Climate finance for the most vulnerable: the role of vulnerability in Green Climate Fund (GCF) financing for adaptation

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Abstract

The serious effects of climate change are today well underway, with the most significant impacts affecting the most vulnerable communities and systems. Increasing levels of financing are needed, particularly in developing countries, to address climate change and more specifically to adapt to its consequences and move towards climate-resilient sustainable development. The newly established and largest international climate fund, the Green Climate Fund (GCF), plays a key role in channeling financing for adaptation to climate change in developing countries. Until now, most discussions have focused on where the necessary funding will come from, given the significant gap in finance for adaptation. However, it remains unclear to what extent vulnerability is being taken into consideration, potentially missing the opportunity to make a more effective difference for those who need it most. This study examines the role of vulnerability in GCF adaptation finance, using both quantitative and qualitative research designs. The correlational and content analyses point to the fact that while vulnerability (as defined by the Intergovernmental Panel on Climate Change) is rather well considered within the fund's adaptation projects, there is no relationship between the relative vulnerability level (as measured by two prominent indices) and the amount of adaptation finance that developing countries receive. This implies that further action should be taken to ensure that adaptation finance reaches those who need it most. Science and policy must be reconciled when it comes to the conceptualization of climate vulnerability. To this end, the GCF, supported by the UNFCCC, should further emphasize a more precise consideration of vulnerability and clarify its assessment against clear criteria. Indeed, the importance of effectively taking vulnerability into account extends to broader sustainable development, for which adaptation to climate change is a main factor.

Acronyms

AR4	Forth Assessment Report (from the IPCC)
AR5	Fifth Assessment Report (from the IPCC)
COP	Conference of the Parties
GCF	Green Climate Fund
GEF	Global Environmental Facility
GIZ	Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH
IDRC	International Development Research Centre
IPCC	Intergovernmental Panel on Climate Change
LDCs	Least Developed Countries
MDBs	Multilateral Development Banks
ND-GAIN	Notre Dame-Global Adaptation Index
OECD	Organisation for Economic Co-operation and Development
PPCR	Pilot Program for Climate Resilience
SCCF	Special Climate Change Fund
SDG	Sustainable Development Goal
SIDS	Small Island Developing States
UNCTAD	United Nations Conference on Trade and Development
UNFCCC	United Nations Framework Convention on Climate Change
UN	United Nations
V20	Vulnerable 20
WRI	World Risk Index

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First Chapter: Introduction

1.1 Context

1.1.1 Climate change

After voices from the scientific community started to warn the world about the harmful effects from human greenhouse gas emissions as early as in the late 19th century, it is now widely recognized that human-induced climate change is under way and its serious effects are being felt in all parts of the world. Undeniably, the average global temperature is rising at an alarming rate and the resulting climate-related disasters and events such as floods, droughts, severe storms and sea level rise illustrate the reality in which more and more people now live in. As a matter of fact, the ground-breaking 2018 Intergovernmental Panel on Climate Change (IPCC) report warns that the planet will reach the 1.5 degrees Celsius threshold above pre-industrial levels by as early as 2030 (IPCC, 2018), when it has been stressed that if the 1.5 degrees threshold is exceeded, a number of climate change impacts could not be avoided anymore. Communities in all parts of the world are increasingly in the need to build capacity to cope with this new normal.

1.1.2 Climate change vulnerability

The degree of vulnerability to the impacts of climate change varies among countries and communities. Vulnerability is a key factor that comes into play, as climate change is most harmful for communities in risk areas, who are the first victims in climate related disasters and impacts. Yet, climate vulnerability is a complex notion. According to the IPCC (2007), it is the result of three key dimensions, namely exposure ("nature and degree to which a system experiences environmental or socio-political stress"), sensitivity ("degree to which a system is modified or affected by perturbations") and adaptive capacity ("ability of a system to evolve in order to accommodate environmental hazards or policy change and to expand the range of variability with which it can cope") (Adger, 2006). These three factors are themselves shaped by broader social, economic, political and ecological conditions (Smit & Wandel, 2006), which must be well understood in order to design appropriate action that effectively reduces target communities' climate vulnerability. Vulnerability is also context and time specific – it

varies from one location and community to another, and as such, there is no formula that can be followed and applied: each case is different.

