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Financial Market Services: Finance Flows for Climate Change Adaptation

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Definitions

Financial market service describes a marketplace where financial assets (e.g., equities, bonds, currencies, loans, and derivatives) are traded. Climate finance refers to the trade of financial assets, within a market, for the purpose of financing projects that combat adverse effects associated with climate change. Most discussions on climate finance also include a discussion on climate finance flows, i.e., who is contributing financial resources and how much, and what types of assets are being traded and for what specific purpose. Simply put, climate finance flows refer to the breakdown and movement of climate finance from funding sources to climate projects.

Currently there is no single definition of climate finance (Buchner et al. 2011; Haites 2011; Stadelmann et al. 2011). According to the authors of the first ever climate finance chapter in the Intergovernmental Panel on Climate Change's (Gupta et al. 2014) assessment report, some scholars and institutions make distinctions as to what qualifies as climate finance. These distinctions can be based on the source of financial resources – public or private. Some may qualify the full value devoted to a project, while others focus on the incremental investment, which refers to the extra resources required for a climate-friendly project over a less-friendly alternative. One example of incremental costs includes the extra funds needed for a wind turbine project over a coal or natural gas facility. Another distinction is whether funds finance climate mitigation or climate adaptation projects.

The United Nations Framework Convention on Climate Change's (UNFCCC) Glossary of Climate Change Acronyms and Terms (2014) refers to *mitigation finance* as financial resources dedicated for climate mitigation-reduction in greenhouse gases, e.g., substituting fossil fuel use with renewable energy, expanding forests to remove carbon dioxide from atmosphere, etc. *Adaptation finance* is financial resources, specifically aimed at adaptation actions, which typically "reduc[e] the vulnerability of, and maintain [or] increase[e] the resilience of, human and ecological systems to negative climate change impacts" (UNFCCC B 2014). In other words, adaptation actions usually come in the form of development that protects communities from, or help them to adjust to, the negative consequences associated with sudden climate change.

Perhaps the greatest distinction is whether climate finance refers to "financial resources devoted to addressing climate change globally,

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[or] financial flows to developing countries to assist them in addressing climate change" (Gupta et al. 2014, p. 1112). The latter definition is in accordance with UNFCCC support for the principle of "common but differentiated" responsibility for climate finance. The Convention states that developed countries should feel compelled to contribute financial resources to assist developing countries with adaptation and mitigation projects (UNFCCC 2014). This support should be provided on the grounds that developed countries' historical emissions are largely responsible for climate change, while climate change impacts will disproportionally affect developing countries. Further, many developing countries have limited institutional capacities (Schalatek et al. 2012) and financial resources to address climate-related consequences such as flooding, cyclones, coastal erosion, and droughts.

This entry refers to the most broad definition of climate finance, where it is the full value of financial flows, public and private, domestic and international, for both mitigation and adaptation projects (Buchner et al. 2014; Gupta et al. 2014), while placing a special emphasis on climate finance with respect to adaptation. The entry is organized as follows: The *Introduction* first provides an overview of climate finance flows. The second object of the introduction is to describe climate flow trends pertaining to adaptation climate projects specifically. The *Key Issues* section discusses the current lack of funding for adaptation and the barriers to mobilizing additional financial resources for adaptation. Finally, the *Future Directions* section discusses the role that public actors can play in removing barriers to private investment and hence attracting more private resources for adaptation finance in the future.

Introduction

Climate Finance Flows

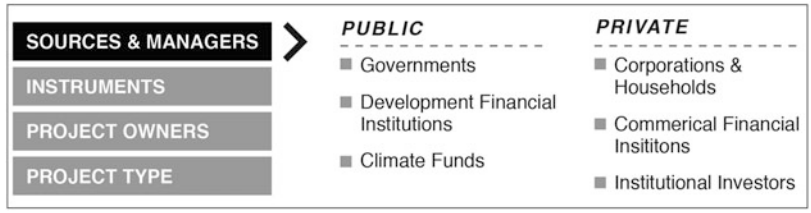
Although climate finance is critical to the implementation of any climate change project, 2014 marked the first year that the IPCC assessment report included an entire chapter dedicated to climate finance. One of the chapter's key findings was that in spite of the UNFCCC Paris Agreement's mobilization of an annual commitment of 100 billion dollars (USD) from developed countries to developing countries, "resources to address climate change need to be scaled up considerably over the next few decades, both in developed and developing countries" (Gupta et al. 2014, p. 1210). The Paris Agreement was adopted at the UNFCCC in December 2015; the annual commitment of funds for climate projects begins in 2020 and is intended to accomplish the Agreement's main goal of limiting manmade warming to 2 °C by the end of the century (Buchner et al. 2017; Pillay et al. 2017). The Agreement, in turn, is expected to have substantial effect on climate finance flows.

