Playbook for Identifying and Selecting Solutions for Climate-Smart Digital Agriculture in Africa

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of

**The Alliance of Bioversity and CIAT**

With the support of

**The Global Center on Adaptation and the African Development Bank**

**Version 1.0**

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**List of Acronyms**

|  |  |
| --- | --- |
| AAAP | Africa Adaptation Acceleration Program |
| AfDB | African Development Bank |
| AICCRA | Climate Change Research in Africa |
| CGIAR | Consultative Group on International Agricultural Research |
| CIAT  CIS | International Center for Tropical Agriculture  climate information services |
| CSA | climate-smart agriculture |
| CSDA | climate-smart digital agriculture |
| CTA | Technical Centre for Agricultural and Rural Cooperation |
| D4Ag | Digital for Agriculture |
| FAO | Food and Agriculture Organization |
| GCA | Global Center on Adaptation |
| GSMA | Global System for Mobiles (GSM) Association |
| IPCC  IT | Intergovernmental Panel on Climate Change  Information Technology |
| ITU | International Telecommunication Union |
| KII | key informant interview |
| NGO  PPPEEE | non-governmental organization  Progress, Policy, Potential impact, Efficiency, Equity, and Environment |

# The Role of Digital Technology in Agricultural Adaptation in Africa

Digital technology has permeated nearly every aspect of daily life. This is true worldwide, and throughout the Global South, digital solutions are of increasing importance in everything from financial inclusion to improved decision-making associated with agricultural practices. Given the massive economic importance of agriculture throughout Africa, public initiatives and private ventures to support the use of digital tools in agricultural adaptation are emerging on what seems like a near-weekly basis. In their [2019 report](https://cgspace.cgiar.org/handle/10568/101498) on the digitalization of African agriculture, the Technical Centre for Agricultural and Rural Cooperation (CTA) estimated a potential total addressable market of over 2B United States dollars (USD); a simultaneous and exponential growth was also observed in terms of available technology solutions in the “Digital for Agriculture” (D4Ag) sector.

At the same time, the CTA highlights the need for the development of clear, coordinated, and integrative agendas at both a national and regional scale. A failure to address this need would negatively impact the sustainability, efficacy, and inclusivity of implemented plans and systems. Given the pressing adaptation challenges found across the continent, the accelerated identification and implementation of digital solutions represent a triple-win scenario, with the potential to help improve food security and nutrition outcomes, increase the size and efficiency of the agricultural economy, and foster the emergence of a new technology sector that will attract young people and major investments in “agripreneurship” for many years to come.

## Key adaptation challenges in Africa

Adaptation in agriculture essentially refers to a collection of mechanisms that are largely aimed toward climate risk management. Different adaptation approaches may be required at different scales, and may refer to something as simple as the appropriate timing of planting season or as complex as an interconnected set of complementary solutions such as improved crop varieties, crop insurance, livestock insurance, access to credit, and tailored agro-advisory services all working together to help farmers minimize seasonal risk.

A full review of adaptation challenges and their responses is beyond the scope of this playbook. There are, however, several key messages that users of this resource should consider when it comes to adaptation.

* Long-term climate change trends have resulted in increased warming at differential rates worldwide. This warming has resulted in gradual changes in precipitation regimes, seasonality, levels of solar radiation and cloudiness, and daily temperature extremes.
* Climate change has also resulted in substantial increases in climate variability: once consistent and predictable trends in temperature and rainfall are substantially less consistent in terms of timing, quantities, and extremes (although still predictable by the use of appropriate forecasts in some instances).
* Extremes in climate variability have also resulted in an increasing frequency of hazard events including heat stress, hail, extended drought, extreme rains, and flooding. These events are spread differentially throughout the continent and may be highly localized, with negative effects such as reducing the availability of both forage and water for livestock, damaging crops during critical growing stages, or limiting access to the market.
* Simultaneously, while climate trends are driving changes in the production of different crops, the niches for pests change too, with changing climates creating more suitable conditions for pest infestations, among other threats.
* In addition to the climate-driven challenges, unsustainable and uninformed farming decisions—such as monoculture, low-input agricultural practices, and a lack of conservation practices—further escalate the climate impacts.
* At the same time, producers in Africa are increasingly connected to the global marketplace, either directly or indirectly; they are consequently exposed to price fluctuations related to both the produce they sell, including potentially lower-priced imports, as well as the inputs they need, e.g., fertilizer, agrochemicals, and certified seeds.
* Finally, adaptation strategies should simultaneously consider how changes in livelihood strategies, including both on- and off-farm jobs in the agri-food system, may become a critical element in the changing agricultural landscape.

The Africa Adaptation Acceleration Program ([AAAP](https://gca.org/programs/africa-adaptation-acceleration-program/#:~:text=The%20African%20Development%20Bank%20and,the%20impacts%20of%20Covid%2D19%2C)), developed in coordination with the Global Center on Adaptation (GCA) and the African Development Bank (AfDB), identifies “Climate-Smart Digital Technologies” as its first pillar of action. Climate-smart digital technologies have many potential uses in addressing the abovementioned adaptation challenges, and these are briefly explored in the following section.

## Emergence of climate-smart digital agriculture (CSDA)[[1]](#footnote-2)

Pillar 1 of the AAAP identifies the need to “scale up the availability, access, affordability, and applicability of digital and data-enabled solutions in African agriculture.” The surge in application development characterized by the CTA demonstrates a significant surge in the development of different digital solutions. In a recent policy brief in support of the Accelerating the Impact of CGIAR Climate Change Research in Africa (AICCRA) program, [Prager et al. (2022)](https://cgspace.cgiar.org/handle/10568/117774) demonstrated how bundling approaches that link climate information services (CIS) and climate-smart agriculture (CSA) solutions are becoming increasingly relevant and useful within the agricultural domain.

CIS, specifically seasonal forecasts tailored to support decisions made by producers, are among the early examples of digital approaches in agriculture. Basic forecasts have been available via smartphones and text messages for quite some time, and more recently, a spate of applications (see [DACA](https://www.pabra-africa.org/putting-digital-agro-climatic-services-in-the-hands-of-bean-value-chain-actors/)) and websites (see [aClimate](https://pronosticos.aclimatecolombia.org/)) have emerged that help tailor this information to specific user needs. Platforms promoting financial inclusion and improved farm management efficiency—specifically access to banking and complementary agriculture-related services (see [Lersha](https://lersha.com/))—and linking agronomic advice and agriculture insurance ([aMaizing](https://acreafrica.com/a-new-project-offers-smallholder-farmers-in-kenya-the-opportunity-to-insure-themselves-against-the-consequences-of-drought/;)) are starting to become more commonplace.

In other examples, information may be generated and tailored through digital approaches, but disseminated via other means. One example is the successful provision of climate services and other CSA advice via multimedia services such as television in Kenya ([Shamba Shape Up](https://ccafs.cgiar.org/news/these-are-some-impacts-agriculture-tv-show-can-have;)), and radio in Rwanda ([CS Rwanda](https://ccafs.cgiar.org/research/projects/building-climate-services-capacity-rwanda)).

## Overview of challenges in CSDA

While promising, the few examples described above also highlight the substantial challenges associated with digital solutions for agriculture. First, the landscape of digital literacy is highly variable throughout Africa. The digital gender gap also remains a challenge that is deeply rooted in socio-cultural norms. Moreover, even within countries that are seen as being at the forefront of digital transformation, the reach and use of the internet may be limited or cost-prohibitive, access to smart devices is highly varied, and there may also be questions about the trustworthiness and quality of the information and services provided by digital means.

Connecting CSA with digital solutions for agriculture requires addressing a range of issues simultaneously. At the outset, the capacity of national partners to understand information needs, generate relevant information, and provide it to the next users in an understandable form is critical. Depending on specific adaptation needs (influenced by specific climate hazards, as well as the demographics of those affected, among other factors), this may be a relatively simple or potentially more sophisticated endeavor. Likewise, it is important to understand the capacity of the next users and how they might successfully engage with digital approaches (e.g., directly, through an intermediary, or via a message or an app, etc.). Equally important is the technical infrastructure. Considerations here relate to the general electricity and telecommunications infrastructure, and the technical infrastructure required by national partners (e.g., the meteorological service, insurance providers, universities and other research organizations, etc.) to generate, translate, and distribute the information component at the core of many digital solutions.

