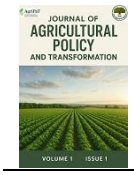

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Policy and practice for building climate-resilient agricultural systems, India

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ABSTRACT

In India, as in many other developing nations, climate change is increasingly contributing to productivity crises among smallholder farming communities that rely heavily on climate-sensitive resources for their livelihoods. Erratic rainfall, rising temperatures, and more frequent extreme weather events such as floods and droughts are intensifying production risks and undermining yield stability. These weather-related shocks further aggravate long-standing structural challenges, including environmental contamination from excessive agrochemical use, declining soil health, water scarcity, and public health concerns, while simultaneously suppressing already fragile rural income levels. Incremental and piecemeal interventions have proven insufficient to reverse these trends or build meaningful resilience. Although many of the technical solutions required for healthier, more efficient, and climate-resilient agricultural systems such as climate-smart practices, improved water management, and sustainable input use are well established and widely discussed, the enabling policy frameworks necessary for scaling these solutions remain inadequate. The policy landscape is highly fragmented, dispersed across multiple ministries and departments with overlapping mandates, weak coordination mechanisms, and inconsistent priorities. In addition, critical research components, particularly interdisciplinary and applied research, are underdeveloped or poorly integrated into policymaking. This results in a complex and disjointed system in which individual policy initiatives operate in isolation and fail to reinforce one another. Nevertheless, several recent and anticipated policy innovations offer promise, provided they are coherently aligned, sufficiently funded, and effectively implemented at scale.

1. Introduction

South Rising global food demand, driven by population growth and shifting dietary preferences, is rapidly coming into conflict with climate-induced disruptions to food production. Asia's agricultural sectors show pronounced susceptibility to climate change, especially in model scenarios that explore the impact of medium to high global temperature increases (e.g., Nath et al. 2024). Under such scenarios, arid regions of India, Pakistan, and China experience extreme regional temperature increases and extended droughts (Ullah et al. 2022). The South Asian monsoon becomes both more erratic and more intense, with increasing aggregate annual rainfall despite great regional variability including intermittent droughts and increased aridity in some areas (Yadav 2022, Prabhu & Chitale 2024). The region is also likely to see more dust storms and intensifying tropical cyclones (Panda et al. 2025); the Pacific is already witnessing a rise in the intensity of tropical cyclones (Knutson et al. 2021, Wang et al. 2023).

Climate change is projected to substantially affect India's agricultural productivity perhaps by as much as 25% by the end of the century (Datta et al., 2022) although impacts will vary across regions and cropping systems (Pattanayak & Kavi Kumar 2021). Rising temperatures and heatwaves have already reduced wheat yields in north-western India by shortening grain-filling periods; for example, the 2022 heatwave caused national wheat production losses of 4–5%, and as much as 15% in some regions (Lobell et al., 2012; Sidhu, 2023). Variability in monsoon rainfall is disrupting sowing calendars and reducing yields of rain-fed crops such as rice, maize and pulses by altering rainfall timing and intensity (Mohapatra et al., 2024; Kapa et al., 2025). Higher temperatures increase evapotranspiration and irrigation demand, exacerbating groundwater depletion in major agricultural regions such as Punjab and Rajasthan (Rodell et al., 2009; Datta et al., 2022). Without proactive, region-specific adaptation strategies, these interacting climatic pressures will raise production risks for smallholders and threaten long-term food security.

However, India's millions of smallholders pose major challenges to implementing climate adaptation measures at scale. Most of the country's 117-150 million smallholders cultivate < 0.5 hectare of land, often under conditions of high climatic uncertainty and limited institutional support. Most have little formal education and tend to depend on past agricultural practices and local "rules of thumb", making them relatively risk averse. Access to formal credit, crop insurance, technologies, and extension services is uneven and often remains the preserve of larger farmers. These characteristics complicate the development of effective policy, while also making it imperative. In addition, the extreme diversity of India's ecological and social-agricultural systems means that practices effective in one region may not be suitable elsewhere. These realities underscore the need for policy frameworks that are both nationally coherent and sufficiently flexible to allow state-level and local adaptation.

2. Policy analysis framework

This Climate resilience in agriculture demands vigorous, integrated policy responses. In our analysis, we endorse the theoretical framework developed by Paul Faeth and others 30 years ago, emphasizing the key role of the natural resource base (soil, water, biodiversity) in sustaining production capacity over time (e.g., Faeth 1993, Repetto et al. 1996, 1997). Policies that support the maintenance and good health of the natural resources constituting all farmer's principal assets are preferred over policies that tend to degrade them. Unfortunately, the classic economic definition of *income* "the maximum amount that can be consumed this year without reducing potential consumption in future years, i.e., *without consuming capital assets*" (Faeth 1993) has often been ignored in agriculture, where ascertaining core asset health requires careful observation and may not be straightforward.

