Inclusive Climate Finance

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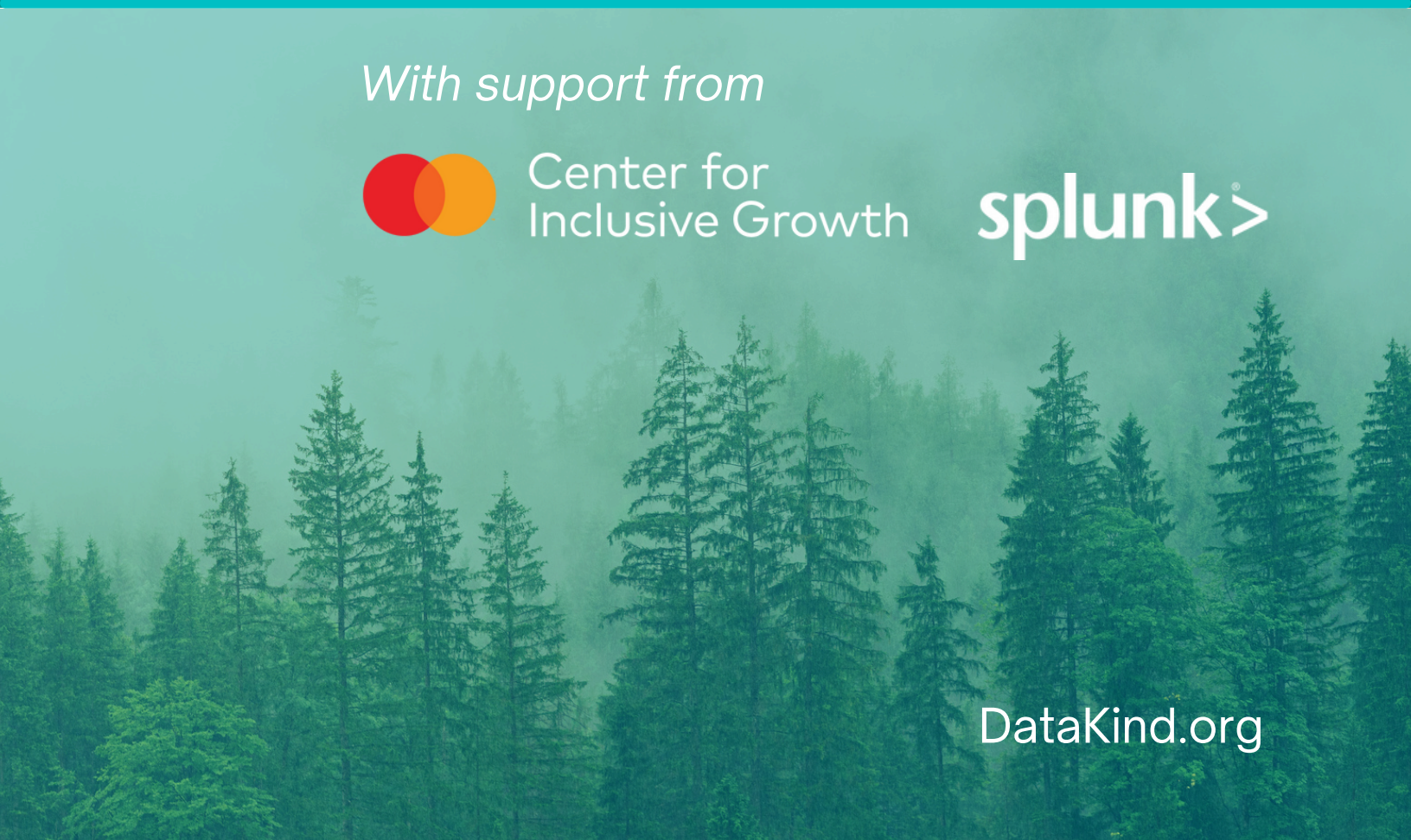

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Table of Contents

Executive Summary

Leveraging the Financial Sector to Address Climate Change

Climate change is truly a global challenge. It is accelerated by transboundary carbon emissions intersecting with geopolitical dynamics and biophysical systems. Its impacts are equally encompassing, affecting individual livelihoods and entire countries. Addressing the drivers and impacts of climate change requires a global commitment. The financial sector is increasingly directing its strategies and mechanisms towards this challenge. Leveraging financial products, markets, and investments is a well-suited approach given the very real need at every scale for financial resources that can support mitigating climate change and coping with its impacts. From countries that need funds to enact climate change plans in accordance with the Paris Agreements, to households that need access to savings to recover from floods, economics is often at the center of climate change action.

In this climate-finance nexus, mitigating the drivers of climate change has been the purview of the climate finance sector. Climate finance, a relative of sustainable finance, was born out of the recognition that mitigation specifically requires large-scale, globally equitable financing and investment.[1] It focuses on directing financial flows toward programs and projects that work to ensure institutions and economic systems are both resilient to financial shocks from climate change and can support decarbonization to reduce climate change's impacts.[2] It has traditionally operated at the industry or national level, primarily concerned with providing funding mechanisms that shift economic incentives to invest in climate change mitigation or that provide direct support to on-the-ground projects. It also directs funds from higher-income countries to support lower- or middle-income countries, recognizing the disparities involved in climate change and the need for everyone to have the resources to tackle it. While climate finance has a track record of success, it largely does not address the immediate impacts of climate change being felt today.

Coping with the impacts of climate change happens in two broad capacities: (1) via resilience, or the ability to recover from immediate shocks; and (2) via adaptation, or the ability to adapt to future shocks. It is a well-known reality that those most likely to suffer from climate change are also those least able to adapt to or recover from it, in addition to being least responsible for the

[1] Azhgaliyeva & Liddle (2020); Long et al. (2022)
[2] Miller, Krishnan, &Ruiz (2023); Long et al. (2022)

emissions that have accelerated it.[3] Indeed, the impacts of climate change are superimposed on existing inequalities across the globe. Yet, those impacts are also increasingly touching everyone's lives, expanding the definition of vulnerable populations.

Across all scales of vulnerability, access to financial resources is a key mediator. The more economically insecure[4] households, communities, or countries are, the more vulnerable they are to shocks of all kinds, including those of climate change.[5] This dynamic also flows the other way: the impacts of climate change, whether acute like floods or chronic like changing average temperatures, also increase household, country, and economy-level instabilities.[6] The movement toward financial inclusion maps onto this space. Financial inclusion works to ensure all people have access to financial services and products as a way to ease financial barriers to economic and social mobility.[7] Increasing access to and uptake of financial resources can increase the capacity of individuals, communities, and small businesses to handle shocks to their livelihoods,[8] but these approaches are only now being tried in the context of climate change dynamics, with uncertain outcomes.

The mechanisms of climate finance and financial inclusion have largely operated in silos, an approach that climate change is rendering insufficient. Climate finance has targeted mitigation-level efforts, and financial inclusion has focused on increasing people's capacity to weather shocks, but in isolation, each produces such a diversity of concepts, data, and strategies that their impact is disjointed. Yet, these two financial approaches have recently begun to merge, learning from each other and working towards inclusive climate finance.[9] Inclusive climate finance is a policy agenda for ensuring that financial solutions to climate change are both socially equitable and effective at reducing climate change drivers and impacts.[10] Even more, the agenda also recognizes the growing calls that responding to short-term shocks or adapting to changing conditions does not go far enough, and that society must also set its collective sights on just transitions, or ensuring an equitable decarbonization shift in our economic system that can support a sustainable world for both humans and the ecosystems on which we rely.[11]

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[3] Abeygunawardena et al. (2009); Cardona et al. (2012)
[4] We use "economic insecurity" here to encompass a broad range of factors, since many different measures of economic challenge are associated with vulnerability (e.g., households in poverty, low GDP)
[5] Ahmed, Diffenbaugh, & Hertel (2009); Cardona et al. (2012); Erikson et al. (2007); Leichenko & Silva (2014); Thomas et al. (2019); Note: It is also possible to be vulnerable to climate change and not economically insecure (see: Erikson et al. [2007])
[6] Ratcliffe et al. (2020); Ahmed, Diffenbaugh, & Hertel (2009)
[7] Cull, Ehrbeck, & Holle (2014)
[8] Weingärtner, Simonet, & Choptiany (2019); Cull, Ehrbeck, & Holle (2014); Demirgüç-Kunt & Singer (2017)
[9] Formally called inclusive green finance, but we have chosen to specify to inclusive climate finance for the scale and scope of this landscape as specificity is vital in the context of data.
[10] Volz et al. (2020)
[11] McCauley & Heffron (2018)

It is evident that economic resources can either help or hinder the ability to recover from shocks, adapt to future conditions, or transition to new livelihoods or economies altogether in a world under climate change. In this way, the development of an inclusive climate finance agenda is an important direction to pursue. However, there is a monumental challenge ahead: uncovering practical, proven strategies to implement this agenda and produce economically viable, socially just, and impactful climate change outcomes is new territory. This is a challenge that data science is suited to address, lending insights that can advance the emerging inclusive climate finance space towards practical and meaningful application.

Landscape Purpose

Because climate finance and financial inclusion, not to mention their merging, are novel, there are gaps in understanding how they can best move forward to be catalysts for facilitating climate change action. Principally, an underlying lack of clarity around the scope and purpose of work in this space, coupled with data gaps, makes leveraging it towards measurable gains at any scale a fundamental challenge. To contribute to this challenge, this landscape utilizes a framework-based approach to explore the strengths and hurdles of these financial approaches, the work being done at their intersection, and how data science can advance the efforts of the emerging inclusive climate finance space (Fig. 1). The landscape adapts the framework for inclusive green finance created by the UN Secretary General Special Advocate (UNSGSA) and the Alliance for Financial Inclusion (AFI),[12] narrowing in on inclusive climate finance (ICF) at the scale of households and micro-small-medium enterprises (MSMEs) (see Box 1 for more details). This framework champions climate change response pathways – mitigation, resilience, adaptation, and transition – to orient and clarify how specific financial strategies fit within the context of climate change. Using this framework provides a shared base of understanding that makes mapping data science solutions onto this field more actionable and accessible.

[12] Miller, Krishnan, & Ruiz (2023); UNSGSA (2023); Volz et al. (2020)

