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How does climate-smart agriculture contribute to global climate policy? Bridging the gap between policy and practice

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The Paris Agreement, which entered force in 2016, requires involved Parties to submit Nationally Determined Contributions (NDCs). Today, it is well known that global agriculture both contributes to, and is affected by, the changing climate, which calls for an integrated role of farming in climate policy formation. Currently, different efforts aim to increase agricultural productivity, and to mitigate and adapt to climate change through the use of climate-smart agriculture (CSA). However, the efficacy of CSA in contributing to the NDCs has been the subject of debate. In this study, we studied the implementation and alignment of CSA and NDCs in two contrasting case-study non-Annex-I countries that are well known for their efforts in implementing CSA, namely Ethiopia and Colombia. We found that CSA can be a useful approach to reaching the climate goals outlined in the NDCs in the agriculture sector, specifically when used in the planning process to ensure the integration of its elements—adaptation, mitigation, and productivity—in sectoral activity. At the same time, the NDCs, which influence subsequent policy development, also offer an opportunity to increase the usage of CSA as an approach by integrating it more fully into national strategies. However, the incorporation of CSA into national-level climate policies is difficult due to myriad challenges, such as a lack of horizontal and vertical alignment, limited capacity and funding, and highly complex and varying contexts in which the policies are being developed. This research analyzes to what extent CSA is utilized as an approach to fulfilling the NDCs in Ethiopia and Colombia, and identifies entry points to further its use in different contexts.

KEYWORDS

climate-smart agriculture, NDCs, institutional coherence, policy design, horizontal engagement, vertical engagement, climate policies

Highlights

- The pillars of CSA are useful elements to include in national-level policy planning, and CSA as a framework can help implement these policies at a local level; however, different strategies for the effective use of it as an approach are needed, depending on the existing policy environment.
- An enabling environment for the integration of CSA's pillars into the climate change agendas requires effective national strategies, platforms to encourage coordination across levels and

actors, the identification of leading institutes, and the inclusion of CSA's pillars in planning processes.

- To use CSA effectively as an approach in other contexts, it is recommended that countries undertake stakeholder and policy analyses in order to determine where it fits, and how it can be integrated most effectively.

1. Introduction and background

1.1. Agriculture and climate change

Agriculture has been a growing focus within the climate change discussion in recent years, and for good reason: it is one of the most significant contributors to greenhouse gas (GHG) emissions worldwide. It is estimated that between 10% and 12% of non-CO₂ anthropogenic global GHG emissions come from agriculture, mostly from agricultural soils and enteric fermentation (Smith et al., 2014). Furthermore, when the scope is expanded to include the entire Agriculture, Forestry, and Other Land Use (AFOLU) sector, this estimate rises to almost a quarter of global anthropogenic GHG emissions (Edenhofer et al., 2014). The relative share of agriculture as a proportion of national emissions is very dependent on a country's status; for most non-Annex I¹ countries, this share is higher than in Annex I countries (Richards M.B. et al., 2015).

In addition, agriculture is, and will continue to be, one of the sectors most affected by climate change (Challinor et al., 2014). Increased frequency of extreme weather, heat, and variability in pests and diseases are examples of potentially yield-damaging changes that are already being felt in some parts of the world (Müller et al., 2017; Van Meijl et al., 2018)—and especially in some of the world's most vulnerable regions (Ross and Agostini, 2016). 53% of all agricultural land is used for food production by family farmers (Graeub et al., 2016), which demonstrates the detrimental effect that production declines could have on individual livelihoods, particularly in poor populations. Not surprisingly, in many of these vulnerable regions, climate change exacerbates the impact of political unrest on agricultural policies (Beg et al., 2002; Hendrix and Haggard, 2015).

1.1.1. Climate-smart agriculture

Climate-smart agriculture (CSA) aims to respond to these challenges in an integrated approach with its three pillars: to increase agricultural productivity and improve livelihoods, to create more resilient agricultural systems through productivity, and to reduce GHG emissions through mitigation measures. It was introduced in 2010 by the Food and Agriculture Organization of the United Nations (FAO) as an approach to pursue multiple benefits in the collaborative

space between sustainable development agendas, agriculture, and climate change (Scherr et al., 2012).

According to the FAO (2016), CSA strategies should be specified to their local contexts, and include capacity-building for participating stakeholders to offset higher implementation costs. Many CSA programs have focused on field- and farm-level implementation, and although the effectiveness of field-level adaptation practices is much disputed, there is agreement that with the use of agronomic adaptation, farmers can improve their yields by an estimated 15%–18% (Porter et al., 2014). The FAO (2016) further states that, “often, but not always, practices with strong adaptation and food security benefits can also lead to reduced GHG emissions or increased carbon sequestration.”

1.1.2. Global response

CSA is positioned to address climate challenges at a farm level, which takes place within a context where policy decisions are made at global scales, namely the Paris Agreement. In 2016, this legal framework defined a pathway to keep the global temperature rise below 2°C above pre-industrial averages (Art. 2.1, UNFCCC, 2015), with an aspiration to keep this rise to below 1.5°C. Nationally Determined Contributions (NDCs),² are the foundation of climate action in the Paris Agreement, representing each Party's unique national responsibility and capability (Art. 4.3, UNFCCC, 2015) in the attainment of this goal; they are a new mechanism for climate action since the Kyoto Protocol (Lipper et al., 2018). The NDC formulation process, in part, sparked the development of sectoral policies and programs at national levels (Höhne et al., 2017)—thus, climate change was more present in agriculture policy formation than it had been previously, and CSA has been identified in many NDCs as a pathway to fulfill sectoral targets while also developing more resilient and food-secure systems (Lipper et al., 2014). Because the NDCs are developed at a different scale than most of the implementable actions in agriculture (e.g., farm and field level), CSA could be an interesting framework for effective scaling of these national-level commitments. The growing support for CSA as an approach to reach national and international development and climate targets is evidenced by its inclusion in the NDCs; according to a CGIAR research program on Climate Change, Agriculture, and Food Security (CCAFS) dataset (2022), CSA in general was referenced by 56 countries, with 24 specifying it as a mitigation measure and 47 as an adaptation measure. Furthermore, the pillars of CSA (without explicit use of the nomenclature) have also been heavily referenced in the NDCs.

¹ The original work by Richards M.B. et al. (2015) referred to these countries as “developing,” but for the sake of consistency this article will use the terms non-Annex I and Annex I to indicate developing and developed countries, respectively; these terms were originally developed by the United Nations Framework Convention on Climate Change (UNFCCC) for the Kyoto Protocol.

² Intended Nationally Determined Contributions (INDCs) are converted to Nationally Determined Contributions (NDCs) when a country submits an instrument of ratification, accession, or approval to join the Paris Agreement (UNFCCC, 2015). For simplicity, this paper will use “NDCs” in place of “INDCs.”

Adaptation measures, for example, are important for the non-Annex I Parties that will be especially vulnerable to the changing climate (Art. 7.2, UNFCCC, 2015), especially because agriculture will be one of the most-affected sectors; 94 countries included goals that are specific to the agricultural sector in their NDCs, making it the most-included sector for adaptation (Mills-Novoa and Liverman, 2019).

Porter et al. (2014) point out that the reduction of some of the risks associated with climate change through adaptation measures can increase food security and have direct benefits on livelihoods, as well as social and economic co-benefits.

1.2. NDC and CSA implementation in non-Annex I countries

The period leading up to 2020 was a pivotal time for NDC implementation. The current national commitments are not ambitious enough to limit global temperature rise to 1.5° (Kuramochi et al., 2017); in fact, it is estimated that the proposed NDCs would result in a rise of twice the magnitude (Höhne et al., 2017). In response, by 2020, Parties were required to either raise their ambitions, or enhance their NDCs (United Nations Framework Convention on Climate Change, 2016). In non-Annex I countries, the implementation of climate action in the agriculture sector is complicated. NDCs are developed and enhanced at the national level, and thus reflect the unique priorities and responsibilities of each Party. Some are built on existing policies, programs, and projects, whereas others do not identify specific action points for implementation (Ross and Agostini, 2016); furthermore, some have access to robust datasets, while others do not (Lipper et al., 2018)—the heterogeneity of their development and content implies that different countries have specific support needs, and generally (though not exhaustively), the primary requirements for support are: technology transfer, capacity building, and financial support (Richards M. et al., 2015; Ross and Agostini, 2016).

