



# Agile Agronomy for Climate Action



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## Executive Summary

This strategy paper underscores the urgent necessity for climate change adaptation in agriculture, emphasizing its crucial role in safeguarding the livelihoods of both present and future generations. It outlines how agronomy, which offers varied tools to modify how crops experience their environment, can reduce many climate-related risks. Crucially, the paper emphasizes the need for innovative models that can amplify the impact of agronomic climate action, steering transformative change at a large scale rapidly.

The Excellence in Agronomy Initiative (EiA), spearheaded by CGIAR, aims to be at the forefront of that transition. Drawing inspiration from agile methodologies prevalent in the technology sector, EiA is pioneering a user-centric, demand-driven approach to developing and implementing agronomic research programs on adaptation with mitigation co-benefits. The primary goal is to equip 55 million smallholder farmers with the tools necessary to adapt to climate change by 2030, with particular attention to women and youth.

### Box 1. Who Should Read This Paper?

This strategic paper is written for many stakeholders, all of whom are essential to advancing the agricultural change that EiA aims to support. Suppose any of the following apply to you. In that case, we encourage you to explore these pages:

- Researchers will learn about tactics, best practices, and examples of how agronomy contributes to climate change adaptation and resilience from this paper.
- Agricultural Advisors can use the examples presented in this paper as a resource for specific illustrations of extension-enabled adaptation.
- Policymakers can understand the case for agronomy's effectiveness in supporting climate change adaptation.
- Development Practitioners and NGOs will be equipped with many strategies to incorporate into your programs and new initiatives.
- The private sector will find valuable insights to develop and align your products and services with the needs of smallholder farmers facing climate change.

We hope this strategy paper starts a conversation with you.

EiA operationalizes its strategy through applied Use Cases and innovative research for development. Use Cases are executed in over 20 countries, addressing a broad spectrum of agronomic issues tailored to specific public and private sector partner requests. These projects not only offer locally relevant solutions but also generate insights applicable on a global scale, promoting efficiency and scalability. Some of the EiA's work explores innovative research questions and driving reform in agronomic research practices.

EiA's climate-related strategic research program embodies this approach, spanning theoretical inquiries to practical implementation. It addresses critical knowledge gaps while promoting a paradigm shift in agronomic research, guided by approaches leveraging big data and the principles of findability, accessibility, interoperability, and reusability. EiA's processes undergo regular evaluations to ensure continued relevance and impact, mirroring the adaptive spirit it advocates.

By leveraging agile, user-centric strategies, Use Cases, and strategic research, EiA research, outreach, and capacity building is poised to help agronomy to be more adaptive, accessible, and effective in service to the farming community and food system.

## Adaptation is no Longer an Option, Now it is an Imperative

Current countries' climate commitments place us in a trajectory to a warmer, 2.7 to 3.2 degrees Celsius, world by the end of the century (IPCC 2023). This projected increase far exceeds the 1.5-to-2.0-degree Celsius thresholds widely regarded as the critical limits beyond which the impacts of climate change become significantly more severe. The dire consequences of such a temperature rise include more frequent and severe heatwaves, droughts, floods, and other extreme weather events (IPCC 2023). It is important to recall that the 1.5-degree threshold refers to a global average and thus conceals significant regional differences. The magnitude and rate of temperature rise, and impacts will be unequal across regions. Some regions, particularly those in the tropics and sub-tropics, are projected to experience temperature increases and the corresponding changes in weather that exceed this average. The changing climate means that agriculture needs to begin to respond today but will also need to respond continuously in the future to new conditions as they arise.

Indeed, most of the 600-plus million small-scale producers globally live in regions already experiencing the impacts of climate change. From 1974 to 2013, climate change has been associated with decreased yields of maize, rice, and wheat by -5.8%, -3.1%, and -2.3% in Sub-Saharan Africa, and by 1.0%, -0.8%, and -0.9% in Western, Southern, and Southeastern Asia, respectively (Ray et al., 2019). Furthermore, climate change has reduced total factor productivity—a key economic measure—by an estimated 20% globally, and up to 40% in Africa and Asia since 1961 (Ortiz-bobea et al., 2021). Extreme events related to climate change have also resulted in agricultural losses in low- and middle-income countries, estimated at US\$108 billion between 2008 and 2018 (FAO, 2021). Climate change is also intensifying climate variability related to ENSO (El Niño Southern Oscillation), which is a key driver of drought occurrence and productivity loss in many areas across the tropics and subtropics (Funk et al., forthcoming). These productivity losses, both from changing average conditions and extreme events, highlight the severe current impacts of climate change and provide a stark forecast for the years ahead.

