CGIAR
SCIENCE FOR A FOOD-SECURE FUTURE

Policy Brief

SukhaRakshak AI – Transforming Drought Preparedness in India

Giriraj Amarnath, Petra Schmitter, Alok Sikka, K.V. Rao, Susama Sudhishri and Vinod Kumar Singh

December 2025

Authors

Giriraj Amarnath, Research Group Leader - Water Data for Climate Resilience (WDCR) and Principal Researcher – Disaster Risk Management and Climate Resilience, International Water Management Institute (IWMI), Colombo, Sri Lanka
Petra Schmitter, Research Group Leader – Climate Mitigation & Adaptation Pathways, IWMI, Colombo, Sri Lanka
Alok Sikka, Country Representative – India & Bangladesh; Senior Fellow, IWMI, New Delhi, India
K.V. Rao, Head-DRM, ICAR-Central Research Institute for Dryland Agriculture, Hyderabad, India
Susama Sudhishri, Technical Expert, National Rainfed Area Authority, Ministry of Agriculture and Farmers Welfare, Government of India, New Delhi, India
Vinod Kumar Singh, Director, ICAR-Central Research Institute for Dryland Agriculture, Hyderabad, India

Acknowledgements

This work was carried out under the CGIAR Climate Action Program, the CGIAR Sustainable Farming Program and the CGIAR Accelerator for Digital Transformation. We would like to thank all funders who support this research through their contributions to the CGIAR Trust Fund (www.cgiar.org/funders).
The authors gratefully acknowledge the research and funding support of the Indian Council of Agricultural Research (ICAR).

CGIAR Climate Action Program

The Climate Action Program aims to drive science, innovation, and collaboration to transform food, land, and water systems for a climate-resilient, net-zero, and equitable future in Bangladesh, Cambodia, Côte d'Ivoire, Ethiopia, Honduras, India, Kenya, Nepal, Nigeria, Pakistan, Philippines, Senegal, Sri Lanka, Sudan, Tanzania, Zambia, and Zimbabwe.

Citation

Amarnath, G.; Schmitter, P.; Sikka, A.; Rao, K. V.; Sudhishri, S.; Singh, V. K. 2025. *SukhaRakshak AI – transforming drought preparedness in India*. Colombo, Sri Lanka: International Water Management Institute (IWMI). CGIAR Climate Action Program; CGIAR Sustainable Farming Program; CGIAR Accelerator for Digital Transformation. 16p.

Cover photo: Tanmoy Bhaduri/IWMI

Disclaimer

This publication has been prepared as an output of the CGIAR Climate Action Program and has not been independently peer-reviewed. Responsibility for editing, proofreading, layout, opinions expressed, and any possible errors lies with the authors and not the institutions involved.

Content

Key Messages

- **India must shift from reactive drought relief to anticipatory risk management** — AI-driven systems like SukhaRakshak provide predictive, localized drought intelligence that enables farmers, policymakers, and extension officers to act before impacts escalate.

- **SukhaRakshak AI complements and strengthens existing national policies** — by aligning with frameworks such as Pradhan Mantri Fasal Bima Yojana (PMFBY), Pradhan Mantri Krishi Sinchayee Yojana (PMKSY), National Mission for Sustainable Agriculture NMSA, NDMA (National Disaster Management Authority) Drought Guidelines, Watershed Development Component-PMKSY 2.0, National Technical Guidelines for improved watersheds by National Rainfed Area Authority (NRAA) and state contingency plans, the platform enhances the timeliness, targeting, and effectiveness of drought preparedness actions.

- **Localized, multi-channel advisories in 22+ languages ensure last-mile reach** — integrating AI4Bharat and vernacular communication modes (SMS, IVR, WhatsApp, community radio) bridges information gaps and improves adoption by smallholders, especially women and marginalized groups.

- **Multi-stakeholder benefits extend beyond farming** — from reducing crop losses and stabilizing farmer incomes, to enabling proactive resource allocation by drought managers, to supporting insurers, agri-businesses, and researchers with actionable data for resilience planning.

- **Policy action is needed to institutionalize AI drought services** — integrating SukhaRakshak AI into official drought protocols, financing mechanisms, and extension systems will scale its benefits nationally, building a culture of preparedness that safeguards livelihoods, water and food security.