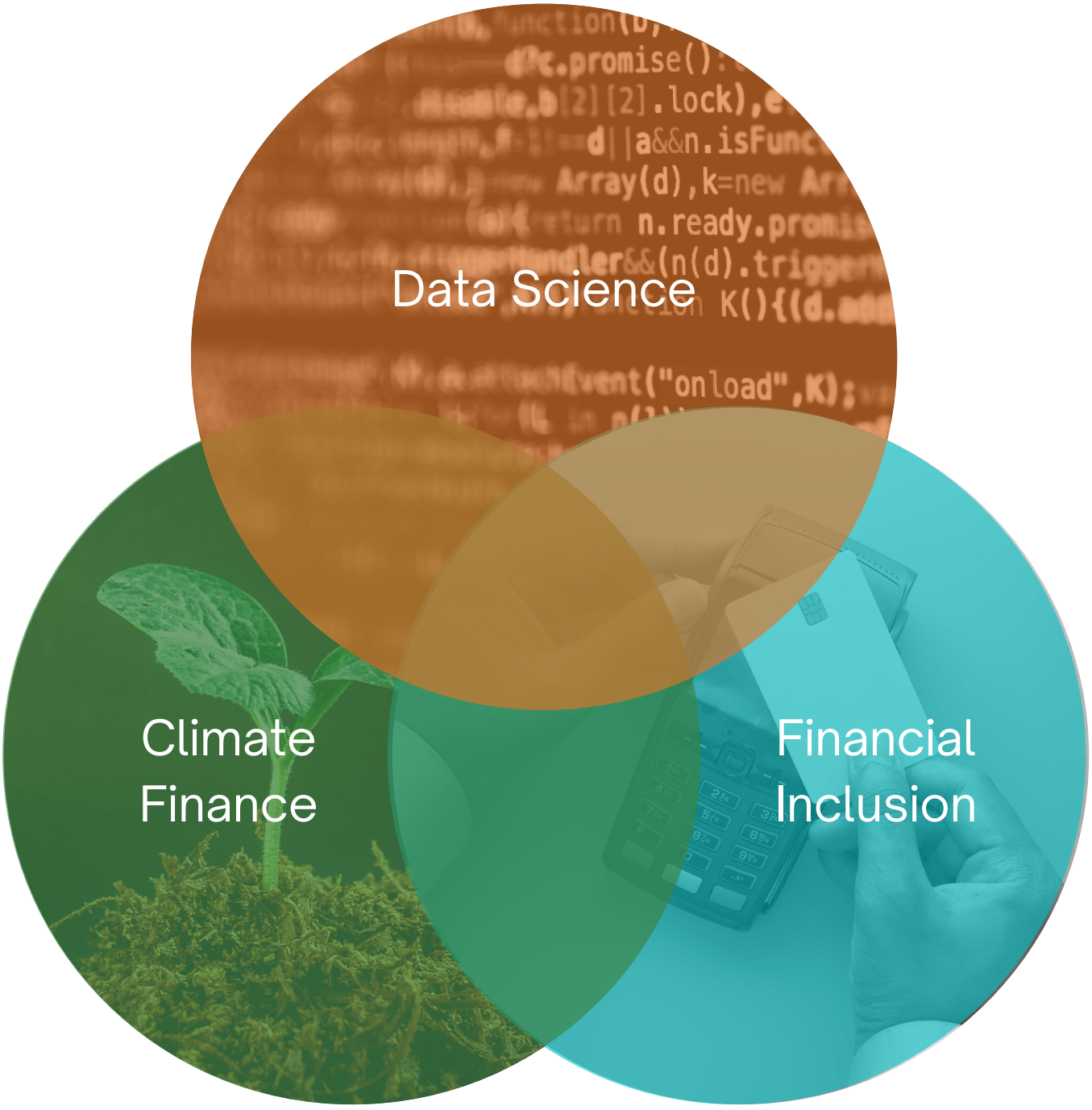

Fig. 1 - Conceptual Diagram of Landscape

Key Takeaways

Trends and Challenges at the Climate-Finance Nexus

A broad review of climate finance and financial inclusion finds that these fields have robust innovations. For instance, climate finance has created new ways, like climate bonds, to direct financial flows to climate change projects,[13] and financial inclusion efforts have developed digital tools for last-mile communities to access remittances to absorb the impacts of natural disasters.[14] However, there are important challenges to address, especially as these approaches overlap within the inclusive climate finance agenda.

First, there is not enough funding to support climate change response needs, especially for low- and middle-income countries and those most vulnerable to climate change impacts,[15] making a focus on financial solutions especially timely. There is also an inextricable link between economic conditions and vulnerability to climate change, yet the existing financial mechanisms of climate finance and financial inclusion are still adapting to the climate change space. As such, these mechanisms often do not take into account (or were not designed for) the complex, cyclical interplay between climate change variability and economic factors.[16] There is a lack of data that tracks impacts beyond short-term economic behaviors, in addition to an over reliance on the presumed logical link between access to financial resources and climate change resilience and adaptation.[17] This reality makes finding evidence of climate finance's or financial inclusion's ability to move the needle on climate change and social equity targets challenging, and complicates finding effective strategies and solutions. Even more, there is conceptual ambiguity across the entire space – with terms like resilience and adaptation being used interchangeably and without reference to scale, or the term "green" being used so broadly that tracking what interventions are actually affecting climate targets becomes nearly impossible.

[13] E.g., green bonds (Long et al., 2022), see also robust list of mechanisms in Bhandary, Gallagher, & Zhang (2021)
[14] See example use cases in Fee & Celada (2023)
[15] Buchner et al. (2021); Canny, Kaziba, Mitchell, & Prest (2020)
[16] Miller, Krishnan, & Ruiz (2023)
[17] Cull, Ehrbeck, & Holle (2014); Duvendack & Mader (2020); Moore, Niazi, Rouse, & Kramer (2019)

The Work Being Done

Despite these challenges, there is substantial interest and work happening at this climate-finance nexus. Stakeholders span multilateral organizations such as the UN and the World Bank, which provide the bulk of climate finance in the industry, to commercial financial institutions and emerging FinTechs, which provide the specific financial products and services that directly target households and MSMEs. There is also a large coalition of knowledge producers and technical assistance organizations, typically nonprofits or academic institutions, involved in supporting the work and providing the research and innovation that under gird many of the policy directions and practical solutions. Examples include the Center for Sustainable Finance at the University of London, Alliance for Financial Inclusion, Overseas Development Institute, and the Center for Financial Inclusion, among others (Appendix contains a larger sample).

Across the work being done by these actors, a few trends emerge. Chiefly, most ICF interventions targeting households and MSMEs center around the climate targets of mitigation (i.e., reducing emissions and using renewable/regenerative practices) and resilience (i.e., coping with and recovering from short-term shocks) in the context of rural, agricultural, low-income, and/or geographically isolated communities. These are also the characteristics of those most vulnerable to climate change, making this focus logical, but not without gaps, especially given that the footprint of climate change is increasing beyond these communities. There is a lack of attention paid to urban communities and women, in particular,[18] an increasingly recognized issue that many are looking to address as the field matures.[19] Pay-as-you-go (PAYG) solar programs are one popular example that illustrates many of the trends in ICF – financial service providers offer microloans for solar panels to rural communities that do not have power, allowing them to build their credit and access more financial resources (i.e., financial inclusion) while also providing a renewable energy source (i.e., climate mitigation). While heavily promoted, these programs also illustrate the challenges found throughout this space – evidence of their impact on social, economic, or climate goals is often conflicting and difficult to establish.[20]

[18] Notta (2022)
[19] E.g., see work by Adegbite & Machethe (2020)
[20] Ockwell et al. (2019)

The Role of Data Science

The current status of ICF efforts reflects a number of data challenges and highlights the ways in which data science can be an ally in moving the field forward. First is the dire need for establishing clarity, particularly if the big picture goal is to achieve large-scale benefits for society under climate change. Ambiguity of terms, indicators, and data availability are common trends that ultimately destabilize the foundation of understanding how ICF operates and achieves its goals, with many arguing for the development of concept and data taxonomies as a remedy.[21] The call for clarity is precisely why this landscape champions the use of the ICF framework.

Beyond the pursuit of clarity, it is crucial to grasp the context in which ICF strategies operate. This entails understanding who most benefits from ICF, when these strategies are most effective, and the circumstances that maximize their impact. Data science can help identify populations most in need of resources and/or most at risk by using innovative strategies like machine learning applied to mobile phone use to predict poverty.[22] It can also work to combine climate models with financial inclusion data to predict where the highest climate risks and financial needs overlap.[23]

Relatedly, there is inherent financial risk involved in climate change projects at all scales, resulting in the need for more data to understand and manage these risks to improve their attractiveness for investment.[24] This is particularly prevalent in insurance products, another area where data science has a track record of using innovative approaches to understand risk to facilitate climate adaptation.[25]

Finally, adding an inclusive lens to climate finance and a climate lens to financial inclusion is new territory with substantial uncertainty, not least of which is that while data rich, the data stories in this space are diffuse, making implementation and impact assessment elusive.[26] Nonetheless, innovative use of machine learning and statistical analysis of satellite data have allowed verification of mitigation practices, fostering access to carbon markets, and facilitating payment for ecosystem services,[27] a data science contribution that can be leveraged in many ways. Ultimately, investing policy attention, resources, and capacity in data science is vital for moving ICF into an era where it can make the most impact on our shared future amid the challenges of climate change.

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[21] Deary & Huret (2022); Vikas, Venegas, & Aiyer (2022); Miller, Krishnan, & Ruiz (2023)
[22] E.g., the Novissi G2P Program in Togo
[23] E.g., see similar use case of Inner City Fund's Climate Sight program, which quantifies the mental health risks of climate change through a combination of Global Climate Models and national suicide data
[24] NGFS (2019)
[25] Lyubchich et al. (2019)
[26] Deary & Huret (2022); Miller, Krishnan, & Ruiz (2023); NFGS (2019)
[27] E.g., see the Cynk carbon financing model

Box 1. ICF Framework Orientation

The ICF framework used in this landscape integrates climate change response pathways with impact scales. This combination explicitly outlines the climate change goal, the scale at which it is implemented, and the audience that is benefiting (see diagram below). This framework introduces clarity to a space rife with ambiguity, a fundamental insight from this landscape. The UN also champions this framework, which lends reach and momentum and increases the likelihood of its adoption in multiple arenas.

The climate change response pathways define the scope at which a climate change intervention is operating, encompassing mitigation, resilience, adaptation, or transition. The impact scales are either the providers (financial sector) or recipients (households/micro-small-medium enterprises).[28] This landscape focuses on the impact scale of local recipients, largely since the bulk of work in the financial inclusion space targets households and micro-, small-, and medium-sized enterprises. The climate change response pathways are used in this landscape to lay out the state of knowledge and the core challenges of inclusive climate finance. Then, the landscape adds a data science lens to the framework, illustrating specific engagement points for how data can advance inclusive climate finance along the climate change response pathways for ICF recipients.

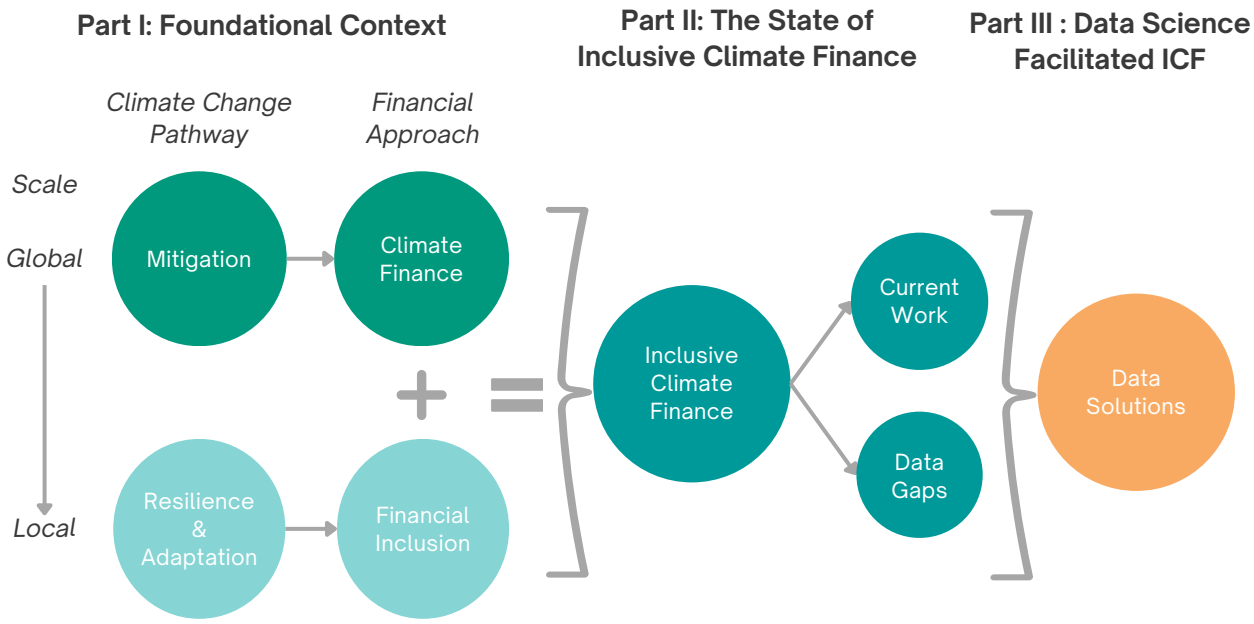
Climate Change Response Pathway	**Impact Scale: Recipients of ICF (Households/MSMEs)** *Examples of ICF strategies*
Mitigation Reducing greenhouse gas emissions/regenerating ecosystems	• Subsidies or guarantees for credit to invest in new resource-efficient or low-carbon practices and technologies (e.g., clean cookstoves, solar lighting, smart agriculture)
Resilience Increasing capacity to cope with/recover from short term climate shocks	• (Digital) cash transfers to disaster affected • Weather/livestock index insurance • Easy-access savings • Social protection payments for food or wage security
Adaptation Increasing capacity to plan for and adapt to future climate shocks	• Subsidies or guarantees for credit to invest in adaptation or resilience-enhancing activities (e.g., crop diversification, weatherproofing housing)
Transition Shifting livelihoods and economies when adaptation is no longer feasible	• Financing/remittances for migration to new locations • Financing to invest in vocational training to new livelihoods

Adapted from: Miller, Krishnan, & Ruiz (2023)

[28] There are many other scales that could be used, but for the scope of this paper, these two scales are most appropriate

Box 2. Landscape Map

The following diagram illustrates the flow of the landscape. Part I establishes context by reviewing the foundations of inclusive climate finance – the constituent fields of climate finance and financial inclusion. Part II reviews the ongoing efforts within ICF, summarizing the participants, implementation trends, and impacts, followed by a summary of data gaps. Finally, Section III maps data science solutions onto the ICF framework, providing clear examples of strategies that can advance current trends in work.