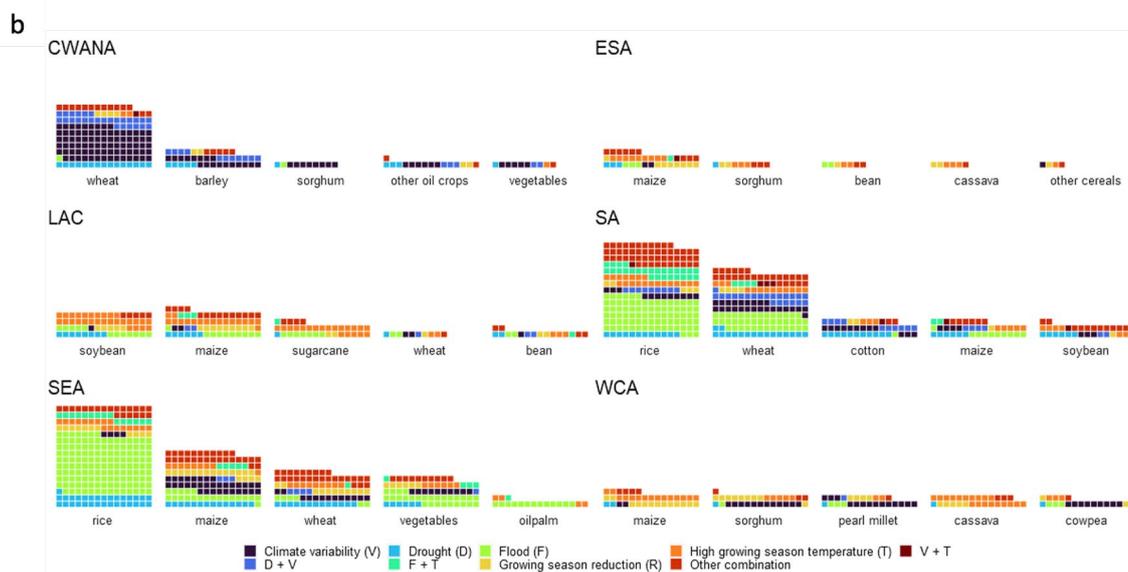
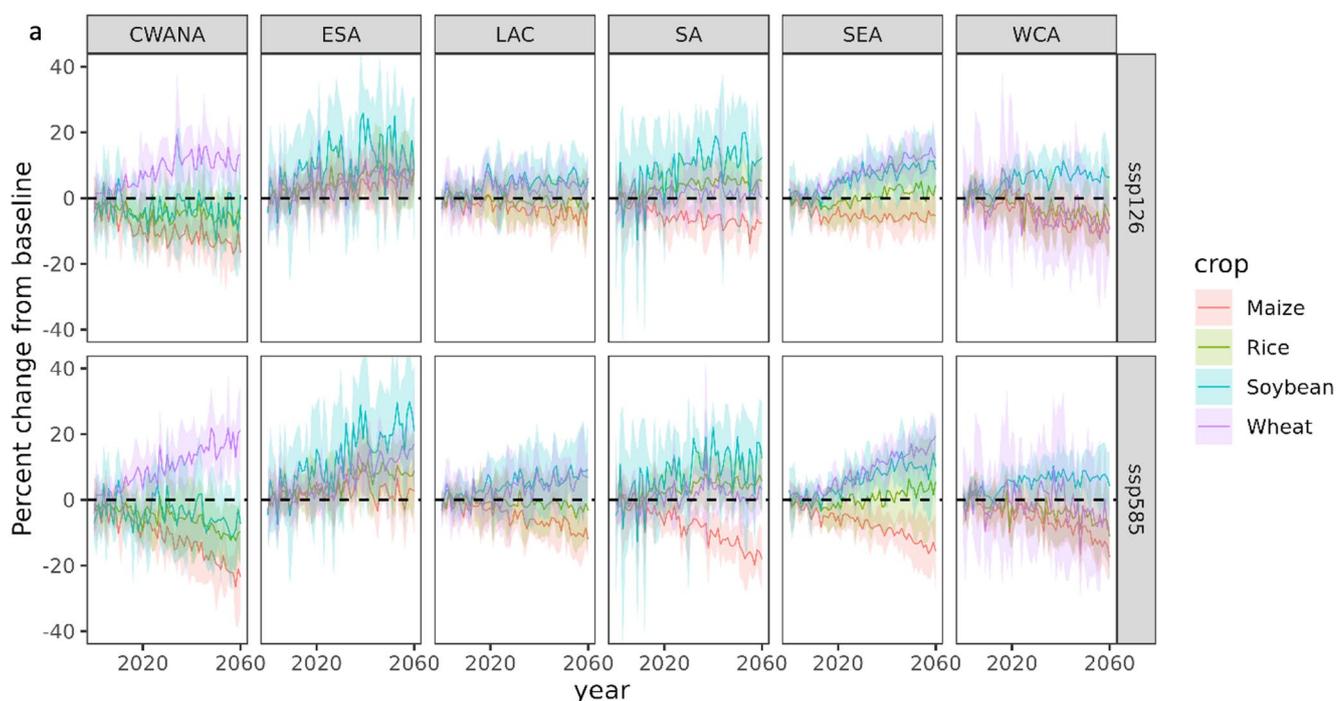
Projections from the latest crop-climate models are also grim. Impacts are likely to arise sooner than previously thought. For example, while projections suggest that maize yields between 2069 and 2099 will be 24% and 6% lower than they were between 1983 and 2013 under high and low GHG emission pathways, respectively, meaningful yield declines are likely by mid-century across every region (Fig. 1a) (Jägermeyr et al., 2021). Our knowledge on climate impacts is limited because models are only available for a handful of staple crops. Yet, climate change will have broad effects across cropping systems, including those important for nutrition such as leafy vegetables, pulses, and tree fruits (Carr et al., 2022; Yang et al., 2020) as well as internationally traded commodities such as coffee (Kath et al., 2020; Requena Suarez et al., 2019) that drive local economies and provide a critical pathway out of poverty.