There is partial but growing consensus on the main technical requirements for building assets to reduce climate change impacts. Practices like minimum tillage, (part-)aerobic rice cultivation, cover crops and mulching, etc. can protect soil structure against periods of excess water and too little water. Providing soil nutrients mostly or entirely in organic form reduces problems with long-term soil depletion. Using crop varieties that are relatively well-adapted to the most likely

3. India's current climate-policy landscape

The ***International context:*** The characteristic complexity of India's national agricultural policies is partly the historically contingent outcome of responding to a variety of national and international pressures at different times. For example, a multinational *Policy Action Agenda for Transition to* weather extremes can minimize soil losses and stabilize productivity in the long term. Certain relatively simple newer technologies such as drip irrigation and solar-powered irrigation systems can make significant contributions. However, such interventions depend on large and persistent investments in outreach and extension to large numbers of smallholders. As Khangura et al. (2023) point out, their long-term effectiveness under a wide range of Indian agroecological conditions remains insufficiently tested, and the systematic research programs that would be necessary to validate them do not yet exist in India.

The resilience advantages of biodiversity in agricultural landscapes (*agrobiodiversity*) are well-documented and largely uncontroversial (Seidler et al. 2025). Biodiversity in the surrounding ecosystem can provide critical redundancies in ecological services such as pollination and natural pest control. Crop diversity and between-field diversity spreads local risks. Genetic diversity within crops and among crop varieties can help protect against pests and diseases.

Carbon neutrality is arguably not a necessary characteristic of climate resilience, but agricultural field systems such as those sketched above tend to emit less greenhouse gas than those using synthetic inputs. In the case of India, most agricultural GHGs are produced by livestock but at least in the medium term, livestock will remain an integral part of resilient soil fertility maintenance systems. The technical dimensions of resilience can only be developed within appropriate policy frameworks. In recent years, the Government of India has formulated a myriad of polices and national missions for climate resilience. Such efforts have often been organized around co-benefits, including reductions in chemical toxicity of soils and waterways, improvements in human health and security, and pathways out of the chronic financial indebtedness so common among farming households (e.g., Pouchepparadjou et al. 2024).

Here, we critically examine some of the major policy frameworks intended to promote agricultural sustainability in India while reducing greenhouse gas emissions from agricultural processes. We note that government policies to date have been piecemeal, fragmented, sometimes even contradictory. We propose practical methods and approaches to bridge policy gaps and to improve their implementation.

Sustainable Agriculture was introduced at the UNFCCC's COP26 in 2021, offering a strategic framework to support global agricultural production while countries transition toward sustainable practices. Signatory countries committed to improving food systems, enhancing farmers' livelihood resilience, protecting natural ecosystems, halting

biodiversity loss, and reducing emissions from agriculture (JRT 2021). It is a fundamentally integrative effort, providing guidelines to help bring stakeholders (government agencies, international organizations, businesses, financial institutions, civil society, farmers) together to shift public support and subsidies toward sustainable agricultural practices.

However, India chose not to endorse this international Agenda, arguing that its own National Mission on Sustainable Agriculture (NMSA), one of eight Missions under the 2008 National Action Plan on Climate Change (NAPCC), already integrates many of the proposed principles. The declared goal of the NMSA is to move Indian agriculture toward climate-smart and ecologically sustainable practices, focusing especially on rainfed area development, soil health management, and water efficiency (NMSA, 2010).

NMSA 2014: The NMSA was officially launched in 2014 with four component programs:

1. Rainfed Area Development (RAD),
2. On-Farm Water Management (OFWM),
3. Soil Health Management (SHM), and
4. Climate Change and Sustainable Agriculture Monitoring, Modelling & Networking (CCSAMMN),

in addition to satellite initiatives and sub-components to promote organic farming and soil health.

Although India points to the NMSA as embodying the principles of sustainability, studies have found that it lacks adequate financial support, clear institutional mechanisms, and measurable outcomes, raising doubts about its effectiveness (Byravan & Rajan, 2013; Rattani et al., 2018). These deficiencies reflect broader problems with the NAPCC framework itself – including fragmented implementation, inadequate integration across sectors, and limited accountability (Kumar & Naik, 2019). The NAPCC, published 6 years before NMSA's launch, is a broad framework addressing multiple sectors in addition to agriculture and defining major goals for many of India's climate-related initiatives.