At the same time, many different stakeholders have been involved in the implementation and development of CSA, which, at its inception, led to some confusion about its overall purpose (Lipper et al., 2018). Its development started at the international level and quickly moved down to regional programs and projects (often with farm- and field-level actions), in partnership with international organizations. This rapid dissemination of the concept happened before a clear methodology had been articulated, which furthered the confusion about its purpose and, in turn, led to controversies (Lipper et al., 2018). It has since been more clearly defined, but effective coordination of stakeholders is still a challenge (Brandt et al., 2017). Additionally, although CSA programs have arguably moved from the international level to the regional and local levels, there are still limited opportunities for local land managers to participate in the international climate discussion space (Fanen and Olalekan, 2014), which has led to questions of who benefits from its adoption (Westermann et al., 2018). Since its inception, however, the developers of CSA (e.g., the FAO and CCAFS) have attempted to create dialogue between diverse stakeholder groups to create a framework that could highlight synergies between international climate and agricultural development goals, while allowing for flexibility across very different economic, political, and biophysical agricultural landscapes (Lipper et al., 2018). Although there are frameworks that aim to deliver support to decision-makers at the

national level to ensure that the CSA approach is implemented with integrated stakeholder involvement combined with spatial datasets, it is still difficult to ensure that CSA practices are sufficiently specified to the local contexts in which they are implemented (Brandt et al., 2017). Access to adequate data represents a major challenge in this regard, because it is essential to the identification of suitable CSA practices for diverse areas (Fellmann, 2012; Lipper et al., 2018).

Many of these associated challenges (with both the implementation of the NDCs and with CSA) are similar, and across their operating spaces, they are being exacerbated by a lack of vertical and horizontal alignment. Vertical alignment refers to the level of governance: international, national, regional, and local. Horizontal alignment refers to cross-sectoral cohesion, which, according to Gillespie et al. (2015), can represent coordination and collaboration among sectors in order to leverage resources towards action. Additionally, this alignment can be among impact categories (e.g., water quality and nutritional security) as well as institutions with different purposes at the same level of governance (e.g., national government ministries and national research organizations).

1.3. Knowledge gap and research objective

It is clear from the burgeoning addition of CSA (and its pillars) in the NDCs, that the CSA approach is put forward as an implementation mechanism for national climate commitments in agriculture. In theory, since these actions generally happen at different levels—CSA at a local to regional scale, and NDCs at a national to global scale—the two could work harmoniously to identify and implement potential pathways for monitoring and scaling agricultural climate action. We know that within many contexts, climate initiatives and CSA are not aligned—however, we do not know the nature of this misalignment, including where bottlenecks in action occur within the governance systems and what remedial steps could overcome this.

Since it has already been identified in other research as a useful pathway to fulfilling multiple national objectives in non-Annex I countries (e.g., climate change, agriculture, and development agendas) (Lipper et al., 2014; Steenwerth et al., 2014), this research does not focus on CSA's viability as an approach, but rather seeks to provide policymakers with recommendations to utilize CSA as an approach to more effective NDC implementation and monitoring, and to create an enabling policy environment for the integration of its pillars (adaptation, mitigation, and productivity) into agricultural agendas aimed at delivering on the NDCs.

2. Methodological approach

2.1. Think-do-gap framework

The Think-Do-Gap framework seeks to find solutions to complex gaps between science and implementation through effective stakeholder involvement: O'Sullivan et al. (2018) used this analysis framework to engage diverse stakeholders in the design of optimized governance instruments for catchment areas with multiple agri-environmental objectives, which resulted in facilitated knowledge production from local to national scales. The research in this current paper adapted O'Sullivan et al.'s (2018) framework to describe the

current state of regional and national institutional arrangements by engaging with individuals and organizations from different scales of governance (vertical) and focus (horizontal). The original framework's sequence of steps as described by O'Sullivan et al. (2018) was followed during the literature review, but was then modified to be an iterative process in the next phases of the study:

2.1.1. Identify "Vision"

In the study by O'Sullivan et al. (2018), the *vision* is an identified solution; in their work, this related to the successful implementation of Functional Land Management, but it was also described through global goals, such as high-level policy instruments like the Sustainable Development Goals (SDGs). In this study, the latter interpretation was utilized. To identify the vision, an extensive bibliographic review was undertaken with CCAFS, which consisted of the collation of over 500 resources, such as peer-reviewed articles, international research organizations' datasheets, webinars, presentations, and scientific information notes, all of which focused on the nexus between climate change and agriculture. This review illustrated that many national and international actors recognize that CSA could help to reach national climate and agriculture objectives, and that national strategies could likewise facilitate more effective scaling of CSA's pillars—which was then set as the *vision*.

2.1.2. Identify "Gaps"

In O'Sullivan et al.'s (2018) original framework, these gaps related to different aspects that limited regional level cooperation towards the achievement of the aforementioned *vision*, such as, "bureaucratic issues," such as misalignment of policy timelines. In this study, a detailed analysis of the barriers to achieving this *vision* was conducted. These *gaps* were first identified in the preliminary bibliographic review, and were further disaggregated and reassessed with the input from Key Informant Interviews (KIIs).

2.1.3. Identify "Actors"

Actors, in this study, refer to stakeholders that work within the climate-agriculture nexus. They came from different organizations and levels (within the agriculture sector), and were originally identified through stakeholder mapping, which illustrated a comprehensive view of the institutional environment. Finally, they were engaged in the study to identify both gaps and bridges in achieving the vision—Although CSA and the NDCs are often implemented at different scales, this research was undertaken at the regional-, national-, and international-actor scale, since it is these actors that are tasked with connecting and aligning international policies with local actions and initiatives.

2.1.4. Identify "Bridges"

The *bridges* represent possible solutions to the aforementioned *gaps*, and pathways to achieving the *vision* (O'Sullivan et al., 2018). Through its strong focus on stakeholder engagement, the Think-Do-Gap encourages the actors to determine the best solutions to these gaps, because it recognizes that from within a context comes the most intimate understanding. In this way, actors take the lead role in the identification of the bridges. For this study, the KIIs identified existing successful bridges from their own countries that could be strengthened in order to create an enabling environment for the integration of climate and agricultural agendas.

2.2. Case study approach

According to Yin (2009), the case study approach is useful for research that aims to, "explain some current circumstance," or investigate, "the structure of a given industry." It is a meta-methodology that can be combined with other research methodologies to gain a deeper understanding of the subject area (Yin, 2009). In this research, it was used to determine whether similarities can be captured within different situations—in this case, the synergistic potential between CSA and NDCs—and then paired with another methodology (i.e., KIIs) to describe them (Yin, 2009).

To explore the extent to which CSA is used as an approach to implementing the NDCs in non-Annex I countries, Ethiopia and Colombia were chosen to be case studies, based on multiple criteria: first, both make reference to CSA's pillars, but rarely feature it specifically in their NDCs (Colombia's Updated NDC, 2020; Ethiopia's Updated NDC, 2021)—this illustrates that both countries, at a high-level, recognize the importance of agriculture in reaching their climate objectives, and more specifically, in adaptation, mitigation, and productivity; next, although it should be noted that the research will be difficult to generalize to other non-Annex I countries, the similarities found in the extreme heterogeneity (e.g., in landscapes, climates, agricultural sectors, cultures, political scenarios, and types of governance) between the two case studies could point to high-level processes in climate strategy that may be of relevance to others; and last, the robust presence of CCAFS in each country strengthens the knowledge conditions for effective horizontal and vertical alignment.

2.2.1. Ethiopia

The Ethiopian agricultural sector is extremely vulnerable to climate change and variability; much of its population relies on subsistence, rain-fed agriculture, which is sensitive to drought, flooding, and other climate hazards (National Meteorological Agency (NMA), 2007). Its NDC, which is conditional to multi-lateral agreements, heavily focuses on the AFOLU sector, aiming to reduce sectoral GHG emissions by 220 Mt. CO₂e ("which makes up approximately 86% of their total reduction goal as compared to the 'business-as-usual' scenario") and to build resilience in their agricultural systems (Ethiopia's NDC, 2017). Although the NDC does not explicitly mention CSA, it is used as an approach by the governmental ministries and their partners (Ethiopian Ministry of Agriculture, 2018; Ethiopia's NDC, 2021).