Climate finance flows refers to the movement of climate financial resources from parties with resources toward climate adaptation and mitigation projects in need of resources (Atteridge et al. 2009; Buchner et al. 2014; Gupta et al. 2014). One of the main objectives of analyzing climate finance flows is to uncover (1) the major sources of climate finance, (2) the financial resources being directed to climate projects, (3) who owns/develops climate projects, and (4) the types of projects receiving funding. Figures 1, 2, 3, and 4 indicate the flows of financial resources to projects at four major stages: sources and managers, instruments, project owners, and project types (Atteridge et al. 2009; Buchner et al. 2014; Gupta et al. 2014).

Funding *sources and managers* will either directly distribute or mobilize financial resources to project owners also known as recipients.

Financial instruments are financial agreements between an owner of a project and a key financial sources and managers (Gupta et al. 2014).

Project owners have property rights over both adaptation and mitigation projects. In many instances a project owner can finance projects using support from multiple funding sources or managers (Buchner et al. 2011; Juergens et al. 2012); owners can also directly finance their projects using their own financial resources. In this case, the owner and source/manager would be the same.



Financial Market Services: Finance Flows for Climate Change Adaptation, Fig. 1 Key public and private sources and managers within climate finance flow. (Adapted from Atteridge et al. 2009, Buchner et al. 2017, Gupta et al. 2014, and S. UNFCCC 2014)

Financial Market Services: Finance Flows for Climate Change Adaptation, Fig. 2 Financial instruments within climate finance flow. (Adapted from Atteridge et al. 2009, Buchner et al. 2017, Gupta et al. 2014, and S. UNFCCC 2014)

Financial Market Services: Finance Flows for Climate Change Adaptation, Fig. 3 Project owners within climate finance flow. (Adapted from Atteridge et al. 2009, Buchner 2017, Gupta et al. 2014, and S. UNFCCC 2014)

Financial Market Services: Finance Flows for Climate Change Adaptation, Fig. 4 Project type within climate finance flow. (Adapted from Atteridge et al. 2009, Buchner 2017, Gupta et al. 2014, and S. UNFCCC 2014)

Finally *project type* refers to whether a project *mitigates* greenhouse gas emissions (GHG) and/or helps communities *adapt* to adverse climate change effects. Below are diagrams and descriptions of the primary *sources and managers*, *financial instruments*, *project owners*, and *project types* within climate financial flows.

Sources and Managers

Descriptions of climate finance flows typically make distinctions between private and public sources of managers of financial resources. Recent data on climate financial flows indicate that public financial resources, unlike private resources, are primarily distributed in the form of financial donation, meaning the financial asset is not traded within a market, but rather redistributed from one party to another. Recent data also indicates that most of climate finance is mobilized from private sources, which are the dominate actor within the world economy (Atteridge et al. 2009; Buchner et al. 2014; Gupta et al. 2014; S. UNFCCC 2014).

Public Sources and Managers

- *Governments*, since public funding refers to funding from government entities, are the sole source of public funds for climate finance. Governments can contribute general tax revenue, as well as other sources of local funding (e.g., levies, environment taxes, etc.) to climate change projects directly, or through financial intermediaries, such as development financial institutions.
- *Development financial institutions* (DFIs) are public financial intermediaries that pool and mobilize financial resources from governments

to public and private project owners. National DFI provide financial resources to domestic project owners. These include national development banks, such as the Brazilian development Bank or the African development Bank. While bilateral and multilateral DFI's pool financial resources from developed counties to mitigation and adaptation projects in the developing world. DFIs also support non-climate-related projects in the developing world, such as programs related to poverty alleviation and education (Levere et al. 2006). Bilateral DFIs are set up by one individual country, while multilateral DFIs pool resources from two or more developed countries. An example of a bilateral DFI includes Germany's international climate initiative, which has approved 952 million USD for a total of 284 mitigation and adaptation projects (Nakhooda et al. 2013). A multilateral DFI example includes the global environment facility (GEF), a financial mechanism of the UNFCCC, where 31 countries have pledged and disbursed just over one billion USD for climate change mitigation and adaptation projects (Nakhooda et al. 2013).