Finally, any endeavor must also look at the policy landscape. The policy perspective must consider both macro drivers (e.g., the national ease of doing business, infrastructure plans and conditions, educational institutions, etc.) as well as more direct drivers (i.e., how digital solutions factor into national adaptation planning processes, priority value chains, etc.).

## Purpose of the playbook

It should be clear by now that CSDA is a promising component, as well as an enabler, of the overall set of climate adaptation solutions. It should also be clear that, for digital solutions to be effective and sustainable, they should be implemented in a manner that is simultaneously rigorous and systematic while also encouraging ongoing innovation. No single innovator or government agency is capable of “owning” the entire process. For these reasons, a comprehensive and consultative process is required to identify the areas of greatest need, explore potential priority opportunities, and ensure that the solutions developed are relevant, sustainable, and consistent with best practices.

Along with a variety of different examples, this manual provides guidance to support this process from end to end. From understanding the national context and adaptation priorities, to identifying priority value chains and viable solutions, this playbook facilitates a replicable, systematic process for strategy development and the identification of best-bet digital solutions for CSA. This resource will help adaptation practitioners bridge the gap between the adaptation challenge and the adaptation solution, and support the design of key interventions along with the approaches needed to ensure quality products and their adoption.

The next sections lay out the use of the playbook in greater depth and offer a series of steps for deriving actionable information to be used on the path toward improved digitally-based agricultural adaptation outcomes.

# A Playbook to Accelerate CSDA

From early warning systems and seasonal agroclimatic forecasts (e.g., [ISKA](https://www.ignitia.se/iska)) to improved access to microcredit, crop insurance (e.g., [Picture-based insurance](https://acreafrica.com/our-products-picture-based-insurance-pbi/)), and farm-specific agronomic advice (e.g., localized precision agriculture such as [PxD](https://precisiondev.org/what-we-do/our-model/)), digital tools and services are rapidly making headway in agriculture throughout the developing world. Despite this proliferation, much progress is needed with regard to the actual uptake and use of these digital services by smallholder farmers. Large-scale climate adaptation will require prioritizing, selecting, and promoting a range of locally suitable solutions that address important local climate challenges. This playbook intends to help decision-makers draw a consistent “line of sight” between the climate adaptation challenge, the affected regions and value chains, and the most relevant digital solutions.

## Need for a strategic approach to digital agriculture

The shift toward CSDA requires a clear understanding of the line of sight between the adaptation challenge and the corresponding solution. Furthermore, approaches should be developed in an anticipatory manner; investments to expand the use of digital solutions to enhance CSA should be oriented not only around what problems and capabilities we have now, but in terms of what *challenges we anticipate* and what *capabilities we will need* to address those challenges in the future.

For these reasons, a structured approach is required to unpack specific (present and future) adaptation challenges. It is important to identify the context in which an investment is being made, the priority systems in which to invest, and the best options for investment—with regard to a specific solution, capacity building, or infrastructure.

An important aspect of the strategic approach is the recognition of potential complementary activities taking place within the national or regional context. To the extent that synergies can be realized, digital solutions for agriculture can become a self-reinforcing process with advances in one area enhancing advances in others. An appropriate strategy will thus carefully consider where to begin, how to position technology in relation to both the current needs and characteristics of intended beneficiaries, and identify potential obstacles and challenges as well as approaches to ensure that technology implementation is anticipatory in nature. The following sections address these elements.

### Identifying entry points for new digital solutions

The implementation of digital solutions is often heavily supply-driven. Solutions are often developed and put forward without sufficient consideration for the users or context in which they operate. This results in solutions being developed for the sake of using new technology, rather than in a manner that sufficiently considers whether the solution is a good match for the intended beneficiaries.

For digital solutions to be effective in supporting climate adaptation, it is necessary to understand the specific adaptation challenge, potential solutions, and context in which the solutions will be implemented. A highly sophisticated solution that is only relevant to a limited number of beneficiaries will not serve to address the challenge of climate adaptation on a wide scale. Additionally, whereas a solution may be technically feasible, upstream investment (e.g., in capacity building or infrastructure) may enable a broader range of downstream opportunities.

### Minimizing barriers

The design and implementation of digital solutions for agriculture must consider the different types of barriers that could prevent successful implementation. Several key areas require examination, including the policy environment, the institutional capacity required in key domains, the availability of technological infrastructure (e.g., data processing and telecommunications resources), the capacity of beneficiaries to access and use a digital solution, and the means to incentivize its use.

### Designing and implementing context-appropriate technology

The idea of minimizing barriers carries through to the design and implementation of the required digital solutions. Working to implement these solutions for agriculture in the Global South requires an understanding of the problem space (i.e., the climate impacts on agriculture systems), the institutions and individuals responsible for maintaining and providing the digital solutions, and, of course, the next users of the solutions—whether they are extension agents, agribusinesses, or farmers.

Digital solutions must align with the needs and capacities of those they are intended to serve. Depending on the region, women and men may have very different levels of access to cellphones (either feature phones or smartphones); disparate levels of general literacy, numeracy, and digital literacy; and differing abilities to objectively evaluate information and services provided by digital solutions. The effective design of CSDA solutions starts with recognizing the heterogeneity of targeted next users. Understanding the specific needs, expectations, and capacities of affected stakeholders, whether institutional or individuals, is key.

### Future-proofing and anticipatory approaches

Sustainable solutions also require anticipation of future needs, future capacity, and future demand. Investment in digital solutions for agriculture should be made with the recognition that, with time, not only will technology evolve, but so will the problem space and the ability of users to take advantage of the technological solutions in question.

CSDA is itself an adaptive process. Investments in new solutions should be anticipatory in the sense that investment in a capacity or a particular technology now should feed forward to solutions that meet future needs. In terms of capacity, this means investment approaches framed around “learn to learn” principles. In terms of technology solutions, this refers to technology that can adapt to the changing needs of users, e.g., a platform that can provide users with new services as they become available. Adopting a “modular and extensible” mindset in every aspect of CSDA is the basis for the strategies presented in this playbook. Finally, the playbook also examines a technological aspect of future-proofing that is often overlooked; multiple and sometimes competing solutions should use the same technology infrastructures so as to foster ongoing investment in underlying infrastructures and capacities while avoiding dependencies that result in single points of failure.

## Key considerations when contemplating CSDA

For the purposes of developing strategy around adaptation solutions built on digital technology, four themes frame the priority space for the strategy development process. These four themes include infrastructure, capacity, governance, and priority applications. Each is addressed in turn.

### Infrastructure

Adaptation approaches are enabled by resilient infrastructure. In CSDA, the relevant infrastructure includes not only roads and electricity networks, but also telecommunications and information technology (IT) infrastructure. The latter is particularly important as the specific IT infrastructure required will vary depending on the solutions being implemented. This may include facilities for advanced data processing and database management, measurement stations that enable the provision of real-time information and access to satellite imagery or other sensor data processing capability, and other related support systems.

### Capacity

Capacity in the context of the development of digital solutions for climate adaptation is an encompassing term. At one level, it refers to the capacity of institutions and individuals to design, develop, and maintain services required for the implementation of digital approaches. However, it is also essential to consider the capacity of next users to adopt and employ the innovations in their day-to-day workflows, as well as the capacity of key intermediaries to facilitate the dissemination of such services; these intermediaries include different types of agents and actors, from extension technicians to agribusiness owners.

### Governance

Given the range of coordinated infrastructure and capacity needs, governance can either enable or impede efforts in the field of digital agricultural development. Factors such as access to credit and investment policies, literacy-related initiatives, funding of education and research, and policies affecting access to and availability of information and communications technologies can all foster positive or negative synergies around digital solutions for climate adaptation. For example, farmer registries are a key tool in bringing crucial services to farmers, but these require balanced privacy policies to recognize farmer data rights while also facilitating fair and equitable business practices.

### Priorities

Every entity interested in considering an investment in digital approaches to support adaptation and CSA will have distinct priorities. These priorities may be driven by the predominant agricultural systems affected by climate variability in each region, the population that the investment might target and service (e.g., women farmers), or the specific climate phenomenon that presents the greatest adaptation challenge (e.g., flooding, drought, temperature extremes, locust outbreaks, etc.). Additional considerations that may influence priority setting include the recognition of barriers and opportunities specific to the factors mentioned above (i.e., capacity or infrastructure gaps may drive the selection of the most relevant digital approaches).