Climate hazards pose diverse and compounding challenges with their type, frequency, and intensity varying dramatically, between regions and within countries. This variability presents severe obstacles for both farmers and policymakers. Detailed analysis of regional, national, and local climate risks is essential to appreciate the stakes and identify the factors most likely to influence cropping systems (Figure 1b). For instance, Southeast Asia faces escalating threats from flooding. At the same time, their counterparts in Central, West Asia, and North Africa are threatened by a combination of hazards such as rainfall variability, drought, and high temperatures (Jarvis et al., 2021). Estimates from the same study suggest that climate risks put annual production at staggering economic risks, ranging from US\$114 billion in Sub-Saharan Africa to US\$295 billion in Latin America and the Caribbean. The vast scale of this exposure carries grave implications for global food security and underscores the pressing need for swift and efficient adaptation.

The significant productivity losses in these climate-impacted regions threaten both food systems and farmers. At the broader scale, these declines disrupt a key strategy used to meet the world's escalating food demand: increasing productivity sustainably (Fuglie, 2018). Intensification has not only been the cornerstone of historical gains in global food security but also is the foundation of future strategies such as 'sustainable intensification' that aim not only to feed more people, but also to do so in a manner that prevents further biodiversity loss, water insecurity, and greenhouse gas (GHG) emissions. For the individual producers, these productivity losses can have devastating effects. Lower yields can lead to asset sales, loan defaults, missed educational opportunities, food rationing, and further degradation of natural resources (Hansen et al., 2018). Hence, agronomic efforts to climate adaptation must be grounded in principles of environmentally sustainable productivity and economic gains with mitigation co-benefits.

Despite the high uncertainties, climate risk projections and crop yield reductions due to climate change present a sobering picture, particularly for vulnerable and impoverished communities. The challenges intersect with existing poverty, amplifying the vulnerabilities of these already disadvantaged groups. Those in poverty are typically the most susceptible to climate shocks, and these shocks, in turn, can deepen their poverty. Anticipated declines in crop yields could further exacerbate these conditions, threatening to roll back progress made in poverty alleviation. This is particularly concerning considering the anticipated increase in food demand by at least 35% by 2050 from 2010 levels (van Dijk et al., 2021). The disproportionate impact of climate change on the world's poorest regions underlines the essential role of justice in climate action (Rockstrom et al., 2023). Therefore, our response to this crisis must ensure that interventions are technically sound and founded on equity and justice principles, ensuring that the most vulnerable are protected and empowered (Whitfield et al. 2021).

**Figure 1. a) Climate impacts on regional crop production.** Projected changes in productivity against baseline figures (1983–2013) under low emissions (SSP126) and high emissions (SSP585) scenarios, according to the CMIP6 model by region (data from Jägermeyr et al., 2021). **b) Regional exposure to climate hazards to the top five crops in areal extent.** Spatial correspondence between climate hazards and cropping locations. Abbreviations for regions: Central, West Asia, and North Africa (CWANA); East and Southern Africa (ESA); Latin America and the Caribbean (LAC); South Asia (SA); Southeast Asia (SEA); West and Central Africa (WCA). Each square equals 100,000 ha. (Agriculture Adaptation Atlas, unpublished).