- *Climate funds* are relatively new and important institutions within the climate finance landscape (Buchner et al. 2017). Similar to DFIs, there are also bilateral and multilateral climate funds. In most instances climate funds are administered by DFIs and are designated for specific and focused climate projects. For example, the UNFCCC's GEF also administers the Least Developed Countries Fund (LDCF) and the Special Climate Change Fund (SCCF). Both of these funds specifically support small-scale adaptation projects (Nakhooda et al. 2013). In addition to these funds, the UNFCCC also established the Green Climate Fund (GCF) in 2015. The GCF has pledged to assist developing countries by providing a "balanced" support of 50:50 to both adaptation and mitigation (UNFCCC 2016). Furthermore, one of the fund's objectives is to move forward with a Business Model Framework (BMF) that allows for increased involvement from the private sector (Climate Development and Knowledge Network 2013). Traditionally, climate funds, along with DFIs, are classified as public, since their funding sources predominantly come from donor governments; however the GCF is a prime example of a public entity that is trying to attract financial resources from private investors by reducing risks associated with investment in climate projects (Buchner et al. 2017).

Private Funding Sources and Intermediaries

- *Corporations* are key private actors. Corporations can contribute their own revenues to projects that they own, or they can invest in climate projects owned by other entities. Energy corporations, such as power and gas utilities, independent power producers, energy companies, etc., typically design, commission, operate, and finance their own renewable energy projects (Buchner et al. 2014). In most instances, energy corporations will supplement their revenues with loans and contributions from other key actors and intermediaries. Non-energy corporations, on the other hand, invest in mitigation measures that they usually do not own, in order to reduce their energy bills, meet voluntary commitments, or comply with emission trading schemes (Smallridge et al. 2013; Birchall et al. 2016).
- *Households*, like governments and corporations, can use their income and savings to invest in their own or other owner's climate projects. However it is usually supplemented by financial resources from additional private or public actors (Berensmann and Lindenberg 2016; Buchner et al. 2014).
- *Commercial financial institutions* are any establishment where the primary activity is fostering financial transactions. Because of this broad definition, there are a wide variety of financial institutions; however commercial and investment banks play a critical role in facilitating climate finance. Commercial banks provide loans to project owners such as households, corporations, and governments, while investment banks raise investment capital, from investors, for project financing (Saunders and Thomas 1997).

- *Institutional investors* are organizations, or asset/investment managers, that invest on behalf of their members. Examples include mutual, endowment, and pension funds as well as insurance companies. There are a number of institutional investors that support climate change projects. The Investor Group on Climate Change in Australia and New Zealand (IGCC) invest in adaptive infrastructure such as transportation, agriculture, and network infrastructure. Similar institutions include the European Institutional Investors Group on Climate Change, based in the UK, which currently represents assets of around €7.5 trillion, while the North American Investor Network on Climate Risk supports 100 institutional investors with assets exceeding US$10 trillion (IIGCC, INCR, IGCC, AIGC, GIC 2013).

