

Capacity for Change: Strategic Pathways to Scale Climate-Smart Agriculture in Jordan



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Abstract

Climate-Smart Agriculture (CSA) is an integrated framework for building resilience in agricultural system, promoting environmental sustainability, and addressing pressing challenges of food security and water scarcity. The widespread adoption of CSA in Jordan faces significant barriers, including financial constraints and inadequate capacity development.

The paper investigates capacity development needs to effectively promote and scale CSA, supporting Jordan's Economic Modernisation Vision objectives. The paper identifies key capacity gaps and outlines strategic pathways for advancing CSA. It argues that a successful national transition depends on targeted strategies across three interrelated levels: Policy, Finance, and Knowledge and Capacity Building. Key findings indicate that effective CSA implementation requires creating coherent policy incentives, strengthening knowledge-sharing systems - including establishment of actionable climate information services - and developing tailored financial instruments. The paper concludes with recommendations designed to strengthen the enabling environment and accelerate the transition toward a more productive, resilient, and climate-smart agricultural sector.

الملخص

الزراعة الذكية مناخياً هي إطار عمل متكامل لبناء المرونة في النظم الزراعية، وتعزيز الاستدامة البيئية، ومعالجة التحديات الملحة للأمن الغذائي وندرة المياه. يواجه التبني الواسع للزراعة الذكية مناخياً في الأردن عوائق كبيرة، أبرزها العوائق المالية وتنمية القدرات.

تبحث هذه الورقة في احتياجات تنمية القدرات اللازمة للتوسع في نطاق الزراعة الذكية مناخياً، ودعم أهداف رؤية التحديث الاقتصادي في الأردن. كما تستعرض هذه الورقة الفجوات الرئيسية في القدرات الحالية، وتقترح مسارات استراتيجية للنهوض بالزراعة الذكية مناخياً. مُبرزة أن النجاح في الانتقال الوطني نحو الزراعة الذكية مناخياً رهينُ بتكامل السياسات والتمويل وبناء المعرفة والقدرات. وتُظهر النتائج أن التنفيذ الفعال للزراعة الذكية مناخياً يتطلب وضع سياسات داعمة وحوافز مُحفزة، وتعزيز أنظمة تبادل المعرفة - بما في ذلك تطوير خدمات معلومات مناخية قابلة للتطبيق - وإتاحة برامج مالية مُصممة خصيصاً لهذا الغرض. وفي ضوء ذلك، تقدّم الورقة جملةً من التوصيات الهادفة إلى تعزيز البيئة التمكينية وتسريع الانتقال نحو قطاع زراعي أكثر إنتاجية ومرونة وذكي مناخياً.

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1 Introduction

Jordan's agricultural sector faces profound and interconnected challenges that are critical to the nation's food security and economic stability. As a resource-poor, food-deficit country with extreme water scarcity, Jordan's agricultural challenges are significantly exacerbated by climate change. The sector, which contributes 4.9 percent to the country's Gross Domestic Product (GDP)¹ and employs around 5.5 percent of its workforce,² is increasingly threatened by rising temperatures, erratic rainfall, and a higher incidence of droughts and heatwaves. These environmental pressures intensify long-standing structural constraints, such as limited arable land, and reinforce a stark import dependency, with nearly 98 percent of Jordan's consumable food items being imported³ at an annual cost of approximately 3 billion USD.⁴ Despite growth in high-value exports like fruits and vegetables, the country's grain self-sufficiency remains critically low, with wheat and barley reserves covering less than a year of domestic consumption.⁵

The Jordan Economic Modernisation Vision (EMV) 2023-2033 prioritises a transition toward a more resilient and efficient agricultural sector, emphasising sustainable resource management and climate-smart innovation. Achieving this transformation necessitates a paradigm shift toward Climate-Smart Agriculture (CSA), an integrated approach designed to enhance climate resilience, food security, and environmental sustainability concurrently. However, the effective scaling of CSA is constrained by significant capacity gaps, including limited financial resources, insufficient technical support, inadequate knowledge dissemination, and institutional coordination weaknesses. This paper, therefore, identifies and analyses the specific capacity development prerequisites and strategic action points required to catalyse this shift, structured across three levels: 1) Policy Level, encompassing cross-ministerial coordination, regulatory frameworks, and the creation of an enabling environment; 2) Finance Level, examining mechanisms, incentives, and instruments to de-risk and fund CSA transitions; and 3) Knowledge and Capacity Building, focusing on strengthening extension services, climate information systems, and the skills of all actors. The paper is guided by the following research question:

- What are the critical capacity development needs for scaling Climate-Smart Agriculture in ways to enhance Jordan's food security and significantly reduce its agricultural water footprint?