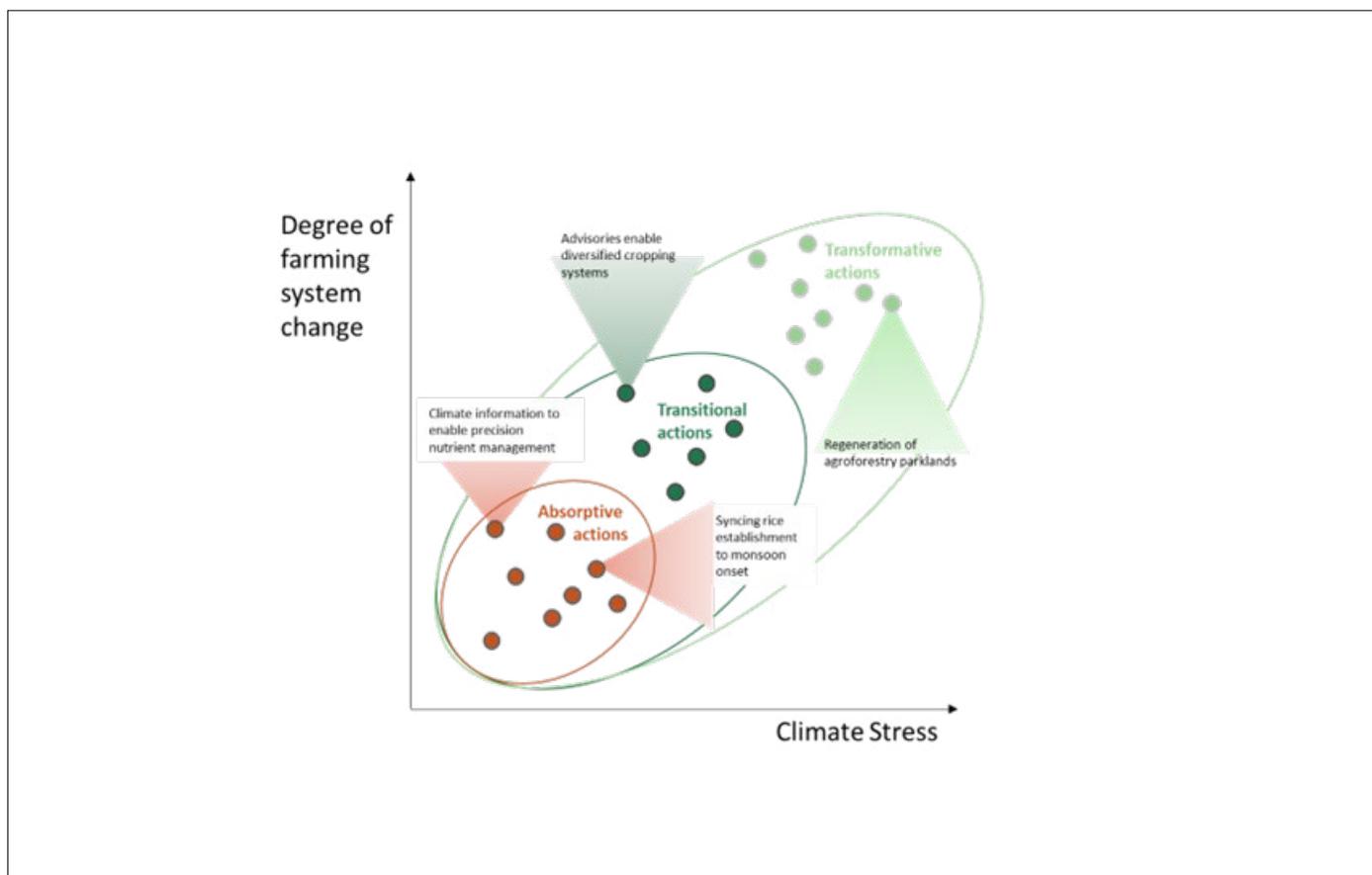


# Agronomy is Climate Action

Agronomic practices stand as a farmer’s primary countermeasure against the impacts of climate change. Agronomic decisions such as the selection of seeds, preparation of land, choice, and establishment of crops, and the management of water and nutrients empower farmers to modify their production conditions and thereby manage how crops interact with their environment. For example, modifying planting dates can help align key crop growth periods with rainfall (Lana et al., 2018; McDonald et al., 2022). Interspersing trees together with crops as well as the planting of stress-tolerant seeds can buffer heat stress (Antwi-Agyei et al., 2018; Sida et al., 2018). Thus, agronomic decisions provide farmers a direct means to manage to some extent their exposure to and reduce their vulnerability to the effects of climate change (Hansen et al., 2018).

Agronomy offers tangible solutions for today’s climate stress. Given its capacity to maintain farming system structures and absorb system perturbations, this field is exceptionally equipped to manage both minor and near-term climate stress already in effect (Figure 2). Even small, absorptive measures can lead to substantial improvements in both system resilience and performance. For instance, the practice of early wheat planting in India can mitigate heat stress, resulting in yield improvement (McDonald et al. 2022). Interventions that support intensification and adaptation, such as small-scale irrigation, could significantly impact household food and nutrition security during droughts (Mekonnen et al., 2022). However, as severe climate stresses, likely to become increasingly frequent, manifest, more significant interventions become necessary. Transitional agronomic actions, like shifting to new crops, aid farmers in adapting by providing additional production and income streams, thereby mitigating risk. In areas where climate stress renders certain crops nonviable, transformative actions that introduce new livelihood systems may be required (Vermeulen et al., 2018).

**Figure 2. Types of Agronomic Adaptation.** Many agronomic solutions can respond to near-, medium-, and long-term climate change risks. Several examples are highlighted to illustrate the degree of change required. Note that the types are not unique but represent a continuum. The baseline level of effort is high for system change, as even minor changes require many enablers to be in place.