Financial Instruments

- *Project debt*, in its most general form, refers to the amount of money a project owner has borrowed from another party. It is accompanied by an arrangement to pay back the borrowed funds over a designated period of time along with interest. It allows the climate project owners a means of financing projects that they currently do not have funding for. Within the climate finance framework, there are two types of debt: low-cost and market value debt (Buchner 2017). Low-cost debt, or concessional loans, is characterized by lower interest rates and or longer grace periods than market value loans (OECD 2003). Public financial intermediaries, e.g., DFI and climate funds, distribute both low-cost and market value debt. However, recent trends suggest that public intermediaries share of market-rate debt is decreasing as private financial intermediaries, e.g., commercial banks, are increasingly lending to project owners (Buchner 2014, 2017).
- *Project equity* refers to the amount of ownership a project owner has disbursed in exchange for revenue. In most instances, new owners are paid back exclusively with future project cash flows. Through this process the project owner is able to raise capital. Equity financing spans a wide range of activities in scale and scope, from a few thousand dollars raised by an entrepreneur from friends and family, to giant initial public offerings. Project equity investments can also take place through balance sheet financing (Buchner et al. 2014; Gupta et al. 2014a).
- *Balance sheet financing*, like project equity, disburses a portion of ownership of a project in exchange for revenue. However, as opposed to project equity financing, in balance sheet financing, all project assets can be liquated and used for collateral for repayment if future cash flows are deficient (Buchner et al. 2014; Gupta et al. 2014; Pillay et al. 2017).
- *Grants* are financial resources provided to project owners for a specific purpose. They typically come from a government, DFI, climate fund, or charity. Climate projects, specifically adaptation projects, such as infrastructure development, are associated with large up front capital expenses. Often, smaller private investors or developing government budgets may not have the financial resources to cover such large costs. Grants, or donations, however can cove or reduce the size of the initial capital cost, hence making the project more financially viable among smaller private investors and developing governments (Buchner et al. 2011).

Project Owners

Governments, *Corporations*, *and Households*. It is important to note in many instances project owners and key actors are the same. This is because, project owners, have the option of using their own resources to finance their projects. In most instances, project owners will use their own resources as well as resources from other key actors and intermediaries (Buchner et al. 2017). For example, In November 2015, the GCF approved USD 12.7 million for a climate information and early warning system in Malawi (Schalatek et al. 2012). The project owner, the Malawi government, will likely use its own revenues, and project debt, in addition to the GCF grants to finance the project. Private project owner, such as corporations and households, can also receive public funding. “In 2015 and 2016, an

average of 13% of publicly sourced climate finance went to private sector entities, 1% to private sector non-government organization or foundations, 2% to public-private entities, and 38% to other public entities such as DFIs and Climate funds"; the remaining flow of public sector revenues is unknown due to data limitations (Buchner et al. 2017, p. 9).

Project Type

Adaptation and Mitigation. The UNFCCC (2014) specifically refers to climate finance as the trade of financial assets for both climate adaptation and mitigation projects. As noted earlier, climate mitigation finance is financial resources devoted to climate mitigation. Likewise, climate adaptation finance refers to resources for climate adaptation projects. Mitigation efforts reduce levels of greenhouse gases, by substituting, eliminating, or ameliorating existing sources of emissions, whereas adaptation projects specifically refer to actions that help communities cope with changing climate condition.

An example of mitigation finance is investment in alternative energy, such as a solar energy facility, which is associated with far fewer emissions than fossil fuels. Because the energy sector is a large part of mitigation, mitigation projects receive the lions share of climate finance. This is because energy sectors provide reasonable rates or return on investments and are associated with private economic interests (Buchner et al. 2017).

While investment in mitigation is warranted, adaptive measures have distinct tangible benefits to specific geographic locations and populations. An adaptation project typically is associated with the adjustment of development so that it could alleviate or minimize the physical climate change impacts associated with global emissions (Pillay et al. 2017). Adaptive projects can be structural in nature, such as sea walls and other coastal protection structures. They can also address social needs by bringing awareness to local communities about impending danger. Although mitigation efforts are successful at reducing greenhouse gases, warming and the subsequent impacts will remain for many years, thereby making adaptive projects and financial support for these projects necessary (Farber 2007).

Climate Adaptation Financial Flows

In the case of climate adaptation flows, data suggest that public contributions' far exceed private investment. DFIs are the largest contributors to climate finance in general, while climate funds consistently contribute a slightly larger share of their financial resources to adaptation in particular (Nakhooda et al. 2013; Schalatek et al. 2012). This trend is likely to continue with recent commitments by the GCF and other climate funds to provide greater support for adaptation (Pillay et al. 2017). It is important to note that domestic government budgets play a significant role in adaptation finance (e.g., domestic investment in infrastructure, government shares in utility operations); however, due to data limitations, several reports reviewing climate finance flows either know relatively little on the contributions among local government budgets (Buchner et al. 2017) or they choose to focus on the flow of funding from developed countries to developing countries (Gupta et al. 2014; Pillay et al. 2017). This focus is justified on the grounds that the distribution of climate change damage and the need for subsequent adaptation measures will be higher in developing countries which have limited capacities to address adaptation needs. For example, Bangladesh is much more vulnerable to sea level rise and has far fewer economic resources than Switzerland (Pillay et al. 2017). Furthermore, current mechanisms, such as the Paris agreement, hope to motivate the transfer of financial resources to the developing world are well underway.