Ethiopia's climate policy environment is described more fully in the work by Eshetu et al. (2014), as well as in the stakeholder map included in Figure 1. However, in summation, it is important to note that the Ethiopian Climate Resilient Green Economy (CRGE), which was developed in 2011 as an economy-wide approach to GHG emission, is one of the only policy frameworks in the world that formally consolidates the aim to develop a green economy with the creation of more resilient systems (Eshetu et al., 2014). The Climate Resilient part of this strategy focuses largely on the agriculture, and has found 41 options to build climate resilience in the sector (Pers. comm., Environment and Climate Change Directorate of the Ethiopian Ministry of Agriculture, 23 January 2020). The CRGE overarches the CRGE Facility, which is a single national funding mechanism that collaborates with government ministries and other stakeholders, recognizing that climate change affects the entire economy (Eshetu et al., 2014). Additionally, the Strategy builds on policy objectives that had been

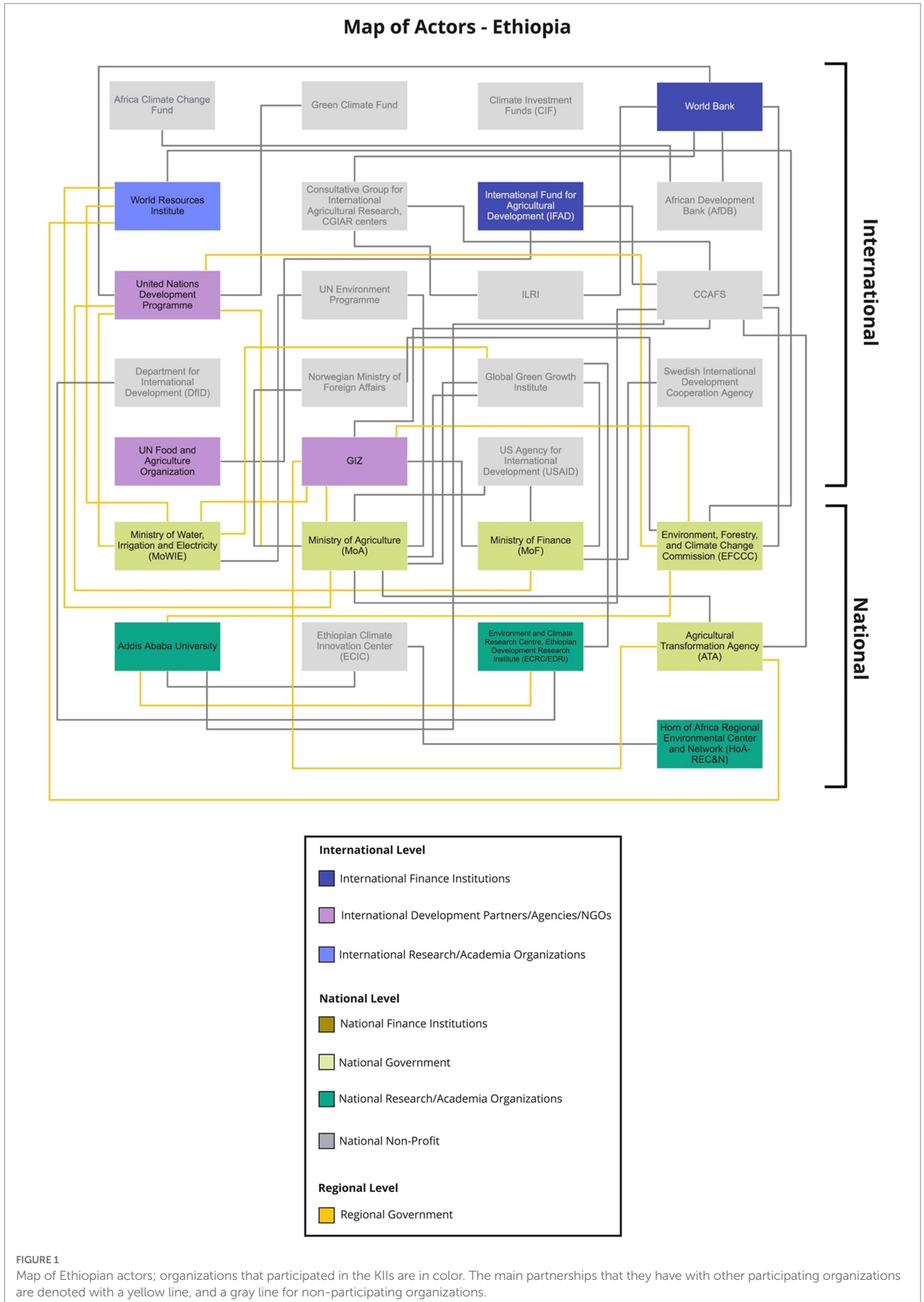


FIGURE 1 Map of Ethiopian actors; organizations that participated in the KII are in color. The main partnerships that they have with other participating organizations are denoted with a yellow line, and a gray line for non-participating organizations.

outlined previously in the first Growth and Transformation plan (GTP), the National Adaptation Plan of Action (NAPA), and the Nationally Appropriate Mitigation Actions (NAMA) (Eshetu et al., 2014).

2.2.2. Colombia

Colombia's climate-dependent agricultural sector, which makes up about 6.3% of its GDP (World Bank, 2015), is highly vulnerable to climate change due to its diverse agroecological areas and farming systems, as well as social inequity (Ramirez-Villegas et al., 2012). The importance of building resilient agricultural systems is reflected in its NDC, in which agriculture is identified as a high-priority sector for adaptation action (Government of Colombia, 2018). The sector (AFOLU) also represents the country's largest GHG emitter, totaling about 58% of its emissions (IPCC, 2014). Colombia's NDC does not specifically make reference to CSA, but its practices have been used in the country's agricultural systems for decades (World Bank, CIAT, and CATIE, 2014; Colombia's NDC, 2015).

A fuller description of Colombia's climate policy environment can be found in the work of Tapasco et al. (2019), but in brief, it has a number of institutions and policy instruments that largely focus on climate action, as well as CSA. In 2011, the National Council for Social and Economic Policy (CONPES) released the CONPES 3700, or the "Institutional Strategy to Articulate Climate Change Policies and Actions in Colombia" (DNP, 2011; World Bank, CIAT, and CATIE, 2014) as an overarching framework that guides climate action. In 2016, the National System of Climate Change (SISCLIMA) was established as a platform for national and international actors to manage climate change matters (Jaramillo, 2014; Ministry of Environment and Sustainable Development, Decree 298, established 24 February, 2016; Tapasco et al., 2019), which integrates work on different strategies and plans, such as the Climate Change Adaptation Plan (PNACC), the National Climate Change Plan (PNCC), and the Colombian Low-Carbon Development Strategy (CLCDS) (World Bank, CIAT, and CATIE, 2014). A visual depiction of relevant actors and governance can be found in the stakeholder map (Figure 2).

2.3. Methods

2.3.1. Stakeholder mapping

The stakeholder mapping approach of Mehrizi et al. (2009) was adopted to determine links across different actors. Consistent with the Think-Do-Gap analysis process, in the case studies in Colombia and Ethiopia, stakeholders were defined and referred to as actors that directly affect NDC or CSA implementation, rather than those who are also affected by it.

Depending on its application, the term stakeholder mapping can apply to a range of methodologies (Crosby, 1992), but the process for this study was as follows: first, CCAFS' resources (e.g., workshop attendance sheets and personal contacts) and a literature review were used to identify relevant groups, organizations, and people. Through snowball sampling, these resources were expanded upon to include a more comprehensive illustration of the "playing field" beyond direct CCAFS' partners. Next, these actors were systematically analyzed by their specific roles, interactions, and processes, which were then categorized into eight groups that were based off of and modified from the work by Tapasco et al. (2019): (1) International Finance Institutions; (2) International Development Partners/Agencies/NGOs;

(3) International Research/Academia Organizations; (4) National Finance Institutions; (5) National Government; (6) National Research/Academia Organizations; (7) National Non-Profits; and (8) Regional Governments. Then, the actors were mapped in conceptual matrices, or stakeholder maps (Figures 1 and 2).

2.3.2. Key informant interviews

Key informant interviews (KIIs) were then performed using the process outlined by Kumar (1989). In each case study country, 15 actors were interviewed in a semi-structured way. An interview guide (Appendix A) helped to explore the use of CSA as an approach for NDC implementation; this guide was limited to 15 discussion items to reduce superficiality in the conversation and allow for nuanced dialogue.