1.1.3 Climate finance

In response to the growing problems associated with climate change, the United Nations Framework Convention on Climate Change (UNFCCC) was formed as one of the three conventions resulting from the historic Earth Summit in 1992. The UNFCCC supports the global response to the threat of climate change and specific action for climate change mitigation and adaptation. Adaptation, defined as "the process of adjustment to actual or expected climate and its effects" (IPCC, 2014), is increasingly important particularly for developing countries where climate impacts are growing and most felt. Developing countries are indeed often suffering the most from the negative consequences of climate change "because of vulnerable geography and lesser ability to cope with damage from severe weather and rising sea levels" (Center for Global Development, 2019). By the same token, developing countries have contributed the least to climate change since developed countries emitted the most greenhouse gases unimpeded from the Industrial Revolution. "The historical concentration of industry and wealth in developed countries means that they are responsible for 79% of the emissions from 1850 to 2011" (Center for Global Development, 2019). History and current circumstances put developing communities in a situation in which they are most harmed by climate change, while they have contributed the least to it, and have the least capacity to cope with it.

In this context, developed countries have agreed, as part of the UNFCCC, to provide financial resources to support climate change efforts in developing countries (Article 4.3 of the UNFCCC). This is re-stipulated in Article 9 of the Paris Agreement[1]. This support is referred to as climate finance, representing climate investments in developing countries. The need for climate finance is significant given the magnitude of the problems associated with climate change that communities in developing countries face. Often, government funding is scarce, especially when combined with investment needs in other areas for development. In particular, the needs for adaptation finance are growing in

[1] Developed countries shall provide financial resources to assist developing countries "with respect to both mitigation and adaptation in continuation of their existing obligations under the Convention" (UNFCCC, 2015)

developing countries, while so far the majority of climate finance flows have been targeted at mitigation. In fact, in 2017, donor countries provided 13.3 billion for adaptation, compared to 52.4 billion for mitigation and 5.5 billion for cross-cutting activities (both mitigation and adaptation), (OECD, 2019).

1.1.4 Climate change and development

The linkages between climate change impacts and development are increasingly witnessed and recognized. Climate change threatens the development progress achieved in the last years and decades in many developing countries. “There is a growing recognition that poverty and the impacts of climate change are closely interconnected, e.g., impacting upon land availability (due to sea-level rise), water availability for rain-fed agriculture and reducing production in fisheries due to the emergence of new diseases and other factors” (Reed et al., 2013).

It is also important to highlight the close link between poverty and climate vulnerability. Their bidirectional relationship is one in which “climate change puts people at greater risk of becoming poor” (Asian Development Bank Institute, 2019) and in which poor people are most vulnerable to climate threats. This reveals the complicated web of links embedded in the notion of climate vulnerability and the close links to development challenges.

In 2015, UN member states agreed to implement the 2030 Agenda and the accompanying Sustainable Development Goals, representing “the blueprint to achieve a better and more sustainable future for all” (UN, 2019). Each of these goals and targets are set to be achieved by 2030, including Goal 13, which calls on the international community to “take urgent action to combat climate change and its impacts” (UN, 2019b).

1.2 Research objective

Given the insufficient provision of funding for adaptation, and the increasingly competing needs for it as more and more sectors and communities require investments to adapt to climate change, it becomes crucial to understand if adaptation finance is reaching those who need it most: the most vulnerable to climate change.

The Green Climate Fund (GCF), set to become the main channel for the provision of climate finance under the UNFCCC, has been approving projects since November 2015, giving now the opportunity to study its initial experience, specifically regarding the role that vulnerability plays for the allocation of adaptation finance, and the consideration of it within the so-far approved adaptation projects. Being the most important international climate fund, many developed countries channel increasing levels of climate financing through the GCF.

This research thus focuses on adaptation projects from the GCF, which aims to allocate half of its funding to adaptation projects. More specifically, it examines whether there is a correlation between allocated adaptation funding and climate vulnerability (including its three components as established by the scientific definition of vulnerability through the IPCC), at the country-level, and to what extent is vulnerability and each of its components considered as part of GCF adaptation projects.