NAPCC 2008: The NAPCC was drafted over just 3 weeks leading up to COP15 in Copenhagen 2009. Pillai and Dubash (2021) point out that this was partly a response to international pressure for mitigation efforts in advance of the COP. Until then, India's negotiating position had been devoted primarily to reinforcing the idea of "common but differentiated responsibilities." The NAPCC views the climate challenge through the lens of development needs, emphasizing the need for expanded access to energy, and pledging that India's per capita emissions "will at no point exceed that of developed nations even as we pursue our development objectives" (NAPCC 2008). It contains India's first substantive commitments to GHG emissions reduction.

Each of the NAPCC's eight National Missions is administered through a separate Ministry, with MoEFCC (a relatively weak member of the ministerial hierarchy) designated as the coordinating ministry and the NMSA placed under the Ministry of Agriculture & Farmers' Welfare. This mission-mode approach and the lack of an integrative climate resilience framework almost guarantees that India's approach remains locked into separate sectoral silos, struggling to coordinate. Initiatives like NMSA remain as unintegrated "add-ons" to pre-existing agricultural policy frameworks within their respective Ministries.

Realistically, multiple aspects of rural development need to be reformed in a coordinated way, not just the farming techniques themselves, but also the extension services, the peer-to-peer learning systems, off-farm rural employment opportunities including the large MGNREGA social jobs program, farm insurance programs, and even the problem of human-wildlife conflict, which is significant in many areas. In practice, NMSA and other climate programs have lacked integration with these rural development concerns, instead focusing on technological solutions that tend to benefit large, well-resourced farmers more than vulnerable smallholders (Chauhan & Wehrden 2025). Precision agricultural technologies, land levelling, balanced fertilizer use, crop insurance, credit support, market access, livelihood diversification, even digital extension services (Jena et al. 2024) all depend in practice on more than basic literacy and numeracy – yet many farmers have little or no formal schooling. Thus, strengthened extension services and capacity building efforts emerge as essential cornerstones of any large-scale agricultural reform. To address the vast smallholder farm systems, policy frameworks should support simple interventions first, such as balanced and minimal synthetic fertilizer use and locally appropriate crop choices. Coordinated research programs must be established and supported across the country.

NICRA 2011: The *National Innovations in Climate Resilient Agriculture* (NICRA) program was launched in 2011 by the Indian Council of Agricultural Research (ICAR) to focus on four areas: strategic research, technology demonstration, capacity building, and sponsored research through small grants programmes (ICAR, 2018).

NICRA research emphasizes climate-resilient crop varieties, as well as sustainable livestock and fisheries management (ICAR, 2018; PIB, GoI, 2021). Technology demonstration components under NICRA involve implementing region-specific adaptation measures in pilot villages across India, including water harvesting systems, weather-based crop advisories, precision nutrient management, and agroforestry-based solutions (ICAR, 2018). NICRA's capacity building programs operate through Krishi Vigyan Kendras (KVKs, community-based extension groups) and local extension services, including NGOs.

How successful has NICRA been in realizing its objectives? An assortment of small survey-based studies has been carried out in several states, but it is difficult to draw firm conclusions because the survey methods are rarely described clearly in reports. Most surveys were implemented through NICRA's KVKs and were directly supported by NICRA. Many of the responses among farmers toward the NICRA programmes were positive, reporting improvements in crop yields, net farm income, household savings, social participation, and out-migration for work (e.g., Das & Rahman 2018, Pise et al. 2018, Thakor et al. 2022, Kumawat et al. 2024, Samuel et al. 2024).

However, given the opportunity, beneficiary farmers also complained about technical, financial and social constraints, including lack of support from institutions, non-availability of improved seed, lack of community involvement, insufficient financial assistance, ineffective financial management by local authorities, and others (e.g., Gadhage et al. 2023). Das & Rahman (2018) recorded high rates of programme discontinuance, while Singh et al. (2023) found that 90% of respondents considered NICRA to have "low or medium impact" and only 10% judged it "transformative" for agriculture.