Background

India's agrarian economy is highly vulnerable to droughts, which are among the most devastating slow-onset disasters (Bahinipati 2020; Taha 2021). Approximately 68% of India's cultivated area is drought-prone, exposing millions of farming families to water scarcity, crop failures, and income losses. Major droughts in 1965–1967, 1979, 1987, 2002, 2009, and 2015–2016 led to substantial agricultural losses – for instance, the 1987 drought cut national food grain production by over 10 million tons, while 2002 saw a drop of ~29 million tons (Gupta et al. 2011). Smallholder farmers (over 80% of Indian farmers) are especially at risk due to limited irrigation, credit, insurance, and adaptive technologies.

India's institutional framework for drought management (Ministry of Agriculture & Farmers' Welfare, India Meteorological Department (IMD), Central Water Commission (CWC), National Disaster Management Authority (NDMA) and National Rainfed Area Authority (NRAA) has traditionally emphasized reactive relief over proactive prevention. Drought response often centers on crisis measures like compensation payments and emergency water supply, with delays and coordination gaps hindering timely action. Climate change now intensifies these challenges: more frequent and severe rainfall deficits, rising temperatures, and erratic monsoons are projected. The IPCC warns of increased agricultural drought frequency in South Asia (IPCC, 2007), heightening food security risks and deepening farmer distress and migration. This evolving risk landscape underscores an urgent need to shift from relief to resilience through better preparedness and early action.

India's Agriculture-Related Policies and Initiatives

India has launched numerous policies and initiatives to build agricultural resilience, many of which provide entry points for drought preparedness and climate adaptation:

- **National Agriculture Policy (2000)** – The first comprehensive agricultural policy for India, it set the vision of achieving over 4% annual growth in the agricultural sector through sustainable, technologically driven, and market-oriented practices. The policy emphasizes diversification of crops, conservation of soil and water resources, and expansion of irrigation to reduce vulnerability to climate variability and drought. It promotes participatory irrigation management, integrated watershed development, and enhanced research in drought-tolerant crop varieties, thereby creating a policy foundation for long-term drought resilience.

- **National Mission for Sustainable Agriculture (NMSA)** – A mission under the National Action Plan on Climate Change aimed at enhancing agricultural productivity, especially in rainfed areas, through integrated farming, water-use efficiency, soil health management, and resource conservation. It includes programs like Rainfed Area Development and promotes water conservation and livelihood diversification to mitigate drought impacts.

- **National Innovations in Climate Resilient Agriculture (NICRA)** – A flagship ICAR (Indian Council of Agricultural Research) network project launched in 2011 to advance climate-resilient farming. NICRA focuses on strategic research, technology demonstration in 100+ vulnerable districts, and capacity building to develop and deploy climate-resilient technologies (drought-tolerant crop varieties, water management). It enhances the climate resilience of crops, livestock, and fisheries through adaptive strategies and improved risk management.

- **Gramin Krishi Mausam Seva (GKMS)** – An agro-meteorological advisory service by IMD that delivers localized weather forecasts and crop advisories to farmers. By providing timely weather and drought- related information at the block/district level, GKMS helps farmers make informed decisions (e.g. sowing, irrigation) and is a key component of early warning systems for agriculture.

- **Pradhan Mantri Fasal Bima Yojana (PMFBY)** – Launched in 2016, PMFBY is a government-sponsored crop insurance scheme that insures farmers against crop loss due to natural calamities (including drought). It aims to stabilize farm incomes by providing prompt insurance payouts for crop failure and encourages adoption of modern practices. Technological tools (remote sensing, smartphone apps) are used for quick yield assessment under PMFBY, making it a vital safety net in drought years.

- **Pradhan Mantri Krishi Sinchayee Yojana (PMKSY)** – A national irrigation program launched in 2015 with the vision of “Har Khet Ko Pani” (water to every farm) and “More Crop Per Drop”. PMKSY emphasizes water conservation, micro-irrigation, and watershed development to expand irrigation coverage and improve water-use efficiency. By investing in drought-proofing infrastructure (check dams, farm ponds, drip irrigation), it reduces agriculture’s vulnerability to rainfall deficits.

- **Paramparagat Krishi Vikas Yojana (PKVY**) – An initiative under NMSA launched in 2015 to promote organic farming and sustainable agricultural practices. Through group-based farmer clusters and support for organic inputs, PKVY enhances soil health and climate resilience, making farms more drought-tolerant over time.