Whilst agronomy is a significant opportunity to adapt to climate stress, it's crucial to acknowledge that climate change adaptation in agronomy can occasionally conflict with other development goals. For instance, the practice of sustainable intensification, which focuses on maximizing productivity per unit of input, can inadvertently lead to an increased reliance on fertilizers and irrigation. In rainfed systems, excessive fertilizer use becomes risky due to its water requirements, thereby heightening farmers' vulnerability to weather unpredictability. Likewise, expanding irrigation in regions already grappling with water scarcity can exacerbate existing shortages and inequalities. Furthermore, overemphasizing high-yielding crops can diminish agrobiodiversity, increasing susceptibility to pests, diseases, and climate changes. Paradoxically, effective climate adaptation strategies often champion crop diversification. Thus, striking a balance that aligns the unique goals and are responsive to each farmer's context whilst taking a systems approach to potential unintended externalities is a crucial step towards harnessing agronomy.

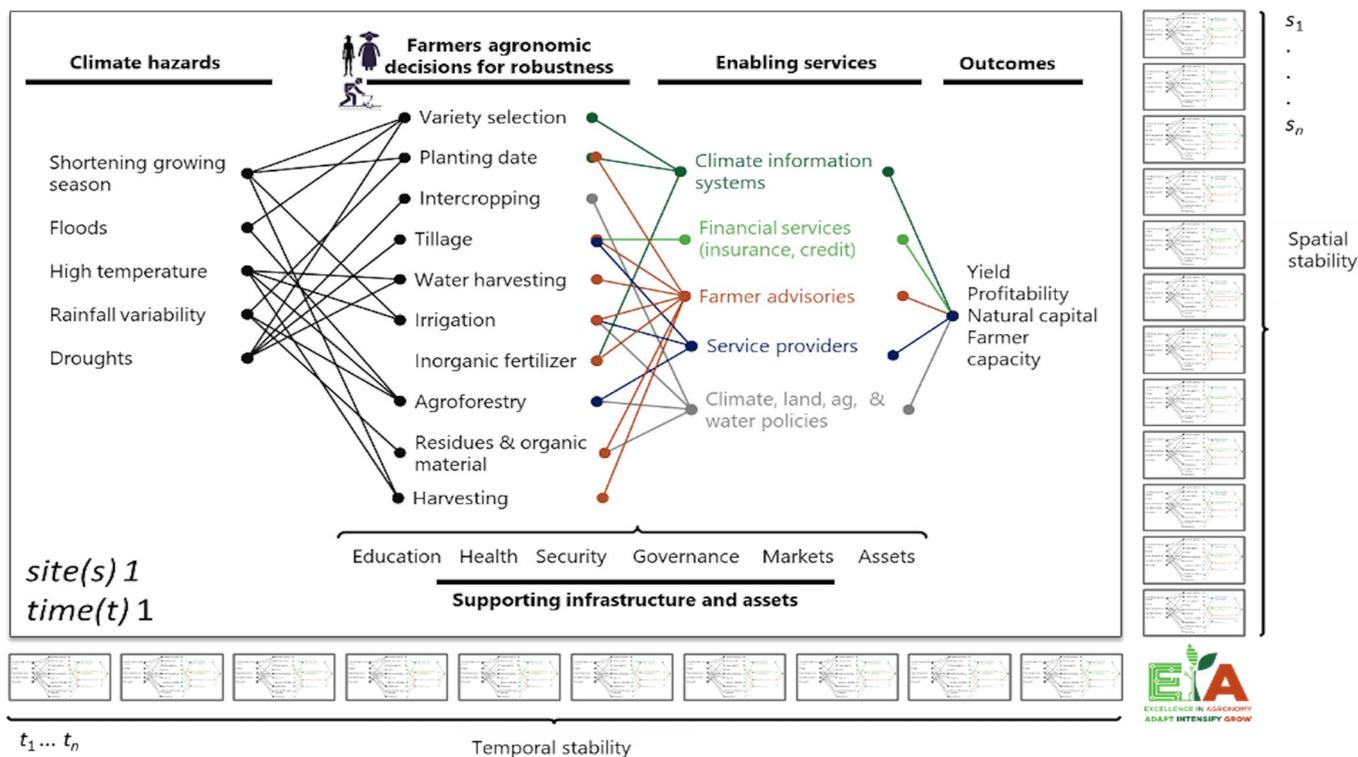
This necessity for careful consideration of unintended consequences also extends to the effects of modifying agronomic practices on GHG emissions. The adjustments made in agronomic practices can influence water and nutrient cycling, soil properties, and microbial activity, significant factors driving greenhouse gas emissions and carbon sequestration in agricultural systems. Many proposed adaptation techniques, such as periodic drainage of flooded rice systems (Liang et al., 2016; Oo et al., 2018), precision management of organic and inorganic fertilizers, (Linguist et al., 2012; Tesfaye et al., 2021), planting trees (Feliciano et al., 2018; Kim, Dong-Gill et al., n.d.), utilizing renewable energy, and conservation agriculture (Dossou-Yovo et al., 2016), have the potential to reduce emissions. Yet, there is a cautionary note: the intensification of agriculture can inadvertently increase emissions. Given that approximately 12% of annual emissions result from crop production, large-scale, agronomy-focused adaptation represents an opportunity to mitigate future climate impacts but also a potential risk for increased emissions.