1.3 Research questions and hypotheses

Therefore, this research seeks to answer:

- What role does climate change vulnerability have in adaptation finance within the Green Climate Fund (GCF), and what are the resulting broader climate finance and sustainable development implications?
- What role does exposure have in adaptation finance within the GCF, as part of the IPCC scientific conception of vulnerability, and what are the resulting broader climate finance and sustainable development implications?
- What role does sensitivity have in adaptation finance within the GCF, as part of the IPCC scientific conception of vulnerability, and what are the resulting broader climate finance and sustainable development implications?
- What role does adaptive capacity have in adaptation finance within the GCF, as part of the IPCC scientific conception of vulnerability, and what are the resulting broader climate finance and sustainable development implications?

- How correlated is the level of vulnerability, and its components of exposure, sensitivity and adaptive capacity, with the provision of adaptation finance within the GCF?

The four hypotheses being tested are:

H1: Climate change vulnerability is positively correlated with provision of climate adaptation finance within the GCF, with the vulnerability components of exposure, sensitivity and adaptive capacity being well considered and justified within the projects.

H2: Climate change vulnerability is not correlated with the provision of climate adaptation finance within the GCF, with the vulnerability components of exposure, sensitivity and adaptive capacity not being well considered and justified within the projects.

H3: Climate change vulnerability is not correlated with the provision of climate adaptation finance within the GCF, but the vulnerability components of exposure, sensitivity and adaptive capacity are well considered and justified within the projects.

H4: Climate change vulnerability is positively correlated with the provision of climate adaptation finance within the GCF, but the vulnerability components of exposure, sensitivity and adaptive capacity are not being well considered and justified within the projects.

1.4 Conceptual framework synopsis

The conceptual framework guiding this study has four main components which are all interconnected and must be considered hand-in-hand for a comprehensive view of the context in place. First, the main piece of the framework is the conception of vulnerability, as scientifically defined by the IPCC Forth Assessment Report (AR4), (2007) with the three main constituting components of exposure, sensitivity and adaptive capacity. Second, the notion of climate change adaptation also occupies an important place, as it in turn reduces climate vulnerability and is the target objective of all adaptation finance. The realization of adaptation itself depends on the provision of adaptation finance, subset of climate finance which is shaped by the broader UNFCCC international climate change policy and negotiations. Lastly, the UN Sustainable Development Agenda has inherent

links with climate adaptation, specifically for those who are most vulnerable to climate change.

1.5 Subject relevance and timing

Understanding to what extent vulnerability is being considered in currently funded adaptation projects will contribute to addressing issues of the broader context, in which the need for adaptation finance is increasing, potentially leading to competition for this type of funding. Climate-related disasters are indeed recurrent around the world, affecting more and more communities in numerous ways. In that context, the broad message that funding contributes to supporting most vulnerable communities persists, and this research will contribute to understanding the actual ways in which this is ensured for individual projects from the GCF. Moreover, research results are timely. In fact, current and future discussions around climate finance levels, access, distribution and effectiveness are amplifying, especially with developed countries' pledge to reach $100 billion in climate finance by 2020, which will soon be followed by a new global commitment. These amounts reveal that climate finance, and more specifically adaptation finance flows are becoming significant, when it remains unclear if they are making a real difference for the most vulnerable, who are most impacted by climate change. This research will also allow understanding the different interpretations of vulnerability from GCF projects, while also possibly identifying any gaps between the scientific conception of vulnerability and the practical use of the term, giving an idea of which elements of the scientific definition are prioritized by project design. Ultimately, a result of this research will be to identify ways in which vulnerability can be more effectively considered in GCF adaptation projects and in the allocation of adaptation finance, to successfully reach those who are most vulnerable to climate change.

Second Chapter: Literature review

There is a growing body of literature that relates to international climate finance, given its key role for international climate policy and more generally the increasing coverage of climate change. This chapter first presents the state of adaptation finance, the subset of climate finance that is pertinent to this study. Literature is then reviewed for the concept of climate change vulnerability for which research intends to capture and define key drivers. The third and final section of this chapter links the two preceding pieces, exploring literature related to vulnerability in the context of adaptation finance and the UNFCCC, to start providing insights to address this research's research objectives.