To summarize, after a decade it appears that the NICRA interventions have had some success in the limited contexts where they have been implemented but monitoring and evaluation have not been systematic. In themselves, the technologies are uncontroversial water harvesting/efficiency, high quality seed, shared access to mechanical equipment, etc. Villages that have contact with KVKs return positive informal evaluations and report benefitting economically. By integrating meteorological data with field-based knowledge, NICRA is said to have contributed to improved climate risk assessment, helping policymakers and farmers make informed decisions (ICAR, 2018; PIB GoI, 2021). However, major challenges remain in scaling up climate-resilient technologies and ensuring that resource-poor farmers have access to necessary financial and institutional support. Strengthening NICRA's linkages with state agricultural departments and private-sector partners would enhance its outreach and effectiveness.

MoEFCC as a central government node for climate policy: In 2014, the erstwhile Ministry of Environment and Forests was renamed the Ministry of Environment, Forests, and Climate Change (MoEFCC). Today, MoEFCC serves as the primary agency responsible for India's international environmental commitments. This is an expansive remit for a relatively weak agency that does not generate revenue and is rarely top priority for funding and other support. Any attempt to regulate economic development to protect climate is guaranteed to bring the ministry into conflict with the Ministries of Revenue, Power, Transport, Urban and Rural Development, Agriculture and others. Senior officials have noted off-the-record that MoEFCC is "ill-suited" for building new climate goals into the bureaucratic hierarchies since "it lacks convening power if the environment secretary chairs a meeting, the finance secretary will not go" (Pillai & Dubash 2021, S102). To the extent that bureaucratic structure both reflects and generates political privilege, it appears that confronting the climate challenge has not yet been given high priority.

Other initiatives: Meanwhile, dozens of other semi-independent initiatives, programs, and sub-missions have emerged in different ministries and under different administrative directives to address other aspects of climate-aware rural development. Complex institutional relationships and frequent changes of authority have made it difficult to build momentum over a decade or so. Forward movement on most of these programs has been slow or negligible (e.g., De Roy 2017, Dev 2021, Bathla & Hussain 2022).

A new arrangement: In October 2024, P.M. Modi's Cabinet merged many of these programs into two "umbrella schemes", placing them under the Ministry of Agriculture & Farmers' Welfare (MAFW) (PIB GoI 2024):

1. *Pradhan Mantri Rashtriya Krishi Vikas Yojana* (PM-RKVY), intended to promote sustainable agriculture, and
2. *Krishonnati Yojana* (KY), intended to address food security.

The new PM-RKVY now contains most of the programs previously housed in the NMSA, plus some gathered from other parts of the bureaucracy. The new KY is the same as the KY from 2018, but with two added Missions.

It is too early to know whether this restructuring will make things more efficient. The streamlined profile seems advantageous, but there are new anomalies, for instance, the new PM-RKVY incorporates most of the agriculture programs previously housed in NMSA, yet the NMSA itself is not placed in the PM-RKVY. More fundamentally, it seems questionable that *agricultural sustainability* (the goal of PM-RKVY) and *food security* (the goal of KY) can realistically be addressed in separate units. Will these programs interact, communicate and collaborate? Or will the "mission-mode" structure once again promote the siloed approach that has historically stymied progress in reforming India's agriculture?

4. The road ahead

Two recent and potentially significant policy developments figure prominently in the effort to make India's vast, complex agricultural systems more resilient to climate challenges. One is the launch in November 2024 of a new National Mission on Natural Farming (NMNF). The other is the formulation of India's National Adaptation Plan (NAP), which missed its intended release date in November 2025.

National Mission on Natural Farming (NMNF)*:* NITI-Aayog, the Indian government's premier policy think-tank (chaired by the Prime Minister) has been promoting natural farming since 2018. According to the GoI Press Information Bureau, natural farming aims to "enhance climate sustainability in agriculture by promoting location-specific agro-ecological practices that reduce dependency on chemical inputs and strengthen natural ecosystems" (PIB GoI 2025). Many forms of natural farming are said to be practiced in India, based in many cases on regional indigenous traditions. Over the next two years the new National Mission on Natural Farming plans to introduce natural farming systems to 10 million farmers on 750,000 hectares, offering incentives of INR 4000 per acre per year (PIB GoI 2025). These are ambitious goals. As of July 2025 (latest data), 806 training institutes had been engaged, 1,100 model farms developed, and >1 million farmers had been enrolled (PIB GoI 2025).

