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Scaling Up Agronomic Technologies through Participatory Extension Approaches

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Many useful agronomic technologies are developed and tested at research stations, but their adoption by farmers often remains limited. Participatory extension can help reduce this gap by involving farmers in testing, learning and sharing new practices under their own field conditions. Approaches such as Farmer Field Schools, Participatory Rural Appraisal, Participatory Technology Development and farmer-to-farmer learning give farmers an active role in the extension process. This article discusses how these approaches can support the wider adoption of agronomic technologies in India. Examples from Krishi Vigyan Kendra demonstrations, the ICAR Farmer FIRST Programme and the System of Rice Intensification are used to explain their role in technology scaling. Field demonstrations, local knowledge and interaction among farmers can build confidence and encourage adoption of suitable practices. However, limited institutional support, financial constraints and unequal access to digital services can restrict their wider use. Strengthening farmer participation and combining field-based extension with suitable digital tools can help agronomic technologies reach more farmers.

Keywords: participatory extension, technology scaling, agronomic technology, Farmer Field Schools, farmer participation

Introduction

Agricultural research in India has developed many useful technologies for improving crop production. These include improved crop varieties, better nutrient and water management practices, conservation tillage and climate-resilient farming methods. However, technologies that perform well under research conditions are not always adopted widely by farmers. One reason for this gap is that conventional extension methods often focus mainly on transferring information from scientists and extension workers to farmers, with limited involvement of farmers in testing and adapting the technology. Participatory extension provides a different approach by involving farmers directly in the extension process. Farmers can test new practices in their own fields, observe the results and make changes according to their local conditions and available resources. They can also share their experiences with other farmers in the community. This practical involvement can improve farmers' understanding of a technology and help them decide whether it is suitable for their farming situation. This article discusses the role of participatory extension approaches in scaling up agronomic technologies in India, with particular attention to the methods used, examples of their application and the major challenges involved in reaching a larger number of farmers.

Participatory Extension: Concept and Core Approaches

In practice participatory extension is built on the idea that farmers are co-creators of knowledge, not just its recipients. Rather than following a linear technology-transfer model, it treats extension as a continuous, two-way learning process between researchers, extension workers and farming communities (Vidyawati et al., 2025). Four approaches are especially widely used in India and elsewhere:

Participatory Rural Appraisal (PRA): A set of tools-resource mapping, seasonal calendars, group discussions-used to understand local conditions, priorities and constraints before introducing a technology, ensuring that what is promoted actually fits farmers' circumstances. It also helps extension workers understand differences within a community, since farmers may not have the same resources, problems or priorities.

Farmer Field Schools (FFS): Season-long, hands-on learning groups in which farmers regularly meet in a field to observe crop growth, pests and natural enemies, and jointly decide on management actions. This field-based learning also gives farmers an opportunity to compare different practices and understand which ones work better under their own conditions. FFS were first developed for integrated pest management and have since been adapted for a wide range of agronomic practices.

Fig. 1. Farmer Field School (FFS) as a participatory approach for field-based learning and dissemination of integrated pest management practices.

Participatory Technology Development (PTD): A joint process in which scientists and farmers co-design and test technology options on farmers' own fields, adapting them to local agro-ecological and socio-economic conditions rather than promoting a single fixed package (Vidyawati et al., 2025). This helps farmers adapt technologies to their local conditions.

Farmer-to-Farmer Extension: In many cases, this local trust can encourage other farmers to try the technology.Lead or master farmers who have successfully adopted a technology mentor and demonstrate it to their neighbours, using trusted peer relationships to overcome scepticism that outside experts often cannot.

Why Scaling Matters: From Plot to Landscape

In Practice, wider adoption depends on more than the performance of the technology alone. A technology proven on a research plot creates value only once it reaches enough farmers to matter at scale. Scaling up is not simply about repeating the same demonstration in more villages; it requires attention to the wider innovation system-input supply, markets, policy support, capacity of extension staff and financing-alongside the technology itself (Pawera et al., 2024). International guidance increasingly recommends that the intensity of farmer participation be matched to the stage of a technology's development: early-stage innovations benefit from close co-design with farmers, while more mature, well-tested technologies can scale faster through demonstration and farmer-to-farmer diffusion once basic suitability is confirmed (Pawera et al., 2024). This means participatory extension is not a single method but a spectrum of engagement that should be adjusted as a technology matures from an idea to a widely adopted practice.