2.1 The state of adaptation finance

The increased frequency and magnitude of climate-related hazards in developing countries has been unmistakably driving up the cost of tackling climate change. Developed countries are urged to scale up climate finance levels in light of their international obligations. At the Copenhagen conference in 2009, developed countries committed to mobilizing jointly $100 billion per year by 2020 for climate action in developing countries (UNFCCC, 2019b). While investments are being made both for mitigation and adaptation, they remain far from sufficient, specifically for adaptation for which needs of developing countries outstrip the current supply by far. "In 2016, public finance for adaptation totaled $22 billion, just a fraction of the $140-300 billion per year that UN Environment estimates will be needed by 2030" (Chan & Amerasinghe, 2018). This investment gap is critical, all the more so when considering that adaptation is a priority for developing countries which no longer face the choice but to build resilience in face of climate repercussions that are already happening.

Several milestones in international climate change negotiations have raised adaptation finance as an important item on the agenda since the conception of the UNFCCC in 1992. In 2001, the Marrakesh Accords established three funds specific to adaptation: the Special Climate Change Fund (SCCF), the Least Developed Countries Fund (LDCF) and the Adaptation Fund (UNFCCC, 2001). Parties also established the GCF, today's most important international climate change fund, as a financial mechanism of the UNFCCC,

which committed to allocate half of its funding to adaptation. More recently, the 2015 Paris Agreement, considered as an historic accord, calls for a balance of climate finance between mitigation and adaptation (UNFCCC, 2019a), which comes in answer to the fact that the majority of investments tend to favour mitigation. The Agreement also emphasizes "GCF's role as a key provider of predictable financial resources in the post-2020 framework" (Climate Focus, 2016) and the importance of adaptation finance, on which however it remains relatively ambiguous. In fact, some critics speak of the need of more robust information on adaptation needs, costs, and finance "to guide and inform the successful implementation of the Paris Agreement" (Mostafa et al., 2016). On a more general note, as climate change worsens and countries are being pushed to their limits to meet the needs of their citizens, adaptation finance is raised as a critical debate within the UNFCCC (Mostafa et al., 2016).

Adaptation funding is delivered mainly through both multilateral and bilateral channels. On the multilateral side, the GCF is becoming a major source of adaptation finance, given the current pledge of $10.7 billion and its commitment to allocate half of its resources to adaptation. Out of the $5.6 billion committed to projects so far, $1.3 billion pertains to adaptation projects and over a billion dollars of funding is also dedicated to cross-cutting projects (which target both mitigation and adaptation activities), (Green Climate Fund, 2019b). Other multilateral funds, established years earlier to the GCF, also represent large sources of funding for adaptation. The $1.2 billion Pilot Program for Climate Resilience from the World Bank's Climate Investment Funds puts emphasis on supporting the world's most vulnerable countries and small islands. The Global Environment Facility manages the LDCF and the SCCF, which together amount to $1.7 billion of funding to date[2]. Ferreira (2017) argues that funding has lacked for both, which impacted SCCF's ability to fulfill its mandate and resulted in the LDCF to continuously lack "sufficient financial resources to cover the costs of the LDCs' requests for funds". Regarding the Adaptation Fund, $720 million have been committed since 2010 to climate adaptation and resilience activities (Adaptation Fund, 2019). Moreover, multilateral development banks (MDBs) also play an important role in adaptation finance flows. In

[2] Amounts pledged as of September 2018 (LDCF: $1.3 billion; SCCF: $352 million), (GEF, 2018).

2018, MDBs collectively committed $43,101 million in climate finance in developing and emerging economies, with $12,936 million or 30% for adaptation finance (Inter-American Development Bank, 2019). Although this funding is once again prioritising mitigation, it represents an increase in adaptation finance (compared to $7,352 million or 21% in 2017), (European Bank for Reconstruction and Development, 2017). In fact, recent analysis shows that overall, "the share of adaptation in multilateral climate finance increased from just over 20% ($3.1 billion) in 2013 to 27% ($7.4 billion) in 2017" (OECD, 2019) pointing to the fact that multilateral support for adaptation is on the rise and will continue to take an important place given the remaining investment gap.

Significant amounts of adaptation finance are also provided bilaterally. This type of support is delivered through the donor country's own development cooperation agency (i.e. Agence française de développement, United States Agency for International Development). In 2017, developed countries provided $5.6 billion in bilateral adaptation finance (OECD, 2019). Research discusses on several occasions that this support is largely drawn from public aid budgets, which points to "the clear synergies between adaptation and development" (Weiler, Klöck, & Dornan, 2018). Several donor countries recognize this and describe their aim to mainstream climate action into development assistance support, given the interrelation of the two.