- **National Agroforestry Policy (2014)** – A policy to mainstream agroforestry (integrating trees with crops/livestock). Agroforestry practices are encouraged for their benefits in soil moisture retention, shade, windbreaks, and diversified income, all of which help farming communities withstand droughts. The policy supports tree planting on farms and links farmers with horticulture and timber markets.

- **Atal Bhujal Yojana (Atal Jal)** – A central sector scheme launched in 2019 focused on sustainable groundwater management in water-stressed regions. It empowers communities in seven states to monitor and conserve groundwater through participatory Water User Associations. By arresting groundwater decline and promoting aquifer recharge, Atal Jal strengthens drought preparedness at the village level.

- **Jal Jeevan Mission (2019)** – A flagship mission to provide functional household tap water connections to all rural households by 2024. By ensuring reliable access to safe drinking water, it reduces community vulnerability during droughts and supports overall rural resilience.

- **Soil Health Card Scheme (2015)** – A nationwide initiative to provide farmers with individualized soil health assessments every two years, along with crop- and soil-specific fertilizer recommendations. This promotes balanced nutrient management, improves soil productivity, and enhances drought resilience by optimizing input use and soil water retention.

- **National Disaster Management Authority (NDMA) Drought Guidelines (2010)** – NDMA's guidelines for drought management stress a holistic, proactive approach with early warning, vulnerability assessment, and mitigation measures. They standardize criteria for drought declaration and promote preparation of Drought Management Plans at state and district levels. These guidelines frame drought as a disaster to be managed through risk reduction and timely response (e.g. activating relief funds, fodder provisions) rather than ad-hoc relief.

- **District Agriculture Contingency Plans** – NRAA has prioritized 158 districts of the country under drought through different indices. Under ICAR-CRIDA (Central Research Institute for Dryland Agriculture), location- specific contingency plans have been developed for over 600 districts. These plans outline actionable strategies for different drought scenarios – such as short-duration crop varieties, alternate crop rotations, water conservation techniques, and livelihood support measures – tailored to each agro-climatic zone. They serve as ready reckoners for local authorities to implement during early signs of drought.

The above initiatives provide a policy landscape that SukhaRakshak AI can leverage, ensuring that technological innovation aligns with and amplifies ongoing efforts in drought risk management and climate-resilient agriculture.

SukhaRakshak AI for Drought Preparedness

SukhaRakshak AI (meaning "Drought Protector") has emerged as India's first integrated, AI-powered drought advisory system designed to bridge the gap between early warning and early action. It was conceived in response to the escalating drought risks and the need for more proactive approaches. SukhaRakshak AI combines advanced technologies – artificial intelligence, satellite earth observation, weather forecasts, and on-ground contingency planning – to deliver actionable drought insights in local languages. This innovation represents a paradigm shift for India's drought management: moving from a largely reactive relief-centric model towards one of anticipatory risk reduction and resilience building. The tool can be provided with guidelines to Krishi DSS, a gateway to the repository of data layers with advanced analytics for informed decision making in Agriculture developed by Department of Agriculture and Farmers Welfare, Ministry of Agriculture and Farmers Welfare, Government of India (GOI) for a more robust and in implementable form.

At its core, SukhaRakshak AI focuses on drought preparedness. It continuously monitors climatic and agricultural conditions and provides early alerts before droughts manifest at the ground level. For example, the system can forecast rainfall deficits weeks in advance and trigger advisories for farmers to adjust sowing dates or crop choices. By tailoring information to the village level and communicating in user-friendly formats (vernacular languages, mobile alerts), it empowers stakeholders – from small farmers to district officials – to take proactive measures such as activating water conservation and saving plans, deploying drought-tolerant seeds, or arranging fodder supplies before a crisis peaks. In doing so, SukhaRakshak AI aims to save livelihoods and reduce losses, marking a decisive shift in drought preparedness across India.

The Innovation: SukhaRakshak AI

SukhaRakshak AI's Architecture and Technology: This platform is built on a cutting-edge fusion of data sources and AI techniques to generate hyper-local drought intelligence:

- **Multi-Source Data Integration:** SukhaRakshak ingests a rich array of data – from weather and climate forecasts (short-term one to ten day forecasts to seasonal outlooks) to satellite imagery of vegetation/soil moisture, and even digitized drought contingency manuals. For instance, it leverages the South Asia Drought Monitoring System (SADMS) outputs developed by IWMI, which provide near real-time regional drought assessments using indices like rainfall anomaly (SPI) and vegetation health (NDVI/VCI). These diverse inputs ensure the AI has a comprehensive picture of emerging drought conditions.