## **For Adaptation to Work, the Enabling Environment is Crucial**

Despite their potential, the large-scale adoption of agronomic solutions remains a formidable challenge. In ten African countries, adoption of agronomic practices range between 3 and 18% while the adoption rate of full suites of effective management practices such as conservation agriculture in Zambia and Malawi hovers around a mere 1%, despite the backing of scientific research and substantial investments in development and extension services (Stevenson et al., 2019). This modest adoption is particularly alarming considering the urgent need for agricultural adaptation to climate change, which necessitates farmers' readiness and ability to continually modify their field management practices in response to dynamic environmental conditions. This disparity underlines the need for innovative support models and strengthening of the enabling environment if we are to unlock the full potential of agronomy for smallholder farmers soon.

Translating the potential of agronomic solutions into on-the-ground results requires transparency of risks, benefits and investment needs and the empowerment of for farmers and actors along the value chain actors. Even seemingly minor agronomic changes necessitate measures beyond the farmer's control. For example, changing planting dates requires weather forecasting, easily understood and relevant delivery to farmers, flexible labor availability, a functioning market with minimal price volatility, timely availability of seeds and other agronomic inputs, and access to finance. Emerging evidence demonstrates that services that strengthen farmers' agency/agencies? can create conditions for widespread agronomic change. Farmers empowered with climate information services can leverage weather forecasts to make better decisions about crop variety selection, fertilizer application, and planting schedules (Borne et al., 2021). Crop insurance scheme offer a financial buffer, accelerating recovery from climate-induced setbacks (Kumbhat et al., 2020). Peer groups foster social learning, helping to build trust and encouraging the adoption of climate-resilient agronomic practices (Blundo-Canto et al., 2020; Chiputwa et al., 2019). Additionally, service providers can ease the transition towards capital-intensive technologies, such as zero-tillage and mechanization, especially for resource-constrained farmers (Keil et al., 2017). By empowering smallholder farmers, enabling services provide critical leverage points support for agronomy to reach scale (Figure 3).

**Figure 3. Agile Agronomy for Climate Change Adaptation.** Each agronomic decision gives farmers an entry point to reduce crop vulnerability to a climate hazard. Options are available and specific to farmers operating within diverse contexts and constraints. Enhancing farmer capacities with climate-specific and more general capacities facilitates uptake and innovation (adaptation) increasing and stabilizing location productivity. Over time, some adaptations can enhance water retention and boost soil health. Over time, some adaptations can enhance water retention and boost soil health.



The diversity of agronomic decisions and supporting services means that there are agronomic entry points for adapting most cropping systems (Table 1). The challenge lies in prioritizing, organizing, and scaling agronomic interventions in the context of specific production ecologies. This is difficult because the options available to farmers and their capacity to implement them varies (Aguilera et al., 2020). Thus, options need to be matched to projected climate hazards and farmer constraints (Table 1). Attempting to broadly scale certain technologies without considering differences in farming systems, farmer perceived risks, and the environmental conditions will likely fail. This approach will ensure that chosen practices are suitable to the area's socioeconomic, agricultural, and environmental conditions. Notably, climate change and socioeconomic progress imply that the context constantly changes. Efforts to predict which solutions work and can be scaled, such as with the Evidence for Resilient Agriculture (Arslan et al., 2022; Rosenstock et al., 2015), can be combined with engagement with farmers, public, finance and private sector to avoid dead ends.

Table 1. Select examples of EIA's typology according to the type of hazard, capacity, and action. An extensive catalogue of system and location-specific adaptation options will be developed to quickly identify potential climate-explicit agronomic options when evaluating EIA Use Cases. Hazards: D=drought, F=flood, V= unseasonable climate variability, R= shortened growing season, T=high temperatures during the primary growing season. Capacities: I=Information, F=Finance (resources), T=Technology. Levels: – Low, + Medium, ++ High

Action type	Hazards					Exposure		Capacities			Agronomic practices / practice bundles
	D	F	V	R	T	Crop	Location	I	F	T	
Absorptive	√	√	√	√		Cereals, roots, and tubers	Global	++	-	+	Climate information for planting time and variety decisions
Absorptive	√		√	√		Cereals	West Africa	-	-	-	Water harvesting
Absorptive	√					Rice	West Africa	+	-	++	Alternate wetting and drying
Absorptive	√		√	√		Vegetables, legumes	East Africa	++	-	+	Mulch, climate advisories for planting and harvesting timing
Absorptive	√	√	√	√	√	Maize	Southern Africa	++	+	+	Nutrient management advisories linked to weather services
Absorptive	√		√	√		Maize	Southern Africa	++	++	++	Changing planting dates, mechanization, no-till planting
Absorptive	√		√			Wheat	South Asia	+	++	++	Changing planting dates, mechanization, no-till planting
Absorptive			√			Rice	South Asia	++	-	+	Synchronizing rice establishment to monsoon onset
Absorptive	√	√	√			Rice, wheat	South Asia	++	+	+	Climate information to enable precision nutrient management
Absorptive	√	√				Rice, wheat	South Asia	++	++	+	Dynamic decision support for irrigation management
Transitional	√	√		√		Rice	West Africa	+	-	++	Small-scale land and water development in rainfed lowlands
Transitional	√		√	√	√	Rice, vegetables	West Africa	+	+	+	Diversified crop rotations
Transitional	√	√	√	√		Maize	Southern Africa	++	-	+	Intercropping, rotations, conservation tillage
Transitional		√				Rice	South Asia	+	++	+	Stress-tolerant varieties, relay cropping,
Transformative	√				√	Millet	West Africa	+	-	+	Regeneration of agroforestry parklands