Many observers agree that reducing synthetic inputs and maximizing soil health are important steps toward agricultural sustainability and climate resilience in most smallholder agrarian systems (e.g., Seidler, Gavai & Bawa 2025). Major questions persist concerning the relative productivity of natural farming in its various forms compared with chemically assisted farming. Resolving these questions definitively will require implementing systematic research programs, carried out under field conditions in multiple agro-ecological zones (Seidler, Gavai & Bawa 2025). Where rigorous evaluations have been carried out, they often show good results for practices (e.g., Tanti 2024, Khosla 2025). The NMNF website lists the immediate goals of "creating institutional capacities for documentation and dissemination of best practices, make practicing farmers as partners in promotion strategy, ensure capacity building and continuous handholding" If thoroughly implemented, these steps will be consonant with preparation for systematic testing and monitoring. In May 2025, ICAR put out a call for research proposals under NMNF (https://nmnfresearch.in/CRG-notification.pdf).

National Adaptation Plans (NAPs) are the current stage in the UNFCCC's multi-year attempt to help transition the world's nations stepwise toward greater readiness for the expected impacts of climate change. India's NAP proposal was provisionally approved in September 2024; its fully formulated NAP has been repeatedly postponed. Speaking in Belem on November 20, 2025, MoEFCC Minister Yadav stressed that "adaptation is not an optional add-on but an essential investment" and that adaptation and mitigation are "complementary pillars of the Paris Agreement." However, progress indicators "should remain voluntary, non-prescriptive, and subject to national interpretation, and frameworks must avoid creating additional reporting burdens and respect diverse national contexts." He pointed out that international adaptation funding continues to fall short, since "developing countries will need between $310 and $365 billion annually by 2035, while current flows are around $26 billion only" (PIB GoI 2025). These are the core themes of India's multilateral climate negotiating position.

Agriculture is key to the NAPs, given that food production systems play a central role in maintaining social stability and economic functioning. Agriculture and Food Security is the second of nine sectors that organize India's climate adaptation strategy but each of the nine sectors is closely tied to food systems (Table 1).

Table 1: India's prospective NAP sectors

1	Water Resources: Addressing water scarcity, conservation, and efficient management.
2	Agriculture & Food Security: Enhancing climate-resilient agricultural practices.
3	Disaster Management & Infrastructure Resilience: Strengthening disaster preparedness and infrastructure resilience.
4	Health: Tackling climate-related health challenges.
5	Forests, Ecosystems & Biodiversity: Protecting natural ecosystems and biodiversity.
6	Poverty Alleviation & Livelihoods: Ensuring climate resilience for vulnerable communities.
7	Traditional Knowledge & Heritage: Incorporating indigenous wisdom in adaptation measures.
8	Adaptation Resourcing: Ensuring adequate financial and technological support.
9	Gender Inclusivity: Mainstreaming gender-sensitive adaptation strategies.

According to previous MoEFCC Minister K.V. Singh, the NAP will be "not just a static document but a dynamic process, evolving with time through scientific innovation and ground-level realities" (UNDP 2025a). This is good if it promotes collaborations among relevant extant programs. If the NAP becomes simply another bureaucratic layer, much of its potential will be lost.

An important goal of the NAP process is to "enhance access to adaptation finance by mobilizing private sector investments in climate resilience" (UNDP 2025b). Funding from the Green Climate Fund (GCF) Readiness Programme is intended to "support developing countries in increasing their climate ambition over successive Paris Agreement cycles" (GCF 2023). Since 2016, India has drawn some US$ 1.6 million to support development of its NAP in three phases. Readiness support has targeted four interrelated vulnerable sectors (agriculture, water resources, health, disaster management) and two regions (the Himalayas and the coastal regions) (GCF 2022).

Implementation, as ever, is a less clear story. Many of the previously submitted NAPs have been criticized for having weak or non-operational M&E systems (Leiter 2021). By 2021, no more than 40% of countries with a published NAP had been able to evaluate or report on their progress, greatly diminishing society's ability to understand whether adaptation planning is making a difference on the ground (Leiter 2021). India must provide solid M&E plans in its NAP.

5. Conclusion and Policy Implications

During the next two decades, policy makers and the institutions responsible for implementing polices must avoid mistakes of the past and develop new approaches to prepare for the challenges of climate change along with the related problems of soil degradation, dwindling water supplies and nutritional deficits. These are the most severe challenges India's agricultural systems have faced since the 1950s-60s, when food grain production had to be ramped up to feed the growing population.