- **AI-Driven Analytics:** A core innovation is the use of advanced AI models in a cloud-based, scalable framework. SukhaRakshak AI employs a hybrid AI architecture – including a vector database for knowledge storage (e.g. Qdrant) and Retrieval-Augmented Generation (RAG) powered by large language models (Gemini AI) – to dynamically handle user queries and generate contextual advisories. Machine learning components (such as transformer networks and time-series LSTMs) are trained on 20+ years of historical climate and drought impact data, enabling the system to recognize complex patterns and make probabilistic drought forecasts at district and sub-district scales.

- **Personalized Local Advisories:** The platform tailors outputs to local needs. It integrates AI4Bharat's Sarvam, a suite of Indian language models supporting 22+ languages, to translate and deliver advisories in the local language/dialect. Thus, a farmer in Maharashtra might receive a Marathi voice/text alert about an impending dry spell, while a Tamil Nadu farmer gets the message in Tamil. This localization is crucial for accessibility and farmer uptake. The advisories are also enriched with district-specific contingency actions (pulled from the pre-existing District Agriculture Contingency Plans), ensuring recommendations are practical and region-specific (e.g. suggesting alternate crops or water conservation actions appropriate to that area).

- **Cloud and Geospatial Infrastructure:** SukhaRakshak AI runs on a cloud-native infrastructure (utilizing services like AWS and Docker containers for scalability) and harnesses geospatial engines such as Google Earth Engine for rapid satellite data processing. This allows it to handle high volumes of data and provide timely, georeferenced outputs even as conditions evolve. The system architecture prioritizes high availability and speed – for example, new satellite data on vegetation/moisture stress can be ingested and translated into updated drought alerts with minimal lag. An integrated API framework (FastAPI) allows various government apps and portals to pull SukhaRakshak's data, facilitating easy integration into existing agricultural digital services.

Overall, through this AI-driven pipeline, SukhaRakshak AI delivers actionable, location-specific drought advisories directly to end-users, enabling them to anticipate, act, and adapt – effectively transforming drought management from reactive emergency response to proactive resilience. By marrying state-of-the-art technology with field-level agricultural knowledge, it stands as a novel solution to protect livelihoods against the growing threat of drought and implementation at National level in coordination with NRAA and NDMA.

Policy Opportunities: Aligning SukhaRakshak AI with Existing Policies

To maximize impact, SukhaRakshak AI should be woven into the fabric of India's agricultural and disaster management policies. Key opportunities to align this AI innovation with current frameworks include:

- **Embedding in Drought Planning and Declaration Processes:** SukhaRakshak's analytics can support official drought declarations and management protocols. Working closely with NDMA and the Ministry of Agriculture ensures the AI's indicators and triggers align with national drought manuals and codes. For instance, SukhaRakshak automatically calibrates its drought severity thresholds to the Government's Drought Manual criteria (rainfall deviation, vegetation indices, etc.), which could standardize and speed up drought identification across states. Collaboration with NDMA and NRAA would help integrate AI outputs into the national disaster response system, including financial mechanisms like the National Disaster Response Fund and implementation of drought mitigation/management plan.

- **Integration into Existing Schemes (Center and State):** There is scope to plug SukhaRakshak AI into flagship programs. At the state level, Agriculture Departments and State Disaster Management Authorities can integrate it with Pradhan Mantri Fasal Bima Yojana (PMFBY) for crop insurance and with state contingency plan operations. For example, AI-generated early drought warnings could trigger "prevented sowing" claims or quicker insurance payouts under PMFBY, thus aligning financial relief with predictive warnings. Similarly, states can use SukhaRakshak to operationalize their district contingency plans (prepared by CRIDA/ICAR) by automatically activating relevant advisories when drought thresholds are met. Integrating the platform into schemes like Jal Shakti Abhiyan (water conservation campaign), rainwater harvesting or watershed programs (WDC-PMKSY 2.0 and REWARD) can guide where to prioritize water harvesting, village ponds, or tank revival/rehabilitation before a drought.