The aforementioned stakeholder maps were used to preliminarily select organizations for the KIIs that would adequately reflect the heterogeneous nature of the institutional environments. Then, participants were contacted through the CCAFS network, as well as by directly reaching out via institutional webpages. After the interviews were conducted, they were then transcribed and coded using the qualitative analysis software ATLAS to identify patterns in processes, narratives, and strategies (Pas Schrijver, 2019). Patterns were preliminarily identified by manually reviewing interview content. They were then systematically categorized (using the analysis software) into codes that reflected the disaggregated gaps and bridges that were identified by the key informants. For example, a key informant in Ethiopia expressed that their organization had expected to receive more international funding for NDC-related programs. Initially, this was put into a *funding* category; then, after all comments were categorized, they were further disaggregated into codes—this example then was coded as a "lack of international NDC support" within the *funding* category. This process ultimately resulted in three main categories, seven sub-categories, and 14 gaps for the Ethiopian context, and three main categories, six sub-categories, and 11 gaps for Colombia (Figures 3 and 4).

3. Results

3.1. Actors

The actors that participated in the KIIs came from the international, national, and regional levels, with categories as described in Figures 1 and 2; however, primary representation came from the international and national levels: in the Ethiopian case, there were no participants from the regional level, but seven and eight from the international and national levels, respectively. In Colombia, there was one participant from the regional level, six from the national, and eight from the international.

3.2. Gaps

In Ethiopia and Colombia, the major gaps identified by the key informants were related to either *funding*, *engagement*, or *capacity-building*. These categories are shown in Figures 3 and 4; *funding* either refers to international or national funds; *engagement* refers to coordination gaps, such as a lack of horizontal and vertical alignment; and *capacity-building* refers to barriers related to data management,

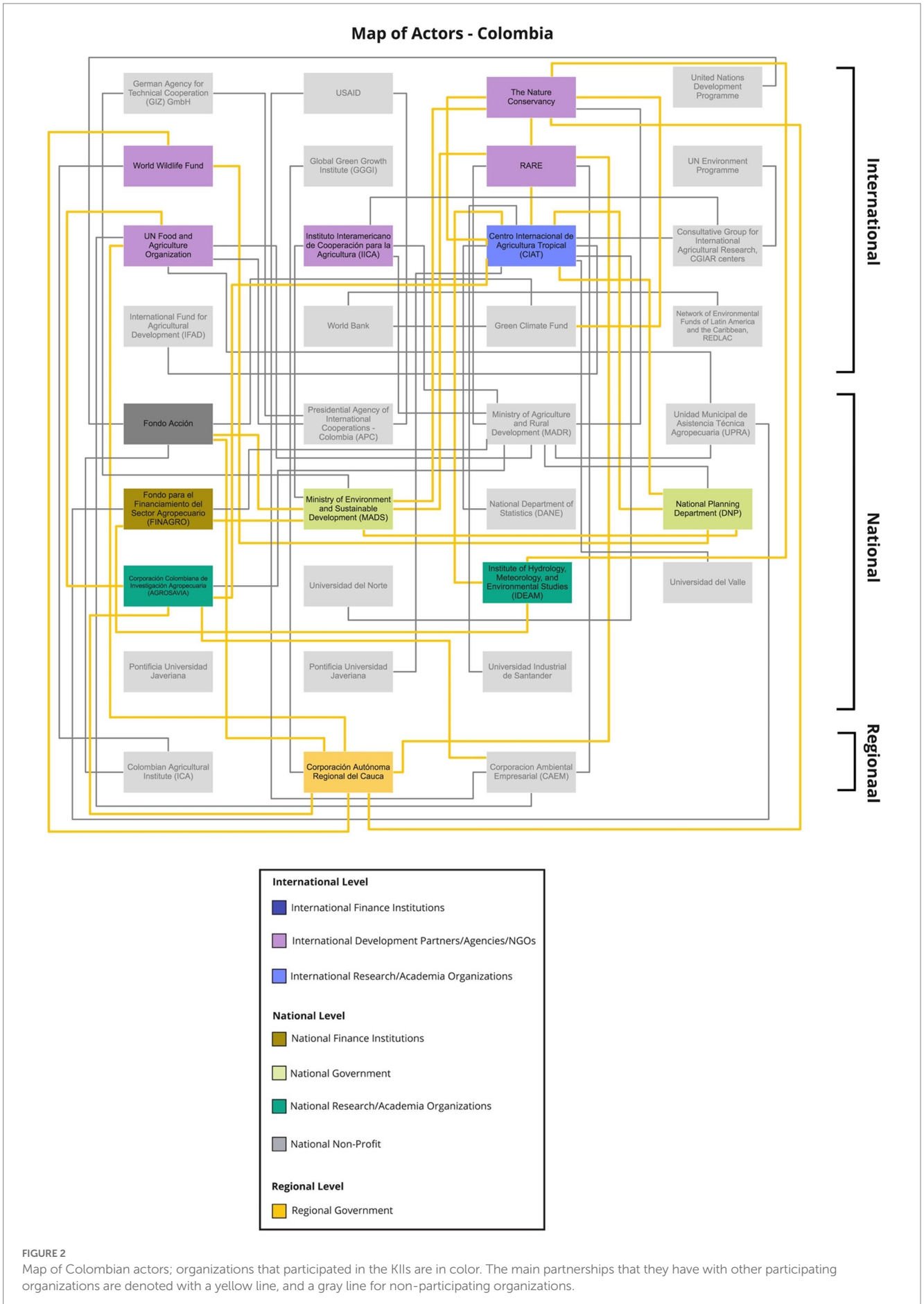


FIGURE 2 Map of Colombian actors; organizations that participated in the KILs are in color. The main partnerships that they have with other participating organizations are denoted with a yellow line, and a gray line for non-participating organizations.

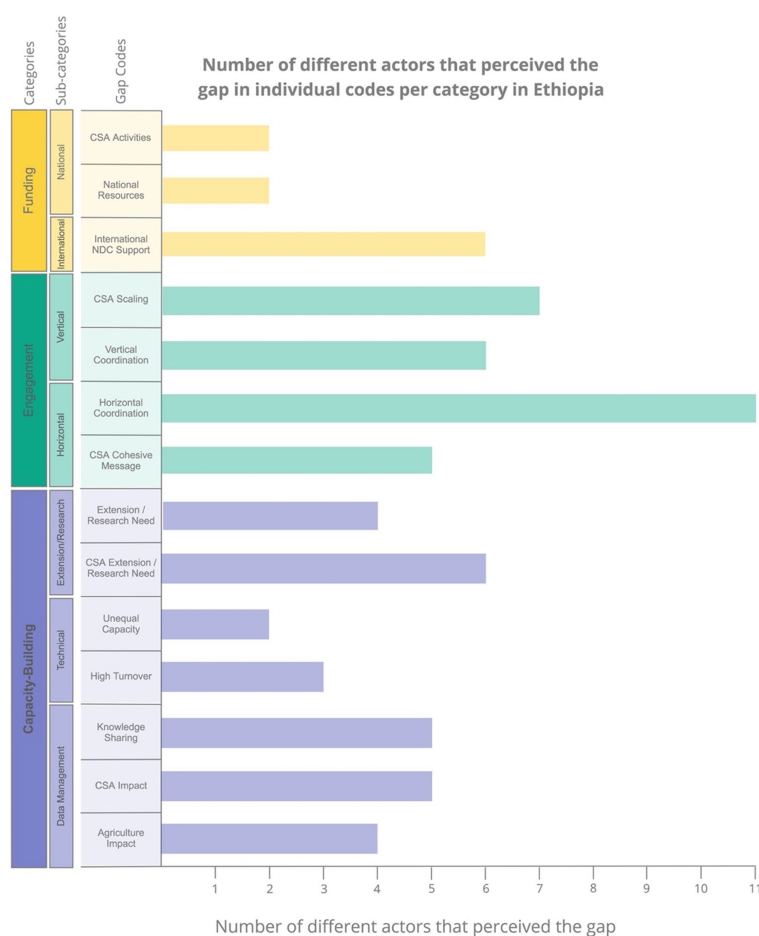


FIGURE 3 Breakdown of gaps in Ethiopia: to the far left are the categories, and then sub-categories, before reaching the final code breakdown.

technical capacity, or extension/research. Though the over-arching categories were the same in both countries, the sub-categories and the gaps within them (once further disaggregated) had slight differences. Full descriptions of these gaps can be found in the supplementary material (Appendices B,C).