Concepts and Definitions

Box 3. Term and Concept Clarification

This type of interdisciplinary landscape requires orientation to the key terms used throughout, as different sectors and disciplines refer to common concepts in many diverse ways, especially concerning the terms resilience, adaptation, and mitigation. These definitions will provide the necessary clarity for the discussion that follows. All terms are within the context of either climate change or financial systems.

Adaptation: "The ability of social systems to adapt to multiple, long-term, and future climate change risks, and also to learn and adjust after a disaster. It is the capacity to take deliberate and planned decisions to achieve a desired state even when conditions have changed or are about to change."[29]

Climate change vulnerability: "Propensity for individuals and households to be adversely affected by climatic and other environmental shocks and stresses."[30] It is a factor of absolute exposure to risk and social components that shape how households/individuals can respond, making this vulnerability differential.

Climate finance: Financial flows directed toward climate adaptation and mitigation projects or programs.[31]

Emerging markets and developing economies (EMDEs): Markets and economies that are transitioning from low-income or pre-industrial status towards modernized models and higher-income status.[32] There is no universal definition of an indicator of this characterization, but it is heavily used in the field.

Financial health: "For financial inclusion, the outcome is "to be included" – to have access to (at least one) account, which is being used (with some degree of regularity). Financial health seeks to understand how being "included" (or not) impacts the financial security, freedom and resilience of individuals and communities."[33]

Financial security: "Financial security is the ability to meet current and ongoing commitments, including basic needs and planned expenses such as food, rent, bills, debt payments, and health care. It also includes expenses earmarked for the future,such as saving for old age, and higher education costs. In addition to planned expenses, financial security also addresses the ability to manage unexpected or adverse events, such as car breakdowns, job loss or sudden health emergencies. This component is often termed 'financial resilience,' or the ability to respond to and recover from shocks."[34]

[29] Bahadur et al. (2015)
[30] Leichenko & Silva (2014)
[31] GSMA (2023)
[32] Investopedia (2022, May 11)
[33] UN Capital Development Fund (n.d.)
[34] Ibid.

Box 3. Term and Concept Clarification cont.

Financial inclusion: "Financial inclusion means that individuals and businesses have access to useful and affordable financial products and services that meet their needs – transactions, payments, savings, credit, and insurance – delivered in a responsible and sustainable way."[35]

Note: Financial inclusion is being used as a benchmark/indicator for Sustainable Development Goals.[36] It is also realized via many different mechanisms and scales:

- Policy (e.g., state/local inclusion policies, consumer protection policies)
- Products (e.g.,microfinance, fintech, insurance)
- Insights (e.g., research on consumer needs/behaviors to target the right solutions)
- Services (e.g., digital and financial literacy programs)

Inclusive Climate Finance: For this paper, we are using the term inclusive climate finance, which derives from the movement toward inclusive green finance, which is defined as: "Inclusive green finance (IGF) helps low-income households, small businesses, and vulnerable groups access financial services and products to build resilience and facilitate the financing of climate-smart investments and income opportunities. It is part of the solution to manage the impact of climate change and the transition to green economies – yet it must be embedded in a broader approach and strategy for climate-resilient development that brings together government, civil society, and the private sector."[37] We chose to narrow in on "climate" instead of "green" to ensure that the scope of this paper is focused on climate change-related actions and issues, versus the broader scale of anything environmentally related.

Just transitions: "The just transition is defined here as a fair and equitable process of moving towards a post-carbon society. This process must seek fairness and equity with regard to the major global justice concerns such as (but not limited to) ethnicity, income, and gender within both developed and developing contexts. By its very nature, this transition must take place on a global scale, while connecting effectively with multi-scalar realities. It involves the development of principles, tools, and agreements that ensure both a fair and equitable transition for all individuals and communities."[38] Within the inclusive green finance framework, "transition" is used more narrowly to define the livelihood shifts that may be necessary when climate change fundamentally alters a community beyond the ability of adaptation or resilience to address.[39]

Low- and Middle-Income Countries (LMICs): This term is used to capture countries by their economic status as defined by the average gross domestic product, in part as a way to combat the problems with the use of terms like "developing countries" and "Global South."[40] The World Bank provides specific definitions of the income categories.[41] Since it is a relatively new approach to summarizing the host of factors that create trends and differentiate countries, it is not yet part of everyday language. Most publications that this landscape cites use the terms "developing countries" or "Global South," but this landscape uses LMIC for consistency.

[35] The World Bank (2022, March 29)
[36] FindDev Gateway (n.d.)
[37] UNSGSA (2023)
[38] McCauley & Heffron (2018)
[39] Bahadur et al. (2015)
[40] Silver, M. (2015, Jan 4)
[41] The World Bank (n.d.)

Box 3. Term and Concept Clarification cont.

Mitigation: Activities that work towards reducing greenhouse gas emissions and/or supporting ecosystems (e.g., conservation, renewable energy, carbon capture, energy efficiency, etc.) to reduce the core drivers of climate change.[42]

Micro, Small, Medium Enterprises (MSMEs): a term regularly used in the financial sector to refer to small businesses in a more nuanced capacity.

Poverty: "The inability of an individual to address basic human needs, such as food, clean water, shelter, and access to medical care."[43]

Resilience:[44] Resilience is perhaps the most diversely used term within this space, but we are aligning our definition of it to the inclusive green finance frameworks used in this landscape as the ability of people to "prepare for, manage through, and recover from the acute risks associated with climate change. In this context, resilience is a form of coping capacity, or people's capacity to absorb shocks."[45] It can be understood at individual, household, community, country, or global scales. For other ways of conceptualizing resilience, including its many dimensions, see Bahadur et al. (2015).

Table of Climate Finance Mechanisms vs. Financial Inclusion Mechanisms

Sector	***Key Mechanisms***
Climate Finance [46]	Targeted lending Green bonds Loan guarantees Weather indexed insurance Tax credits Feed-in-tariffs National development banks National climate funds Disclosures
Financial Inclusion [47]	Mobile banking Low-cost savings and transaction accounts Microloans Microinsurance Accessible credit

[42] Miller, Krishnan, & Ruiz (2023)
[43] Bradley et al. (2012)
[44] DFID (2014) in Bahadur et al. (2015)
[45] Miller, Krishnan, & Ruiz (2023)
[46] Bhandury et al. (2021)
[47] CGAP (2023)

Part I: The Foundations of Inclusive Climate Finance

There are many ways to understand and act on the levers that make climate change the defining challenge of the century, depending on the scale, scope,and goal of a given strategy and the sector in which it is situated. This diversity is both a boon and a barrier to innovation, creating nuanced ways to tackle the challenge while also hindering interdisciplinary and inter-industry learning due to specialized terminology and metrics. The goal of this section is to provide a foundational understanding of the constituent components of inclusive climate finance – climate finance and financial inclusion – mapping them onto the climate change pathways that they operate within. Anchoring the discussion on these pathways is important because this fosters a shared understanding and terminology, which is often lacking when the worlds of climate change and the financial sector collide. This foundation creates the launching point for discussing the current work and gaps in inclusive climate finance in Part II.

Mitigation and Climate Finance

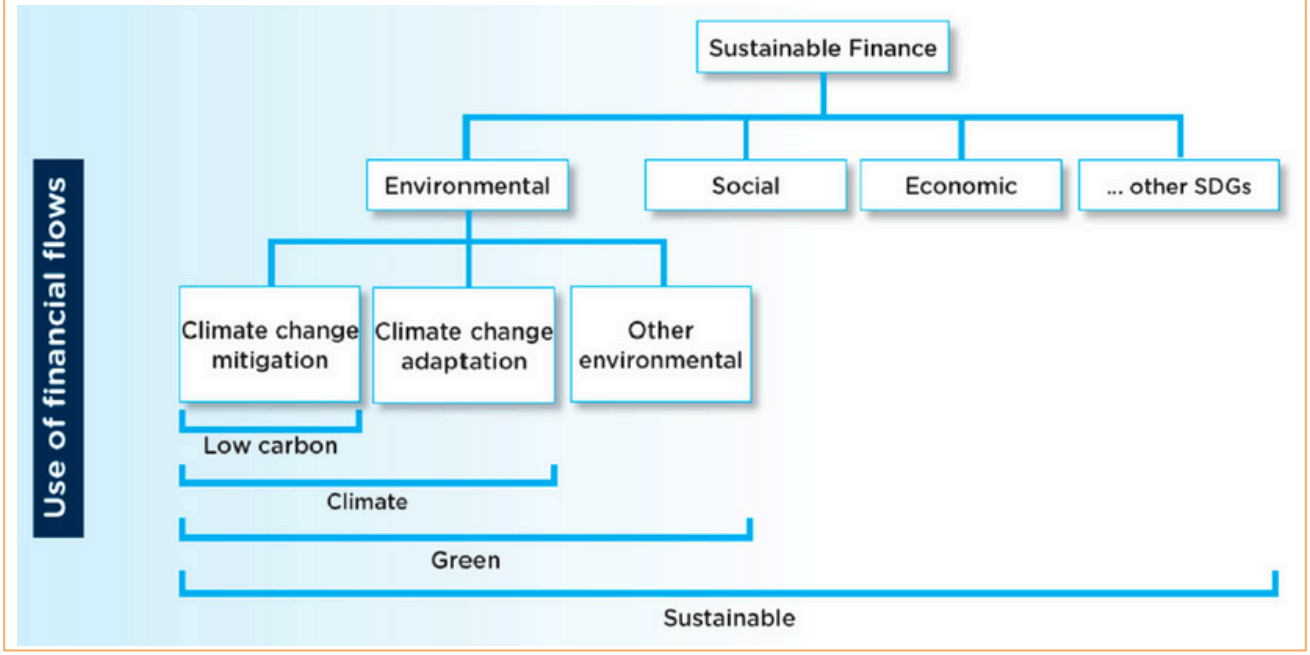
The broadest, most encompassing, and fundamental challenge of climate change is mitigation – the reduction of greenhouse gas emissions that are the key accelerator of climate change. Because emissions are an inherently transboundary issue – a global entity that spans every industry, country, and ecosystem – working to reduce them requires large-scale, institutional, and government coordination. Unsurprisingly, such coordination is a challenge, not least because the global economy is largely built on carbon, and so drastic reductions in carbon necessitate economic changes that have substantial momentum to overcome. This economic barrier to mitigation is what climate finance emerged to address.

Climate finance is defined most simply as directing “financial flows towards climate adaptation and mitigation,”[48] with similar terms such as “green finance,” “adaptation finance,” or “regenerative finance” also used. The underlying concept is finance for a purpose beyond profits alone, with the qualifier indicating the purpose of the financial flows. Climate finance can be considered a specific subset of sustainable finance (Box 4). This is another term with an ambiguous history that arguably coalesced in the 1990s as an effort to direct financial markets and investments to consider not only the bottom line but also environmental, social, and governance goals.[49]

[48] GSMA (2023)
[49] Azhgaliyeva & Liddle (2020); Dimmelmeier (2021); Kumar et al. (2022)

Box 4. Taxonomy of Financial Flows

Source: Fig. 1 in Azhgaliyeva, D., & Liddle, B. (2020). Introduction to the special issue: scaling up green finance in Asia. *Journal of Sustainable Finance & Investment, 10*(2), 83-91.



Climate finance emerged in the early 2000s out of a global recognition that mitigating climate change requires collective financing and consideration of justice. Climate finance acknowledges that financial resources need to be redistributed from developed countries, which historically contributed the most to greenhouse gas emissions, to help low- and middle-income countries (LMICs) pursue economic growth in a climate-friendly way as well as adapt to the climate change impacts they are disproportionately likely to suffer.[50] As such, the focus of climate finance has been mitigating the drivers of climate change,facilitating funding for green energy transitions, decarbonizing the economy, and shoring up adaptation resources in the global south.