Participatory Models Driving Technology Scaling in India

Krishi Vigyan Kendra Cluster Demonstrations: At the field level, India's network of 731 Krishi Vigyan Kendras (KVKs) conducts front-line demonstrations directly on farmers' fields, using a "seeing is believing" approach: neighbouring farmers observe a new practice performing well on a demonstration plot before deciding to adopt it themselves. Over toime, farmer engagement with KVK activities has grown from about 1% in 2003-04 to 18.8% in 2024-25, reflecting the expanding reach of this cluster-demonstration model (ICAR, 2025; Global Agriculture, 2025).

ICAR Farmer FIRST Programme: Launched in 2016, In this approach the Farmer FIRST Programme (FFP) positions farmers as central partners-alongside scientists, input suppliers and local institutions-in identifying problems, testing solutions and refining technologies on farmers' own terms. More recently An assessment across 51 FFP-implementing institutions found the programme improved food availability, purchasing power and dietary diversity among participating households, and recommended a more interdisciplinary, participatory approach to scale the programme further across India's agricultural research and development landscape (Venkatesan et al., 2023).

Civil-Society-Led Scaling: The System of Rice Intensification: The System of Rice Intensification (SRI)-a set of agronomic practices involving wider spacing, younger seedlings and careful water and nutrient management-was first researched by state agricultural universities in Tamil Nadu and Andhra Pradesh in the early 2000s. Its spread in India relied heavily on farmers' own success stories rather than top-down promotion, since early yield-loss apprehensions slowed adoption until "seeing is believing" demonstrations by early adopters built confidence among neighbouring farmers (CEEW, 2023). Since 2008, a Tata Trusts-supported consortium of non-governmental organisations has promoted SRI and related System of Crop Intensification practices across more than 170,000 farmers in about 3,500 villages spanning 104 districts across eleven states, extending the same participatory principles to wheat, pulses, finger millet and other crops (CEEW, 2023).

ICT-Enabled Participatory Advisory: Digital tools are increasingly used to widen participatory reach beyond what field visits alone can achieve. India's National Pest Surveillance System combines farmer-submitted field observations with expert verification and machine-learning-assisted advisory, though an assessment in Odisha found that farmer adherence to digital advisory still declined for costlier recommendations under high pest pressure (Kumar et al., 2025), underlining that digital participation must be paired with continued trust-building and affordability-sensitive follow-up to support scaling.

Participatory Approaches and Their Role in Scaling Agronomic Technologies

Approach	Core mechanism	Contribution to scaling
Farmer Field Schools	Season-long group observation and joint decision-making	Builds skills and confidence for wider self-directed adoption

Participatory Rural Appraisal	Community mapping of resources, needs and priorities	Ensures scaled technologies fit local conditions
Participatory Technology Development	Joint scientist-farmer design and on-farm testing	Produces locally adapted variants that spread more readily
Farmer-to-farmer extension	Peer mentoring by lead/master farmers	Uses trusted local networks to accelerate diffusion
KVK cluster demonstrations	"Seeing is believing" front-line plots	Converts visible results into neighbourhood-level adoption
ICT-enabled participatory advisory	Farmer-submitted data with expert/ML verification	Extends reach to remote farmers, complementing field visits

Case Examples of Agronomic Technologies Scaled through Participatory Approaches

Technology	Participatory approach	Scale/Reach	Source
System of Rice Intensification / System of Crop Intensification	Farmer-to-farmer diffusion, NGO-facilitated demonstrations	170,000+ farmers, ~3,500 villages, 104 districts, 11 states (since 2008)	CEEW, 2023
Farmer FIRST crop and livestock modules	Participatory Technology Development, farmer-scientist interface	51 ICAR institutions across 15 agroecological zones	Venkatesan et al., 2023
Sustainable agricultural practices (citrus)	Farmer Field Schools	Measurable gains in practice adoption and yield, Punjab, Pakistan	Jabbar et al., 2022
KVK front-line demonstrations (various crops)	"Seeing is believing" cluster demonstrations	Farmer engagement risen to 18.8% nationally, 2024-25	ICAR, 2025

Farmer Reach of the KVK Extension Network

The pie chart below illustrates the scale of the task that participatory scaling still faces nationally: even after two decades of expansion, KVK cluster demonstrations and related activities reach fewer than one in five Indian farmers each year, underlining why complementary participatory channels-farmer-to-farmer networks, NGO-led programmes and digital advisory-remain essential (ICAR, 2025).