## Importance of a participatory approach

Any implementation of CSDA must consider actors along the entire information value chain. It is important to consider how potential options fit with current policy or, alternatively, where policy change may be needed to facilitate effective investment. Discussions around strategies for effective CSDA must include technical experts—on agriculture and climate, as well as the technology and IT sectors—as well as targeted next users. It is also critical to include members of the research community since many adaptation approaches are initially developed by researchers affiliated with universities or national and international research entities. This holistic engagement of various stakeholders, from information providers to farmers, is exemplified by the “[PICSA](https://ccafs.cgiar.org/resources/tools/participatory-integrated-climate-services-agriculture-picsa)” approach that has been used as a starting point for bringing digital climate services to farmers in many places around the world.

Investment and innovation in the relevant technology, capacity, and infrastructure for digital solutions in agricultural adaptation thus benefit from the adoption of an integrated “triple helix” approach that facilitates interactions between research, business, and industry. Each type of entity brings a unique set of expertise. Participatory processes—whether workshops, focus group discussions, key informant interviews, or even online surveys—should work to bring these multiple viewpoints together to foster co-creation and long-term ownership of the implemented solutions. As farmers are also key stakeholders in many processes, farmer perspectives and user journeys should also be considered through structured interaction and engagement with farmers and other on-the-ground partners.

## Summarizing a strategy development process

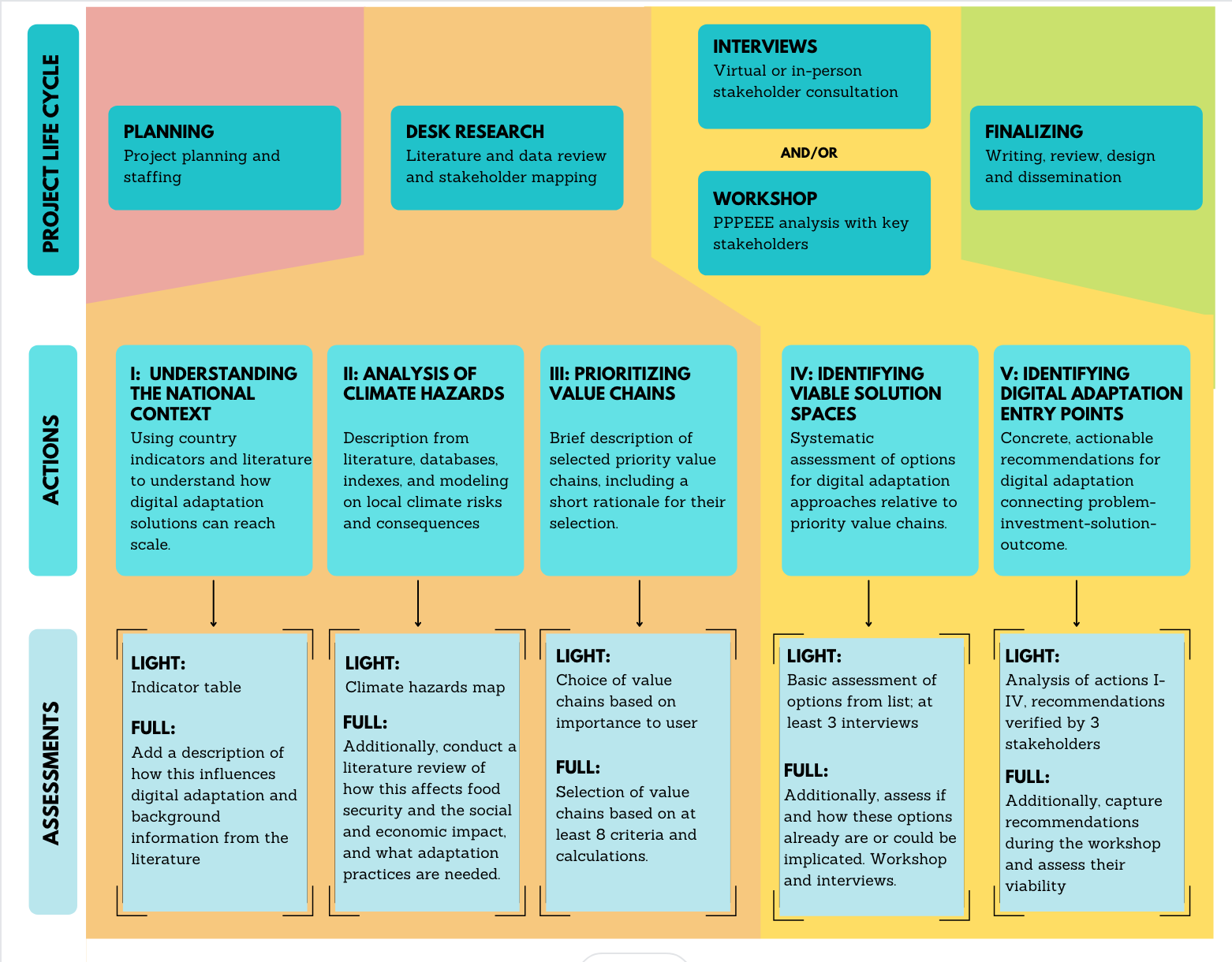
There are many pathways to implement CSDA. The right pathways will depend on a variety of factors, ranging from the readiness of different actors in the information value chain, to the policy environment, to the priorities among relevant business and industry partners. In some contexts, a more entrepreneurial model may drive digital development with a bottom-up and “fail forward” approach. In other contexts, efforts may follow a more directed and centralized approach, with an initial study and roadmap, corresponding policy work, and deliberate, stepwise implementation. Both approaches work and are in fact quite complementary; when combined, they result in innovation platforms such as [Agrifin Digifarm](https://www.mercycorpsagrifin.org/2019/05/27/building-the-digifarm-innovation-platform-the-journey-to-one-million-farmers/).

A complete strategy for defining investment in digital approaches to climate adaptation in agriculture will address the abovementioned steps associated with 1) characterization of the national context, 2) selection and prioritization of key value chains, 3) understanding the relevant solution spaces, 4) clarifying gaps and barriers, and 5) making recommendations. While these steps function sequentially, each one can also be conducted independently, depending on time constraints, available resources, and the requirements of those interested in making investments. In the following section, we review the overall process and discuss how any of the steps may be conducted independently or in coordination and conjunction with one or more of the others.

## Staging and sequencing of the playbook process

This chapter is more of a roadmap of necessary steps to implement this work, regardless of who the user is. For users of this playbook, it is important to understand that the duration of the set-up stage of a project is determined by the presence of staff and strength of networks in digital agriculture and climate adaptation in the countries under analysis.

As seen in Figure 1, there are four key steps in the project life cycle which are explained in further detail below. Two of these steps, namely desk research and the stakeholder consultative process, can be further divided into five actions. The first three actions reveal a deep understanding of adaptation needs and possibilities within a national context, and the latter two identify specific and actionable opportunities for using digital technologies in climate adaptation planning. For each action, there are different levels of how deep the assessment can go, with a light version indicating the bare minimum, and the full version including all necessary information for a deeper dive into the problem and solution spaces.



**Figure 1:** Project life cycle and necessary actions and assessments

### General considerations

In this section, we provide insights that users of the playbook may wish to consider during the implementation of the processes detailed throughout.

**Project planning and staffing**

A successful CSDA strategy will depend on staffing a small project team and sound project planning. CSDA strategy teams should include experts on climate adaptation in agriculture, as well as experts in digital agriculture and related technologies. Ideally, at least some members of the team should be familiar with the current state of applied research and development related to CSDA, and others should have experience working in the private sector. In addition to this subject matter expertise, experience working in the selected country is very important; the inclusion and involvement of local staff will greatly benefit the project. If this combination is hard to procure in-house, hiring in-country consultants is recommended.

Team leaders require experience in project management and coordination, and need to assemble the expertise to support workshop facilitation, key informant interviews (KIIs), and consortium building. The authors of this playbook worked with teams composed of three to five subject matter experts and two to four in-country consultants. For project planning and timing, it is important to consider whether a process will include country missions or (virtual) KIIs. Planning and conducting in-country missions and workshops will take up more time than virtual meetings. The duration of this step is dependent on in-country presence, and contracting, hiring, and financial policies.