In Ethiopia, gaps were perceived most frequently in *engagement*, with all 15 actors mentioning one or more issues in this category. Within this, “horizontal coordination” was most widely-mentioned, with 11 out of 15 actors perceiving it to be a gap (Figure 3). Twelve of the 15 actors perceived a gap within the *capacity-building* category, most frequently mentioning a need for further “research and extension of CSA” (Figure 3). Seven of the 15 highlighted gaps in *funding*, which were predominantly disaggregated as a “lack of international NDC support” (Figure 3).

Colombia showed similar patterns. Though to a lesser extent than in Ethiopia, *engagement* was once again the most frequently mentioned category, with perceived gaps mentioned by 12 out of the 15 actors. Within this category, “horizontal coordination” was again the most widely spread gap (Figure 4). Next, gaps within the *capacity-building* category were mentioned by 11 out of the 15 actors, of which “unequal capacity” was most frequently highlighted (Figure 4). As in Ethiopia, seven actors mentioned a gap within the *funding* category; of these, “scarce national resources” was the most frequently cited (Figure 4).

3.3. Bridges

The three main bridge categories that were consistently identified by the actors in Ethiopia and Colombia were: *creation of platforms*, *effective national strategies*, and *CSA as an approach* (Figure 5). These refer to categories of solutions that each country is pursuing in order to effectively integrate climate work into their agriculture sectoral agendas. This does not necessarily mean that the bridges have reached their full potential in the case study countries—according to the key informants, many times these bridges represent priority areas for improvement.

In both Ethiopia and Colombia, *CSA as an approach* was the most frequently mentioned bridge category, in which actors described the way that CSA has been or could be used in their countries as an approach to strengthen the linkage of climate and agriculture. In Ethiopia, the second most prevalent bridge was *effective national strategies*, which refers to the use of successful frameworks, policies, and plans at the national-scale. This was the least prevalent bridge category that was perceived in Colombia, preceded by the *creation of platforms*—this refers to effective platforms that bring together different sectors, stakeholders, or levels of governments, and was the least frequently mentioned category in Ethiopia.

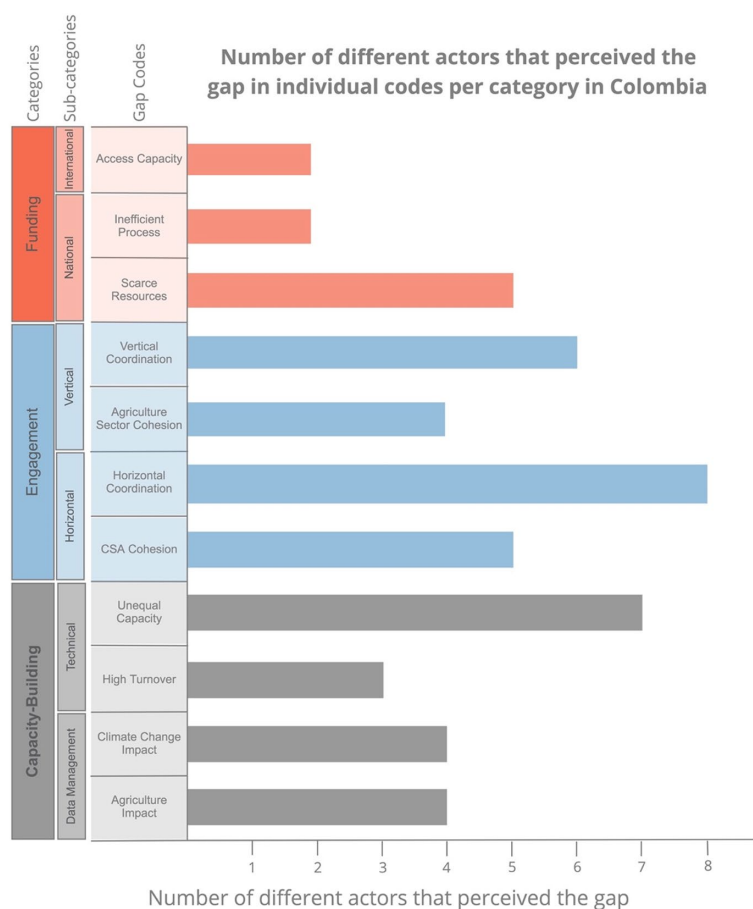


FIGURE 4 Breakdown of gaps in Colombia: to the far left are the categories, and then sub-categories, before reaching the final code breakdown.

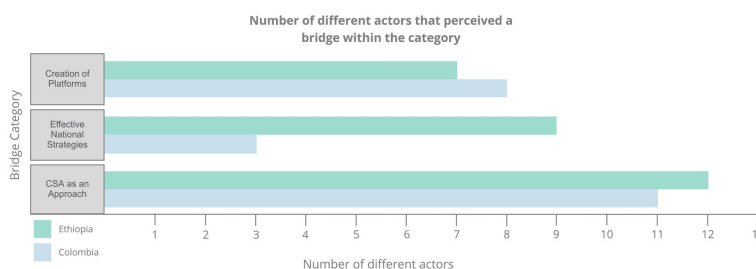


FIGURE 5 The perceived bridge categories and frequency of identification by actors in Ethiopia and Colombia.

4. Discussion

4.1. The use of CSA as an approach in Ethiopia and Colombia

Through the KIIs, it became apparent that CSA is being used as an approach to NDC implementation in Ethiopia and Colombia: although it is not always explicitly referred to as “CSA”, its pillars—adaptation, mitigation, and productivity—were often referenced in the climate space (thus referring to the previously identified *vision*).

Actors from the two countries, however, expressed very different policy environments for uptake of the CSA pillars: in Ethiopia, many participants communicated that more policy instruments were needed in the agri-climate policy environment, and that CSA could potentially be a welcome framework to assist in the achievement of climate objectives. In Colombia, on the other hand, actors often expressed that the terminology around CSA is not consistently utilized across scales (it is only referred to as CSA in the academic and research communities, due to mainly linguacultural reasons), and furthermore that they experience an inundation of approaches, platforms and frameworks in their policy space—and referenced CSA as a potentially

confusing addition. This is because it often lacks a cohesive message; though it was popularized by just a few leading entities, such as FAO, CCAFS, and the World Bank (Lipper and Zilberman, 2018), its message was often interpreted differently by the various organizations that participated in the KIIs, thus leading to confusion around its pillars and methods. Ambiguous leadership of CSA as an approach and the lack of standardization (e.g., lack of indicators for monitoring and evaluation across organizations) has led to other issues, such as the duplication of activities and inaccurate impact measurements. According to the KIIs, this is in part due to the complex, heterogenous nature of agro-ecological zones within each country—however, this apparent weakness of the CSA approach was also regarded as a strength by some key informants, because it allows for the flexibility to adapt CSA to many different contexts.

Ethiopia's work around CSA, on the other hand, has a clear leader (and thus, leadership is a *bridge*, in this case)—it is led by the Ministry of Agriculture (MoA), which has created a manual and strategy as a tangible example of leadership (with the help of national and international partners) in an attempt to mainstream and standardize its implementation (Ethiopian Ministry of Agriculture, 2018). According to the actor interviews, it is expected that the manual will offer guidelines to practitioners and implementing agencies, thus cohering some of the aforementioned ambiguities. This, partnered with the CSA strategy, is expected to encourage CSA activity to move from the national level (at which most planning happens) to the regional and local levels (at which most implementation happens), according to the KIIs. Thus, unlike Colombia, Ethiopia is attempting to streamline the terminology of CSA as a way to standardize action around its pillars in the agriculture sector; ultimately, the MoA would use this manual and strategy to measure CSA activity and to demonstrate Ethiopia's efforts to donors. Though both approaches are valid (to use the explicit term “CSA”, or to integrate its pillars into climate agendas without the title), it depends on the context of the country in which it is implemented. In summary, in both countries, it was clear that the pillars of CSA are indeed important priorities to include in national climate strategy; however, there were clear differences in the current policy environment in terms of the potential uptake of the CSA framework itself as a tool for implementing the NDCs (the original vision of this study).