1.1 Climate-Smart Agriculture Framework

CSA is a conceptual framework for transforming and supporting existing agricultural systems under climatic stress. First conceptualised by the Food and Agriculture Organisation (FAO) in 2010, it was developed with a strong focus on ensuring food security under current and future climatic conditions.⁶

¹ Jordan's Economic Modernisation Vision 2023-2025, <https://www.jordanvision.jo/>, page 37.

² Jordan's Economic Modernisation Vision 2023-2025, <https://www.jordanvision.jo/>, page 37.

³ International Trade Administration, "Jordan - Agricultural Sectors," Country Commercial Guides, last modified January 17, 2024, <https://www.trade.gov/country-commercial-guides/jordan-agricultural-sectors>.

⁴ A January 2024 report indicated that Jordan imported \$2.8 billion in consumer-oriented products in 2021. While a final figure for the full 2024 calendar year has not yet been published, the \$2.8 billion figure remains the most commonly cited benchmark for the annual cost of food imports.

⁵ Jordan's Economic Modernisation Vision, first quarter of 2025 performance report.

⁶ Food and Agriculture Organization of the United Nations, 2010. "Climate-Smart" Agriculture: Policies, Practices and Financing for Food Security, Adaptation and Mitigation.

CSA explicitly aims for three core, synergistic objectives, which distinguish it from singularly focused agricultural interventions:⁷

1. **Productivity and food security:** sustainably increasing yields and improving farmers' incomes, food security, and overall development, while ensuring natural resource conservation.
2. **Adaptation and resilience:** building and enhancing the resilience of agricultural systems to withstand climate-related shocks and stresses.
3. **Mitigation:** reducing greenhouse gases (GHGs) emissions from the agriculture sector to minimise its environmental footprint.

A core tenet of CSA is its explicit consideration of climatic risks that are occurring with greater intensity and frequency. This necessitates proactive transitions in agricultural technologies and approaches to improve the livelihoods and to prevent the loss of hard-won developmental gains. The framework advocates for the concurrent consideration of its three objectives across spatial scales—from farm to landscape—and across governance levels, from local to global, with implementation pathways tailored to specific national and local contexts and priorities.⁸

This holistic approach is particularly pertinent to Jordan's condition, where the severe constraints of water scarcity, high import dependency, and extreme vulnerability to climate change require solutions that simultaneously address productivity, adaptation, and resource efficiency. Consequently, CSA is not a standardised package of technologies but an integrated on-farm management with off-farm interventions, supported by aligned policies, institutional arrangements, and strategic investments.⁹

1.2 CSA Adoption Landscape in Jordan

The current status of CSA in Jordan is characterised by a clear strategic recognition but coupled with fragmented implementation and significant on-the-ground barriers. The Jordanian government has integrated CSA as a priority within key policy frameworks, including the dedicated Jordan Climate-Smart Agriculture Action Plan (2021),¹⁰ the National Food Security Strategy (2021-2030),¹¹ and the Green Growth National Action Plan (2021-2025).¹² This reflects a crucial political consensus that CSA is a core component to the country's climate adaptation and economic resilience agenda, particularly given that the agricultural sector is the most climate-vulnerable of all sectors in the country.¹³

⁷ Food and Agriculture Organization of the United Nations, 2013. Climate-Smart Agriculture Sourcebook.

⁸ FAO, 2021. Synergies and trade-offs in climate-smart agriculture – An approach to systematic assessment. Rome. <https://doi.org/10.4060/cb5243en>.