With regard to where contributions are going geographically, most international public adaptation finance has primarily been directed to sub-Saharan Africa, East Asia, and the Pacific, followed by programs and activities in Latin America and the Caribbean (Schalatek et al. 2012). The top country recipients of adaptation financing have been Bangladesh, Niger, Cambodia, Mozambique, Nepal, and Zambia, all of which are PPCR recipient countries. However, some of the most vulnerable developing countries receive very little adaptation finance; these

include Somalia and Central African Republic as well as Small Island Development States (SIDS) (Pillay et al. 2017; Schalatek et al. 2012). Likewise, international private finance is currently concentrated in a small number of emerging economies and resource-rich developing countries instead of least developing countries.

There are a large variety of adaptation projects. The nature of adaptation projects vary with sectors. Primary adaptation sectors include coastal protection/infrastructure investment (e.g., sea walls), disaster risk management projects (e.g., early warning and response systems), and agriculture (e.g., new crop varieties and technologies). Chief among them is water/waste water management. Since 2013 over 50% of adaptation finance has gone toward this sector (Buchner et al. 2014, 2017). However, water infrastructure will likely be among the costliest adaptation needs in the future, and public sources will be insufficient to cover increasing cost associated with water adaptation (Fankhauser 2010). Therefore one emerging issue is how to scale up adaptation finance such that it can keep pace with future needs. Attracting greater levels of private investment for adaptation is one means of addressing future needs. However, there are many barriers to private investment in adaptation. The next section discusses the barriers facing private, as well as, public investment in adaptation. The Future Directions section discusses the role that public actors can play in attracting future private investment; these include risk transfer mechanisms (such as insurance and green bonds) (Torvanger et al. 2016).

Key Issues

Over 90% of all climate flows, public and private, are invested in mitigation, the majority of which went to the renewable energy sectors (e.g., solar and wind power) (Buchner et al. 2017). Therefore, one of the key issues facing adaptation is how to remove barriers in order to incentivize greater investment. More specifically, a number of seminal climate finance reports emphasize the role that public actors can play in further incentivizing private investment, since public budgets will often fall short of climate finance needs (Gupta et al. 2014; Pillay et al. 2017; Reichelt 2010; Trabacchi and Mazza 2015).

Because the benefits associated with public adaptation interventions are overwhelmingly geographically concentrated, international public actors have less incentive than domestic public actors to finance adaptation goods (Pillay et al. 2017). Take, for example, the development of a sea wall or the implementation of irrigation infrastructure. Benefits for both projects will be greatest for communities located closest to the project. International public actors' incentive to invest is further reduced by the uncertainty of climate change damages. Although developing countries, in general, are the most vulnerable to climate change, DFIs are unaware of specific regions and communities that will be impacted the most. This uncertainty reduces the benefits associated with preemptive investment in specific locations, since damage may ultimately not occur (Lecocq and Shalizi 2007). As a result, international public actors have greater incentive to sustain their unbalanced contributions toward mitigation, since reductions in GHG emissions are associated with global benefits. Likewise, national or subnational funding sources have the greatest incentive to invest in adaptation, since they benefit the most from such projects (Wilbanks and Sathaye 2007; Klinsky et al. 2012). However, domestic governments, particularly in developing countries, also face barriers to adaptation investment including a limited ability to finance and insufficient expertise to implement adaptation projects (Pillay et al. 2017).

Similar to international and domestic public investors, private investors face barriers as well, including low expected returns to adaptation investment. Many adaptation interventions are not revenue generating; instead they primarily prevent damage and save costs associated with future damage (Atteridge 2011; Christiansen et al. 2012; Pauw 2015). In addition to low or little returns, other key barriers to private investment include high upfront costs and long-term investment time frames (Berensmann and Lindenberg 2016; Trabacchi and Mazza 2015).