4.2. The integration of climate change into agricultural agendas: lessons learned

In general, Ross and Agostini (2016) found that NDC-specific gaps (which they refer to as support needs), which reflect similar needs for the integration of CSA (regardless of the use of its nomenclature), fall into the categories of technology transfer, capacity building, and financial support. The gaps outlined in the current study were consistent with those found by Ross and Agostini (2016). Our research further focused on the integration of the pillars of CSA into the agriculture sector, and additionally identified the gap of engagement, which focuses on horizontal and vertical coordination.

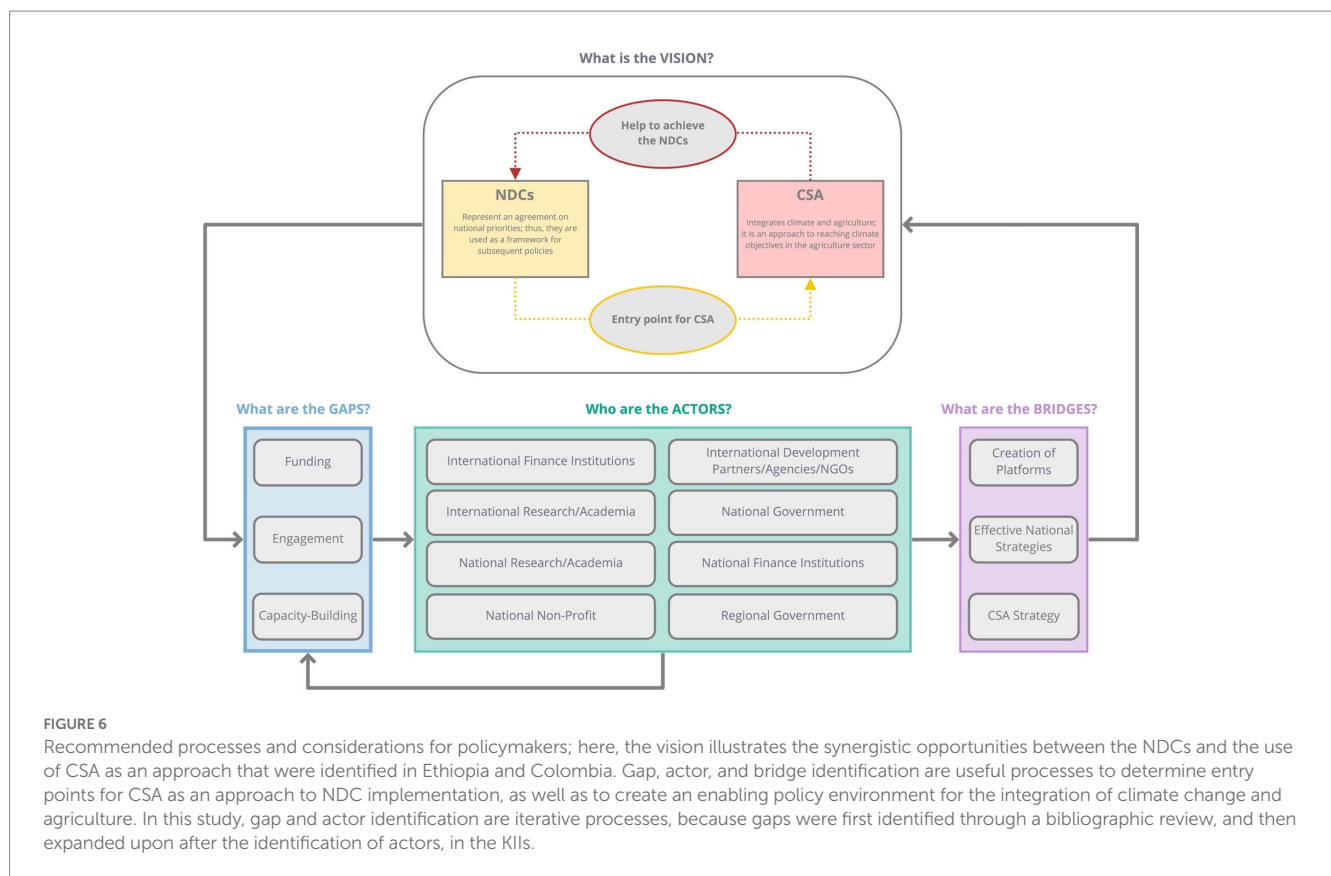
Despite their heterogeneity, in both Ethiopia and Colombia the integration of the pillars of CSA into the agriculture sector in national-level policies, regardless of whether or not the terminology is used, proves to be a challenge. According to the

KIIs, examples of these gaps were: governance instruments are constantly added, changed, or withdrawn; experts are few, and concentrated at the national level; political turnover leaves frameworks half-finished. Multiple sectors and organizations, across levels, are trying to work towards the creation of more resilient governance systems in the face of the changing climate; duplication of projects happens frequently, and resources are not always used efficiently. From the perspective of the agricultural sector, the gaps that are related to the integration of climate change into their agendas can be categorized into: engagement, capacity-building, and funding (Gaps, Figure 6). These considerations could be applied more broadly to the creation of an enabling environment in many policy scenarios, but in this case, we illustrate that CSA could be used as an approach to effectively bridge them.

4.2.1. Engagement

The most widely mentioned gap, horizontal coordination, ultimately exacerbates other gaps as well. For example, climate finance, which is often in short supply, could have a farther reach if organizations and sectors were aligned more effectively. In Ethiopia, for example, it was noted in the KIIs that the MoA is often unaware of regional-level projects that international NGOs are undertaking; thus, collaborative opportunities are missed, and potential for further efficiencies in resource use remains untapped. From the development partners' perspective, it is also a challenge to coordinate amongst themselves: for example, according to the KIIs, at times an implementing institution has requested and received support from a number of different development partners, which has inundated a single project with resources and removed a funding opportunity for others. Colombia faces similar challenges: one key informant described a partner organization's project that is nearly identical to their own, explaining that if the two organizations had combined resources, it could have reached a wider scale. Some key informants even noted that there were coordination gaps within their own institutions. To overcome this horizontal coordination gap, both countries have tried to create platforms that can help to coordinate agro-climatic activity. For example, in Colombia, the *Mesas Técnicas Agroclimáticas* (Local Technical Agro-Climatic Committees (LTACs)) have worked well to give experts from different organizations the opportunity to share information amongst themselves and with farmers regarding topics such as climate change adaptation strategies (Giraldo-Mendez et al., 2018; Loboguerrero et al., 2018). Apart from this example, however, many of the key informants explained that the over-abundance of platforms in Colombia detracts from their efficacy, as many actors are unsure of each one's specific purpose.

Additionally, a lack of vertical coordination can hinder the integration of climate change into agricultural plans at different levels: in Colombia, for example, the primary authorities for regional environmental development are the *Corporaciones Autónomas Regionales* (Regional Autonomous Corporations (CARs)), and although these are technically directed by the Ministry of Environment and Sustainable Development (MADS), they have a great deal of independence from the federal government. For example, even though they are eligible to apply for and receive federal funds, if they allocate private resources



(instead of governmental resources), they do not need to obtain project approval from the national-level. Additionally, these regional-level environmental authorities aren't linked with the Ministry of Agriculture and Rural Development (MADR), thus leaving further opportunities for collaboration at the nexus of climate and agriculture. In Ethiopia, on the other hand, the primary authorities at the regional level are the bureaus, which integrate rural development, agriculture, and environment activities—they are part of regional administrations and funded by the regional government, which are an arm of the federal government. Although this demonstrates that the national governance strategy is present throughout the levels, some key informants highlighted that there is a need for stronger representation from the regional governments in national-level policy processes.

CSA could aid in these challenges with engagement by providing a framework (with tangible, locally contextualized actions collated in a platform or manual, such as the example in Ethiopia) to horizontally align policies that are imperative to agricultural development, such as those relating to infrastructure (The World Bank Group, 2016). This vertical and horizontal coordination between levels and stakeholders could also reduce costs and prevent the duplication of programs and projects (Taibi and Konrad, 2018).