In 2013, over 90% of climate investment went to mitigation, a trend that continued into 2020.[51] Two of the largest climate funds are the Adaptation Fund created by the Kyoto Protocol and the more recent Green Climate Fund created by the Paris Agreement. The Green Climate Fund was built to support a given country's implementation of its commitment to developing national adaptation and mitigation plans. A more recent iteration of this mechanism is the creation of a Resilience and Sustainability Trust (RST) via the International Monetary Fund (IMF), which focuses on supporting macro-level financial resilience to climate.[52] Indeed, financing, at any scale, is one of the main

[50] Colenbrander, Dodman, & Mitlin,D. (2018)
[51] Fankhauser, Sahni, Savvas, & Ward (2016); Buchneret al. (2021)
[52] Steele, Patel, & Volz (2021)

mechanisms by which low- and middle-income countries (LMICs) gain the necessary capacity to carry out mitigation and adaptation efforts.[53] And institutions are listening - the World Bank Group contributed $31.7 billion in 2022 alone to LMICs to address climate change.[54]

So far, climate finance has established financial pathways and mechanisms to address climate change by financing projects in high-emission and vulnerable areas.[55] It has also fostered the development of financial instruments like climate bonds and emissions trading systems, in addition to directing many existing financial mechanisms towards climate efforts.[56] For instance, feed-in tariffs in some countries support fixed prices for low-carbon electricity providers, and financial disclosures are increasingly requiring companies to report on climate change information to increase transparency.[57]

Yet, understanding the impact of climate finance is challenging due to ambiguity about what counts as mitigation or adaptation; many things are labeled as such, making measurement and monitoring of environmental and equity impacts inherently difficult.[58] As with any intervention, the benefits also depend on context and goal.[59] Some mechanisms, like tax credits, are effective at mobilizing finance, but mostly benefit larger firms. Whereas national development banks have shown promise in making measurable differences in environmental impacts, they are vulnerable to political instability.

Although climate finance has contributed substantial financial flows to climate change mitigation, across all kinds of mechanisms, demand is high and gaps are prevalent, particularly for lower and middle-income countries.[60] Some estimates put this gap at $2.4 trillion annually between 2016 and 2035.[61] There is also a gap where funds are targeted, with most going towards mitigation via the renewable energy sector, leaving insufficient large-scale financial resources for resilience and adaptation projects.[62] And, similar to most forms of development-focused financing, the allocation is not always equitable. Funding doesn’t necessarily go to those most in need and is often directed based on the capacities and preferences of the funders or financial intermediaries involved in implementing the funding for climate projects.[63]

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[53] Canny, Kaziba, Mitchell, & Prest (2020)
[54] Long et al. (2022)
[55] Nakhooda et al. (2014); Bhandary, Gallagher, & Zhang (2021)
[56] Long et al. (2022); Bhandary, Gallagher, & Zhang (2021)
[57] Bhandary, Gallagher, & Zhang (2021)
[58] Hall (2017)
[59] Bhandary, Gallagher, & Zhang (2021)
[60] Buchner et al. (2021); Fankhauser, Sahni, Savvas, & Ward (2016); IPCC (2023)
[61] Schoenmaker & Volz (2022)
[62] Buchner et al. (2021); IPCC (2023)
[63] Canny, Kaziba, Mitchell, & Prest (2020)

This phenomenon is exacerbated by the frequent lack of integration with local organizations and civil society, reducing the role local goals and interests play in the implementation of climate finance.[64] Further, project planning, a necessary element under climate change conditions, is often not given enough funding, which reduces the ability of projects to sustain themselves past their initial funding periods.[65] Finally, climate finance is at such a large scale and primarily targets the global issue of mitigation that it is not designed to address household or MSME-level resilience and adaptation to climate change, so funds may not reach those most in need once resources are filtered through the bureaucratic and political lens of a given country.[66] This household and small business gap is the scale at which the next intersection of climate change and finance meets.

Resilience, Adaptation, and Financial Inclusion

Mitigation is a long-term, large-scale endeavor, the benefits of which may be slow to realize, but the impacts of climate change are happening now and strongly felt at the local level via households and micro-small-medium enterprises (MSMEs). Responding to these impacts can occur in two broad capacities – via resilience and adaptation – terms that are often conflated or used in differing ways depending on the sector. For the purposes of this landscape, we use the definitions from the inclusive climate finance framework, positioning resilience as the capacity to cope with and recover from climate shocks when they happen, and adaptation as the capacity to change in anticipation of future climate shocks, aiming to reduce their impact.[67]

Complicating the resilience and adaptation response at this level is the fact that vulnerability to climate change is differential – a dynamic and changing level of risk based on social, political, economic, and environmental drivers.[68] Not only do communities, MSMEs, and households experience more severe climate change impacts if they physically exist in an environment more prone to them (e.g., coastal areas), but also if they are in groups that have traditionally suffered from systemic biases or underrepresentation (e.g., women, rural communities, people of color). This makes climate change risk management a justice issue as much as a technical one.

One of the largest mediators of climate change vulnerability is economic status. Poor households are more likely to be affected by natural hazards, disasters,

[64] Colenbrander, Dodman, & Mitlin (2018)
[65] Canny, Kaziba, Mitchell, & Prest (2020)
[66] Colenbrander, Dodman, & Mitlin (2018)
[67] Miller, Krishnan, & Ruiz (2023)
[68] Thomas, et al. (2019)

and climate change shocks; they are more likely to live in areas prone to exposure, have livelihoods that depend on climate-vulnerable ecosystems (e.g., agriculture), lose more resources from a shock, and are less likely to have the resources to recover.[69] MSMEs are also more economically precarious, with fewer resources and less access to markets and labor than larger businesses, which increases their risk of suffering from climate shocks.[70] MSMEs also typically engage in more short-term coping strategies that continue to leave them vulnerable to future shocks.[71] Further, it is estimated that climate change will push more than 130 million people into poverty by 2030,[72] increasing the vicious cycle between economic insecurity and climate change. Because of this link, there is important potential for innovative financial solutions to make a difference in this space.

There is growing evidence that access to financial services such as savings, credit, and insurance is a crucial mediator that allows households and MSMEs to manage risks, recover from shocks,and invest in the future.[73] These capacities are vital for coping with and adapting to climate change impacts.[74] Yet, there are approximately 1.7 billion adults who do not have access to these kinds of formal financial services, creating a substantial financial equity gap.[75] This gap is what financial inclusion aims to address – providing more households and small businesses with access to financial products and services that meet their needs, particularly when they have been excluded from traditional services either due to a lack of geographic or logistical reach, or because they are deemed too financially risky to support.[76]

This trend arguably began in the 1970s with the use of microfinance via institutions like Grameen Bank, which provided small loans to households in poverty to build their financial assets in an accessible way.[77] Financial inclusion has since grown into a robust industry with activities ranging from FinTech companies that provide digital transaction accounts to last-mile communities,[78] to microinsurance that protects against crop losses,[79] to financial literacy programs to improve the uptake of financial products,[80] all with the goal of improving access to financial services in order to foster well-

[69] Hallegatte, et al. (2020)
[70] Alam et al. (2022); Linnenluecke & Griffiths (2012)
[71] Crick, Eskander, Fankhouser, & Diop (2018)
[72] UNSGSA (2023)
[73] Weingärtner, Simonet, &Choptiany (2019); Cull, Ehrbeck, & Holle (2014); Demirgüç-Kunt & Singer (2017)
[74] E.g., see case study on financial capital and adaptive capabilities to flood risks by Azad & Pritchard (2022)
[75] Kass-Hanna, Lyons, & Liu (2022)
[76] CGAP (2023)
[77] Agrawala & Carraro (2010)
[78] E.g., see the work of Hive Online
[79] The World Bank (2022, June 15)
[80] Grohmann, Klühs, & Menkhoff (2018)

being.[81] Financial inclusion programs and products are implemented by a variety of actors at different scales. These include entire governments and banking institutions as well as small nonprofits and networking alliances (see Appendix for summary table). There is a wealth of interest and momentum in supporting financial inclusion, as made clear when the UN situated it as one of the key enablers of the 2030 Sustainable Development Goals.[82]

As the field matures, more empirical studies and evaluations shed light on the ways financial inclusion fosters its financial and social equity goals. Some of the most supported trends include finding improvements in household economic indicators such as smoothed consumption, using savings for emergencies, growth in small businesses, and reduced likelihood of being in absolute poverty.[83] However, due to the sheer variety of financial inclusion approaches and a persistent lack of household-level and long-term data,[84] it is a challenge to find overarching trends or strategies to recommend. Impact results are often very mixed, with outcomes dependent on context, type of product offered, and overall goal/impact measured.[85] Financial inclusion efforts, like microloans, can also result in unintended consequences if they do not consider supportive services and contexts (e.g., housing, health, and education needs), and households can get trapped in a debt cycle.[86] There is also a lack of understanding of how financial inclusion might impact larger-scale macroeconomic stabilities.[87]

That said, there are some more consistently reported successful strategies, such as targeting savings programs to women, which allows them to increase their resilience to income and livelihood shocks.[88] In general, interventions that focus on establishing savings accounts are particularly successful in reducing indicators of poverty (e.g., total savings, increased incomes, improved food security) in sub-Saharan Africa.[89] Mobile payments also have a track record of facilitating remittances, which can improve resilience after economic or disaster-related shocks.[90] Ultimately, most support for financial inclusion lies in short-term household-level economic behavioral changes,[91] a trend that has substantial support and promise but leaves the question of how financial

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[81] The World Bank (2022, March 29)
[82] Klapper, El-Zoghbi, & Hess (2016); UNSGSA (2018)
[83] Cull, Ehrbeck, & Holle (2014); Demirgüç-Kunt & Singer (2017); Duvendack & Mader (2020); Dawood, Pratama, Masbar, & Effendi (2019)
[84] Demirgüç-Kunt & Singer (2017)
[85] Duvendack & Mader (2020); Milana & Ashta (2020); Moore, Niazi, Rouse, & Kramer (2019); Ozili (2021)
[86] Rajasekhar, Manjula, & Suchitra (2017)
[87] Ozili (2021)
[88] Beaman, Karlan, & Thusybaert (2014); Fenton, Paavola, & Tallontire (2015)
[89] Steinert et al. (2018)
[90] Cull, Ehrbeck, & Holle (2014)
[91] Moore, Niazi, Rouse, & Kramer (2019)

inclusion affects longer-term social impacts.[92] The promise of financial inclusion, even in the short-term, sparked a recent interest in applying this approach to climate change resilience and adaptation efforts.[93] While this is a relatively new space, there is evidence that financial inclusion mechanisms have the potential to support resilience to short-term climate shocks, particularly when they offer different kinds of financial services for different shock exposures while also reflecting the socio-cultural needs of the audience.[94] However, the question of financial inclusion's ability to foster more complex climate change benefits like longer-term mitigation and adaptation capacities is much less well understood.[95]

A key factor here is that there is not a linear relationship between reducing economic risks and reducing climate change vulnerability – improving financial indicators does not necessarily improve the capacity to respond to climate change.[96] Many financial inclusion efforts, particularly microfinance models, are often too short term and limited in scope to also address the larger-scale and slower-onset impacts of climate change.[97] There is also the potential that financial inclusion can foster economic benefits in ways that can put negative pressure on climate change goals at different scales. One study found that while household financial inclusion improved indicators of economic growth at a country level, those same mechanisms decreased environmental quality by increasing CO2 emissions.[98] Furthermore, climate change affects the ability of financial institutions to provide services, either by introducing risk that reduces their incentive to provide products to those most in need of them or by threatening their assets via direct climate impacts like storms or floods.[99] For example, in 1998, flooding in Bangladesh made microfinance institutions almost shut down due to liquidity problems as so many people withdrew funds.[100]

Because of the complex intersections between small-scale economic mechanisms and larger-scale climate change dynamics, it is important for financial inclusion solutions to be actively cognizant of how they operate within this broadened context. While helpful in other sectors, when some finance models migrate to climate sectors (e.g., PAYGO), they do not have enough consumer protections, leaving those that use them with penalties or limited repayment flexibility, [101] conditions often needed when coping with climate