**Desk research: Literature review and stakeholder mapping**

Once the project team and workplace are established, the next step is desk analysis to provide a high-level overview of the national context and ongoing CSDA-related activities. Though good desk research is vital for the quality of the report, the availability of relevant information can vary dramatically depending on the country in focus. Common indicators from sources like the World Bank, Food and Agriculture Organization (FAO), and International Telecommunication Union (ITU) are not available for some countries and may be outdated for others. Similarly, the amount of documented evidence (e.g., research articles or institutional reports) on climatic challenges, technical infrastructure, and experiences with digital agriculture varies considerably across countries.

Language is another important consideration and should inform staffing as important reports may not be available in English. Understanding local languages can also facilitate stakeholder mapping. Stakeholder mapping may be developed through an analysis of publicly available documents and internet research, and by engaging in-country expertise from local staff or consultants. The duration of desk research and stakeholder mapping will depend on the experience and network of the project team (as it extends to users engaged in CSDA or related work), the availability of relevant information, and the number of countries selected.

**In-country mission, workshop, and KIIs**

Desk research and stakeholder mapping set the stage for in-person workshops and targeted interviews. The conduction of at least one country mission workshop with local CSDA stakeholders is recommended to obtain a better characterization of local needs, challenges, and opportunities. KIIs can be conducted with local entrepreneurs, farmer representatives, policymakers, and other relevant stakeholders, either virtually or in person. The balance across in-country missions and KIIs will determine the depth of analysis of the report, as well as the duration and budget of the project. In-country missions are expected to enhance the overall understanding and depth of the analysis. Two other benefits of organizing workshops and in-person meetings are as follows: 1) the building of a stakeholder network that can be useful in later stages, especially with regard to program implementation; and 2) bringing stakeholders in contact with each other can also benefit the stakeholder community through cross-learning and spontaneous collaboration. The choice between in-country missions and (virtual) KIIs is dependent on the budget of a project, in-country presence, and the security situation in the selected country.

**Final Steps: Analysis, writing, review, and dissemination**

The last steps include the compilation and consideration of all the results from a full analysis of the literature review, stakeholder mapping, KIIs, workshops, and/or the in-country mission in a final report. For an external review, it is important to engage reviewers with a thorough understanding of the country or region under consideration, in addition to subject matter expertise. The duration of these processes depends on the number and caliber of the writers, the desired length and depth of analysis of the report, and the time required by reviewers. When the goal is to produce these reports for public use, dissemination of the final product may include presenting the report to involved stakeholders and governments; publishing and promoting the report through well-known and accessible repositories, blogs, and social media platforms; and presenting findings during conferences or seminars and webinars.

### Developing a country-level CSDA strategy

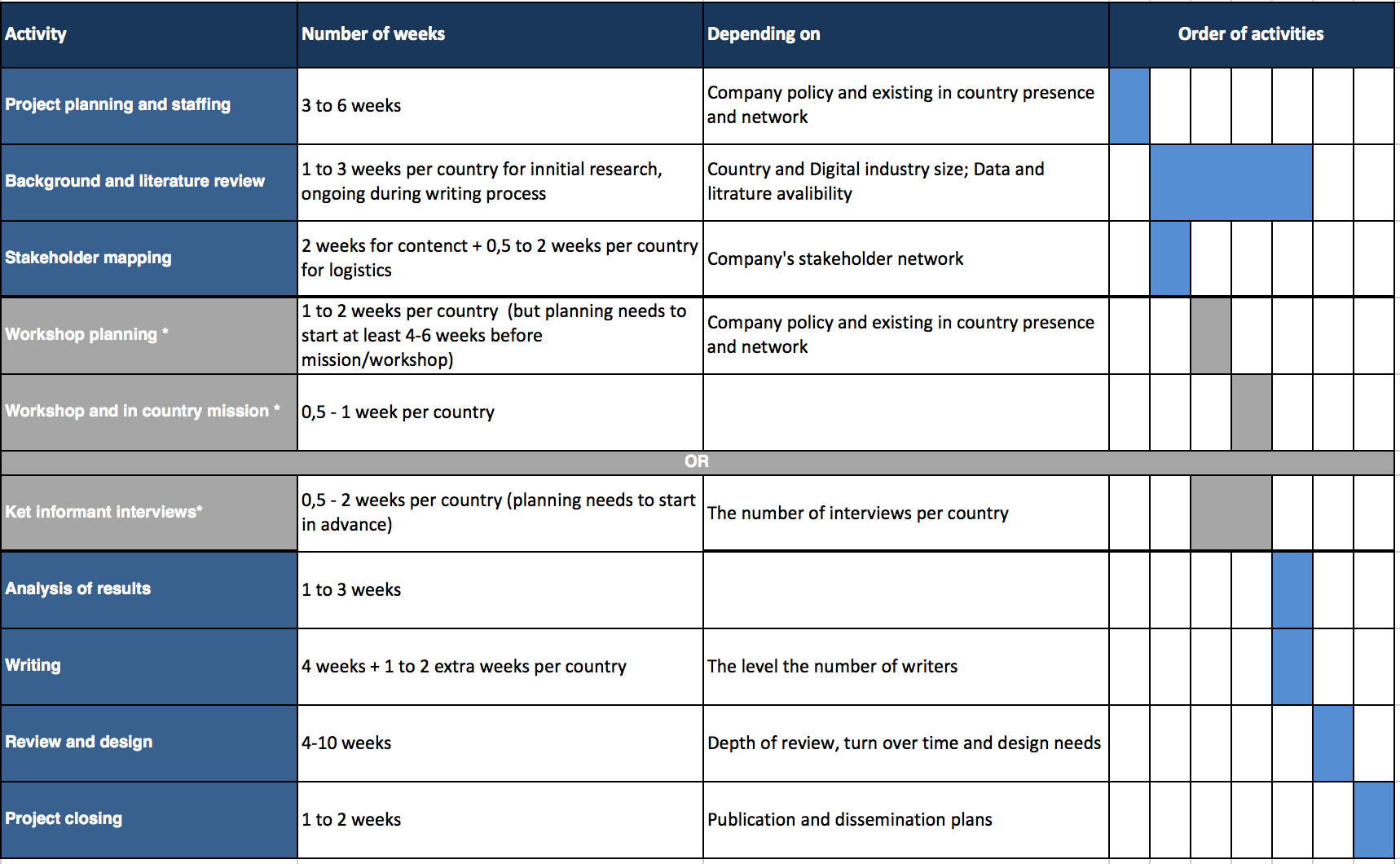
The suggested Gantt chart in Figure 2 outlines the estimated number of weeks and sequence of steps taken over the course of a project. These estimates apply to a typical core team size of around four to six part-time contributors. For in-depth reports, it is strongly advisable to have an in-country mission and a one-day workshop with diverse stakeholders of current and upcoming digital agriculture initiatives. Planning for the workshop should start well in advance so stakeholders can receive an invitation at least one month before the workshop is conducted. The duration of the literature review and writing will depend on the level of in-country and subject matter expertise, the number of writers, and the hours committed to compiling the report.



**Figure 2:** Approximated time allocations for project phases and project flow for a single country analysis. The number of weeks per activity will vary depending on the institution undertaking this process due to company policy, time spent working on the project, and the number of staff—but most importantly, their prior knowledge and existing networks in the country.

### Developing a regional CSDA strategy

With regard to analysis at a regional level, the project process and duration will vary depending on the number of countries included in the analysis, and whether in-country missions or KIIs are included in the process. The size of the country’s digital agriculture ecosystem and data and literature availability also affect the project duration and depth that can be achieved in the analysis. Furthermore, the time needed for the steps of the initial planning process, stakeholder mapping, and organizing the in-country mission is largely dependent on the staffing and their access to an appropriate network of stakeholders in the selected countries. Figure 3 shows the project steps with corresponding durations (expressed in weeks), the factors these durations are dependent on, the order of the steps, and whether they occur sequentially versus concurrently.

**Figure 3:** General time allocations for project phases and project flow for a multi-country regional engagement.

In the following sections, we present the specific steps, activities, and products required to put the above process and plan into practice.

# Activity I: Understanding the National Context

The first step in defining the strategies to implement CSDA is to characterize and understand the national context. Characterizing the national context begins with general issues and progresses to digital readiness and progress related to the incorporation of CSA in the national agenda. The objective is to provide insights regarding opportunities that are potentially “low hanging fruit,” as well as identify areas where broader investment may be required in advance of more targeted, advanced, or tailored strategies.