- **Mainstreaming into Agricultural Extension Workflow:** The Ministry of Agriculture's extension apparatus (including Krishi Vigyan Kendras (KVKs) and ATMA network) can adopt SukhaRakshak AI as a decision- support tool. By embedding the AI platform in regular extension services, field officers can receive standardized drought advisories aligned to national guidelines and push them out to farmers through SMS, WhatsApp, or community meetings. This mainstreaming would effectively turn SukhaRakshak into a backbone for climate-informed farm advisory services, ensuring that insights reach the last mile. The platform's dashboard and maps highlighting high-risk villages enable officials to target resources and advisory efforts to hotspots in advance.

- **Water Resource Management and Irrigation Schemes:** Under schemes like PMKSY and Atal Bhujal Yojana, SukhaRakshak AI can inform water allocation and conservation strategies. Its early warnings could prompt timely releases from reservoirs or the positioning of water tankers in vulnerable areas (a proactive step currently rare). Integrating AI with the Ministry of Jal Shakti's programs would promote a shift from reactive drought relief (digging new wells in crisis) to preventive action (recharging aquifers, promoting micro-irrigation when a drought forecast is issued). This also aligns with India's push for water-use efficiency – the AI can identify regions where impending drought necessitates fast-tracking micro-irrigation or rainwater harvesting projects.

- **Digital Agriculture and Data Initiatives:** SukhaRakshak AI dovetails with the government's vision for a Digital Agriculture Ecosystem (e.g., the upcoming IDEA platform). Policy support for open data sharing (from IMD, ISRO, ICAR) will enrich the AI's predictive power. Conversely, making SukhaRakshak's outputs openly accessible (as APIs or data services) allows private agri-tech apps and government portals (like Meghdoot or Kisan Suvidha) to incorporate drought alerts into their offerings. This interoperabili ty should be a policy aim, as it amplifies reach. Moreover, including SukhaRakshak in programs like the Digital Agri Mission can secure funding for continuous R&D and scaling.

In essence, aligning SukhaRakshak AI with existing policy instruments creates a win-win: the AI platform enhances the effectiveness of schemes (by adding foresight and precision), and these programs provide institutional channels to deploy the technology widely. By embedding AI-driven drought advisories into government workflows, proactive drought preparedness measures can be mainstreamed into routine agricultural planning, risk financing, and rural development initiatives. Such policy integration will ensure that this innovation does not operate in a silo but becomes an integral part of India's climate resilience strategy.

Use Cases: Multi-Stakeholder Benefits

The SukhaRakshak AI platform is designed to serve a spectrum of stakeholders by providing timely, actionable information that each can use within their domain. Key use cases and benefits include:

- **Smallholder Farmers:** For farmers, SukhaRakshak AI provides decision support well before and during droughts. They receive localized advisories (via SMS, voice, or app) on matters like when to delay planting due to an expected dry spell, or which drought-resistant crop variety to switch to if rainfall is likely to be deficient. Early warnings enable farmers to optimize water use – e.g. scheduling irrigation or adopting mulching and other water-saving techniques proactively. The system also issues guidance on protecting livestock (such as planting alternate fodder crops or utilizing government fodder depots in drought times). Crucially, timely yield forecast alerts give farmers a chance to adjust their financial plans – they might reduce input spending on a crop if poor rains are forecast, or make arrangements to cover a loan, thereby averting deeper debt. By reducing uncertainty and providing concrete advice, SukhaRakshak AI helps lower the stress and mental agony farmers face during looming droughts, instilling greater confidence and adaptive capacity on the ground.

- **Agricultural Extension Officers:** Extension agents and KVK experts use SukhaRakshak AI as a force- multiplier in outreach. The platform offers standardized, evidence-based advisories that align with national and state guidelines, which helps cut through conflicting information and ensures all farmers get a consistent message. Through geo-referenced risk maps, extension officers can pinpoint drought hotspot villages and prioritize those areas for visits and interventions. In village meetings, an officer can consult the AI dashboard in real time to answer farmer queries ("Will the rains next week be enough for sowing?") on the spot, boosting their credibility and trust with the community. SukhaRakshak's user-friendly visual tools also assist in training other frontline workers – for example, panchayat members or NGO facilitators can be quickly oriented on how to interpret and disseminate the drought advisories. Overall, the AI enables extension services to be more proactive, data-driven, and responsive to farmers' needs ahead of a drought.