[92] Lam, Zhang, Ang & Jacob (2020)
[93] Fenton, Paavola, & Tallontire (2015); Sirtaine & McKay (2022, June 5)
[94] Bahadur et al. (2015); Weingärtner, Simonet, & Choptiany (2019)
[95] Fenton, Paavola, & Tallontire (2015)
[96] Eriksen et al. (2007)
[97] Agrawala & Carraro (2010)
[98] Ozturk & Ullah (2022)
[99] Dowla (2009)
[100] Fenton, Paavola, & Tallontire (2015)
[101] Miller, Krishnan, & Ruiz (2023); Ockwell et al. (2019)

shocks. In another example, researchers found that a financial inclusion program increased risks for the smallholder agriculture sector because of competitive market volatility and potential for economically incentivized environmental degradation (i.e., farmers increased cattle production by increasing grazing intensity, which led to degraded grasslands).[102] More generally, areas that have microfinance are still suffering from climate change impacts, and so the funding for household and small business level adaptation (e.g., drought-tolerant seeds, funds for storm-resistant housing) may be insufficient and needs to shift to longer term, more encompassing planning.[103]

It is clear that local-level vulnerability to climate change is mediated by economic drivers, which can be targeted by financial inclusion interventions. However, for whom and under what circumstances these interventions are most beneficial, and how they can advance outcomes at social, economic, and climate change levels, is a key question within this space. While these gaps are important to note, they should not forestall progress. It is vital for financial institutions and programs to look at ways they can foster climate change resilience and adaptation in addition to financial sustainability.[104]

Transition to Decarbonization and Equitable Futures

The current projections for climate change paint a future that is increasingly challenging if we continue on the same economic path, reliant on carbon-based resources.[105] In this future, even if mitigation, resilience, and adaptation strategies at all scales perform well, there is increasing recognition that they may not be enough, and we will need to transition our livelihoods into different sectors and our economies away from their reliance on carbon.[106] Such a shift is all-encompassing, not least because it comes with the risk of introducing even more vulnerability to populations already vulnerable to climate change impacts. In response, a chorus of climate change actors are calling for a just transition, or "a fair and equitable process of moving towards a post-carbon society."[107] Within the inclusive climate finance framework, "transition" is used more narrowly to define the livelihood shifts that may be necessary when climate change fundamentally alters a community beyond the ability of adaptation or or resilience to address.[108]

[102] Li et al. (2021)
[103] Fenton, Paavola, & Tallontire (2015)
[104] Ibid.
[105] IPCC (2023)
[106] Miller, Krishnan, & Ruiz (2023)
[107] McCauley & Heffron (2018)
[108] Bahadur et al. (2015)

While the inclusive climate finance framework incorporates all climate change pathways, advocating for policies and interventions that operate within all of them, a large underlying goal is to help steer the global climate change response toward this just transition at all levels. As the IPCC articulates in their newest report: “Adaptation and mitigation actions that prioritize equity, social justice, climate justice, rights-based approaches, and inclusivity, lead to more sustainable outcomes, reduce trade-offs, support transformative change and advance climate resilient development.”[109] That said, it is arguable that this pathway is among the most challenging to tackle. Consequently, the nascent inclusive climate finance landscape is only in the beginning stages, with few practical examples to offer. It is incorporated here instead as an anchoring goal and is not the focus of laying out the work currently underway or the data science strategies that can facilitate them.

[109] IPCC (2023). P 31

Part II: The State of Inclusive Climate Finance

In reflecting on the strengths and challenges of both climate finance and financial inclusion, key multinational actors within these spaces have recently developed a policy agenda to merge the two, referred to as inclusive green finance (Box 5), with the goal of making sure financial flows are: (1) resilient to the impacts of climate change; (2) targeting climate projects effectively; and (3) supportive of the communities most impacted by climate change.[110] It is a policy framework championed by the UN Secretary General's Special Advocate, along with a number of key financial inclusion stakeholders, including the Center for Financial Inclusion, the Alliance for Financial Inclusion, and the SOAS, University of London.

The framework largely targets multinational NGOs, countries, and financial regulators, but with a very useful articulation of core terminology, issues, and needs within the climate change-finance nexus that can be operationalized at different scales. Importantly, this framework forms the backbone of this landscape in order to lend much-needed clarity to this space, on which Part III will build to suggest where data science specifically can add value. The following section lays out the key stakeholders, trends in work, and data gaps in the emerging inclusive climate finance field (ICF).

Box 5. Original Inclusive Green Finance Network

Source: Miller,H., Krishnan, L., & Ruiz, L.A. (2023). *Green inclusive finance: a framework for understanding how financial services can help low-income and vulnerable people respond to climate change*. Accion. Center for Financial Inclusion.

Pathway	Role of Inclusive Financial Services	Example of Inclusive Financial Solution
Mitigation	To support the adoption of green technologies and practices that can improve local environmental conditions for households and communities	↗ Installment plans to pay for solar lighting systems ↗ Financing of "clean" cookstoves (e.g., those powered by electricity or biogas)
Resilience	To support the financial resources needed to prepare for, manage through, and recover from climate-related shocks	↗ Weather/livestock index insurance ↗ Easy-access savings ↗ Social protection payments for food or wage security
Adaptation	To support necessary changes to livelihood strategies in response to longer-term climate-related events	↗ Financing to farmer producer groups for high-value crop diversification and value chain linkages ↗ Financing to support weatherproofing homes
Transition	To support shifts to new livelihood strategies in response to and in anticipation of future climatic events	↗ Financing/remittances for migration to new locations ↗ Financing to invest in vocational training for new livelihoods

[110] UNSGSA (2023)

Key Stakeholders

This space involves a wealth of stakeholders acting at numerous scales, but we only briefly summarize the core trends below. A more robust sample of actors can be found in the Appendix.

Policymakers

As mentioned, the original impetus for this approach was developed and championed by the UN, with a primary focus on financial regulators and central banks. It is these global actors that are thus shaping the policy agenda at a high level, which also includes entities like the International Monetary Fund (IMF) and the World Bank. Additionally, private-sector organizations and nonprofits like the Center for Financial Inclusion, the Alliance for Financial Inclusion, and the Center for Sustainable Finance at the University of London, are also involved in crafting and driving this overarching policy agenda. Relatedly, a number of nonprofit organizations are advocating for policies that integrate sustainability goals with poverty alleviation (e.g., FINCA International), and while they may not use the ICF terminology, they are nonetheless heavily involved in the policy of the climate-finance nexus.

Funders

Inclusive climate finance largely comes from large public entities or private and philanthropic means.[111] The key public funders are the multinational Green Climate Fund, the Adaptation Fund, the World Bank's Climate Support Facility, and the newly minted International Monetary Fund's Resilience and Sustainability Trust. Private funders include large organizations and foundations like the Rabo Foundation, MetLife Foundation, Landscape Resilience Fund, and the Bill and Melinda Gates Foundation. They also include investors and wealth managers, from Goldman Sachs to smaller firms like Acumen. Large banks also play a role here, such as the Inter-American Development Bank, which has a Green Finance department focused on providing investments in this space. Despite the diversity of the funders involved, and the steady growth of investment in climate action, it is still not enough to reach large global targets.[112] There has also been a recent dip in funding for inclusive FinTechs.[113]

[111] Deary & Huret (2022)
[112] Buchner et al. (2021)
[113] Dokle & Macey (2023)

Product and Program Providers

When it comes to implementing inclusive climate finance at the household and MSMEs level (e.g., financing climate projects, providing loans for adaptation, apps for remittances to recover from shocks, etc.), the providers are centered around traditional financial institutions like banks and insurance companies, and increasingly involving FinTech companies (e.g., EarthBanc).[114] Because of their breadth and diversity, they are too numerous to list (see Appendix for a sample). These service providers are the direct suppliers of the products and programs that carry out the human-centered goals of inclusive climate finance.

There is also a vital role for technical assistance and knowledge producers within this space, as they provide the supportive elements that often make the products and programs possible. There are nonprofit and for-profit organizations that provide research insights that help direct where to focus efforts,[115] develop innovative products that meet consumer needs,[116] create networks that accelerate knowledge sharing,[117] or serve as intermediaries that connect those in need with products that can help them.[118]

Trends in Work

As discussed in the introduction, this landscape focuses on the application of the ICF framework to the recipients of ICF strategies – households and MSMEs. As such, the following section outlines the key trends at this impact level. It is also important to note that the original inclusive green finance framework was developed as a policy agenda, emphasizing how financial regulators can enable inclusive green finance. And so, there are trends in the policy realm that are worth delineating.

Policy Agenda

For the ICF framework, advocacy is one of the key priorities, ensuring that banks, regulators, and other actors are invested in moving in this policy direction. To set the stage for ICF solutions, there is also work that establishes: (1) financial and regulatory policies that enable them; (2) incentives that direct financial flows towards them (i.e., markets, subsidies, loan guarantees); and (3) attention to the social equity factors involved.[119] These enabling, market-shaping policies

[114] EarthBanc
[115] Climate Policy Institute
[116] Fundación Capital helps design financial inclusion strategies for sustainability projects
[117] Network for Greening the Financial System (NGFS)
[118] ACRE Africa provides risk assessments and connects farmers with agriculture insurance products
[119] Zetzsche et al. (2022)

are vital for ensuring the work can be successful.[120] For example, in the energy sector, financial policies are being advocated to support energy companies decarbonizing and the communities that rely on carbon fuels for livelihoods by using green-linked bonds and loans with integrated transition-related social performance targets.[121] Additionally, and seen throughout all trends, there is a growing call to create conceptual clarity, including taxonomy development and the support of a research agenda that prioritizes understanding impacts, a key entry point for data science.[122]

Key Mechanisms

There are many different financial tools used to carryout ICF strategies, and they can fit into the broad categories of investment, direct funding, and microfinance.[123] Within investment, facilitating carbon markets is one of the dominant approaches. There are numerous intermediary organizations that connect the carbon mitigation projects of landowners, farmers, etc. (e.g., regenerative agriculture, reforestation) to corporations that want to offset their carbon, thus allowing them to invest in carbon mitigation via the carbon market.[124] These investments allow the households, communities, and MSMEs doing the mitigation projects to finance their work, which is then verified and turned into carbon credits for the corporations that are investing. Another investment mechanism is de-risking in the form of loan assurances, often supported by an investment fund, which allows more financial institutions to readily invest in typically risky climate mitigation, resilience, and adaptation projects.[125]

ICF strategies are also supported by direct funding, or grants, from either public funds like national development banks or private funds like crowdfunding or philanthropy. Because there is such a diversity of organizations that engage in this type of financial mechanism, it is challenging to summarize its presence. Some examples include GiveDirectly,[126] which sends direct cash payments to rural and otherwise disadvantaged groups experiencing natural disasters like droughts and floods. Another is Grow Ahead,[127] who uses crowdfunding to support agroforestry practices in Latin America.

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[120] Knaack & Volz (2022)
[121] Social Finance Programme and Green Jobs Programme (2022)
[122] Deary & Huret (2022)
[123] see also the key mechanisms table of climate finance and financial inclusion in the definition section
[124] e.g., Livelihood Funds' "Livelihood's Carbon Funds" program as an example of this mechanism
[125] e.g., Agri3Fund and the larger Climate Investment Fund
[126] e.g, GiveDirectly's use case of funds provided to farmers in Malawi to avoid drought impacts
[127] Grow Ahead

Finally, there are a substantial number of organizations that engage with microfinance mechanisms,[128] reflecting the financial inclusion element of ICF, which include loans/credit, easy access transactions and savings accounts, credit lines, and insurance products. These types of mechanisms have generally been focused on getting unbanked populations access to financial resources that they can leverage to build wealth and reduce shocks to their livelihoods. More recently, that work is being trained on the sight of climate change responses. However, few examples are explicitly and intentionally tied to these goals, aside from immediate relief from natural disasters, as this is the most closely tied impact to financial inclusion's primary aim.

Recipients

The bulk of products and programs within ICF are targeted at communities and small businesses that are rural, low-income, agriculture-based, and/or geographically isolated (see Table 1 for a sample of cases). They also tend to target low- and middle-income countries and often have a particular emphasis on short-term resilience or mitigation-focused climate response pathways. These trends make sense given that these are also the characteristics of those most vulnerable to climate change. The agriculture sector is also a notable source of carbon emissions,[129] and thus a logical target for mitigation, in particular at the household and MSMEs level.[130] There is also the reality that while mitigation practices like agroforestry can have secondary benefits that aid in resilience or adaptation, these latter climate response pathways are the impact scales at which the most vulnerable populations need support and thus need more concerted ICF attention.