⁹ FAO, 2013. Climate-Smart Agriculture Sourcebook.

¹⁰ World Bank. Jordan - Climate-Smart Agriculture Action Plan: Investment Opportunities in the Agriculture Sector's Transition to a Climate Resilient Growth Path (English). Washington, D.C.: World Bank Group. <http://documents.worldbank.org/curated/en/099105005092240188>.

¹¹ United Nations in Jordan, 2022. The National Food Security Strategy 2021 - 2030. <https://jordan.un.org/en/201684-national-food-security-strategy-2021-2030>.

¹² Ministry of Environment, "Agriculture Sector Green Growth National Action Plan 2021-2025," 2020. Amman, The Hashemite Kingdom of Jordan.

¹³ Ahmad Abdel-Fattah and Masnat Al Hiary, 2023. "A Participatory Multicriteria Decision Analysis of the Adaptive Capacity-Building Needs of Jordan's Agribusiness Actors Discloses the Indirect Needs Downstream the Value Chain as 'Post-Requisites' to the Direct Upstream Needs." *Frontiers in Sustainable Food Systems*, Vol. 6. <https://doi.org/10.3389/fsufs.2022.1026432>.

However, this recognition has not yet translated into a coherent, cross-sectoral operational framework. The existence of a standalone CSA action plan, without an overarching strategy to harmonize actions across the water, agriculture, energy, environment, and finance ministries, exemplifies a critical gap between policy endorsement and integrated execution.

At the farm level, the adoption of integrated CSA practices remains limited and inconsistent. Farmers, particularly smallholders who are the backbone of Jordan's agricultural sector, face significant barriers including the high initial cost of technology, insufficient technical support, lack of localised knowledge transfer, and insufficient access to modern technologies. These constraints, combined with limited stakeholder coordination, inhibit the transition from traditional practices to climate-resilient farming methods,¹⁴ and have hindered the widespread adoption of CSA practices. Furthermore, the implementation has been heavily reliant on international project funding, creating a dependency that challenges long-term sustainability and nationally-driven progress.

The result is a dual reality: while a strong strategic vision for CSA exists at the national level, its translation into effective, widespread field-level implementation remains limited.¹⁵ To bridge this gap, this paper provides an analysis of the specific capacity development needs required to translate policy into practice, examining the critical constraints and opportunities across the enabling policy environment, organisational and institutional, and individual dimensions.

2 Methodology

The research employed a qualitative methodology to investigate the capacity development prerequisites for promoting and scaling CSA in Jordan. The study was grounded in a two-stage data collection process: a comprehensive desk review of secondary data followed by the collection of primary data through Key Informant Interviews (KIIs).

The desk review involved a systematic examination of national policy and strategies documents, including the Jordan Climate-Smart Agriculture Action Plan (2021), the National Food Security Strategy, and the Economic Modernisation Vision (2023-2033), alongside academic literature, and project reports from key national and international organisations. This initial analysis mapped the existing CSA policy and institutional landscape, identified proven and suitable technologies for Jordan's agro-ecological zones, and analysed systemic barriers to adoption, thereby providing the critical baseline for informing the subsequent primary data collection.

Primary data was collected through eight semi-structured KIIs with representative from a diverse range of stakeholders, including government entities, farmers, Non-Governmental Organizations (NGOs), research institutions, and the private sector.¹⁶

¹⁴ Anber Abraheem Shlash Mohammad, Sulciman Mohammad, Khaleel Ibrahim Al Daoud, Badrea Al Oraini, Asokan Vasudevan, and Zhidong Feng, 2025. Building Resilience in Jordan's Agriculture: Harnessing Climate Smart Practices and Predictive Models to Combat Climatic Variability. *Research on World Agricultural Economy*. 6(2): 171–191. DOI: <https://doi.org/10.36956/rwae.v6i2.1628>.

¹⁵ Frank Van Weert, Marijn Gülpen, and Gert-Jan Wilbers, 2022. Climate-Smart Agriculture in Egypt and Jordan; Building blocks for a vision to create a climate-resilient agricultural sector. Wageningen, Wageningen Environmental Research, Report 3218.