- **Drought Managers and Policy Makers:** For district magistrates, disaster management officials, and policy makers, SukhaRakshak AI provides a strategic advantage in drought response planning. Early hotspot detection through the system's alerts allows officials to initiate resource allocation in advance – for instance, arranging water tankers and fodder supply to tehsils likely to be hit hardest, before severe shortages occur. The AI's monitoring dashboards also display metrics like the number of advisories issued, farmer adoption rates, and village-level preparedness indicators, which aid in evaluating the readiness and targeting of interventions. Importantly, SukhaRakshak can interface with insurance schemes and disaster funds: its data can support automatic triggers for area-yield crop insurance payouts when drought conditions meet predefined thresholds, making relief disbursement faster and more objective. Additionally, the analytics generated (trends, impact projections) help inform policy development, allowing state and national authorities to refine drought contingency plans, update drought policies, and better budget for mitigation measures using real-time evidence. In sum, SukhaRakshak AI equips decision-makers with foresight and accountability tools to shift from crisis management to risk management.

- **Insurance and Agri-Business Sector:** The private sector also stands to gain from SukhaRakshak AI's forecasts. Crop insurance companies (including those part of PMFBY) can use early drought warnings to design "index-based triggers" for payouts, reducing the time farmers wait for claims and improving trust in insurance. By analyzing SukhaRakshak's granular data, insurers can set premiums or develop new products calibrated to local risk levels, making insurance more viable and tailored to farmers' needs. Meanwhile, agri-input firms (seeds, fertilizers, irrigation suppliers) and supply chain companies (commodity buyers, food processors) use the drought forecasts to adjust their planning and logistics. For example, a seed company might pre-position drought-tolerant seed stock in regions where a drought is predicted, or a grain processor can secure produce from less-affected areas in advance to stabilize prices. Some agri- tech startups are already looking to integrate AI advisories into the farming apps used by millions of Indian farmers, thereby enhancing their offerings with climate-smart advice. Through such partnerships, the private sector not only mitigates its own risks (ensuring supply chains and customer base are resilient) but also contributes to the broader goal of agricultural drought resilience.

- **Research and Civil Society Organizations:** SukhaRakshak AI also creates value for policy makers, researchers, NGOs, and farmer organizations. Climate scientists, subject matter specialists, and agricultural universities gain access to high-resolution data on drought onset and farmer responses, supporting studies on climate impacts and the effectiveness of interventions. This evidence can feed into advocacy for improved policies (e.g., more investment in rainfed farming). NGOs and farmer producer organizations can use the platform to educate and mobilize communities, translating the scientific forecasts into local action – such as organizing community fodder banks or water-sharing arrangements when an alert is issued. By serving as a bridge between modern science and traditional knowledge, the AI also documents indigenous drought indicators (like certain animal behaviors or plant flowering patterns) and validates them against data, which can be a powerful way to engage communities and incorporate their wisdom into formal drought planning. These stakeholders ensure the last-mile connectivity of SukhaRakshak AI, fostering greater social capital and inclusivity in the fight against drought.

SukhaRakshak AI's multi-tiered functionality—from supporting farm-level decisions to informing policy and planning—demonstrates how technology can enable stakeholders across the agricultural value chain to make timely, data-driven choices. Each actor's decisions, guided by AI insights, collectively strengthen the system's ability to anticipate and manage drought conditions.

Recommendations for Policy Makers

To harness the full potential of SukhaRakshak AI and institutionalize anticipatory drought management, we propose the following recommendations for policymakers:

1. **Integrate AI into Official Drought Protocols:** Formally incorporate SukhaRakshak AI outputs into state and national drought declaration processes. For example, state governments should use the platform's drought indicators alongside the Manual for Drought Management criteria to support faster, data -driven declarations and activation of relief measures. This integration lends scientific objectivity to what is often a politicized process, ensuring early warnings translate into early government action.

2. **Embed in State Contingency Plans and Extension Services:** Mandate the use of SukhaRakshak AI within District Agriculture Contingency Plans and routine agricultural extension. State Agriculture Departments, in collaboration with ICAR institutions like CRIDA, IISWC, CAZRI, IIWM should configure the AI system with their specific contingency plan triggers. Extension officers and KVKs must be trained to rely on SukhaRakshak advisories as the primary source for drought-related farmer guidance. This will mainstream proactive advisories (e.g. advice on crop/variety changes, water saving) as a regular extension function, not just an emergency measure.