It is also important to note that there are gaps in services and consideration for vulnerable urban communities and nuances within existing targeted audiences. In particular, when disaggregating data, it is clear that ICF solutions for women are lacking, with a gender lens very rarely used.[131] While they may not be difficult to access, urban communities can also be very vulnerable to climate change volatility.[132] However, they are seldom the targets of ICF strategies. These types of “non-traditionally” vulnerable communities are growing as the exposure risks of climate change expand, increasing the need to reimagine who is vulnerable to climate change.[133]

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[128] see rainfall based index insurance provided by ACRE Africa
[129] IPCC (2023)
[130] NOTE: Climate finance dominantly supports the renewable energy sector, see Buchner et al. (2021)
[131] Baur-Yazbeck (2023); Notta (2022); Pailhe (2018)
[132] Ahmed, Diffenbaugh, & Hertel (2009) found urban wage earners to be the most vulnerable to climate change induced poverty across a sample of 16 developing countries
[133] E.g., see work on differential vulnerability to climate change by Thomas et al. (2019), who define vulnerability as a dynamic product of exposure, sensitivity, and adaptive capacity

Aside from these gaps,a few key lessons have emerged from the extensive work related to ICF: the importance of providing wrap-around support for ICF recipients, such as building capacity, trust, and literacy to foster the use of financial services.[134] There is also recognition that there may be unintended consequences of merging climate finance with financial inclusion (e.g., risk management often leads to reduced lending in exposed regions). Thus, echoing the policy agenda, there is a need to understand the impacts of ICF on its recipients more robustly.[135]

Example Cases

The following example tables illustrate projects that combine the goal of directing financial flows toward a climate-related pathway (i.e., mitigation, resilience, adaptation, or transitions) with explicit consideration of financial inclusion at the household/MSME impact level. These exemplify current trends within the inclusive climate finance arena, but do not capture all the work being done. A given example may touch on more than one climate change response pathway, but for clarity, it is placed in the dominant category. Further, highlighting these examples does not constitute an endorsement of their effectiveness for climate or equity goals, but rather showcases trends in the work being done.

[134] Diallo, Giordano, & Simonet (2017); Haworth, Frandon-Martinez, Fayoll& Simonet (2016); Weingärtner et al. (2019)
[135] UNSGSA (2023)

Table 1. Examples of ICF				
Climate Change Response Pathway	*Organization*	*Financial Mechanism*	*Scope*	*Description*
Mitigation Reducing greenhouse gas emissions/ regenerating ecosystems	Indigo Carbon Program	Carbon credit market facilitation	Agriculture, Global	Incentivizes farmers to adopt agriculture practices that produce carbon credits, connecting them with the carbon market and facilitating the carbon payout
	EthicHub	Microloans	Agriculture, Central America	Dubbed as regenerative finance, this program uses crowdfunding to invest (via microloans) in the productivity of unbanked smallholder farms that engage in sustainable practices
	Azuri PayGo	Microloans	Energy, Africa	Providing access to renewable solar energy via microloans
	Agri3 Fund	Loan guarantees	Agriculture, Global	Funding for credit and technical assistance to foster sustainable agriculture value chains and avert deforestation, de-risks by providing funds to banks and FIs that support such projects (NOTE: this case is an example of ICF activity that impacts financial institutions rather than households/MSMEs, but is important to point out as it is a very prevalent trend in ICF)

Table 1. Examples of ICF cont.				
Climate Change Response Pathway	*Organization*	*Financial Mechanism*	*Scope*	*Description*
Resilience Increasing capacity to cope with/recover from short term climate shocks	CelsiusPro	Index-based insurance	Extreme weather events, Global	InsureTech climate risk company, focus is on insurance solutions for businesses
	GiveDirectly	Social protection payments	Agriculture, Malawi	Just-in-time payments that coincided with drought and flood cycles in Malawi to aid the resilience of agricultural communities; also contributes to adaptation as tandem training in climate smart ag with partner United Purpose
	Grow Ahead	Direct payments	Agroforestry, Latin America	Grants for projects that support agroforestry practices that also improve communities' access to income generation
	Savings for Change in Mali (OxFam)	Easy access savings	Rural, Mali	Community savings groups increased ability of women to recover from income shocks
	Ripple	Remittances	Rural, Global	Crypto and blockchain based financial intermediary, has enabled faster remittances for customers

Table 1. Examples of ICF cont.				
Climate Change Response Pathway	*Organization*	*Financial Mechanism*	*Scope*	*Description*
Adaptation Increasing capacity to plan for and adapt to future climate shocks	Acumen Resilient Agriculture Fund	Global Climate Fund investment	Agriculture, Africa	Use of anchor investment to de-risk early stage agribusinesses, support their development of climate adaptive practices
	National Capital Project and the Sustainable Cashmere Project	Carbon offset market investing in sustainable practices	Agriculture, Mongolia	Coalition of goat herding cooperatives, luxury clothing brands working to create a sustainable supply chain for cashmere, funded by a mining company purchasing carbon offsets from sustainable farming practices. On-the-ground work is verified by a third party, including the use of remote sensing
	Mahila Housing SEWA Trust (MHST)	Microloans	Urban, India	Provide microloans to adapt housing to climate risks, particularly heat via cool roof solutions
	United Purpose	Direct funding	Agriculture, Malawi	Provides grants to farmers in Malawi to diversify their crops and value chains, increasing economic value

Table 1. Examples of ICF cont.				
Climate Change Response Pathway	*Organization*	*Financial Mechanism*	*Scope*	*Description*
Transition Shifting livelihoods and economies when adaptation is no longer feasible	UN Women's Livelihood Bond Series	Microloans	Subsistence livelihoods, South/South east Asia	Provides capital to support women investing in income and skills to help them move from subsistence to sustainable livelihoods

Part III: Data Science Facilitated Inclusive Climate Finance

Reflecting on the emerging trends of inclusive climate finance, this section outlines the core data gaps in the space and how data science methods can address them. Finally, it will map examples onto the ICF framework to illustrate how data science can specifically contribute to accelerating ICF along the climate change response pathways at the household and MSME levels.

Data Gaps

Clarity

There is a profound need for clear definitions and data coordination across all elements of work in ICF. A lack of standards on what is considered "green" or Sustainable Development Goal (SDG)-related, let alone the ambiguity of terms like resilience and adaptation, has made effectively measuring and monitoring any kind of ICF effort challenging.[136] There is also a lack of data from the private sector, as well as coordination between the public and private sectors, which has important implications for data analysis (e.g., double counting when tracking climate finance is very difficult to avoid).[137] Further muddying the waters is the fact that financial data in particular is often only available on time horizons that are too short in the context of climate change. For example, risks are often only calculated for year-on-year estimates, and investors frequently look for returns within months, and central banks rarely look at risks beyond three years.[138] This overarching issue of clarity is not helped by the general lack of expertise in the data needs of the field.[139]

Context

Beyond clarity, there is a lack of data and analysis to identify who benefits most from ICF, when, and under what conditions. This context matters, as research in climate finance and financial inclusion finds that the uses, barriers, and impacts of solutions often vary greatly by community or country.[140] This is a known gap in the climate change adaptation field as well, with solutions often being transferred between areas, regions or projects without taking local context into

[136] Buchner et al. (2021); Colebrander, Dodman, & Mitlin (2018); Vikas, Venegas & Aiyer (2022); Miller, Krishnan, & Ruiz (2023)
[137] Buchner et al. (2021); Paris 21 (2022, March 8)
[138] NGFS (2019); Monasterolo (2020)
[139] NGFS (2019)
[140] Ozili (2021); Fee & Celada (2023); Nakhooda et al. (2014)

account, resulting in conflicting impacts.[141] One of the barriers is a lack of data that can identify and accommodate the most excluded populations, including women, indigenous populations, and children.[142] Without data on these populations, it is challenging to know how they are affected by a given ICF strategy. In addition, much of what we know is situated in mitigation contexts, fast-onset climate shocks, and short-term financial solutions, creating a gap in contextual understanding for resilience/adaptation/transition contexts, slow-onset climate stresses, and longer term financial solutions.[143]

Risk

Another data gap emerges when trying to understand risk assessment in terms of financial risks, climate change risks, social risks, and their combined interactions.[144] In the financial system alone, there are physical risks posed by climate change to a firm's assets as well as their location, in addition to the risk of transitioning to climate-focused policies, regulatory changes, and shifting from fossil fuels to renewables.[145] These complex and intersecting risks, compounded by uncertainty, make it challenging to assess financial exposure to climate risks as well as the risk-return ratios for ICF products.[146] A lack of models that can combine and predict these climate-finance risk scenarios makes any effort at risk management a daunting task.[147] A real-world example comes from PG&E's bankruptcy after California's wildfires and the massive liabilities it had to pay because of them, dubbed by some as the first climate-change-induced fall of a financial institution.[148] Another example is the recent pull out of multiple insurance companies from Florida, a state seen as having too much physical risk of climate change impacts and thus presenting too much of a financial risk, particularly for insurance payouts.[149] For the ICF realm, these examples illustrate how risk can dictate what kinds of products and services are available, something that data can contribute to understanding and managing.

Implementation and Impact

Perhaps the largest gap is data that helps understand the implementation and impact of ICF funding and products.[150] This gap exists not only because it is a nascent field but also because the data that exists, while ample, is frequently

[141] Eriksen et al. (2021)
[142] Ozili (2021)
[143] Miller, Krishnan, & Ruiz (2023)
[144] Volz et al. (2020)
[145] Monasterolo (2020)
[146] NGFS (2019)
[147] Ozili (2021); Deary & Huret (2022)
[148] MacWilliams, La Monaca, & Kobus (2019)
[149] Flitter (2023, July 14)
[150] Ozili (2021); UNSGSA (2023)

uncoordinated. As ICF endeavors to impact microeconomics alongside social, economic, and climate sustainability, it requires a combination of data and approaches that are typically siloed.[151] This means that while there are a variety of reports spanning the gray literature providing use case impacts, there is a lack of comprehensive, empirical, and rigorously conducted studies that assess the true efficacy of ICF products and their ability to reach their social and climate change targets.[152] As such, there is a need to coordinate and combine data that speaks to financial, social, and climate change goals, not only to understand impact but also to help steer financial flows towards optimal investments.[153]

Data Science Solutions and Opportunities

There are a number of data science methods that appear to hold the most potential to accelerate ICF's goals. These include machine learning, satellite data analysis, data disaggregation, predictive analytics, and risk modeling. In the following sections, these approaches are mapped onto the data gap areas identified, illustrating some of the key opportunities for data science to advance ICF.

Clarity

While establishing clarity is not inherently a data science-specific strategy, it is a prerequisite for creating a data environment conducive to robust analysis. Terminology, taxonomies, and frameworks are vital to interdisciplinary work, including data systems. For example, CGAP created a typology for climate-responsive and climate-supportive financial products, a distinction that creates a clear scale and impact goal.[154] Climate-responsive products are those with intentional climate design aimed at helping vulnerable populations, whereas climate-supportive products are those that do not have an intentional climate lens but still aide vulnerable populations in coping with climate change. Such specificity allows for a clear mapping of the state of financial products in this space, identifying gaps in products that target urban areas, women, and savings. This is an especially poignant finding given that empirical reviews of financial inclusion projects often find savings programs to be the most consistently beneficial,[155] illustrating the importance of these taxonomies in finding entry points for where to target additional analytical efforts. On a larger scale, the EU developed a taxonomy of sustainable economic activities that are directed

[151] Knaack & Volz (2022)
[152] UNSGSA (2023)
[153] Zetzsche et al. (2022)
[154] Notta (2022)
[155] Cull, Ehrbeck, & Holle (2014)

toward the goal of net-zero emissions by 2050 to foster clarity and allow companies and investors to have a shared understanding of where and how to invest.[156] There are many other examples of similar taxonomies,[157] but the trick is using them in a consistent way to allow for data to become aligned and thus foster better analysis.

Beyond taxonomies, achieving clarity involves unifying segregated data sets and coordinating their use. Interoperability, a concept denoting the capability of multiple systems or components to exchange and effectively employ shared information, underpins the practical progression toward clarity.[158] Within inclusive climate finance, interoperability allows organizations to bridge gaps, share knowledge, and promote collective action. By transcending data silos and promoting cooperation among financial entities, a more comprehensive understanding of climate risks, and the potential development of inclusive solutions that benefit all, particularly those most vulnerable to the impacts of climate change, is possible.

For instance, suppose a coastal community is prone to both flooding from rising sea levels and extreme storms. In an inclusive climate finance framework, interoperability allows various institutions to pool their data. This data fusion would not only paint a clearer picture of the combined risks, but also facilitate the development of financial solutions that cater to the unique needs of the community.