2.2 Vulnerability

Vulnerability can be broadly understood as "the degree to which a system is susceptible to, and unable to cope with, adverse effects of climate change," (IPCC, 2007). The complexity behind what concretely drives climate vulnerability has led to various different conceptualizations and interpretations of the term. Throughout the literature, there are indeed competing terminologies of climate vulnerability. Still, some common characteristics emerge, the first being that vulnerability is dynamic, "often in a continuous state of flux" (Adger, 2006), as the factors that shape vulnerability including biophysical and social processes are themselves dynamic (Adger, 2006), (i.e. changes in social, economic, demographic and other factors). There also seems to be agreement on the fact that vulnerability is spatially variable, meaning that it is determined by local conditions in a way that makes it specific to the context. This is a key defining

phenomenon and is what makes vulnerability a complex notion – in fact, this brings to it a multitude of nuances and explains why it is challenging to have a one size fits all definition of vulnerability that can apply to specific local conditions. Vulnerability, as a multidimensional construct, can indeed not be captured by a single variable (Cutter & Finch, 2008).

The IPCC, as the key scientific body that informs the UNFCCC, has made important contributions to the conceptualization of climate vulnerability. In its Fourth Assessment Report (AR4), which became a key reference for discussions on climate vulnerability, three components of climate vulnerability are identified, namely exposure (to climate stimuli), sensitivity (of the system to these stimuli) and adaptive capacity (of the system to adapt to climate change), (GIZ & CCA RAI, 2014). While these three components are distinguishable from each other, they closely work together towards determining the degree of vulnerability. The approach of vulnerability from the IPCC AR4 "has gained wide acceptance notwithstanding a lack of precision in the meaning of the three components of vulnerability" (Muccione et al., 2017). In the more recent Fifth Assessment Report (AR5), the IPCC made a further contribution to the understanding of climate vulnerability by making "a clearer distinction between physical hazards and vulnerability, where vulnerability is solely driven by societal factors" (Muccione et al., 2017). In fact, the AR5 sets apart the exposure component from the conception of vulnerability, having them both as equally contributing factors to the level of climate risk, along with the direct physical impact from hazards. Figure 1 below (AdaptationCommunity.net, 2019) compares the two IPCC conceptualisations: the AR4 and the AR5, the later putting risk as the focus point. Vulnerability, shaped by sensitivity and adaptive capacity, is clearly identified as a contributor to climate risk (the likelihood of an adverse impact from climate events).

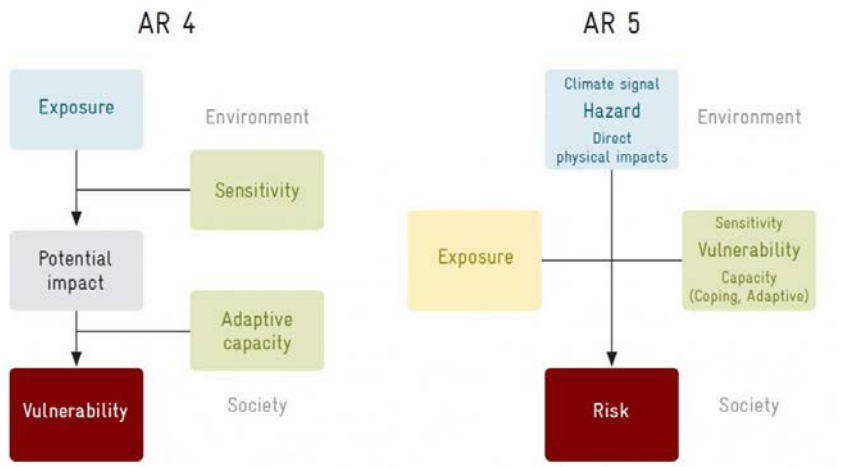

Figure 1: Comparison of the components of climate change vulnerability (IPCC AR4) and climate risk (IPCC AR5) (source: AdaptationCommunity.net)

Vulnerability can be applied to individuals and communities or to ecological systems which both experience the effects from climate change. A more comprehensive view of vulnerability, as understood for this study, is the vulnerability of social-ecological systems – "a bio-geo-physical unit and its associated social actors and institutions" (Glaser et al., 2012) - which recognizes the importance of the close nature-human relationship. In fact, human society is highly dependent upon the natural environment, but also human interventions have the capacity to destabilize natural cycles, as they often do. Humans are part of nature and there is a crucial relational aspect between the two: people's vulnerability is partly dependent on the vulnerability of the ecological systems they rely on.