3. **Align with Disaster Management and Finance Mechanisms:** Ensure coordination between agricultural and disaster management agencies to utilize SukhaRakshak AI. NDMA and state DM authorities should partner in deploying the AI so that its warnings feed into disaster preparedness steps (like positioning relief supplies). The National and State Disaster Response Funds guidelines could be updated to allow pre- emptive use of funds when SukhaRakshak signals an impending severe drought, enabling financing of mitigation actions (fodder provisioning, tank repairs, MGNREGA works) ahead of time.

4. **Strengthen Data Infrastructure and Sharing:** Invest in the required digital infrastructure to support AI- driven agriculture advisories. This includes expanding automated weather stations, hydrological instrumentations, and soil moisture sensors in every block, improving internet connectivity in rural areas for real-time data access, and enforcing open data sharing from IMD, ISRO, and other agencies so that SukhaRakshak AI and similar services have seamless access to high-quality data. A robust data ecosystem will continuously improve the accuracy and lead time of drought forecasts.

5. **Public–Private Partnerships for Scale:** Leverage partnerships with the private sector to scale out SukhaRakshak AI nationwide. Encourage collaborations with agri-tech companies, telecom providers, and farmer platforms to integrate AI advisories into existing digital apps and SMS networks that farmers use. Such partnerships can accelerate user enrollment and disseminate advisories widely at minimal cost. Additionally, involve insurance companies in the partnership – e.g., using SukhaRakshak's analytics, insurers can develop innovative products and faster claim settlement processes, which policymakers can promote under schemes like PMFBY.
6. **Link Crop Insurance and Credit to Early Warnings:** Make SukhaRakshak AI an integral part of the crop insurance framework. Policymakers should work with insurers to establish parametric triggers (for drought onset or yield loss) based on AI indicators, so that farmers receive automatic insurance payouts when conditions cross hardship thresholds. Similarly, direct banks and rural credit institutions to consider AI- based drought forecasts when restructuring crop loans or offering interest subvention – rewarding farmers who take proactive steps (like investing in protective irrigation) in response to advisories.

7. **Capacity Building and Training:** Launch a national capacity building program on AI-driven climate services for agriculture. This should train officials at all levels – from village extension workers up to state agricultural secretaries – on interpreting SukhaRakshak AI outputs and acting on them. Regular mock drills and workshops (especially pre-monsoon) can be held to practice using the platform for decision-making. Incorporate modules on SukhaRakshak in the curriculum of State Agricultural Universities and administrative training institutes, ensuring the next generation of officials and agri-professionals are AI- ready. Ultimately, an informed and trained human network is critical for last-mile delivery of any digital advisory.

8. **Localization and Inclusive Access:** Direct policy attention to last-mile inclusion by NRAA so that SukhaRakshak AI benefits all sections of society. This involves continuing to expand local language coverage and dialect customization of advisories and using multiple channels (IVR phone calls for areas with low literacy, community radio, etc.) to reach marginalized farmers. Policymakers should ensure women farmers, tenant farmers, and tribal communities are specifically targeted through self-help groups and local NGOs for receiving and trusting the advisories. Feedback loops (village meetings, WhatsApp groups) should be institutionalized for farmers to ask questions and provide local insights, which the AI can learn from – fostering a two-way information flow for better uptake.

9. **Sustainable Financing and Incentives:** Establish sustainable funding models to support SukhaRakshak AI's operations and expansion. The government can allocate a dedicated budget line under climate adaptation or digital agriculture missions to maintain the AI system (data updates, cloud costs, improvements). Explore climate finance avenues – for example, seeking support from the Green Climate Fund or World Bank for scaling the service as a public good. Policymakers should also consider incentivizing states (perhaps via performance grants) that actively use early warnings to reduce drought impacts. Showcasing reductions in crop loss or relief expenditure due to SukhaRakshak usage can build a case for long-term investment in such technologies.