Scaling up agronomic practices is not without inherent risks. Programs may inadvertently exacerbate the vulnerability of smallholder farmers or widening existing inequalities – situations known as maladaptation (Eriksen et al., 2021). Digital agronomy, for instance, may offer significant benefits to those who have access to mobile phones. However, this approach could exclude the most vulnerable populations who lack access (Mehrabi et al., 2020) or the necessary technological literacy, consequently reinforcing their relative vulnerability. There are also potential tradeoffs with future vulnerabilities. Take, for instance, the scaling of solar-powered irrigation today. While it may offer short-term benefits, it may also lead to unsustainable choices such as groundwater depletion that could threaten future resource access if adequate water governance measures are not put in place (Pavelic et al., 2021). Historically, the risk of maladaptation has often been overlooked in agronomic programming. However, it's becoming clear that future efforts must incorporate emerging frameworks aimed at predicting and mitigating such impacts (Bertana et al., 2022).

# Implementing an Adaptation Agenda

The current approach to agronomic research for development must catch up to what is required to confront climate change's immediate and future challenges. We need systems that rapidly expand farmer innovation capacity, including utilizing existing tools and co-creating new ones. Moreover, these systems should be guided by the users' needs, subjected to ongoing user testing and performance assessments, and either scaled up or discontinued based on their viability and effectiveness.

## Research in and for Development

Although EiA maintains a global perspective, Use Cases bring its strategic approach to life. The Use Cases are implemented in over 20 countries, in collaboration with public and private sector partners. These Use Cases are designed to respond to specific partner requests, covering various agronomic issues in places where climate and agronomy matter most for food security and economies. For instance, EiA works on developing climate forecasts for wheat production in the Indo-Gangetic Plain, creating climate risk assessments, and developing water requirements for cocoa production in West Africa. These tailored projects directly respond to partners' programmatic and business model needs, enabling them to better serve farmers' real-world conditions. Empowering our partners through scientific evidence and capacity sharing is the mechanism by which EiA aims to achieve scale with agronomy.

EiA's Use Cases generate valuable evidence and insights that can be applied globally, helping to advance the field of agronomy. Each Use Case is evaluated from a climate perspective; an internal group of climate change experts vet and provide recommendations for enhancing its climate ambition and actions. In doing so, EiA uses a combination of climate hazard analysis, data from long term trials, a suite of crop modelling, and big data techniques to develop turnkey solutions. These approaches are geared towards enabling the Use Cases to address local climate hazards whilst allowing replicability and transferability across similar agroecosystems. This approach ensures that all research and interventions are conceived, prototyped, and validated with a climate lens but also scaled with due consideration for climate impacts.

EiA dedicates a portion of its research efforts, although less intensive compared to its Use Case-focused research, towards innovative and strategic research questions, and to the reform of agronomic research practices. This is exemplified in EiA's climate-related strategic research program, which spans the spectrum from abstract "blue sky" inquiries to research for development and practical implementation (see next section). This program addresses key knowledge gaps identified across various EiA working packages by different partners. For instance, EiA research is working on defining drought indices that are relevant to agronomy, a crucial step towards understanding and managing climate risk in water-scarce regions, as well as determining the best methods to monitor the resilience impacts of agronomic programming. At the same time, EiA is instigating a paradigm shift in agronomic research by pioneering a suite of tools designed to enhance the findability, accessibility, interoperability, and reusability (FAIR principles) of research outputs. This comprehensive approach is crucial for integrating existing knowledge and additional expertise into climate change inquiries and ensuring timely dissemination of results to similar agroecosystems and the broader scientific community and stakeholders.

## Priority Research Questions

EiA has identified a series of fundamental research questions to guide its research and development. These questions arise directly from the field, from the lived experiences of farmers, scientists' observations, and policymakers' concerns. They constitute the cutting edge of our current understanding and embody our commitment to breaking new ground in the field of agronomy and climate change adaptation. These priority areas represent our broader research framework's urgent, high-impact, and actionable dimensions.

- Firstly, we seek to address productivity loss: How and to what degree can agronomy mitigate climate-induced crop productivity loss? The urgency to devise agronomic solutions to decrease climate-induced crop damage is paramount in ensuring food security.