2.2.1 Exposure

Social-ecological systems are increasingly exposed to climatic variations and the associated consequences. Exposure - the first component of vulnerability - refers to "the nature and degree to which a system experiences environmental or socio-political stress" (Adger, 2006). This exposure to environmental stress is often in the form of hazards such as "floods, droughts, deglaciation, sea level rise, increasing temperature, and frequency of heat waves" (Oppenheimer et al., 2014). Exposure could be further viewed as the presence of elements, such as population and economic resources, in an area in which hazard events may occur (Cardona et al., 2012). Exposure is an important determinant of climate vulnerability: in the last few years, more and more communities and systems

around the world are exposed to a series of slow-onset and sudden climate-related disasters. For example, the 2017 Atlantic hurricane season consisting of a series of storms including Harvey, Maria and Irma affected around 20 countries and territories (Internal Displacement Monitoring Centre, 2018), causing unprecedented amounts of damage. Thus, an increasing number of social-ecological systems are exposed to climate stimuli and the extent of their exposure is greater – with a likely increased frequency and intensity. Examples of some particularly exposed locations include regions where temperature levels are already high, areas that are already at or below sea level, or permafrost zones where there is a risk of crossing a temperature threshold.

2.2.2 Sensitivity

The occurrence of a hazard can affect a social-ecological system to a greater or a lesser degree, depending on how sensitive the system is to the specific hazard. This characteristic relates to the second component of vulnerability: sensitivity, which is also defined as "the degree a system is affected by climate stressors" (Muccione et al., 2017). In the ecological tradition of vulnerability research, "sensitivity denotes the degree to which a system is instantly effected by a perturbation" (Füssel, 2007), giving a good understanding of what it means for a social-ecological system to be more sensitive compared to another one. This can be illustrated by current realities. For example, the poorest countries and communities are often dependent on climate-sensitive sectors such as agriculture. As such, when a drought occurs, the negative impact for these communities is significantly greater than in a different context, making the country or community more sensitive to such hazards and accordingly more vulnerable. Equally, "sensitivity will be high where the system in question includes, for example, settlements built on flood plains, hill slopes or low-lying coastal areas" (Adger et al., 2003). If a disaster event occurs in this context, the impact will be greater due to the fragility of the settlements. Appropriate actions that can decrease sensitivity are in consequence the avoidance of construction in high-risk locations and the strengthening of existing systems (Adger et al., 2003). Given sensitivity's close connection to the exposure of a system, "exposure and sensitivity are almost inseparable properties of a system (or community)" (Smit & Wandel, 2006). In fact some critics mention that "the boundaries of the concept of exposure and sensitivity are often blurred and the role of the two cannot be easily

disentangled" (Muccione et al., 2017). One important distinction to keep in mind is that while sensitivity refers to internal biophysical factors (i.e. topography), exposure refers to external biophysical factors (i.e. tropical storms), (Füssel, 2007).

2.2.3 Adaptive capacity

While exposure and sensitivity represent the potential impact from climate change on the system, the ability of the system to cope with the consequences is referred to as adaptive capacity. Social-ecological systems have the inherent ability to adapt to changes. Throughout time, humans have indeed been outstandingly successful in overcoming change and dealing with nature to respond to their needs, but it seems that this capacity is now under threat of bigger climate change events. Today's societies and systems "need to learn to cope with the changes that are predicted — warmer temperatures, drier soils, changes in weather extremes and rising sea levels" (Adger et al., 2003). The capacity to adapt to climate change depends on the system's intrinsic qualities and abilities, such as its assets, networks and social capital which are needed to undertake effective adaptive strategies and react to potential disasters (Adger, 2006). The presence of capital assets such as "human, social, natural, physical, and financial capital" (Dulal et al., 2010) determines the level of adaptive capacity, and accordingly shapes the ability of a social-ecological system to face climate event impacts.