**Importance of understanding the macro context**

Understanding national context requires a general understanding of the agricultural sector as well as the socioeconomic situation of farmers and other agricultural stakeholders in a country. In the case of (political) instability or recent natural or man-made disasters, it is important to take note of this, as national context (e.g., resource availability, access to expertise, current skill levels) is often a determinant of the infrastructure and investment landscape. This is also very important for decisions on developing, building, and scaling digital technologies in a specific country or area.

**Digital readiness assessment**

In addition to the macro context, specific indicators for general digital readiness—and especially existing digital-CSA linkages—foster an initial understanding of the national context for CSDA. Factors and indicators that provide insight regarding the level of digitalization in a country and that should be considered in establishing the national context include:

* The infrastructure network, including electricity and telecommunications coverage. Gaps in connectivity lower the effective use of the mobile phone network. Low levels of electrification may result in less inclusion, as populations with limited access to electricity are less likely to own or use mobile devices.
* Poverty affects access to digital technology; although prices of devices have decreased in recent years, smallholder farmers are often unable to afford modern phones. High mobile data prices represent another related price barrier in bringing digital services to poorer populations.
* Low digital literacy lowers net usage and effective usage of digital services. Less digitally literate populations are less able to effectively find, evaluate, and communicate information through digital tools. Digital literacy can be increased through capacity building and accumulated experience.
* Specific indicators regarding gendered access to technology and other related resources are vital. Women tend to have lower access to digital devices than men, their digital literacy skills tend to be lower, and social norms around the use of digital tools may discourage women from engaging with them. Lower incomes among women also lead to lower spending on digital devices or mobile data.

A diverse set of indicators are available to describe these characteristics at the macro level. Compiling an overview of national context and digital readiness will help the users of this guide understand the current situation, and point to priorities that need to be addressed in order to ensure the success of digital interventions for CSA.

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| **Activity I Type:** Desktop research  **Activity I Product**: A table of macro-level country indicators, with a focus on digital readiness, and an analysis of the likely enabling and hindering factors for digital solutions to reach scale. |

## Step 1: Identify and synthesize relevant indicators

The goal of this step is to *identify and* *select different indicators with relevance to the national context* and the criteria defined above. In assessing the values of key indicators, the aim is to identify where there may be issues that impede or enable the implementation and scaling up of new digital solutions. For example, countries with a very low electricity coverage are likely to also have limited network coverage, which will limit the potential impact of interventions that require the use of a mobile phone. In this case, the electricity infrastructure gap would need to be addressed before implementing mobile phone-based solutions on a regional scale.

In the annex material, we provide a list of relevant indicators that characterize the country’s context for 1) the agricultural sector and 2) the state of digitalization. These represent a starting point, but the use of additional indicators, especially locally developed indicators, is strongly encouraged. The sources for all indicators and minimal corresponding metadata should be documented.

To improve the relevance of the gathered information, our recommendation is to use either the most recent values or the average value of the last five years when such data are available.

## Step 2: Review of general enabling environment

CSDA solutions are inherently context specific. The tools and services that will serve the needs of targeted farmers or other users are determined by numerous social and biophysical factors. In addition, however, digital development takes place within regional, national, and sub-national policy environments and economies. A thorough understanding of existing conditions, including barriers and enablers of digital development, will help in defining realistic, locally feasible pathways to CSDA. The purpose of this step is to *systematically characterize the enabling environment* in order to support later strategy development.

To inform further decision-making along with the use of this playbook, two dimensions of the general enabling environment for CSDA are key:

* The local availability of different types of capital (human, technical, financial, etc.), which influences the ease of implementing new digital tools and services; of particular importance are intellectual capital (skilled IT staff) and financial capital (e.g., ease of access to credit for new digital agriculture initiatives).
* The level of support and leadership provided by public authorities, such as the ministries of agriculture in the countries under consideration, especially in areas related to CSA. This support can manifest itself, for example, through the establishment of a coherent, auditable digital agriculture strategy across ministries, the existence of a government unit specifically dedicated to leading digital agriculture development, or favorable policies around issues such as mobile money or public-private partnerships.

To assess the enabling environment for the region of interest, a combination of internet research and communication and consultation with local entrepreneurs and agricultural experts or policymakers is most effective. The combination of indicators and qualitative information is then reviewed and synthesized. Again, relevant examples are provided in the annex material (See Section 9) but other locally important aspects may need to be considered according to the local context.

## Step 3: Summarize indicators and values in a table

The final product of Activity I is the table of macro-level country indicators, with a focus on digital readiness, and an analysis of the likely enabling and hindering factors for digital solutions to reach scale.

While in all cases the summary should be comprehensive and cover both indicators and contextual analysis, the depth of the analysis will vary as a function of invested time and available data. If available data and expertise do not permit a comprehensive analysis, this is itself an important piece of information regarding readiness for CSDA implementation.

# Activity II: Analysis of Climate Change and Hazards

The second stage in understanding a national or regional context considers the imminent biophysical challenges. The characterization of potential impacts associated with climate change and related hazards provides insight into the adaptation challenges that one may expect to face.

Climatic risks are typically analyzed based on the risk framework from the Intergovernmental Panel on Climate Change ([IPCC](https://www.ipcc.ch/report/managing-the-risks-of-extreme-events-and-disasters-to-advance-climate-change-adaptation/)). This framework describes three key components of risk, specifically hazards, exposure, and vulnerability. Hazards address different types of events, including:

* Increases in climate variability
* Changes in temperature and precipitation patterns and extremes
* Consequence of changes in relation to droughts, floods, and combined events

While local experts will typically have a well-developed anecdotal understanding of climate-related hazards, it is also useful to systematically characterize these hazards. Ideally, this should be done in a replicable manner based on a current understanding of the scientific literature.

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| **Activity II Type:** Geospatial Analysis  **Activity II Product**: A description, map, and graphs characterizing the projected impacts of climate hazards on the agricultural sector, and the corresponding social and economic consequences. |

## Step 1: Generate Relevant Hazard Maps

In the supporting material provided with this playbook, we include an early release of the soon-to-be-published “Composite Hazards Dataset.” Built based on a variety of data layers appearing in the also soon-to-be-released “Adaptation Atlas” for Africa, this dataset summarizes the predominant hazards (or combinations thereof) at the pixel level for the entire continent. The Composite Hazards Dataset includes information on temperature extremes (thermal stress), climate variability, flooding, and droughts.

The Composite Hazards Dataset shows the geographic distribution of both the type and severity of the abovementioned hazards. The overall exposure of the agricultural system will depend on the predominant type and severity of hazards relevant to the value chains present in the geographic areas under consideration.

In this step, the objective is to gain a greater understanding of the distribution of specific hazards in relation to their corresponding production systems. The precise steps to summarize composite hazards relative to value chains will depend on the expertise and analytical skills of those involved in the implementation of the activities described in this playbook. The recommended steps include:

* Geographically subset the Composite Hazards Dataset to the region or country of interest.
* Statistically summarize the percentage or net area of each hazard type present in the geographic area of interest.
* Produce a summary map and summary graphs characterizing the geographic distribution of hazards in the area of interest.
* Use locally relevant areal units to further summarize the exposure of specific systems to the hazards; teams with advanced geospatial analysis skills and access to ancillary datasets (e.g., cropping area, farming systems, livestock zones, agroecological regions, etc.) may wish to achieve a greater depth of analysis in this manner—to this end, we have included the full scripts and datasets required to generate the composite hazards map.

Once the geographic distribution of hazards is generally understood, the next step is to do a deeper dive and build a greater understanding of how the specific hazards will influence the most important value chains and typical farming systems in the country or region under consideration. This is especially important as some regions and farmers may be better adapted to different hazards than others. With the information generated in this activity, the following activity can then take into account both the farmer and value chain perspectives as well as the corresponding biophysical hazards.

# Activity III: Prioritizing Value Chains

Different farming systems are affected by climate change in different and sometimes contrasting ways. Heterogeneous climate change impacts mean that, in any given location, different types of farmers may have different adaptation needs and require different types of support. There are no one-size-fits-all digital strategies that span all value chains.