4.2.2. Capacity-building

Lack of knowledge capacity also proves to be a gap, primarily in regards to data management, technical skills, and extension or

research. Very broadly, capacity-building is mentioned in over 70 countries' NDCs, which, according to Ross and Agostini (2016), includes needs such as "adaptation assessments and the development of sectoral finance plans," as well as stakeholder engagement (e.g., vertical and horizontal alignment), and trainings on best management practices for agriculture. Further studies have found that many countries also identified logistical challenges that require capacity-building support, such as resource mobilization (UNDP, 2016). Unlike in the work of Ross and Agostini (2016), which separated the gaps of technical transfer and capacity, this research combined the two in the capacity-building gap. As with horizontal coordination, interconnection amongst these gap categories is common; for example, in Colombia, access to international climate finance requires a high level of capacity because it necessitates, at minimum, bilingualism and grant-writing skills. According to the KIIs, most of this type of capacity is concentrated at the federal-level, which automatically disadvantages some regional- or local-level organizations. This is also true for technical capacity; chiefly, climate-related expertise is unequally distributed, including the information that is shared from the agro-climatic forecasting systems through the National Institute of Hydrology, Meteorology, and Environmental Studies (IDEAM)—which also extends to knowledge of CSA, knowledge of which is primarily held in the academic and research communities in Colombia. High-turnover of staff exacerbates this gap in both Ethiopia and Colombia, as it requires constant training of experts. This affects long-term capacity-building efforts, and perpetuates the concentration of climate-knowledge at the

national-level. The turnover is largely a symptom of shifting government leaderships and ministries (e.g., new presidencies, the changing of ministries into commissions, such as the Environment, Forestry and Climate Change Commission (EFCCC) in Ethiopia, which was previously a ministry), but also it is due to a lack of financial incentivization of experts at all levels. Key informants in both countries expressed that these gaps could be bridged more easily if they had robust data management systems that could capture and demonstrate the impact of their projects; in their views, a cohesive program monitoring system could encourage effective policy development around capacity-building by highlighting the capacity needs of their organizations, as well as project results and impact (which could help to allocate more international and national funding). Mainstreaming CSA could have a positive effect on these scenarios, to help to improve data management systems for measuring impact. Similar to the aforementioned development of a manual and strategy by the MoA in Ethiopia, their development partners are also using CSA indicators to monitor and evaluate some of their projects. If these tools can be integrated, it could directly link the implementation of CSA to the MRV systems for the NDCs (Vision, Figure 6). Additionally, effective platforms, such as the LTACs in Colombia, could also help to transfer knowledge and capacity between levels and organizations.

4.2.3. Funding

In the two aforementioned areas and beyond, financial support is a ubiquitous need for non-Annex I countries. NDCs are one of the ways that countries can illustrate their financial needs to the international community (Mills-Novoa and Liverman, 2019) in the agriculture sector. Sixteen Parties refer to financial requirements within the mitigation component of their NDCs, and 16 also do for the adaptation component (Richards M. et al., 2015). Furthermore, in the Paris Agreement, Annex I countries committed to supporting non-Annex I countries with at least USD 100 billion in climate finance (Art. 9, UNFCCC, 2015; Ross and Agostini, 2016); additionally, efficient access to these resources should be granted to non-Annex I countries through simple procedures and support mechanisms (Art. 9, UNFCCC, 2015). Although climate finance has been increasing from both the public and private sectors, its national and local governance is still a significant challenge, largely due to the fragmentation between the vertical and horizontal scales (Van Asselt and Zelli, 2014; Gomez-Echeverri, 2018). Financial support may be accessed through CSA; historically, it has been difficult to find funding for the agriculture sector, largely due to barriers such as, but not limited to: high risks and low margins for lenders; the inability to demonstrate immediate benefits of changes to agricultural systems; and fragmentation in the communication between governance levels, which can result in a disjointed sectoral message to funders (The World Bank Group, 2016). The adoption of CSA could create a more enabling environment for access to climate finance, because it could help to demonstrate to financiers the potential social, environmental, and financial returns, as well as link effective policies to break down barriers and encourage lending (The World Bank Group, 2016; Dankova et al., 2017).

In Colombia, capacity-building at the subnational-level requires resources for aspects such as: implementation and

planning, technical support and expertise, and extension services. The already scarce national resources, however, are often allocated to other sectors (apart from agriculture) because it is difficult to measure the impact of, for example, agricultural adaptation activity. Thus, the short-supply of funding (that would be allocated to the subnational-level) is increasingly diluted as it moves down through the stratosphere of expert intermediaries; finally, when it reaches the local level, the amount is insufficient for effective project implementation.

On an international-scale, the climate finance that was promised in 2015 during the ratification of the Paris Agreement has not materialized. For Ethiopia, this is a huge challenge: their NDC is largely conditional (relying on this international support for implementation) and will not be achieved in its totality without it. In some cases, international resources are not equally distributed across sectors; Colombia, for example, lacks an effective climate finance mechanism to ensure that these international funds reach all sectors. The MADS sets the primary climate change priorities, then the Department of National Planning (DNP) defines the budgets for different ministries, and finally the funds are disbursed by the Ministry of Finance and Public Credit (MHCP). Usually, these resources are allocated to the MADS or to related institutes, such as IDEAM. As a small ministry with a relatively small proportion of the federal budget, much of these resources are directed to MADS, and though there is a *Comisión Financiera* (Finance Commission) of the SISCLIMA that brings together different actors and ministries to facilitate dialogue regarding climate finance, the MADR is not directly represented in it. Within the agriculture sector specifically, regional governments can apply for funds through a mechanism established by the *Sistema Nacional de Innovación Agropecuaria* (National System of Agricultural Innovation), but in order to access these resources, departments (at the regional-level) must first create a *Plan Departamental de Extensión Agropecuaria* (Departmental Agricultural Extension Plan). So far, only eight of 32 departments have completed these plans. The disaggregation between sectors and governmental levels and the plethora of different mechanisms have created a great deal of confusion within the sector. Conversely, in Ethiopia, the CRGE Strategy exemplifies the potential positive impact of effective national strategies, because it has improved vertical and horizontal coordination by bringing different sectors, stakeholders, and levels together under one framework. For example, all climate-related funds enter the CRGE Facility, which includes sub-committees with representatives from all line ministries, as well as an advisory group of actors from the private sector, civil society, and development partners. According to the KIIs, this mechanism has been very effective in executing the objectives that are outlined in the CRGE Strategy.

4.3. Recommendations

4.3.1. National strategies

Throughout the KIIs, interviewees highlighted the importance of an overarching national strategy that integrates different plans, ideas, and policies (Bridges, Figure 6). In Colombia, one person described that, although the overall CONPES 3700 strategy and SISCLIMA

were established with the right objectives, they led to, “frameworks upon frameworks upon frameworks,” that ultimately disaggregated climate ambition and left stakeholders overwhelmed with information. Conversely, interviewees in Ethiopia generally lauded their national CRGE Strategy’s integrative structure—and, unlike in Colombia, they unanimously referred to it at some point in their interviews. These contrasting examples illustrate the need for cohesive and transparent leadership in the agriculture and climate policy space—specifically, these two different (one cohesive strategy and one incohesive) examples illustrate that clear policies can streamline climate action in agriculture. This recommendation does not aim to imply that new strategies should be developed—rather, it suggests that an analysis of existing policies and policy instruments could be a useful exercise for governments to determine if there are entry points for further integration of practical instruments within their systems. For example, one key informant in Colombia suggested that even a simple manual that describes the existing policy arena (including instruments, organizations, and projects, etc.) could be a helpful tool to orient different stakeholders.

4.3.2. Platforms

To further this end, effective platforms are needed in order to disseminate information, co-learn, collaborate, and avoid program or project duplication. Both case study countries highlighted exemplary (but imperfect) platforms within their own contexts. Thus, to improve the existing system, a balance between the two cases (too many platforms in Colombia, and too few in Ethiopia) would improve coordination, capacity-building, and funding opportunities. As with the national strategies, combining or disaggregating existing platforms as needed could be an effective point of entry for policymakers (Bridges, Figure 6). Furthermore, it is advised that a leading institution or platform is identified to define and mainstream CSA, to encourage transparency and disseminate clear information.

4.3.3. CSA As an approach

The co-benefits between the climate agendas and CSA have been recognized by the 32 Parties that have specified it in their NDCs (Strohmaier et al., 2016). CSA can assist non-Annex I countries with Ross and Agostini’s (2016) previously mentioned support needs for NDC implementation; e.g. in regards to capacity building and technology transfer, CSA can be a concrete approach to extending improved agricultural practices.