However, enhancing adaptive capacity is an elaborate process. The capacity to adapt can take time to develop, as the system goes through several stages of learning. For example, one critical factor for adaptive capacity is the institutions in place: institutions characterized by flexible collaboration and learning potential have greater adaptive capacity than rigid institutions which are less responsive to change, and yet the transformation process for institutions is lengthy and challenging. This reveals that building adaptive capacity goes much further than simply avoiding pertinent risks. In fact, there are greater considerations that explain the system's capacity to adapt, including rights to development and security (Adger et al., 2003). When climate events impact communities, human rights hold a substantial place as, for instance, communities which participate and enjoy economic, social, cultural and political development (that is, the right to development) are better equipped to deal with climate stressors. Adaptive

capacity determines how sensitivity evolves over time (Füssel, 2007), illustrating an additional link between the three vulnerability components.

2.2.4 The materialization of vulnerability

It is essential to understand how vulnerability has come to manifest itself in practice. Specific countries and groups of people are emerging and starting to get recognized as particularly vulnerable to climate change in pragmatic terms.

Least Developed Countries

Income is an important determinant of vulnerability as a lack of income translates into a lack of resources to be able to effectively cope with climate-related consequences. Some of the lowest income countries are part of the UN established group of countries: the Least Developed Countries (LDCs). LDCs are "deemed highly disadvantaged in their development process for structural, historical and geographical reasons" (UNCTAD, 2019). Their vulnerability to climate also stems from the fact that their economic growth is generally dependent on climate sensitive-sectors, such as agriculture, water and forestry. The lower income which leads to higher poverty also means that people are more likely to occupy marginal lands for farming, settle in flood-susceptible areas, or live with precarious access to health services or water (Adejuwon & Leary, 2012), which once again exacerbates vulnerability. LDCs also often lack certain main capacities such as human assets, which makes it very difficult for them to recover from climate events, and to effectively adapt to climate change. All of these factors have led to identifying LDCs as countries that are particularly vulnerable to climate change.

SIDS and costal zones

An additional group of countries often mentioned as being particularly vulnerable to climate change are Small Island Developing States (SIDS), due to their shared characteristics and climate projections that include sea level rise, limited physical size, relative isolation, or high susceptibility to frequent and intense tropical cyclones (UNFCCC, 2005). Climate change thus has significant effects on the economic prospects of SIDS but also on the communities' well-being.

In the same respect, costal zones, in SIDS but also around the world, are highly vulnerable to climate change due to sea level rise. Coasts have always been attractive areas for humans due to their rich ecosystems which provide valuable resources. Humans have also settled on coasts for centuries as a way to access the sea that became a gateway to other lands in an increasingly globalized world. This has led to more and more people settling on coasts around the world. Today, one main consequence from climate change is sea level rise and coastal erosion: "the wearing away of the land by the sea" (Internet Geography, 2019), an event that is already affecting several communities. Recent research finds that "190 million people will be living in areas that are projected to be below high-tide lines come 2100" (Amos, 2019), exemplifying why coastal communities and SIDS are considered as particularly vulnerable to climate impacts.

Specific regions

Research from the IPCC reveals that Asian and African regions are expected to be most exposed to climate hazards, projected to experience 85-95% of global exposure (IPCC, 2018). At a scenario in which the world reaches the threshold of 1.5°C, climate impacts are prevalent predominantly in South Asia (mostly Pakistan, India, and China). At higher levels of warming, impacts spread to sub-Saharan Africa, the Middle East, and East Asia (IPCC, 2018). Other assessments also come to similar conclusions, indicating that much of Africa and Southern regions of Asia "may be considered as most strongly affected by climate change" (Muccione et al., 2017).