CSDA solutions will vary not only in accordance with anticipated climate impacts (e.g., based on the heterogeneous climate sensitivity of different crops), but also with the predominant characteristics of the farming systems in question and their adaptive capacities (e.g., degree of commercialization, reliance on external inputs, availability of credit, etc.). Efficient resources aimed at promoting CSDA should align with programmatic development goals (by governments or donors). Policymakers and investors also need to choose which farming systems or commodities to focus their efforts on. These choices strongly influence the later prioritization of digital solutions and investment opportunities. Recognizing the importance of establishing focal priorities, this activity aims to guide the user in selecting a small group of two to three core value chains that form the basis for subsequent steps.

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| **Activity III Type:** Group Exercise  **Activity III Product:** Brief description of selected priority value chains, including a short rationale for their selection. |

## Step 1: Consultative process to prioritize value chains

Determining the priority value chains requires the consideration of multiple assessment criteria informed by available data. The process begins with the compilation of a list of ten to fifteen commodities that are known to play a significant role in the study region. This list should include value chains with major commercial importance (crops, livestock, aquaculture, and fisheries, if appropriate, and derived products traded on local and international markets) as well as major subsistence crops (cereals, roots, tubers, legumes, and bananas) and small livestock species.

This first selection can be done in quick consultation with a few local experts—such as local senior agricultural researchers, agricultural extension managers, or staff from the local ministries of agriculture—who are able to provide a good overview of the area of interest. A couple of emails or phone calls might be enough to get the job done. The key point here is to avoid relying on a single perspective so as to avoid potential user bias in the selection of the value chains.

The next step consists of compiling secondary data supporting the development of assessment criteria for the long list of proposed value chains. The preliminary assessment criteria should comprise readily available secondary data that span the majority of the long list value chains. Some suggestions are made in Table 1 below.

We suggest that six to eight criteria are sufficient to support the choice of priority value chains. For many indicators, it can be challenging to access reliable data. At this stage, strategic engagement with local experts and decision-makers from the agricultural sector (see above), industry representatives, and others is encouraged. A workshop session of approximately two hours with approximately five experts is suitable for building consensus at this stage. Three major aspects that should be considered include:

1. **Macro-economic relevance**: In many countries, commercial agriculture is an important source of employment and government revenue (through taxes and levies). It also provides a basis for direct foreign investment. For each commodity, users should characterize the importance to the national economy of the country of interest—two core indicators are the commodity’s gross production value, and the number of citizens employed in the sector across the full value chain (including cultivation, processing, packaging, transportation, etc.).
2. **Social relevance**: In addition to supporting national economies, agriculture directly sustains large numbers of rural households across many countries. Commodities can be characterized by the total number of farmers or farming households involved in the value chain (from production to post-harvest operations and processing). This gives an idea of the share of the population that is potentially affected by the corresponding adaptation challenge and has the potential to benefit from the implemented solutions. In addition, it is useful to characterize the farmers themselves: is the commodity typically produced by the most resource-poor (e.g., sorghum), or is it likely associated with some investments and accumulation of assets (e.g., Zebu cattle, coffee)? This distinction can also help in prioritizing digital solutions presented in the later stage of this playbook. Lastly, while often an oversimplification, stereotypical distinctions between women’s crops and men’s crops may support an improved understanding of who is likely to be more strongly affected by the adaptation challenge and, likewise, whom digital solutions should target.
3. **Climate vulnerability and exposure:** As the composite hazards map from the previous activity will illustrate, not all commodities are expected to be affected by climate change to the same degree. The results from the previous exercise can be incorporated here to support further identification of the value chains with the greatest need for digital approaches to improve outcomes associated with CSA.

**Table 1:** Assessment criteria for determining priority value chains (example commodities provided as illustration only) for which to consider CSDA implementation. For all criteria listed here, a higher number suggests a greater priority for adaptation action. A working version of this table is provided in the accompanying annex.

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
|  | | **Macro-economic relevance** | | **Social relevance** | | | **Climate vulnerability/ exposure** |
| Gross production value | Annual production (crops) / herd size (livestock) | Share of producing households below the poverty line | Share of women among farmers | Importance of food security (through subsistence and income) of producing households | Predicted mean decline in productivity or local suitability by 2050 without adaptation |
| **unit** | | USD 1000 | tons / heads | % | % | 1 – weak  2 – medium  3 – high | % |
| **Recommended source** | | (1) | (2) | (3) | (3) | (3) | (4) |
| 1 | Maize |  |  |  |  |  |  |
| 2 | Cassava |  |  |  |  |  |  |
| 3 | Coffee |  |  |  |  |  |  |
| 4 | Rice |  |  |  |  |  |  |
| 5 | Dairy |  |  |  |  |  |  |
| 6 | … |  |  |  |  |  |  |
| 7 | ... |  |  |  |  |  |  |
| (1) <https://www.fao.org/faostat/en/#data/QV>  (2) <https://www.fao.org/faostat/en/#data/QCL>  (3) No international standard source available. The user needs to consider national statistics. If no country-specific information can be found, rely on the average of at least three independent local expert estimates.  (4) For many major crops, forecasts exist at the country level in research literature and policy documents. These can be searched and prepared beforehand. Where explicit numbers are lacking, gather expert estimates. What matters most is identifying variation among value chains: which commodities are relatively more at risk of being affected by climate change than others. | | | | | | | |

With the above list in hand, the next steps are to select the criteria to systematically move from the long list of value chains to a priority shortlist, and then to select the corresponding subset of commodities around which to prioritize CSDA solutions.

## Step 2: Prioritization of value chain assessment criteria

Now that multiple commodities have been identified and characterized based on several relevant assessment criteria, the next step is to determine where national priorities and digitally supported opportunities for agricultural adaptation coincide.

The long list of commodities will generally reflect broad national or regional priorities, but individual commodities tend to address focal policy issues (e.g., climate resilience) or specific national government priorities (e.g., reaching women smallholder farmers). Depending on the specific ambitions associated with a CSDA program, this might signify a need to adjust the weighting of the corresponding relevant criteria.

In short, through expert deliberation and using the information populated in the template associated with Table 1, the users of this manual should identify two to three key criteria for prioritizing climate adaptation efforts in line with existing national development strategies. With this subset of selection criteria, the specific commodity value chains can then be readily identified.

## Step 3: Selection of focal value chains

The final step in the prioritization process is to narrow down a list of ten to fifteen value chains to a smaller set of priority value chains. This choice will be based on (1) the information compiled in Table 1, and (2) the development priorities defined in the previous section.

In this step, the previously identified group of subject matter experts with multi-disciplinary expertise are asked to evaluate, based on the compiled information, which value chains exhibit the highest adaptation needs and are simultaneously aligned with strategic priorities.

At this stage, participants should identify a medium list of approximately five priority value chains based on the corresponding assessment criteria. The participants can also decide to include other criteria (e.g., a key differentiator such as policy context) which may be useful in helping to further narrow the scope of the value chain selection in line with the agricultural and socio-economic context of the area of interest.

Finally, participants are asked to consider which of the value chains included in the medium list can best serve as an entry point for the implementation of digitally enabled CSA solutions. These value chains will comprise the most likely subset in which the successful implementation of digital solutions will have the greatest return on investment, the greatest overall benefits, or even the greatest traction to lay the foundation for ongoing development. Again, these value chains typically receive attention from national policymakers (e.g., in relation to food security) and international donors, which makes them a logical entry point for CSDA interventions.

The expert workshop should focus on the policy convergence related to other climate adaptation activities, where there are existing investments in extension or other related areas (e.g., credit, insurance), and where there is the potential for sustained momentum associated with adaptation-related interventions more generally. Depending on the national priorities, a final selection of one to three value chains then serves as the jump-off point for the identification of potential solutions.

# Activity IV: Identification of Viable Solution Spaces

Solution spaces are the relevant categories of CSDA approaches. For example, a seasonal cropping calendar and projections regarding seasonal precipitation are two CSDA solutions that are easily categorized into a “weather and climate” solution space. Understanding the most relevant solution space for each value chain and the corresponding basis for its prioritization will help identify which digital technologies will best support CSA in a particular national or regional context.