Context

One of the key ways to understand the contexts in which ICF is best suited is to employ data disaggregation and predictive analytics. Data disaggregation is particularly useful when identifying gaps in populations, understanding their needs, and how they may differ from standard groups. For instance, the Reserve Bank of India disaggregated their financial data for women, which lent them valuable insights and disrupted the previously held notion that women were not creditworthy.[159]

Predictive modeling can also aid in finding populations most in need of ICF strategies. In the case of Togo's Novissi program, machine learning-based predictive analytics were applied to mobile phone data, predicting poverty levels where such indicators were not previously available. This approach

[156] EU Taxonomy for Sustainable Activities
[157] E.g., see Just Transition Criteria developed by the Impact Investing Institute
[158] Geraci et al. (1991)
[159] Das Barwa (2015)

allowed the rollout of social protection payments during the COVID pandemic to the most vulnerable first.[160]

With exploration, predictive analytics could also be used to merge climate risks with financial exclusion, creating a map of where the highest priority areas are. Further, climate modeling could help illustrate where slow-onset shocks versus quick-onset shocks are occurring in order to map financial solutions onto them more effectively (e.g., provide insurance in areas with increased flood risks, but savings for areas with sea level rise to foster future migration ability). This would allow a deeper understanding of how financial solutions work within resilience versus adaptation contexts and represents a great future opportunity for data science since there is a gap in the work being done in this space currently.

Risk

Predictive analytics and modeling are also good fits for understanding risk in ICF. Data science has a long track record of using innovative statistical modeling to aid in climate risk assessment to facilitate insurance products.[161] In terms of investment, data science can also forecast where climate change might make conditions better or worse for certain adaptation or resilience projects (e.g., ponds for aquaculture should be placed in areas with low risk of flooding/saline intrusion).[162] Related, the UNEP Finance Initiative program recently developed the Carbon Delta Methodology, which uses climate models to understand how different warming scenarios impact financial portfolios.[163] In an example that uses data science to understand repayment risks, DataKind worked with the Pay-As-You-Go solar company Simpa Networks to build a predictive model of customer repayment likelihood, increasing the potential efficiency of Simpa Networks' business and thus their ability to reach more customers.[164] Moreover, Datakind has demonstrated how engaging with risk assessment in disaster contexts can be accomplished using non-traditional and public data, [165] an important roadmap for actors working in ICF.

Implementation and Impact

Currently, one of the most commonly used data science techniques within ICF is the verification of climate mitigation projects through the analysis of Internet of Things (IoT) sensor data or satellite information. For example, GainForest uses machine learning to analyze satellite, drone, and wildlife camera data to

[160] Novissi G2P Program
[161] See Lyubchich et al. (2019) for a review of statistical models to understand climate risks to insurance.
[162] Agrawala & Carraro (2010)
[163] UNEP (2019)
[164] DataKind (2023)
[165] DataKind (2018, August 23)

measure and verify conservation practices, and then uses a decentralized fund to pay landowners for those practices.[166] Another similar case is Savory Institutes' Ecological Outcome Verification program, which uses satellite analysis to verify the regenerative agricultural practices of agribusinesses, whose products are then labeled as Land to Market products, increasing their access to the sustainable marketplace and contributing to the development of sustainable supply chains.[167]

These examples are innovative, but they also often revolve around the climate change response pathway of mitigation, which highlights a gap in using these solutions for resilience or adaptation-focused work. As mentioned, data science techniques can help align financial solutions more appropriately with specific climate change response pathways. However, it is also an emerging space to gauge their impact along these pathways. For example, if a financial service provider gives an adaptation loan to an agricultural MSME at risk of drought (i.e., for drought-tolerant seeds), satellite data analysis can track how their crop is doing relative to farms that did not receive a loan and provide insight into how well that financial solution performed in terms of MSME adaptation.

Mapping Data Science onto Inclusive Climate Finance

The examples in the table below focus on ICF implemented at the household/MSME scale and the use of specific data science strategies to enhance them, along with opportunities for further advancement based on the previous discussion of data gaps. The core trends of how data science can be helpful in terms of clarity, context, risk, implementation, and impact are also applicable across all cases but are not specifically called out in this table. It is important to note that the mitigation pathway also provides examples of strategies that target larger-scale industry impacts since so much of the climate finance space has focused on carbon emissions at that scale. In particular, climate finance has used machine learning and blockchain technology to bolster the verification of carbon reduction projects, providing a number of examples where FinTechs or other intermediaries are providing opportunities for investment in direct interventions that address both mitigation and financial inclusion.

[166] GainForest
[167] Land to Market

Table 2. Data Science Facilitated ICF						
Climate Change Response Pathway	*Existing Data Science Strategy*	*Data Science Opportunity*	*Examples*			
			Organization	Financial Mechanism	Scope	Description
Mitigation Reducing greenhouse gas emissions/ regenerating ecosystems ***Typical ICF Examples:*** Subsidies or guarantees for credit to invest in new resource-efficient /low-carbon practices/technologies (e.g., clean cookstoves, solar lighting, smart ag)	Machine learning and satellite data analysis to verify practices to either pay/support those directly engaging in mitigation or direct investments to mitigation projects	This is currently a well-developed pathway for the use of data science techniques	GainForest	Fund for direct payments to conservation projects	Conservation, Amazon	Uses machine learning to measure and reward sustainable nature stewardship
			Boomitra	Direct payments for regenerative agricultural practices	Agriculture, India	Satellite data and AI to help farmers with regenerative land management by compensating them for verified practices
			CYNK	Carbon offset market	Agriculture, rural Africa	Uses satellite and IoT data to verify carbon credits of various projects in Africa, which they can use to sell to the carbon market
			Earthbanc	Carbon offset market	Reforest., agroforestry, Global	Climate Fintech using satellite and machine learning to verify carbon offset projects to invest in

Table 2. Data Science Facilitated ICF cont.						
Climate Change Response Pathway	*Existing Data Science Strategy*	*Data Science Opportunity*	*Examples*			
Resilience Increasing capacity to cope with/recover from short-term climate shocks ***Typical ICF Examples:*** (Digital) cash transfers to disaster affected Weather/livestock index insurance Easy-access savings Social protection payments for food or wage security	Machine learningto identify climate-vulnerable users to prioritize; satellite data analysis to create index insurance	There is a gap in financial strategies that provide savings for resilience – data science can be used to identify opportunities where savings programs are most needed/effective There is also a gap in using data science techniques to facilitate cash transfers, representing an opportunity for application	Organization	Financial Mechanism	Scope	Description
			eLEAF + OKO Finance	Index-based insurance	Agriculture, rural Africa	Uses satellite data to assess evapotranspiration and biomass production; partners with inclusive insurance companies (e.g., OKO Finance) to provide products to rural agricultural communities in Africa
			Novissi Program	Social protection payments	Togo	Machine learning of mobile phone data to predict poverty and thus prioritize who receives payments for crisis situations (originally developed for COVID response, but can apply to climate change shocks as well)

Table 2. Data Science Facilitated ICF cont.						
Climate Change Response Pathway	*Existing Data Science Strategy*	*Data Science Opportunity*	*Examples*			
Adaptation Increasing capacity to plan for and adapt to future climate shocks ***Typical ICF Examples:*** Subsidies or guarantees for credit to invest in adaptation or resilience-enhanc-ing activities (e.g., crop diversification, weatherproofing housing)	IoT analysis to increase efficiencies (and profitability); satellite data analysis for verification of adaptation activities	Current emphasis is on verification, creating an opportunity to apply data science techniques to understanding risk and impact across adaptation activities	Organization	Financial Mechanism	Scope	Description
			Aqua Exchange	Tech facilitated direct payments	Aquaculture, Global	Provides affordable IoT crop tracking and management and automated harvest payments, with the goal of increasing efficiency and profits
			Hiveonline	Access to microfinance products	Agriculture, Africa	Uses crop data – forecasts, deliveries, transactions – to create a reputation score for producers. Financial institutions can see those scores and provide loans, purchase crops, or provide agricultural inputs.
			National Capital Project and the Sustainable Cashmere Project	Carbon offset markets investing in sustainable practices	Agriculture, Mongolia	Coalition of goat herding cooperatives and luxury clothing brands working to create a sustainable supply chain for cashmere, funded by a mining company purchasing carbon offsets from sustainable farming practices. On-the-ground work is verified by a third party,including the use of remote sensing

Table 2. Data Science Facilitated ICF cont.						
Climate Change Response Pathway	*Existing Data Science Strategy*	*Data Science Opportunity*	*Examples*			
Transition Shifting livelihoods and economies when adaptation is no longer feasible	This is an emerging space with few examples of existing use of data science for transition-focused ICF strategies	Data disaggregation is an important approach to understanding how transition-focused activities affect their stakeholders and can improve the ability to implement them equitably	Organization	Financial Mechanism	Scope	Description
			This is an opportunity space for data science and ICF to explore together			

Part IV: Final Thoughts

Inclusive climate finance is a new approach to generating insights, identifying new opportunities, and, ultimately, combating climate change via financial solutions. At its core, it applies an inclusive lens to climate finance and a climate lens to financial inclusion. While this goal is laudable and an arguably necessary step for ensuring that the financial flows of the world are working towards social and climate targets in tandem, it is a daunting task. This landscape aims to clarify this space by reviewing the efforts to date, highlighting their strengths and weaknesses, and championing how data science can accelerate ICF's ability to achieve its goals.

Much of the challenge in this work is tied to data, combining different fields and industries, each with its own metrics and ways of collecting them, creating an inherently fuzzy picture. This is an issue experienced regardless of the solution route within climate change action, with a growing call for coherent, shareable, and buildable data ecosystems.[168] As argued in this landscape, the first step towards this vision and the clarity it requires is the use of the ICF framework itself as the launching point for a given stakeholder in this space to identify where and for whom they want to operate. By situating a financial solution,be it easy-access savings accounts or investing in carbon offset projects, within a climate change response pathway with clear definitions and scale of impact, the appropriate metrics that track that solution's progress can be defined. From there, a myriad of data science techniques can be applied to either help understand where to target the solution, measure its impact, or improve its operations.

As shown in the examples discussed in this landscape, there are many ways data science can add value to existing ICF strategies, as well as opportunities where it has yet to be tried in earnest (i.e., just transitions). The climate-finance nexus is a data-rich environment, but coordinating the data in a way that can help tell a coherent story on which to build the next steps is the challenge that needs to be met. This will require significant investment and attention to creating robust data infrastructures for any stakeholder hoping to embark on the work of ICF.

[168] Paris 21 (2022, March 8)

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Appendix

Key Stakeholders at the Climate-Finance Nexus
The following table provides an overview of actors emblematic of the Inclusive Climate Finance work, although they may not adopt that language specifically. Thus, the examples are pulled from organizations that broadly have an overlap between climate action and inclusive financial efforts. It is not an inclusive list.