For example, rehabilitation and replacement of water supply infrastructure and expansion of water reservoirs involve a great deal of initial capital investment, furthermore financial return on investment usually many years beyond the initial investment in the project. In many instances, private investors, particularly smaller to medium private entities, may not have the financial capacity to cover high upfront costs, nor can they afford to wait for the long-term returns on such investments (Berensmann and Lindenberg 2016). Another barrier is private financial intermediaries, e.g., commercial banks, reluctant to lend to adaptation projects due to higher than perceived risk. This is particularly the case when financing nontraditional technologies with little to no previous track record, e.g., water-efficient technologies or stress-resilient plants.

In addition to the above financial barriers, there are a number of country-specific barriers. These include inefficient legal frameworks and investment environments. For example, political and institutional inefficiencies as well as a lack of prioritization among governments in southern Africa have hindered the implementation adaptation interventions among both public and private investors. Given the barriers facing adaptation investment, it is important that public actors sustain support by investing directly into adaptation projects and by using financial and nonfinancial tools to encourage private actors to invest in adaptation as well. Furthermore, there are adaptation projects that can bring significant commercial advantages to private investors (Oxfam 2009; GHK 2010; Baglee 2012; GIZ 2012).

Future Directions

Given the overwhelmingly public nature of adaptation, perhaps the best way forward is for public actors to use their resources to remove adaptive investment barriers and hence mobilize private resources in the future (Gupta et al. 2014; Merk et al. 2012; Pillay et al. 2017; Reichelt 2010). More specifically public actors can use financial instruments, such as green bonds and insurance, that will allow adaptation interventions to offer quicker and more predictable returns to adaptation investment, at an acceptable risk level (Pauw 2015).

It is important to note that one solution to lack of public and private investment toward adaptation is currently being addressed by climate funds that are specifically focused on encouraging additional investment in adaptation. The GCF, mentioned above, is a primary example. Similarly, the Adaptation Fund (AF) has supported adaptation projects specifically since 2009 (Nakhooda et al. 2011). However, climate funds, as well as DFIs, primarily distribute grants and loans which are sustained by public resources. However, diversifying key public actors' pool of resource to include private capital will ultimately make adaptation financing more sustainable.

Public actors, such as DFIs and climate funds, can issue green bonds to attract additional private revenue. Entities issue bonds when they need to raise money to finance new projects. A bond is a fixed income investment where investors loan money to entities for a fixed period of time and a specific purpose (Slack 2009). In the case of green bonds, the purpose pertains to projects that support adaptive infrastructure projects (Slack 2009). Green bonds are particularly attractive to private investors because the issuer promises to repay the loan amount and interests by a specific date regardless of returns on the project. If the issuer is a well-rated institution, which is often the case with international DFIs, private investors bear minimal risk. The World Bank is an example of a multilateral DFI that has issued green bonds for risky adaptation projects (e.g., infrastructure projects in least developed countries). However, there are greater opportunities for more DFIs, as well as other public entities (e.g., national and subnational governments), to issue green bonds. Currently, private investment demand for projects that are environmentally beneficial is greater than supply (Reichelt 2010); green bonds can address this gap while reducing risk to private investors and ensuring that returns to investment are reliable and returned within a specific time frame, thereby addressing all aforementioned barriers to private investment.

In addition to green bonds, insurance can also be a means of private sector involvement in adaptation. Insurance companies can provide protective services to adaptation project owners. Ultimately, insurance products will help them address potential losses due to climate variability and become more climates resilient. However, as it currently stands, while micro-insurance has shown promise, insurance use in general in developing countries is particularly low since premiums contribute to operating costs. Micro-insurance, on the other hand, is characterized by lower premiums and is typically directed toward agriculture protection. One example of effective micro-insurance began in 2005 when the Malawian government and the World Bank's Commodity Risk Management Group embarked on developing a drought micro-insurance product for smallholder farmers (Hess and Sykora 2005). The product was combined with a concessional loan in an effort to protect smallholder farmers from rainfall variability. The loan allowed farmers to invest in higher value-added products, while the higher yields from the improved farming practice helped them pay the micro-insurance premiums, which protected famers from lower crop yields during drier farming seasons.

Cross-References

- Adaptation (Wandera)
- Climate Change Adaptation (CCA) (Barinova and Roka)
- Climate Change Effects Natural and Human Systems (Frederik)
- Climate Change Impacts and Resilience (Garai and Nkue)
- Climate Change Planning (Down and Birchall)
- Climate Resilient Communities (Roka)
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