¹⁶ The majority of KIIs were conducted in-person. In circumstances where face-to-face interviews were not possible, the author conducted online and phone call interview. Before each interview started, informed consent was obtained from all participants using an approved consent form.

The stakeholder selection was based on three main criteria: 1) their institutional authority and mandate; 2) their direct, practical experience and technical knowledge in implementing CSA technologies; and 3) their demonstrated influence on adoption and scaling through funding, technical assistance, or market access.

The data analysis integrated findings from both data streams. The secondary data synthesis provided the contextual framework, while the qualitative data from the KIIs was subjected to thematic analysis to identify points of consensus and divergence regarding effective interventions, implementation barriers, and strategic pathways across the three interdependent levels critical for CSA scaling in Jordan: Policy; Finance; and Knowledge and Capacity Building. This triangulation of secondary and primary evidence enabled the identification of specific constraints within each strategic level and the formulation of evidence-based, context-specific policy recommendations. The following sections of this paper details these findings and the resulting recommendations.

3 Analysis and Findings: Challenges and Gaps in CSA Implementation

Jordan has made commendable strides in recognising the importance of sustainable agricultural practices, with several initiatives already laying the groundwork for a more resilient sector. However, the analysis-informed by secondary data, KIIs, and field visits-reveals that significant gaps remain, particularly in the widespread adoption of CSA. The potential transformation is currently hindered by a deficit in capacity development across three levels: policy, finance, and knowledge and capacity building. This section examines these areas to strengthen existing frameworks and achieve the scale necessary to effectively counter water scarcity and climate-driven pressures.

3.1 At the Policy Level

Jordan's policy landscape provides a robust and strategic foundation for sustainable agricultural development. To further catalyse the widespread adoption and scaling of CSA, the paper identified critical policy areas that require further enhancement to bridge the gap between strategic planning and on-the-ground implementation:

- Technical and Operational Scope of the CSA Action Plan

The existing World Bank-supported CSA action plan provides a foundational framework for integrating climate resilience into the agricultural sector. It prioritises six specific CSA investment packages, two for each of Jordan's primary agro-ecological zones: irrigated, rainfed, and agropastoral areas. This zonal prioritisation is a significant step toward targeted intervention. To build on this, the next step involves enriching these broad packages with more technical depth and operational guidance. For example, the plan identifies "Expanding and upgrading protected vegetable production in the Jordan Valley" as a priority, it does not yet offer the detailed, localised implementation roadmaps required to address the different water requirements and soil conditions found between the Northern and Southern Jordan Valley. This approach within the zones risks overlooking the unique vulnerabilities of smallholder farmers who may lack the capital to adopt the high-tech components of these prioritised packages. Furthermore, augmenting the plan with a robust, data-driven monitoring framework to track real-time adaptation outcomes at the farm level, enabling continuous learning and adaptive management.

Without refining these broad packages into context-specific toolkits that account for localised micro-climates and socio-economic constraints, the transition from strategic prioritisation to widespread on-the-ground adoption remains a significant challenge for the Ministry of Agriculture and its partners.

- Investment Incentives and Regulatory Frameworks

The Economic Modernisation Vision, through both its Phase I and Phase II executive programs, places a strong emphasis on fostering smart-innovation and creating a fertile environment for private sector involvement in national agricultural development. This strategic orientation is designed to establish an "attractive" and competitive investment landscape within Jordan, signalling a clear high-level commitment to sector-wide transformation. To fully realise this vision, there is an opportunity to develop more specific de-risking mechanisms and Public-Private Partnership (PPP) models necessary for empowering private sector investors and attracting large-scale capital to CSA. Currently, the absence of standard operating procedures for investing in smart technologies, resulting difficult administrative processes.¹⁷ Clarifying and simplifying regulations for emerging agri-tech and climate-resilient infrastructure would reduce perceived risks and bolster the continuity of the investment process. As well as developing a targeted financial incentive, such as targeted tax breaks or green subsidies, would further enhance the attractiveness of CSA investments.