Our policy analysis reveals deficiencies in the design and implementation of policy frameworks intended to promote resilience of India's agricultural systems under climate change. A piecemeal or *ad hoc* approach to resilience policy has produced an inconsistent and fragmented mosaic of agricultural programs operating out of different departments and ministries. Improvement of this situation will require five major steps:

1. **Integration of historical lessons**: Many agencies of the GoI experience rapid personnel turnover. There may be good reasons for this, but it has the distinct downside that institutional memory is often weak, making it difficult to learn from the past and improve in the future. A possible current example of this is the rapid, seemingly uncritical

adoption by some agencies of the central GoI of 'Natural Farming' modalities. The evidence for benefits and advantages of these practices in different locations is thin and contradictory at best, yet commitments and investments are being made in advance of developing the research programs needed to test the claims. Policy should only be enacted in response to evidence.

2. Sectoral integration: Policies developed for different sectors including land and forests, agriculture, water, biodiversity, and others are today governed largely by separate agencies. Yet the functions of each of these sectors, within the economy and within landscapes, are far from independent; they influence each other continuously. Hence, the agencies responsible for smoothing sector functioning must talk to one another, and adjustments to current policies must adopt cross-sectoral viewpoints. Institutional integration must come to reflect functional integration. Institutional structures and relationships should not be unrelated to the way things work on the ground.

3. Outcome integration: The goals and objectives of a reorganized agricultural system must be integrated in the sense that one goal should not be pursued at the cost of another. India's food production systems must move simultaneously toward three parallel goals: (a) sustained provision of calories and of nutrients; (b) adaptation to climate change impacts and mitigation of drivers; and (c) maintenance of above- and below-ground agrobiodiversity, which contributes importantly to the two other goals (Seidler, Gavai & Bawa 2025). In approaching these goals, food systems will also contribute to a reduction in precarity and chronic social inequities. In contrast, 'Green Revolution' practices often pursued productivity and calories at the cost of nutritional quality and social equity outcomes. The same can be said of the (closely related) fertilizer subsidy policies, which achieved rapid gains in production quantity while creating perverse incentives and consequently unwanted outcomes in public health and social vulnerability.

4. Implementation: Mechanisms for policy implementation should be integrated into the policy statements themselves. Too often, policies consist of a reiteration of overall goals, perhaps with associated target dates, but without clearly designated pathways to achieving them. It's true that implementation of agricultural policies is partly a local concern, with much local variability. That is one reason why stakeholder consultation is needed during the process of defining the goals as well as the mechanisms. Farming communities must be fully integrated into research programs on agricultural innovations, since they will be the ones implementing the innovations on the ground.

5. Institutional reform: Tautologically, policies exert no impact unless the appropriate institutions are present to guide implementation. In the case of India's agricultural systems, this calls for a much stronger emphasis on extension and knowledge sharing. Research such as that of Shukla et al. (2025) shows that on-ground human resources necessary to bring new skills and climate-resilient practices to smallholders is lacking in most districts. Levan & Shiney (2025) recount a hands-on training program that introduced some 300 farmers in 17 Kerala villages to climate-resilient practices, requiring several years of intensive interactions. One of the primary reasons for Natural Farming's apparent rapid spread in some regions is that neighbours are motivated to share techniques informally with neighbours. In most cases, combinations of strengthened formal extension services with informal networks are likely to exert the strongest impact.

Many of the policy frameworks discussed here if adequately implemented – can be expected to bring co-benefits. In many regions of India, for example, a reduction in synthetic fertilizer and pesticide use could significantly reduce toxics loads in soils and waterways. An increase in farmer's networks and peer-to-peer skill building could strengthen communities. Past attempts to promote climate-resilient agriculture have tried to approach it as a collection of techniques or technologies that could be addressed through a series of 'mission-mode' policy initiatives. However, research shows that a very wide range of social, economic and environmental factors influences household-level adoption of climate resilient techniques (Jena et al. 2024). Approaching agricultural reform as a process more akin to *rural development* may thus prove more effective. Making large-scale changes in any single dimension of food production will tend to require adjusting other dimensions as well. Ideally, policy frameworks should be structured to encourage such cross-cutting interactions. This will presumably require ongoing and sustained communication and collaboration among programs; it will certainly be facilitated if walls and boundaries between programs are broken down as much as possible. Dispersing policy components in different agencies and departments clearly complicates interactivity.

ICAR's program of research in close contact with farming communities is an important step in this direction – among other reasons, because it facilitates the design of solutions both *for* and *by* the direct beneficiaries. Past attempts at reform have stumbled because solutions tended to be designed top-down, with insufficient opportunity for feedback from those on the receiving end. Starting with a

clear picture of the problems tends to produce more flexible and multifaceted solutions.

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