A step-by-step participatory process should be conducted with a large group of key stakeholders in the countries and regions of interest. This activity includes several exercises that can, for time efficiency, fit into a one-day workshop with twenty to forty stakeholders drawn from the agriculture and extension, climate adaptation, and digital agriculture specializations. These stakeholders should be selected to ensure representation from donor agencies, local and international non-governmental organizations, academia, research centers, and the public and private sector, including both start-ups as well as larger agriculture-related companies. In order to have an inclusive process, it is strongly recommended to include representatives from farmer organizations or producer community leaders, as well as stakeholders along the value chain, including input supplies and post-harvest and the processing industry. With the combined contribution of a diverse group of stakeholders, the priority solution spaces will best fit the needs of the key actors involved in the value chains in question.

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| **Activity IV Type:** Group exercise  **Activity IV Product:** Systematic assessment of options for digital solutions for CSA relative to priority value chains |

## Step 1: Evaluation of solution spaces

This first group exercise aims to refine a list of potential approaches and uses of digital solutions for agriculture within a national context.

The process presented here builds on the previous step and considers the local adaptation challenges for prioritized value chains. Stakeholders are asked to break into a set of six pre-defined groups linked to “solution spaces” (i.e., water management, livestock, agronomic advice, market information, digital financial services, and weather and climate) based on both expertise and general interest. The solution spaces serve as broad-brush categories of climate adaptation strategies and collect different examples of digital solutions that have been implemented to support a particular set of adaptation needs. Participants are asked to evaluate the range of digital approaches presented in each solution space in relation to the specific CSA needs identified in previous steps. In turn, these potential options can be compared to a long list of viable digital solutions (see annex material).

One or more digital technologies (e.g., interactive voice response, applications, databases, analytics, etc.) are linked to each of the solution spaces in a manner consistent with current and near-future “state-of-the-art” approaches observed throughout the African continent. This is a living list that will be updated periodically. As such, the list serves as a benchmark set of technologies when examining the national panorama and can help guide new digital strategies based on approaches that have worked in other contexts.

In the participatory session, each group of experts shall be asked to reflect on whether the cluster of solutions makes sense (in general terms and relative to the priority value chains), if there are any major technology-based adaptation approaches missing from the list, and if the digital technologies are consistent with the potential adaptation approaches within a national context. See annex for supporting information.

Through group discussion and plenary presentations, the experts are asked to develop consensus around the most relevant solution spaces and specific applications therein relative to the priority value chains. In turn, the solution spaces are then evaluated for general readiness.

## Step 2: Evaluating implementation readiness using the PPPEEE (Progress, Policy, Potential, Efficiency, Equity, and Environment) framework

An assessment of candidate solutions for CSDA requires understanding the overall readiness of the national or regional policy framework and infrastructure to implement the solution, as well as the potential impact and relevance of the solution within the area of interest.

We provide a template to support this assessment based on a methodology developed by the Alliance of Bioversity International and International Center for Tropical Agriculture (CIAT), the FAO, and the World Bank Group in 2019. This methodology has also been used in assessing digital technologies for agriculture in the [digital agriculture country profile series](https://www.worldbank.org/en/topic/agriculture/publication/digital-agricultural-profiles-for-argentina-kenya-turkey-and-viet-nam) (2019-2021). While the assessment can be conducted as a survey or during an interview, the preferred approach is to implement a second session of breakout groups in the one-day workshop mentioned in the previous exercise. The full list of questions that can be used for the PPPEEE analysis is provided in the supporting annex (see Section 9). The pillars of the PPPEEE assessment are qualitatively assessed using the following dimensions:

* **Progress** is characterized by three aspects: (1) the general technological maturity and readiness of solution spaces through their current degree of development (from the research and development phase to a country-wide scale); (2) the use and uptake expressed in terms of a percentage of the total targeted group; and (3) the profitability and financial sustainability of the current business model.
* **Policy** evaluates the policy and enabling environment around the solution space by quantifying three aspects, namely, the degrees to which (1) policy, (2) governmental programs, and (3) public investments enable further development, adoption, and impact of potential CSDA solutions.
* **Potential impact** is a first-pass approach to estimate the potential of the solution space to improve outcomes in the agricultural sector by looking at (1) the expected uptake as a percentage of the total targeted group, and (2) the expected return on investments over the next decade.
* The **Efficiency** scale intends to capture the extent to which each solution space can improve the effectiveness of agriculture and food systems in terms of returns to labor, use of inputs, yield, transport costs, and overall reduction in transaction costs.
* **Equity** addresses the degree to which the solution space supports improving access to relevant information and services, particularly through greater inclusion and participation of youth, women, and marginalized groups.
* Supporting **Environment** qualifies the extent to which the solution space and corresponding technologies support environmental sustainability through waste reduction, greenhouse gas emissions reduction, improved natural resource use efficiency, and related approaches.

The evaluation of the above categories is a participatory process and semi-qualitative in the sense that it solicits expert opinion based on local knowledge. In turn, this information feeds into the next step of the digital solutions strategy development process.

## Step 3: Ranking of priority solution spaces

The PPPEEE analysis in Step 2 results in a numerical score for each of the evaluation categories. These numbers, ranging from 1 to 5 (where 5 represents a “best case scenario”) can then be used to help differentiate and even rank investment options.

The PPP section of the evaluation can be grouped under Progress, Policy, and Potential, each divided over two to three indicators, as shown in the example Figure 4 with a subset of four of the six solution spaces. It ranks the strength of each solution space relative to the national context and chosen value chains.

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **Progress** | | | **Policy** | | | **Potential** | | **EEE** | | |
| **Digital service category** | Stage | Uptake | Profitability | Supportive Policy | Government supportive programs | Investment | Expected uptake | Expected return on Investments | Efficiency | Equity | Environment |
| Digital Financial Services | 5 | 2 | 2 | 4 | 3 | 3 | 4 | 4 | 3 | 4 | 2 |
| Water & Irrigation | 5 | 2 | 1 | 3 | 3 | 5 | 5 | 4 | 5 | 5 | 5 |
| Livestock knowledge and information | 4 | 2 | 2 | 3 | 3 | 3 | 4 | 3 | 3 | 2 | 4 |
| Weather & Climate | 4 | 2 | 1 | 1 | 2 | 2 | 3 | 3 | 5 | 5 | 5 |

**Figure 4:** Example of heatmap PPPEEE analysis. Note that in this example derived from recent work in Kenya, only four of the six solution spaces are shown.

In addition to the quantification of digital adaptation technologies, it is also important to capture the reasoning behind the grading of the PPPEEE analysis. This information has multiple applications and can be used in several sections of the final report as it relates to digital infrastructure, the current use of digital technologies, enabling environments, the demand and supply of digital technologies, and negative and positive effects on equity and the environment.

# Activity V: Identifying digital adaptation entry points

The previous section identifies context-specific and best-bet solution spaces for each priority value chain. Finally, the last stage of the process helps prioritize specific technical solutions (within the wider solution space) to support digital adaptation. This comprises three major steps: (1) for each priority value chain, the most relevant solution space is identified; (2) the user reviews existing solutions within that solution space and develops a preliminary list of locally viable options; and (3) a consultative process among stakeholders from the agricultural and telecommunications sector will identify a selection of priority solutions that best match local needs, opportunities, and preferences. In the course of this deliberation, key needs for modification and adaptation of proposed solutions, and main needs for investment and policy reform are also identified.

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| **Activity V Type:** Group exercise, information gathering, cost analysis, and reporting  **Activity V Product:** Concrete, actionable recommendations for digital adaptation with line-of-sight analysis connecting adaptation challenge to solution to outcome |

## Step 1: Using user stories to identify the focal solution space(s)

This step considers each of the two to three priority value chains and evaluates context-specific enabling environments for the highly-ranked solution spaces. The heatmap from the previous PPPEEE analysis (Activity IV, Step 3) indicates the strengths and weaknesses regarding the different solution spaces in the country or region of interest. Again, it is strongly recommended to include the farmer’s perspective to ensure that proposed digital solutions for CSA can be tailored to specific farmer adaptation needs.

Each group of stakeholders working on the prioritization of solution spaces for each value chain should work on real case scenarios and develop one or more user stories detailing how specific digital solutions could help farmers become more resilient to climate hazards and improve overall agricultural outcomes. User stories are short, concise statements about what a person does, a goal (i.e., the problem to which they are responding), and why (i.e., what is the outcome). See this link on [creating user stories](https://www.mountaingoatsoftware.com/agile/user-stories) for more information.