3.2 At the Finance Level

The Ministry of Agriculture, primarily through the Agricultural Credit Corporation, provides farmers with loans and funds. Currently, farmers use this capital to finance expansions or improvements within conventional, resource-intensive farming systems-practices they know and trust for immediate returns.^{18 19}

The challenge, therefore, is the misalignment between how existing capital is currently used and the national priority of climate resilience shift to CSA. This presents a clear opportunity: to evolve the current financial ecosystem by introducing purpose-built instruments that make CSA investments more viable for farmers. Building directly on the existing loan infrastructure, for example, could involve creating targeted "green loans" with favorable terms for verified CSA practices. Integrating new tools like index-based climate insurance would protect investments against droughts or extreme heat.²⁰ Additionally, strategically conditioning a portion of existing subsidies to reward proven gains in water or energy efficiency could steer financial flows toward resilience.²¹ Layering these tailored instruments onto the existing financial foundation would help bridge the gap between current usage and the strategic need to fund a sector-wide transition.

¹⁷ Interview with a private sector representative in the climate-smart agricultural technologies, interview by the author, via online video meeting, November 6, 2025.

¹⁸ Interview with an agricultural expert, interview by the author, via online video meeting, November 6, 2025.

¹⁹ Interview with local farmers, Mafrq Governorate, interview by the author, Mafrq, Jordan, November 3, 2025.

²⁰ Interview with an agricultural expert, interview by the author, via online video meeting, November 6, 2025.

²¹ Interview with a senior researcher, National Agricultural Research Centre (Al-Khalidiyah station), interview by the author, Mafrq Governorate, Jordan, November 3, 2025.

3.3 At the Knowledge and Capacity Building Level

- Agricultural extension services to drive CSA

Agricultural extension services are widely recognized as a cornerstone for driving on-farm innovation and are essential for translating CSA into practice. The current extension framework provides a necessary foundation for outreach. To amplify its impact in facilitating a sector-wide shift toward CSA, there is an opportunity to deepen its approach. Moving beyond general advisories, the service's effectiveness could be enhanced by more structured, long-term engagement models, such as Farmer Field Schools (FFS) and targeted training programs. These tools are particularly valuable for generating practical, locally validated evidence of CSA benefits tailored to different scales and agro-ecological zones. A significant strength of this approach lies in its potential to formally integrate valuable traditional knowledge-practices farming communities have refined over generations-with scientific innovation. Blending these knowledge systems fosters co-created solutions that are contextually relevant and build greater trust and ownership among farmers. Additionally, peer-to-peer learning and experience sharing among farmers, they can help build informal networks that accelerate the adoption and adaptation of successful practices.

A broader consideration for strengthening the knowledge ecosystem is the relationship between research, academia, and extension. Valuable insights from on-farm trials or successful FFS pilots are often not systematically compiled or scaled into widely accessible knowledge resources.²² Strengthening this linkage would help ensure that local evidence and innovations inform both broader farmer support and future policy, creating a more resilient and self-sustaining knowledge base for CSA transformation.

- Climate Information and Early Warning Systems

The effectiveness of agricultural decision-making is increasingly linked to access to reliable climate information. In Jordan, initial groundwork has been laid through various projects that have installed agro-meteorological stations, signaling a recognition of this need. The current opportunity lies in transforming these discrete infrastructure investments into a cohesive, operational service for farmers.^{23 24}

For CSA adoption to be effective, farmers require actionable, localised data-such as precise short-term forecasts for irrigation timing or early warnings for extreme events like frosts or flash floods-to optimise their investments in resilient practices. At present, however, the available climate information services are not yet widely accessible or tailored to specific agricultural decision-making.²⁵ This gap means farmers often must rely on traditional knowledge and general forecasts, which can be insufficient for managing the specific risks and precision required by many CSA technologies.²⁶ Consequently, the full potential of investments in water-saving technologies or adapted crop varieties may not be realised.

²² Interview with a senior researcher, National Agricultural Research Centre (Al-Khalidiyah station), interview by the author, Mafrq Governorate, Jordan, November 3, 2025.

²³ Interview with a senior researcher, National Agricultural Research Centre (Al-Khalidiya station), interview by the author, Mafrq Governorate, Jordan, November 3, 2025.

