, IWM, INM, etc. Out of these, role of NRRI is the pivotal or mother cause of India's rice production. Role of NRRI is no doubted praiseworthy, significant, remarkable and memorable. Considering the importance of NRRI in Indian agriculture, govt. should encourage and assist more to this institution for its' smooth functioning. Extension agencies as well as NRRI itself must quick disseminate the outcome technologies from this institution to its ultimate users, so the function of NRRI will be up-to-date and synchronize.

In present days, NRRI will give more emphasis on the following activities, so these institute's acceptability and familiarity will echo to every corner of our country. The main more emphasis things are ;-(1) Development of short duration varieties (2) Development of photo insensitive varieties (3) Development of vitamin and mineral rich rice varieties (4) Low water requiring rice varieties (5) Development of rice varieties which are most suitable for rainy season (6) Development of insect-pest resistant varieties (7) Development of post harvest insect-pest resistant varieties (8) Development of hybrid rice and promotion of hybrid varieties through proper extension work (9) Development of less weight and low cost agricultural implements (10) Emphasis more on development of rice based integrated farming system (11) Make NRRI, one of best reserve banks of rice germplasm in the world (12) Development proper training environment and train the respondents or participants properly etc. Aboveall, announcement of generated technologies of NRRI or facilities of NRRI through radio, television, internet, print media as quick as possible and in such a way that every common educated man, farmer or rice grower will know NRRI's present position confirmly and when knowledge is confirm, adoption automatically starts because knowledge is the precursor of adoption. The first Prime Minister of India rightly pointed out that, "Everything can wait but not agriculture."

REFERENCES

1.www.nrri.com

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