10. **Monitor, Evaluate, and Iterate Policies:** Finally, adopt a learning approach – use SukhaRakshak AI's deployment as an opportunity to learn what works in anticipatory drought governance. Mandate periodic reviews and independent evaluations of outcomes in pilot districts using the AI (e.g.: Was crop loss avoided?; Did farmer income stabilize?). Use these insights to update national drought policies and action plans. For instance, positive results might lead to making AI-based early warning systems a standard part of India's drought preparedness policy and scaling similar models for other climate risks (floods, heatwaves). Continuous feedback from research institutes and ground agencies should be looped back into policy refinement in collaboration with NRAA and NDMA, ensuring that as the technology evolves (e.g., incorporating traditional knowledge or new climate models), the regulatory and institutional framework adapts correspondingly.

By implementing these recommendations, policymakers can create an enabling environment for SukhaRakshak AI to flourish and make a tangible impact. The goal is a future where every farmer and official in India treats drought forecasts and early action as routine practice, significantly reducing the hardship and losses from droughts. Bridging innovation with policy support will help realize the vision of moving from crisis-driven drought relief to a culture of preparedness and resilience in Indian agriculture.

References

Atal Bhujal Yojana (Atal Jal) Accessed on 5th August 2025 https://ataljal-mis.mowr.gov.in/

Bahinipati C.S. 2020. "Assessing the Costs of Droughts in Rural India a Comparison of Economic and Non-Economic Loss and Damage." *Current Science* 118(11):1832–41.

Chaiechi, Taha, ed. 2021. "Economic Effects of Natural Disasters: Theoretical Foundations, Methods, and Tools." London: Academic Press

District Agriculture Contingency Plans Accessed on 7th August 2025 https://www.icar- crida.res.in/assets/img/Books/2011-12/contingency%20plans%20book.pdf

Gramin Krishi Mausam Seva (GKMS). Accessed on 5th August 2025 https://www.pib.gov.in/PressReleaseIframePage.aspx?PRID=1906389

Gupta, A., Tyagi, P. and Sehgal, V. K., 2011. "Drought disaster challenges and mitigation in India: strategic appraisal." Current Science 100(12), 1795–1806.

IPCC (2007) Climate Change 2007: the physical science basis. In: Solomon S, Quin D, Manning M, Chen X, Marquis M, Averyt KB, Tignor HL, Miller M (eds) Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change. Cambridge University Press, Cambridge, pp 1–996

Jal Jeevan Mission. Accessed on 5th August 2025. https://jaljeevanmission.gov.in/

National Agriculture Policy (2000) Accessed on 8th August 2025. https://mdcollege.in/wp- content/uploads/2023/09/National-Agricultural-policy-.pdf

National Agroforestry Policy (2014) Accessed on 5th August 2025 https://faolex.fao.org/docs/pdf/ind203552.pdf

National Disaster Management Authority (NDMA) Drought Guidelines (2010) Accessed on 5th August 2025 https://ndma.gov.in/Governance/Guidelines

National Innovations in Climate Resilient Agriculture (NICRA). Accessed on 2nd August 2025 https://www.dhenkanalkvk.org/nicra.html

National Mission for Sustainable Agriculture (NMSA). Accessed on 1st August 2025 https://nmsa.dac.gov.in/

Paramparagat Krishi Vikas Yojana (PKVY) Accessed on 5th August 2025 https://www.myscheme.gov.in/schemes/pkvy

Pradhan Mantri Fasal Bima Yojana (PMFBY) Accessed on 5th August 2025 https://pmfby.gov.in/ *Pradhan Mantri Krishi Sinchayee Yojana (PMKSY)* Accessed on 5th August 2025 https://pmksy.gov.in/ Soil Health Card Scheme. Accessed on 5th August 2025 https://soilhealth.dac.gov.in/

CGIAR is a global research partnership for a food-secure future. CGIAR science is dedicated to transforming food, land, and water systems in a climate crisis. Its research is carried out by 13 CGIAR Centers/Alliances in close collaboration with hundreds of partners, including national and regional research institutes, civil society organizations, academia, development organizations and the private sector. www.cgiar.org

To learn more about this program, please visit: https://www.cgiar.org/cgiar-research-portfolio-2025-2030/climate-action/

Contact

Giriraj Amarnath, Research Group Leader - Water Data for Climate Resilience (WDCR) and Principal Researcher – Disaster Risk Management and Climate Resilience, IWMI, Colombo, Sri Lanka (a.giriraj@cgiar.org)

CGIAR | CLIMATE ACTION | SUSTAINABLE FARMING | DIGITAL TRANSFORMATION

IWMI International Water Management Institute | ICAR