



Transforming Indian Agriculture: Strategic Policies, Innovations, and the Role of KVK Centric Extension Systems for Sustainable Growth and Food Security

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India stands as a vital global agricultural powerhouse, making substantial contributions to the world's food supply. The government has set an ambitious target to produce over 354 mt of food grains by 2025-26, underscoring the central role of agriculture in national development. Interestingly, the target is achieved with record food production in 2025. Currently, agriculture accounts for approximately 18% of India's GDP and employs nearly 50% of the workforce. However, these figures are gradually declining, reflecting a shift toward industrialization and the growth of the service sector.

Since 1950-51, the Indian Council of Agricultural Research (ICAR) has played a transformative role in revolutionizing Indian agriculture through pioneering research and innovations. These efforts have resulted in remarkable growth: food grain production has increased by 6.21 times, horticultural crops by 11.53 times, fish by 21.61 times, milk by 13.01 times, and eggs by an impressive 70.74 times. Such advancements have significantly enhanced national food security, driven by supportive policies, breakthroughs in agricultural research, institutional innovations, and effective technology dissemination. Recognizing agriculture's critical importance, the Union Finance Minister has allocated Rs. 152 billion to agriculture and allied sectors, with a focus on boosting productivity and building resilience against challenges. A study by ICAR-National Institute of Economics and Policy Research (NIAP) highlights that for every rupee invested in agricultural research, there is a return of Rs. 13.85, while agricultural extension services yield the second-highest return of Rs. 7.40 per rupee invested. The government has allocated Rs. 9,9410 million to the Department of Agricultural Research and Education, supporting 113 ICAR research institutes engaged in fundamental and strategic research, along with operating 731 Krishi Vigyan Kendras (KVKs- Farm Science Centre). These KVKs have played a pivotal role in capacity building and technology transfer across the country, serving as grassroots institutions that are instrumental in transforming Indian agriculture. In 2016, Prime Minister Narendra Modi emphasized their importance, stating, "Krishi Vigyan Kendra Kisano me Viswas Paida Kar Sakte Hai! (Krishi Vigyan Kendras can instil trust among farmers)". The Food and Agriculture Organization (FAO) recognized KVKs as India's institutional innovation inspiring the global agro-food sector of the 21st

century. The Parliamentary Standing Committee on Agriculture (PSCA) also emphasized their significance in its 23rd report, recommending that the Department of Agricultural Research and Education allocate adequate funds to sustain and expand KVK activities. Despite these advances, India's expenditure remains limited—spending only 0.4% of its agriculture GDP on research and development during 2024-2025 (https://www.business-standard.com/opinion/columns/union-budget-2024-25-some-boost-for-agriculture-and-rural-economy-124072300997_1.html assessed on 05-08-2025) and a mere 0.11% on extension activities.

Given the rising demand for food and other agricultural products, coupled with limited scope for expanding arable land, it is imperative to increase investments in agricultural research and extension services. Now is the opportune moment for bold policy reforms to elevate Indian agriculture, align with Sustainable Development Goals (SDGs), and adhere to commitments made in the COP28 UAE Declaration on 'Sustainable Agriculture, Resilient Food Systems, and Climate Action.' A scientific, agro-eco-regional approach—integrating research, planning, and a balanced 'agri-food-system' multisectoral strategy—is essential to accelerate growth and contribute at least one trillion USD (20%) toward India's targeted five-trillion-dollar economy.

The frontline extension system—including ICAR Research Institutes, State Agricultural Universities (SAUs), KVKs, and Agricultural Technology Information Centres (ATICs)—must attain greater efficiency, visibility, and dynamism to address the pressing challenges posed by climate change and conflicts. These institutions have potential to play a pivotal role in fostering economic empowerment and driving agricultural growth. To achieve higher productivity and sustainability, focused efforts are essential to enhance farmers' incomes by optimizing the efficiency of the entire farming-to-market value chain.

In the face of an evolving agricultural landscape, continuous reinforcement of the extension system and its frontline components is critical. The KVK system in India, developed and implemented by ICAR with dedicated funding, must be consistently strengthened

through increased resource investment, institutional reforms, and supportive policies. It is vital to preserve and nurture the KVK system, positioning it as a key organization that provides strong technological support and knowledge dissemination.