- The next question pertains to the limits to adaptation: At what point will climate impacts surpass the effectiveness of agronomic solutions in maintaining and improving farmer livelihoods? Understanding the thresholds of agronomic interventions under various climate scenarios can guide the development of more resilient farming systems.
- Thirdly, we must consider targeting: What agronomic options suit different farmers, cropping systems, climates, and environments, and how can this information help scale tailored solutions? This knowledge can enable us to customize solutions that best serve specific contexts.
- Our fourth question tackles prioritization: How can we empower policymakers, businesses, and smallholder farmers to select agronomic solutions that meet their unique needs and goals based on the latest agronomy and climate change information? Answering this can aid us in creating tools and platforms that facilitate informed decision-making.
- Further, we must explore scaling: What are the institutional, financial, and technical barriers to expanding agronomic adaptation measures, and how can we overcome them? What are the extension approaches that are effective at promoting scaling? This can inform strategies to overcome the impediments to the widescale adoption of practical agronomic adaptations.
- Our sixth question addresses tracking: What frameworks, metrics, and methods, can we use to assess the effectiveness of agronomic adaptation? This will ensure that we're able to gauge the impacts of our interventions and adjust accordingly.
- We also need to investigate co-benefits: What are the emission and mitigation effects of large-scale agronomic adaptation? This will guide the integration of climate mitigation within adaptation strategies.
- Eighth, we explore the potential tradeoffs: Does focusing on adaptation compromise other farming system objectives or result in resource competition? This question can ensure that we adopt a balanced approach to address the multifaceted challenges in agriculture.
- Finally, we must consider the risk of maladaptation: Can we predict and mitigate unintended consequences of climate adaptation programming? This foresight can allow us to preemptively tackle potential issues, ensuring that our interventions deliver the intended benefits without causing undue harm.

## Regional Prioritization

This document provides the foundational concepts that guide EiA's approach to agronomy and climate change adaptation. To ensure that our strategy adequately captures regional contexts and to stimulate a more robust, coordinated action and co-investment into the broader innovation system supporting adaptation, EiA has hosted a series of participatory workshops in 2023. These consultations are crucial platforms for engaging stakeholders deeply acquainted with on-the-ground realities and region-specific evidence. Given the local climatic hazards, they aim to guide the prioritization of cropping systems and identify entry points for climate adaptation solutions. They offer a unique opportunity for various actors, such as farmers, national agricultural research organizations, private sector, policy makers, and other stakeholders, to contribute their perspectives and insights.

Following our framework, these workshops will be designed to differentiate technology scaling priorities from those necessitating further research and development or risk transfer approaches. Following these consultations, post-workshop research and analysis will be conducted to validate the insights and assumptions generated from these engagements, and to pinpoint uncertain areas. The processes will also support refining fundamental research questions to support local innovation for adaptation efforts. This regional prioritization process ensures that our plans and strategies are grounded in robust evidence, boosting their credibility and potential for impact. We will seize this opportunity to grasp regional nuances and adjust our priorities and work plans accordingly, ensuring they remain relevant, practical, and effective. This stage will involve the development of region-specific action roadmaps that will guide the implementation of our strategies in each region. EiA will also collaborate with other relevant CGIAR

initiatives throughout the prioritization process to ensure a collective and integrated approach to climate adaptation leveraging upon the wider One CGIAR knowledge database and R&D efforts. Therefore, this regional collaboration represents a vital step in EiA's journey towards adopting a responsive approach to region-specific climatic hazards and understanding the regional transferability of potent solutions.

### **Streamlining Climate Adaptation Within EiA's Workflow**

EiA will strengthen its processes to ensure that climate relevant work is integrated across the various working packages. The Innovate pillar will continue to address the identified fundamental research questions by funding R&D projects with international and national research partners and offering innovative PhD and postdoctoral scholarships. These innovative research projects will be selected in a way that they do provide valuable insights, new approaches or tools relevant for the other pillars of EiA. With the Use Case leads in the Deliver pillar of EiA, the climate working group will co-develop a quick checklist to assess the degree of climate adaptiveness that the agronomic solutions in the Use Cases provide. This will be used to co-evaluate future Use Cases and, within the Organize Pillar, co-identify opportunities for strengthening climate adaptation efforts with the Use Case stakeholders. The suite of potential adaptation solutions will be derived by combining EiA's access to large data sets, climate-crop modeling efforts and turnkey solutions in the Transform pillar. The evidence on the climate adaptive solutions and their mitigation co-benefits will be included within EiA's current KPI monitoring framework on resource use, productivity gain, GHG, economic benefit etc.

## **Agronomy Can Help Navigate an Uncertain Future**

In conclusion, EiA, with its strategic approach and agile processes, showcases the potential of agronomic research for development in supporting climate change adaptation. By leveraging the latest innovations, fostering collaborations, and focusing on the needs of smallholder farmers within the broader context in which they operate, EiA is transforming the way we conduct and apply agronomic research. The lessons learned from initiatives like EiA are invaluable in shaping a more adaptive and resilient agricultural landscape, ensuring food and nutrition security for millions while safeguarding our environment.

## **Acknowledgements**

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