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A New Era Begins: Tracing the Path from NARI to NAREI

Ayushi Jogi[1]& Jagriti Bhandari[2]

[1]Department of Fisheries Extension, Economics and Statistics, College of Fisheries Science, CCS Haryana Agricultural University, Hisar (125004), Haryana, India.

[2]Department of Extension Education and Communication Management, CCS Haryana Agricultural University, Hisar (125004), Haryana, India.

1. Introduction: Why NARI Needed to Evolve

Changing agricultural challenges and the need for integrated solutions

In the 20th century the conventional National Agricultural Research Institute (NARI) model was developed to address specific problems with crop yields, pest management and local research requirements. But in the post-2020 period agriculture is confronted with even more intricate interrelated challenges such as climate change depleting natural resources, disjointed information systems and growing need for resilient sustainable food systems that go beyond isolated technology solutions. The water-energy-food nexus that is essential to long-term sustainability and climate resilience in agriculture is difficult to address by traditional research organizations which are frequently divided by discipline and industry according to recent studies.

Furthermore, the growing acceptance of integrated farming systems, which combine livestock, crops, natural resource management and socioeconomic results highlights the drawbacks of limited crop-centric methods. Research on sustainable agriculture shows that integrated system models can improve production and resilience while reducing environmental hazards but they need for cross-sectoral research frameworks that are absent from most NARI mandates.

Global agricultural research assessments emphasize the importance of multidisciplinary, systems-oriented innovation pipelines that connect research, extension, education and technology to address 21st-century concerns including food security and climate adaption. Thus, the transition from NARI to a more comprehensive National Agricultural Research,

Education and Extension Infrastructure (NAREI) was critical in developing capacity for integrated solutions that encompass research, stakeholders and long-term outcomes.

2. Understanding NARI: The Foundation of Agricultural Research

Role of National Agricultural Research Institutes in strengthening farm productivity

The foundation of scientific innovation in agriculture has traditionally been National Agricultural Research Institutes (NARIs) which propel research that improves crop performance, maximizes inputs and fortifies the connection between science and field practice. Fundamentally, these institutes do strategic and adaptive research to create high-yielding cultivars and context-specific management techniques, which directly boost agricultural output in a variety of agro-ecological zones. This responsibility is shown by the Indian Council of Agricultural Research (ICAR) and its network of institutes which have developed technologies that have continuously increased main crop production efficiency and resource utilization.

In addition to improving varieties NARIs are essential for knowledge extension and dissemination. They frequently collaborate with agricultural science centers like Krishi Vigyan Kendras to convert research findings into practical methods at the local level, increasing yields and farmers' earnings.

The increasing relationship between research and productivity is highlighted by recent frameworks like the AgriFact framework, which show how agricultural research institutes may incorporate data-driven insights and farmer information needs to better estimate and optimize crop yield across areas. (Godara *at el*., 2025)

Additionally, institutes have made contributions to integrated farming and extension practices that enhance resilience and sustainability directly connecting institutional research with increases in agricultural productivity in the face of climate change.

3. The Shift to NAREI: Broadening the Research Horizon

From agriculture alone to agriculture environment innovation integration

A growing understanding that agricultural research must go beyond crop productivity alone and incorporate environmental sustainability and innovation systems at its core is reflected in the transition from a traditional National Agricultural Research Institute (NARI) framework to a more expansive National Agricultural Research, Education and Extension Infrastructure (NAREI). In line with global sustainability and climate goals modern agricultural research paradigms increasingly view agricultural systems as complex socio-ecological systems where stakeholder collaboration, technology adoption and environmental health are essential components of sustainable development.

This change is prompted by growing evidence that integrated approaches which combine ecological stewardship with cutting-edge innovations like digitalization, precision agriculture, and green technologies, outperform siloed research models in terms of productivity, resilience and environmental outcomes. Research emphasizes the necessity of agricultural innovation systems that connect academic institutions, farmers, business sector players and legislators to jointly develop solutions to address issues related to food security, resource scarcity and climate change.

Additionally, research indicates that integrating digital and smart technologies (such as IoT, AI and precision farming) with environmental indicators greatly improves ecological resilience and resource usage efficiency while preserving productivity.

NAREI represents a comprehensive paradigm that is crucial for tackling the agricultural and environmental issues of the twenty-first century by extending the study horizon to incorporate agriculture–environment–innovation integration. (Vyas & Singh, 2025).

4. What NAREI Means for Farmers and the Future

Climate resilience, sustainability and technology-driven research

Agricultural research under the NAREI paradigm goes beyond productivity to include climate resilience, sustainability and technology-driven solutions that directly help farmers. Climate-smart agricultural innovations protect livelihoods and food security by strengthening farmers'

ability to handle climate shocks like droughts, floods and unpredictable weather. According to research, implementing climate-smart techniques increases resilience, increases yields and lowers greenhouse gas emissions, making agriculture environmentally sustainable and productive.

Modern farming tools, IoT sensors and AI-powered predictive analytics are examples of cutting-edge technology that are being incorporated more and more into agricultural systems to assist farmers make real-time decisions about input use, irrigation and pest control while maximizing resources and lowering risk. (Roy *at el.,* (2025).

Farm-level adoption of better varieties, moisture conservation and diverse cropping improves adaptive ability and advances several Sustainable Development Goals as demonstrated by climate-resilient technologies implemented through programs like NICRA. (Naikat *at el.,* (2025). Farm income and long-term resilience are further supported by holistic approaches that integrate sustainability and circular economy principles. These approaches emphasize the need of extension services, training and supportive policies in bringing these innovations to the grassroots.

5. Conclusion: NAREI as a Pathway to Sustainable and Inclusive Growth

Building a resilient agricultural ecosystem for the next generation

A sustainable, resilient and inclusive agricultural environment for future generations is the goal of the shift to National Agricultural Research, Education and Extension Infrastructure (NAREI) which is more than just a structural development. NAREI seeks to increase productivity while protecting the environment by integrating integrated research, climate-resilient technology and sustainability concepts into agricultural innovation systems. It has been demonstrated that integrated agricultural systems and climate-smart practices improve ecosystem health, increase farm resilience against climate shocks and increase resource use efficiency. In addition to protecting farmers from climate threats climate resilience technologies help achieve several Sustainable Development Goals by promoting responsible production, poverty alleviation and

food security.

By reducing emissions and improving ecosystem services essential for future productivity, sustainable practices like conservation and low-carbon agriculture further support long-term viability.

In order to guarantee that marginalized and smallholder farmers gain from innovations that address climate and market vulnerabilities, research also emphasizes the significance of inclusive governance and equitable technology access. NAREI's integrated vision which combines scientific advancement with sustainability and fair impact offers a strong basis for creating resilient agricultural ecosystems that foster prosperity for present and future generations.

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