Organization	*Type*	*Summary of Relevant Work*
Accion	Technical Assistance/Knowledge	Hosting organization for the Center for Financial Inclusion – key player in the development of the Inclusive Green Finance framework
ACRE Africa	Technical Assistance/Knowledge	Agricultural insurance intermediary that provides tailored risk management solutions to help connect customers to the appropriate insurance products
Acumen	Funder/Investor	Focuses on poverty alleviation-focused investing. There are investments that work to improve productivity, raise incomes, and build climate resilience
ADA	Technical Assistance/Knowledge	Supports the development of green microfinance tools
Adaptation Fund	Funder/Investor	Climate change adaptation funds for developing countries, created by the Kyoto Protocol
African Development Bank	Financial Service Provider and Technical Assistance/Knowledge	Climate Investment Funds (CIF) works with African Development Bank to mobilize investments to pilot and scale cutting-edge climate solutions to address climate challenges
Alliance for Financial Inclusion	Policy/Advocacy and Technical Assistance/Knowledge	Inclusive Green Finance thematic area and key participant in the Inclusive Green Finance Working Group of the UNSGSA
Asian Development Bank	Funder/Investor and Financial Service Provider	First amongst the multilateral development banks to announce a commitment to climate financing in the lead up to the historic United Nations Climate Change Conference held in Paris; made a commitment in 2015 to double climate financing from its own resources to 6 billion dollars annually by 2020
Better than Cash Alliance	Policy/Advocacy	The Alliance is a partnership of governments, companies, and international organizations that advocate for the transition from cash to digital transactions to facilitate the sustainable development goals (SDGs). Has a digital financial inclusion focus on women and climate change
BFA Global	Technical Assistance/Knowledge and Funder/Investor	Works with leaders across the climate resilience and adaptation space to develop programs and solutions that can address climate vulnerabilities. Works with Catalyst Fund to support impact investing
Bill and Melinda Gates Foundation	Funder/Investor	Women's gender equity in financial inclusion work, but not necessarily integrated with climate change impacts

Appendix

Key Stakeholders at the Climate-Finance Nexus cont.		
Organization	*Type*	*Summary of Relevant Work*
BlackRock Institutions	Network/Intermediary	Have a Climate Finance Partnership where they partner with the governments of France, Germany, and Japan as well as a number of leading impact U.S. organizations to design and create a unique blended finance fund structure to mobilize private investment into emerging markets for climate finance
Building Resilience and Adaptation to Climate Extremes and Disasters (BRACED)	Funder/Investor	Funds various projects that help people become more resilient to climate extremes in South and Southeast Asia. Funds come from the UK Department for International Development and knowledge production is managed by Overseas Development Institute
Caribbean Catastrophe Risk Insurance Facility	Financial ServiceProvider	Climate risk based insurance for those in poverty
Centre for Sustainable Finance at SOAS, University of London	Technical Assistance/Knowledge	Provides a forum for interdisciplinary research and teaching on sustainable finance and investment. Key participant in the development of the Inclusive Green Finance framework
Centre for the Study of Financial Innovation (CSFI)	Technical Assistance/Knowledge	Financial services professionals and observers share ideas about the challenges and opportunities facing the sector, including a specific thematic area for sustainable finance
Consultative Group to Assist the Poor (CGAP)	Technical Assistance/Knowledge	The new CGAP VII Strategy is emphasizing inclusive finance that supports green, equitable, and resilient futures
Climate and Development Knowledge Network	Technical Assistance/Knowledge	Climate Finance theme works to enhance the quality of life for the poorest and the most vulnerable by combining research, advisory services, and knowledge management in support of locally owned and managed policy processes
Climate Finance Partners	Financial Service Provider	Investment advisor, develops climate finance solutions and investment products to address capital needs for emerging environmental challenges
Climate Finance Partnership	Funder/Investor	Investment fund initiated by One Plant Summit Philanthropists Task Force to help greenhouse gas mitigation projects in emerging and developing countries Fund's key partners: BlackRock Corporation, French Development Agency, German Ministry of the Environment
Climate Investment Funds	Funder/Investor	Delivers climate finance
Climate Investment Summit	Network/Intermediary	A platform for stakeholder engagement and networking to mobilize market solutions for global climate commitments

Appendix

Key Stakeholders at the Climate-Finance Nexus cont.		
Organization	*Type*	*Summary of Relevant Work*
Climate Policy Initiative	Technical Assistance/Knowledge	CPI is an analysis and advisory organization with deep expertise in finance and policy. They help governments, businesses, and financial institutions drive economic growth while addressing climate change. Their vision is to build a sustainable, resilient, and inclusive global economy
CYNK	Network/Intermediary	Financial intermediary, emissions reduction platform using blockchain verification to connect carbon-reducing projects to financing via carbon market credits
Earthbanc	Financial Service Provider	Climate FinTech working to support mitigation via regenerative practices. Partnership with UNCCD to restore 2.5B ha of land
European Microfinance Platform	Network/Intermediary; Technical Assistance/Knowledge	Achieves their climate resilience goals through diverse publications, year-round expert Action Groups, the annual European Microfinance Week, the prestigious annual European Microfinance Award, and various other activities
Financial Health Network	Network/Intermediary; Technical Assistance/Knowledge	Provides research, innovative tools, ongoing education, and engaging network opportunities to organizations that are committed to improving financial health; no explicit climate change connection
FINCA International	Policy/Advocacy	Works with partners in agriculture, health care, clean energy, FinTech, and other relevant sectors to build a global network of sustainable and scalable social enterprises to alleviate poverty
Floodbase	Financial Service Provider	Provides parametric flood insurance for climate change resilience, with automatic payouts once parameters are exceeded
Fundación Capital	Technical Assistance/Knowledge	Develops solutions based on digital technologies that trains users to make better use of their economic opportunities, generate sustainable livelihoods, improve financial practices, and make more informed decisions
GiveDirectly	Financial Service Provider	Direct cash donations; new project for climate resilience and adaptation-focused donations piloted in Malawi
Global Environment Facility	Funder/Investor	Public-private partnership provides funding to developing countries seeking to meet the objectives of international environmental agreements
Global Parametrics	Technical Assistance/Knowledge	Combine risk models with financial solutions to advise access to capital
Global Partnership for Financial Inclusion	Policy/Advocacy	Platform for G20 countries to work on financial inclusion

Appendix

Key Stakeholders at the Climate-Finance Nexus cont.		
Organization	*Type*	*Summary of Relevant Work*
Global Partnership for Social Accountability	Network/Intermediary; Funder/Investor	Works to expand opportunities for civil society to work with governments to solve development problems and fight poverty; provides grants and holds events
Global Resilience Partnership	Technical Assistance/Knowledge	Network of organizations working to scale innovation and provide knowledge about best practices for resilience Innovative Finance for Resilience program looks to find ways to use finance to increase resilience to both conflict and disaster
Grameen Foundation	Financial Service Provider; Technical Assistance/Knowledge	Climate-Smart Agriculture program supporting investments and innovation in digital farming practices to increase efficiency, profitability, and sustainability
Green Climate Fund	Funder/Investor	World's largest climate fund, created by the Paris Agreement, that supports developing countries raise and realize their Nationally Determined Contributions ambitions towards low emission, climate resilient pathways
Grow Ahead	Financial Service Provider	Crowdfunding/donation campaignsto support community-led agroforestry to foster climate change mitigation and resilience
GSMA	Network/Intermediary; Technical Assistance/Knowledge	ClimateTech programme facilitates collaboration between the mobile industry and private actors through research and expertise
Hiveonline	Financial Service Provider	Gives financially excluded smallholders and their local ecosystems access to credit and markets
HSBC	Funder/Investor	Collaborated with World Resource Institute (WRI) and WWF to develop a five-year philanthropic partnership; powered by 100 million dollars, HSBC is working to scale up climate innovation ventures
International Fund for Agricultural Development (IFAD)	Funder/Investor	Provides access to finance, markets,technology, and information for rural people to escape poverty Facilitated the INSURED (Insurance for Rural Resilience and Economic Development) program: “From 2018, IFAD’s agricultural and climate risk insurance programme, INSURED, has been integrating insurance into IFAD programmes by bundling insurance with other products, including farming inputs and loans. This creates better value for the clients and helps make rural people a less risky investment.” Also supports the Platform for Agricultural Risk Management

Appendix

Key Stakeholders at the Climate-Finance Nexus cont.		
Organization	*Type*	*Summary of Relevant Work*
IFC (a World Bank Group)	Financial Service Provider	Sustainable finance resources
Impact Investing Institute	Technical Assistance/Knowledge	Work to make capital investments more equitable and beneficial for the planet; Just transition finance project working to make Just Transition Criteria
InsuResilience Investment Fund	Technical Assistance/Knowledge; Policy/Advocacy	Supporting countries adoption of climate risk insurance (advocacy, research, and funding for product development)
Inter-American Development Bank	Funder/Investor	Offers capital market and financing solutions to help Latin America and the Caribbean region toward an inclusive and low-carbon economy while also tackling physical climate risks
International Monetary Fund	Funder/Investor; Technical Assistance/Knowledge	Provides loans (including emergency loans) to member countries experiencing actual / potential balance of payments problems as well as works to identify risks and recommend policies for growth and financial stability, including those related to climate change
Landscape Resilience Fund	Funder/Investor	Funds selected SMEs and landscape activities in developing countries where climate risks are particularly high; also facilitates loans for return on investment and thus acts as a Financial Service Provider
Livelihoods Funds	Network/Intermediary	Connects NGOS, efficient and sustainable agriculture practices to create value chains for investors via carbon offsets and high-value products
London School of Economics and Political Science	Technical Assistance/Knowledge	Grantham Research Institute on Climate Change and the Environment provides foundational research that many in the sector use
Mastercard Foundation	Funder/Investor	Mobilizing against climate change directly through their business and supporting suppliers' decarbonization efforts; leveraging the network effect by giving consumers tools to measure their own footprints and make donations to Priceless Planet
Mercy Corp	Policy/Advocacy	Has a climate, environment, and energy program area with a climate finance action area within it. Also has Mercy Corps Ventures Resilient Futures Thesis – which focuses on investing in projects that address climate adaptation (e.g., Adaptive Agriculture and Food Systems)
MetLife Foundation	Funder/Investor	Works to reduce GHG emissions (in alignment with the Paris Agreement and NetZero), collaborates with stakeholders and develops finance solutions to drive progress toward a low-carbon economy. Has a sustainable finance framework.

Appendix

Key Stakeholders at the Climate-Finance Nexus cont.		
Organization	*Type*	*Summary of Relevant Work*
MFS Africa	Financial Service Provider	Fintech digital inclusion company, mobile money network intermediary
Microsave Consulting	Technical Assistance/Knowledge	Partners with participants in financial services, enterprise, agriculture, and health ecosystems to achieve sustainable performance improvements
MUFG	Funder/Investor	Has financed over 450 transactions representing more than 75GW of renewables generation capacity; provides Export Credit Agency-supported loans to sustainable projects, often for developing countries
Network for Greening the Financial System (NGFS)	Technical Assistance/Knowledge ; Network/Intermediary	Group of central banks and supervisors that share their practices, organizes events and research on climate change
Overseas Development Institute (ODI)	Policy/Advocacy; Technical Assistance/Knowledge	Delivers internationally recognized research that informs policy design and convenes leadership across climate challenges
Opportunity International	Financial Service Provider	Creates opportunity for entrepreneurs to build businesses, children to attend school, farmers to feed their communities, and families to end generational poverty
Oxfam	Policy/Advocacy	Offers support by collecting donations and advocating for climate action
Rabo Foundation	Funder/Investor	Impact financing, offers organizations that work with smallholder farmers to access money, knowledge, and network
Savory Institute	Network/Intermediary	Land to Market Program: Connects brands with verified regenerative ag, improving marketsfor farmers and ecosystem health
Stockholm Environment Institute	Technical Assistance/Knowledge	Inclusive Climate Finance for Communities in the Asia Pacific (ICCAP)
Sustainable Banking and Finance Network	Technical Assistance/Knowledge	A platform for knowledge sharing on sustainable finance or financial sector regulators
The Rockefeller Foundation	Funder/Investor	Catalyzes private capital scale to bridge funding gaps and address climate challenges
Tomorrow Bank	Financial Service Provider	Provides an application where people can invest their money easily sustainably

Appendix

Key Stakeholders at the Climate-Finance Nexus cont.		
Organization	*Type*	*Summary of Relevant Work*
UNCDF	Funder/Investor	Assists developing countries by supplementing their existing sources of capital assistance by means of grants and loans; priority areas are "inclusive digital economies and local transformative finance, and the emerging areas of women's economic empowerment, climate, energy, and biodiversity financing, and sustainable food systems financing"
UNDP	Funder/Investor	UNDP works to "help countries to develop policies, leadership skills, partnering abilities, institutional capabilities, and to build resilience to achieve the Sustainable Development Goals. Our work is concentrated in three focus areas: sustainable development, democratic governance and peace building, and climate and disaster resilience."
UNSGSA	Policy/Advocacy; Technical Assistance/Knowledge	Key partner in the development of the inclusive green finance policy framework
USAID	Funder/Investor	Provides humanitarian response by bringing disaster relief and lifesaving assistance
Village Savings and Loans Associations (VSLAs)	Financial Service Provider	Helps marginalized communities mobilize local savings by providing members with a means to cope with emergencies, help manage household cash-flow, build a capital base, and rebuild social networks
World Bank	Funder/Investor	Large funder of global development work, including climate change. Also has the Social Sustainability and Inclusion Global Practice
World Food Programme	Network/Intermediary	Joint program with OxFam – R4 Rural Resilience Initiative – which focuses on providing crop insurance and food assistance through assets
World Resources Institute	Technical Assistance/Knowledge	Sustainable finance initiative focuses on helping direct the investments and financial flows of banks, investment firms, and multilateral funds to climate-sustainable projects