Developing skilled human resources within the frontline extension network is equally important. Key strategies and policy measures to build a resilient and effective extension system include investing in capacity building, promoting interdisciplinary research, adopting ICT and digital tools, strengthening linkages with research institutions, implementing performance-based incentives, establishing robust monitoring and evaluation mechanisms, providing policy support for extension financing, creating clear career progression pathways, offering professional development opportunities, and recognizing extension professionals' contributions. These initiatives will support sustainable agricultural development and serve as essential policy instruments. Specific policy actions to strengthen the frontline extension system include:

- ICAR Institutes can spearhead flagship participatory research-cum-extension projects (such as 'Farmer FIRST'- Farm Innovations Resource Science and Technology), participatory seed production, conservation of the genetic resource base, collaborative research projects with frontline extension systems, and initiatives to effectively validate and integrate farm innovations.
- As in the case of other ICAR Institutes, there is an urgent need to strengthen ICAR-Agricultural Technology Application Research Institutes (ATARIs) by establishing three distinct sections. (i) Research on Technology Delivery/Application, (ii) Data Science and Artificial Intelligence (iii) HRD, Coordination, and Monitoring. Each section may be provided by a Principal Scientist, Senior Scientist and Scientist.
- ICAR-ATARI may establish a Prioritisation, Monitoring, and Evaluation (PME) cell along with a Research Advisory Committee (RAC) to conduct relevant social science research in its respective zones, showcasing the output, outcome, and impact of mandated activities. ATARI may serve as a mentor for KVKs, and promote network research

projects that emphasis the socioeconomic and policy dimensions of agricultural innovation system. These projects also encompass on-farm adaptive research and the application and impact of emerging technologies such as qualitative analysis, structural equation modelling, bibliometric analysis, artificial intelligence, drone application, modelling, forecasting, IoTs, and ecosystem services in the global partnership mode.

- The mandate and role of the Directorate of Extension Education at the SAUs/CAUs/DUs should be revisited. Adequate human and financial resources are vital for University Directorates. Institutional reforms are needed to boost the visibility of university extension programs. Enhancing research-extension-farmer-market linkages is crucial for efficiently disseminating innovative agricultural practices and technologies to farmers.
- The Agricultural Technology Information Centre (ATIC) functions as a pivotal single-window delivery system and is an institutional innovation. During the implementation of World Bank Funded-National Agricultural Technology Project (NATP), ATIC demonstrated significant visibility and impact. However, it is crucial to revisit and enhance the structure and operational mechanisms of ATICs. This enhancement should include full-fledged manpower and increased funding to improve the capabilities. A sustainable ATIC could involve periodic funding and monitoring by ICAR-ATARI to ensure that it continues to provide essential inputs and advisory services to farming communities. Collaboration among ATIC, KVKs, and Agriculture Technology Management Agency (ATMA) is essential for creating synergy and improving outreach in agricultural extension efforts.
- The experiences of 4-H clubs in the USA, initiated in 1862 and still thriving, serve as valuable benchmarks. In that parlance, KVK is an 'Indian-origin Concept' developed and

implemented by ICAR with its own funds, therefore, we have to preserve and nurture the KVK System and to brand KVK as an organisation to play a robust role in technical advisory and knowledge backstopping at district level. Specifically; KVK is the 'Fountainhead of Technology' and it must not deviate and venture into general extension.

- In view of the increased responsibilities and functions, KVKs need to be considerably strengthened, and their cadre strength needs to be revised with additional expertise in social behaviour, ICT, digital agriculture, agri-entrepreneurship, value addition, post-harvest management, and business development. The KVKs could be mandated to function as 'Knowledge-Skills-Innovation Centres' to attract youth in agriculture, thereby transforming them into employment generators rather than employment seekers. In this context, concerted efforts are needed to implement the recommendations of the High-Power Committee on Management (HPCM) of KVKs (2013) constituted under the Chairmanship of Padma Bhushan Dr. R.S. Paroda to ensure improved efficiency, effective monitoring, and the prioritisation of the required farmer-science connection.
- Based on insights from Vice-Chancellors' and Directors' conferences, ICAR could consider organising the 'Host Institutes Chairman Conference', aimed at sensitising stakeholders and driving operational and policy reforms within the KVK system. This conference serves as a platform for stakeholders to collaborate and address pertinent issues.

Therefore, revisiting the roles and mandates of extension institutions, policy reforms, improving financial and human resources, strengthening research-extension-farmer-market linkages, and encouraging pluralistic public-private-NGO partnerships are essential for driving Innovation, Inclusivity, and Impact (3Is) within agricultural innovation and extension system and to achieve a goal of *Vikasit Bharat @ 2047*.