Although the pillars of CSA are more important than the terminology that is used, there are undoubtedly benefits to mainstreaming the approach. Primarily, it was noted that CSA is helpful in planning processes. For example, one key informant in Ethiopia explained that instead of focusing solely on one climate aspect in their programs, CSA encouraged them to work towards two or all three of its elements. To use CSA effectively in other countries, it is recommended that first stakeholder and policy analyses are undertaken in order to determine the most effective approach to its integration. Ideally, there are existing strategies into which CSA can be incorporated as an approach. In some cases, if the terminology is little-known and actors are already inundated with information, it may be more useful to focus on the integration of CSA pillars into agriculture agendas.

4.3.4. Did the Paris Agreement catalyze the use of CSA?

The ratification of the Paris Agreement undoubtedly had an effect on global climate action, but the amount of change it catalyzed differs across countries (Table 1). Its impact in Colombia, for example, was more widely recognized by key informants than it was by those in Ethiopia: only two key informants in Ethiopia explicitly referred to it as a catalyst for the integration of climate change and agricultural agendas, while seven did in Colombia. In general, the interviewees in Colombia highlighted that the primary importance of the Paris Agreement was that it helped to link climate to other sectors. Many felt that, had it not been for this focus from the international community, climate change would not be such a high priority in their current policy development. In Ethiopia, key informants felt that their own CRGE Strategy has been more important in this regard; in fact, the CRGE Strategy was nearly synonymous with the Paris Agreement or the NDCs in Ethiopian KIIs. Although the CONPES 3700 from Colombia was established around the same time as the CRGE Strategy, it was not discussed in the KIIs with great frequency.

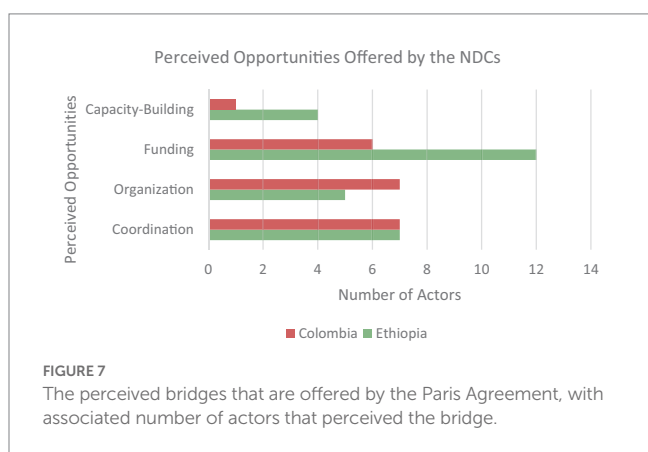
Apart from this, multiple actors in each country highlighted the potential bridges that are offered by the NDCs, in regards to funding, project or program organization, coordination between sectors and entities, and capacity-building (Figure 7). The NDCs, which influence subsequent policy development, also offer an opportunity to strengthen the usage of CSA as an approach by integrating it more fully into national strategies (Vision, Figure 6).

4.3.5. Suggestions for further research

This research attempted to illustrate the networks and fora at the nexus of agriculture and climate change across governance and program implementation levels (international, national, and regional), and although many of the key informants represented multiple scales (e.g., international development partners that implement projects at both regional- and national-levels), the inclusion of regional-level governments was lacking in this study. This was because of the accessibility and availability of interviewees (e.g., primarily contacts at the national- and international-levels responded to interview requests within the timeframe of this study). Expansion of this research at the regional- and local-levels is required to validate that the usage of CSA terminology indeed is focused at the national- and international-levels, and the identified gaps and bridges are relevant across levels. Additionally, in the stakeholder mapping process, this research focused on high-level actors, rather than the farm-level—as we have learned in other research, farmers receive an overload of information from different actors, that may often be contradictory (O’Sullivan et al., 2018; Valujeva et al., 2023). Key to supporting farmers is to align messages and approaches of all these actors from a high-level, which is where we mapped the landscape in order to study the alignment of the NDCs and CSA. It would be interesting to consolidate this broad landscape through a transdisciplinary approach in further research. Lastly, similar research in additional countries could validate and expand upon the gaps and bridges identified in this study; of specific interest could be those countries that included CSA explicitly in their NDCs.

TABLE 1 Considerations from the main gap categories that were identified in the KIIs in the two case-study countries; includes the commonalities and differences between the two, and the lessons learnt from them.

		Ethiopia	Colombia
Engagement	Commonalities	Imperfect horizontal integration leads to duplication of efforts and initiatives, and therefore dilution of resources	
	Differences	Administration through nested government hierarchy, which is a challenge for regional representation	Administration through independent CARs, which is a challenge for vertical integration
	Lessons learnt	The effective integration of CSA across governance levels requires that it is included explicitly in national-level strategies. Representation from farm and regional levels must be part of this integration process, in order to underpin actions in local contexts as well as to build capacity; this coordination requires a streamlined approach to ensure that the policy space is not inundated with different platforms related to CSA	
Capacity-building	Commonalities	Technical capacities are concentrated at the national level, which poses a challenge in scaling CSA in regional agricultural systems; high-turnover (often brought on by lack of financial incentivization for experts) and shifting governmental leadership/programs negatively affects long-term capacity-building efforts	
	Differences	There are not many effective knowledge-sharing and capacity-building programs that are evenly distributed throughout the agricultural sector, which creates a challenge in scaling CSA efforts	There is an overabundance of programs/knowledge/approaches at the regional levels, which inundates local capacity to scale approaches, especially in regard to CSA
	Lessons learnt	The creation of robust data management systems (and capacity-development around their use), along with clearly delineated knowledge-sharing platforms, could help to build capacity across scales; in terms of CSA, these platforms should be created and governed with representatives from all governance levels	
Funding	Commonalities	National resources are often allocated to sectors apart from agriculture, and are concentrated at the national level	
	Differences	Ethiopia's CRGE facility has been an effective mechanism in ensuring that climate funds reach the agriculture sector due to the representation from all sectors and governance levels	There is no effective climate finance mechanism to ensure that international climate funds are equally distributed across sectors; rather, there is a disaggregation between different governmental planning departments, without direct inclusion of the Ministry of Agriculture and Rural Development
	Lessons learnt	Unification of climate finance under one funding mechanism can aggregate resource allocation efforts, and it is important to bring together sectors and governance levels for these processes. CSA can be used to access more funds, because, with more robust data management and capacity-building, it provides a framework with tangible actions (defined by regions) that can be monitored to demonstrate impact to funders	



5. Conclusion

This research provided an in-depth analysis of the extent to which CSA is used as an approach to achieving the climate objectives outlined in the NDCs, as well as identified entry points to strengthen its use in two case-study countries. Through stakeholder mapping and KIIs, we found that:

- 1) CSA can be useful as an approach to NDC implementation, in that its framework can assist in scaling climate action across levels—and, conversely, can help to encourage more robust monitoring schemes to bring climate action from the local level back up to national MRV systems if a strong system is put in place surrounding CSA's pillars.
- 2) An enabling environment for the integration of climate change into the agriculture sector requires: effective national strategies that include the creation of platforms to encourage coordination across levels and actors, the identification of leading institutes, and the inclusion of CSA's pillars in planning processes.
- 3) To use CSA effectively as an approach in countries and regions that were not included in this research, it is recommended that stakeholder and policy analyses are undertaken in each specific context in order to determine where CSA fits into and can be best integrated in the policy arena. If possible, incorporation into existing agricultural and climate strategies is advisable, so as not to inundate the policy space with superfluous concepts and approaches. Additionally, it should be pre-determined if explicit CSA terminology should be the focus of integration, or if the nomenclature of its pillars will be better-received by the relevant actors.

- 4) Future research should focus more strongly on the linkages (if any) between the local- and national-level that are helping in the implementation of agricultural NDCs; this could demonstrate if the NDCs are the best entry points for raising ambition to promote climate action in relation to agriculture. Additionally, this same research could be expanded to more countries to elucidate underlying factors that can determine success in terms of promoting climate action in agriculture.

Data availability statement

The original contributions presented in the study are included in the article/[Supplementary material](#), further inquiries can be directed to the corresponding author.

Author contributions

EF, RS, and AL contributed to the study's design and conceptualization. EF undertook the research for this manuscript and including the implementation of the detailed methodologies. EF wrote the first draft of the manuscript, which was then revised by RS and AL. All authors contributed to the article and approved the submitted version.

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Conflict of interest

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Supplementary material

The Supplementary material for this article can be found online at: <https://www.frontiersin.org/articles/10.3389/fsufs.2023.802289/full#supplementary-material>

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