For example, consider a region focusing on fresh vegetable production that is increasingly challenged by a lack of water for irrigation. Farmers have already started implementing adaptation measures, combining mulching with drip irrigation. Solutions for drip irrigations have been promoted by input providers, but farmers still do not have the knowledge to set up an optimized system. The digital solution space should focus on water efficiency and irrigation, using digital solutions for knowledge transfer and training—in addition to supplementary equipment for drip irrigation with smart apps that can guide the farmers in terms of water application and timing of irrigation events based on the plant’s growth stage.

In the above example, the user stories might include:

* As a farmer, I want to improve my irrigation system efficiency to make better use of limited water supplies.
* As an irrigation solutions provider, I want to provide farmers with planning tools to design their irrigation systems so that I can deliver tailored solutions that meet their needs as efficiently as possible.
* As a local watershed committee, we want to provide farmers with up-to-date information on seasonal climate and weather related to their crops to help them make better planning and water management decisions.

From the above example, we see an overlap in at least two solution spaces—namely water management, and weather and climate—with the potential for several different digital solutions, including irrigation planning tools, weather and climate forecasts, and localized, crop-specific information resources. With these user stories, specific CSDA solutions can be considered.

## Step 2: Crosswalk user stories with existing solutions

To distil a set of locally viable solutions from within the identified solution space(s), the next step is to review documented examples of digital adaptation in online databases. The objective now is to identify a set of three to five promising and relevant solutions through a thorough analysis of existing examples. Useful resources that can be filtered by solution space and value chain include:

* The Digital Agri Hub dashboard (<https://digitalagrihub.org/en/web/guest/dashboard>)
* Agriculture in the Digital Age (<https://agricultureinthedigitalage.org/explore-data/>)
* GSMA’s (Global System for Mobile communications Association) AgriTech Deployment Tracker (<https://www.gsma.com/mobilefordevelopment/m4d-tracker/magri-deployment-tracker/>)
* CGIAR Big Data Platforms Evidence Clearing House <https://bigdata.cgiar.org/evidence-clearing-house/>
* Sprout Open Content Platform (<https://sproutopencontent.com/>)
* Earlier Mercy Corps AgriFin work on Digital CSA (<https://www.mercycorpsagrifin.org/2020/01/10/digital-climate-smart-agriculture/>)

These online resources include information on (1) fully functional, commercial digital adaptation solutions that are relatively simple to replicate or scale to a new context; (2) previously implemented services that had worked well but had limited funding horizons; and (3) proof-of-concept studies that document a solution’s potential.

In screening these documents, strategy development participants should keep in mind that the goal is to identify digital adaptation options that are useful and viable in the target context—i.e., options address the adaptation needs and priorities outlined in Activity III. The set of solutions also needs to align with the ambitions of policymakers and industry representatives to foster capital investment and sustain the resources needed to develop new solutions and support the growth of operational and sustainable business models over time.

The output of this step for each solution and value chain is a short “CSDA Solution Specification” document of no more than one to two pages describing each specific solution and its rationale, including:

* How the solution responds to identified farmer needs and demand
* How the solution fits with the current policy environment
* Documented impacts on farmer livelihoods, return on investment, and cost-benefit estimates
* Required investments, partnerships, policy interventions for implementation, and long-term sustainability in the target context
* Areas of uncertainty and potential barriers to implementation

## Step 3: Preliminary cost estimation for CSDA solutions

Perhaps one of the biggest challenges in initiating CSDA solutions relates to the understanding of implementation costs. The understanding gained through each of the proceeding activities supports the clear articulation of a line of sight between adaptation challenges, potential solutions, and desired outcomes. The previous activities also generate substantial information that can support a preliminary cost estimation process.

To support the development of a preliminary understanding of implementation costs, we borrow from recent work developed by the CGIAR that uses vetted probabilistic approaches for assessing the performance of agricultural research (see [Rosenstock et al., 2021](https://cgspace.cgiar.org/handle/10568/117725)). Based on the approach and figures presented in the aforementioned report, we include a simple rubric for establishing the cost of implementation based on an assessment of the overall number of expected beneficiaries and a characterization of the implementation environment. The document entitled “Action 5\_3 CostEstimate.xlsx” provided with the playbook supports this calculation. For the purpose of this calculation, users will be asked to:

1. Approximate the total number of beneficiaries
2. Weight the cost per beneficiary values based on the PPPEEE analysis
3. Provide a characterization of general uncertainty regarding the estimates for #1 and #2

Two results are obtained from this calculation: the first is a simple estimation of project cost based on the number of beneficiaries and the user weightings; the second is a statistical distribution of project costs considering differing cost per beneficiary estimates from the literature, and a probability distribution based on the uncertainty estimates provided in #3. As mentioned, these are to be considered very rough estimates and should be used as a starting point for more detailed cost estimation with potential project partners.

## Step 4: Consultative process to define implementation roadmap

The final step in this playbook is to start a consultative process to evaluate a potential roadmap for the implementation of one or more specific CSDA solution development activities. This process will vary from context to context, from national to regional initiatives, and from more targeted to more general investments (e.g., investments focused on specific solutions or more general digital infrastructure, respectively).

There are many approaches to identifying investment roadmaps, and like the solutions themselves, these vary from targeted plans to overall national strategies. At a minimum, we recommend the development of a strategic plan that includes multiple components:

* Development of a stakeholder-driven “coalition of the willing”
* Assessment of stakeholder willingness to adopt new business models to support digital solutions for their corresponding value chains
* Evaluation of the readiness of agribusiness actors to support implementation and long-term sustainable business models
* Understanding and further development of farmer capacity to effectively select and use CSDA-oriented solutions
* Definition of short- and long-term ownership and institutional partnerships for successful implementation
* Co-development of a five-year roadmap for each solution space and value chain and/or an overall set of planned activities
* Implementation planning and timeline development with measurable milestones.
* A buy-in and commitment process with key stakeholder groups

The implementation roadmap will be a living document to guide project implementation over time and serve as a communication tool for stakeholders, investors, and researchers.

# Conclusion

The purpose of this playbook is to present a replicable process to support the sustainable implementation of new digital solutions in support of CSDA. Many adaptation challenges lend themselves to digital solutions, but few one-size-fits-all solutions work in every context. This playbook provides users with a structured approach to document needs and present solutions in a transparent and traceable manner within a stakeholder-driven process.

# List of Annex Material

The processes described in the playbook are information intensive in that are designed to bring the most current data and evidence to bear in support of improved decision making regarding appropriate investments in climate smart digital agriculture. To expedite the process and facilitate implementation in a replicable manner, we include a series of annexes that are intended to serve as support material and additional guidance in both the desktop and participatory phases of the outlined activities. The annexes are organized as follows:

**000 CSDA Master Annex - [DATE]**

This is an Excel worksheet that serves as the primary collection of annex material. The first tab in the spreadsheet (“List of Annexes”) lays out the organization of the material by Activity and provides links to the other tabs containing the corresponding information.

The CSDA Master Annex includes support for Activity I, Activity III, and portions of Activity IV. In a handful of instances, the annex material is provided in additional files (e.g., the climate hazards dataset and code from the Adaptation Atlas used in Activity II).

The [DATE] as indicated above corresponds to the last update to the Master Annex and will be updated as the information resources are updated or otherwise modified over time.

**200 Annex AII.1 – Hazards Data Analytics – [DATE]**

This annex is delivered in the form of a compressed “zip” file that contains a combination of both geospatial datasets and code. The primary dataset is referred to in the main text is the “Composite Hazards Dataset” which is used for the mapping and analysis mentioned in Activity II.

Advanced users may wish to explore the code and additional datasets to generate more detailed locally specific analyses.

**400 Annex AIV.1.3 Worksheet - Activity1**

This is a worksheet used to support of the group activities in Activity IV.

**401 Annex AIV.2 - PPPEEE Analysis Template**

This is the Excel spreadsheet used to perform the assessment of the overall readiness and relevance for implementation in the different CSDA solution spaces.

**500 Annex AV.3 - Cost Estimation Worksheet**

This Excel spreadsheet presents a novel method based on recent literature on scaling in agriculture development. The approach presented in this spreadsheet is intended to provide a first pass estimate of the cost associated with any implementation based on several simple factors and information otherwise derived from the PPPEEE analysis.

1. While we note that the climate change and agriculture development communities do not need another acronym, given the number of times that “climate-smart digital agriculture” appears in this document, we will use CSDA for purposes of brevity. [↑](#footnote-ref-2)