²⁴ Interview with the manager of the Food Security and Biodiversity Studies Division, Royal Scientific Society, interview by the author, Amman, Jordan, November 4, 2025.

²⁵ Interview with local farmers, Mafrq Governorate, interview by the author, Mafrq, Jordan, November 3, 2025.

²⁶ Ibid.

Building on the existing infrastructure, a clear pathway forward involves integrating these stations into a dedicated agricultural climate service. The focus would be on processing raw data into user-friendly advisories and timely alerts delivered through accessible channels, such as mobile technology. Developing this integrated system, which combines meteorological data, remote sensing, and agronomic insights, would provide a foundational tool for proactive farm management. It represents a critical step in enabling data-driven decisions that enhance both productivity and resilience.

4 Recommendations: Strategic Pathways for CSA Implementation

Based on the constructive analysis of existing frameworks, the following strategic considerations are proposed to enhance Jordan's climate resilience efforts. These suggestions aim to build upon current systems, offering a pathway to greater alignment, accessibility, and impact.

At the policy level:

1. **Deepen the technical and operational scope of the CSA Action Plan** by developing localised implementation roadmaps and context-specific toolkits for the interventions. This would ensure that national strategies account for distinct local conditions; such as micro-climates, soil variations, and socio-economic constraints; and include data-driven monitoring to track farm-level adaptation outcomes.
2. **Translate high-level investment incentives into actionable frameworks** by establishing clear Public-Private Partnership models, streamlined administrative procedures for smart agriculture investments, and targeted financial instruments to attract private capital and reduce perceived risks for CSA adopters.

At the Finance Level:

3. **Evolve existing financial mechanisms** by tasking the Agricultural Credit Corporation, in partnership with commercial and microfinance institutions, to design and promote accessible, concessional loans or funds explicitly linked to verified CSA investments.
4. **Introduce complementary risk-mitigation tools**, beginning with the piloting and scaling of climate index-based insurance schemes that provide automatic payouts for predefined shocks, thereby de-risking farmer investment and enhancing lender confidence.

At the Knowledge and Capacity Level:

5. **Strengthen the national extension service** by establishing a network of long-term Farmer Field Schools as community-based learning hubs, blending indigenous knowledge with validated CSA practices, and equipping agents with participatory and digital tools to foster peer learning.
6. **Develop a unified agricultural climate service** by creating a user-friendly digital platform that delivers localised agro-meteorological data, CSA advisories, and early warnings directly to farmers, supported by enhanced collaboration between meteorological, agricultural, and research institutions.

5 Conclusion

The escalating pressures of climate change and water scarcity present a critical imperative for Jordan to fundamentally transform its agricultural sector. Climate-Smart Agriculture provides the necessary, integrated framework to achieve this, aligning national objectives for food security, resource conservation, and economic resilience. This analysis confirms that a successful transition depends not on technological availability alone, but on a systemic paradigm shift to address interconnected capacity deficits.

The findings demonstrate that the widespread adoption of CSA is constrained by gaps across three strategic levels: Policy, Finance, and Knowledge and capacity building. Promising practices will remain underutilised without remedying the foundational challenges. This requires moving beyond isolated projects to create a coherent national strategy that incentivises sustainable practices, unlocks tailored investment, and ensures cross-ministerial coordination. Specifically, transforming extension services into active hubs for knowledge co-creation and establishing a robust climate information system are essential to bridge the gap between innovation and on-farm application. Concurrently, developing a dedicated financial ecosystem-with de-risking instruments and reformed incentives-is crucial to making the economic case for CSA viable for all farmers.

Supporting this integrated, multi-level capacity development represents the most strategic investment for securing Jordan's agricultural future and directly advancing the goals of the Economic Modernisation Vision 2033. By implementing the evidence-based recommendations outlined in this paper; focusing on institutional coherence, financial innovation, and revitalised knowledge systems; Jordan can systematically build a more productive, resilient, and sustainable agricultural sector. This proactive pathway is essential to safeguarding the nation's food and water security for generations to come.



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