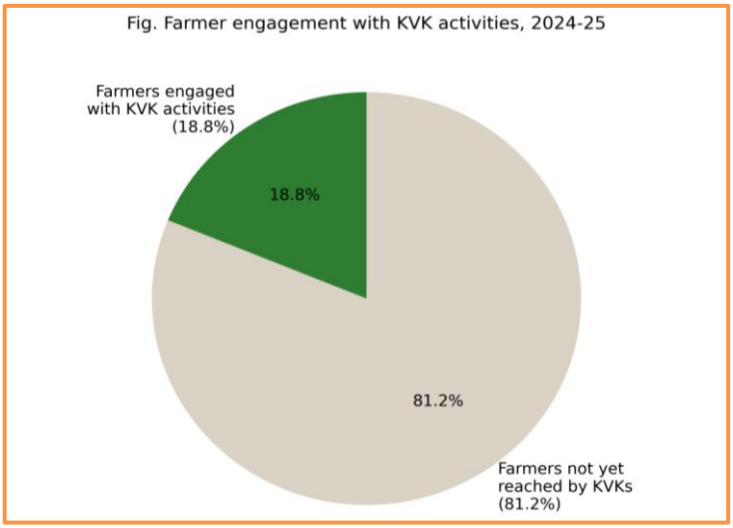

Fig. 2. Share of farmers engaged with KVK activities, 2024-25 (Source: ICAR, 2025).

Challenges in Scaling via Participatory Approaches

Participatory approaches take more time and skilled facilitation than simply distributing a leaflet, and recruiting and training enough competent facilitators has been a persistent constraint on scaling Farmer Field Schools and similar models. Financial and institutional support for sustained, multi-season engagement is often limited, and participatory processes can be harder to fund and evaluate than one-off input distribution. Digital participatory tools widen reach but depend on connectivity and digital literacy that remain uneven across

regions, and adherence to advisory still drops when recommended practices are costlier or riskier for resource-poor farmers (Kumar et al., 2025). Finally, scaling driven mainly through visible "success stories" can under-represent farmers whose conditions differ from early adopters, so care is needed to ensure scaled technologies remain genuinely locally adapted rather than a single fixed package extended uniformly.

Measuring the Success of Participatory Scaling

The success of participatory extension cannot be judged only by the number of farmers contacted or demonstrations organized. What matters equally is whether farmers continue to use a technology after the initial support is withdrawn and whether the practice spreads to other farmers. Changes in crop productivity, input-use efficiency, farm income and participation of small and marginal farmers can also help in understanding the actual impact of scaling efforts. Another important consideration is how farmers adapt a recommended practice to suit their local resources, farming conditions and needs. Farmers can also be involved in monitoring these changes and sharing their experiences with researchers and extension personnel. Such feedback helps identify practices that work well under local conditions and those that require further modification. In this way, assessment can move beyond simply counting beneficiaries and focus more on sustained adoption, local adaptation and farmer-to-farmer spread.

Way Forward

Strengthening the pool of trained facilitators-KVK subject matter specialists, NGO field staff and progressive lead farmers-would ease the single biggest bottleneck to participatory scaling. Matching the intensity of farmer participation to a technology's stage of development, as recommended in recent international guidance, can make scaling more efficient: closer co-design for newer practices and lighter-touch demonstration once a technology is well proven (Pawera et al., 2024). Blending field-based participatory methods with digital advisory can extend reach to farmers that in-person visits cannot easily cover, provided digital tools are paired with continued local trust-building. Finally, deliberately tracking who is and is not being reached by "seeing is believing" demonstrations would help ensure that scaling benefits a genuinely representative range of farmers rather than only those closest to early adopters.

Conclusion

Participatory extension approaches-Farmer Field Schools, Participatory Rural Appraisal, Participatory Technology Development and farmer-to-farmer learning-have repeatedly shown their value in moving agronomic technologies from research plots to widespread farmer adoption across India, from KVK cluster demonstrations to the civil-society-led scaling of the System of Rice Intensification. Their success rests on treating farmers as partners rather than recipients, building trust through visible, farmer-led results, and adapting technologies to local conditions rather than promoting one fixed package. Addressing facilitator shortages, financing constraints and the digital divide, while matching participation levels to each technology's stage of maturity, will be central to scaling agronomic technologies further and more equitably across Indian agriculture.

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