In addition, the International Development Research Centre (IDRC) identifies three specific hotspots defined as "areas where strong physical and socio-ecological effects of climate change come together with large numbers of vulnerable and poor people and communities" (IDRC, 2018). The first hotspot are semi-arid regions of Africa and Asia, where research confirms that vulnerability to climate stresses and capacity to respond are due to a mix of social, economic and political factors, closely coupled with wider development challenges. Countries from these regions are, for example, Ghana, Kenya, Mali and India. The second hotspot are deltaic regions in Africa and Asia (Volta, Mahanadi and Ganga-Brahmaputra-Meghna delta). In these regions "while only a small proportion of households perceive environmental risks as the principal reason for

migration, perceptions of insecurity around livelihoods, caused by environmental factors, are directly link to observed migration behaviour" (IDRC, 2018). Lastly, three glaciated river basins—the Indus, the Ganges and the Brahmaputra in South Asia are also identified as highly vulnerable. In fact, "rising temperatures, seasonal shifts in glacier and snowmelt induced runoff, and increased frequency of extreme events in the mountains and floodplains are threatening the lives and livelihoods of over 1.5 billion people living in the region" (CARIAA, 2019). Communities living in these three regions are particularly vulnerable to climate change, for different and yet equally serious causes and contexts.

Vulnerable 20

In 2015, at the Climate Vulnerable Forum, 20 countries came together to form the group Vulnerable 20 (V20). The group was established to "serve as a new high-level mechanism for dialogue and action to concentrate attention on economic and financial responses to climate change through the dedicated cooperative efforts of economies systemically vulnerable to this global phenomenon" (V20, 2019). This group of nations includes low-and middle-income, least developed, arid, isthmus, landlocked, mountainous, and small island developing countries from Africa, Asia, the Caribbean, Latin America, and the Pacific (V20, 2019).

Social and economic characteristics

In addition to certain regions and groups of countries having higher levels of vulnerability to climate, some characteristics at the community and individual level also affect the level of vulnerability. First, gender is increasingly recognized as an important variable in climate vulnerability: depletion of natural resources and extreme climate events place additional burdens on women's health and income-generating activities. For example, a recent study established a link between climate change and a high rate of miscarriages in Bangladesh. The increased amount of salt that women drink (due to climate change) causes several health risks, including hypertension, risk of strokes but also miscarriages among pregnant women (BBC News, 2018). Second, climate vulnerability is also higher for the elderly because of factors such as physical limitation, declining cognitive abilities to process hazard information, and fewer economic resources

to repair damaged homes (Cutter & Finch, 2008). Thirdly, in a similar reasoning as for the LDCs discussed above, the poorest people and communities (in low income countries, but also elsewhere) naturally have the least means to cope with the consequences from climate change, making them highly vulnerable to it. Some poor communities also depend on climate-sensitive sectors and livelihoods such as agriculture and are also often the first affected by climate effects on drinking water and health. Research also points to other social groups as being more susceptible to experience higher climate vulnerability, such as indigenous people, children, and people and ecosystems in the Artic, showing that vulnerability is high for a number of social groups and therefore it is an issue that must be tackled straightaway.

2.3 Vulnerability within the UNFCCC adaptation finance context

Directing adaptation finance to the most vulnerable countries and the most vulnerable people remains an imperative (Climate Funds Update, 2018) in a context in which the more vulnerable a country is, the higher is its need for adaptation. Linking vulnerability with financial support is not a new concept as it is somewhat acknowledged as part of the Convention, the Kyoto Protocol and the Paris Agreement – the main guides for supporting the global response to the threat of climate change.

First, the Climate Convention (UNFCCC) itself makes explicit references to vulnerability. Article 4.4 commits developed countries "to assist developing countries that are particularly vulnerable to the adverse effects of climate change in meeting costs of adaptation to those adverse effects" (UN, 1992). While there is no particular indication of which countries are to be considered as particularly vulnerable to climate change, the UNFCCC preamble also reads: "recognizing further that low-lying and other small island countries, countries with low-lying coastal, arid and semiarid areas or areas liable to floods, drought and desertification, and developing countries with fragile mountainous ecosystems are particularly vulnerable to the adverse effects of climate change" (UN, 1992). Reflecting on this characterizations of vulnerability, it should be pointed out that this conception can be applied to a multitude of countries and communities and it "leaves room for interpretation regarding its meaning" (Horstmann, 2011). This issue is confirmed by Harmeling and Kaloga, who point out that "this UNFCCC definition, […]

is so broad that every developing country can find itself covered (2011). As a consequence, it is up to the specific financing mechanism itself to further specify how they apply the vulnerability lens in their funding and approach.

The most recent Agreement, in Paris, also makes mention of vulnerability on several occasions. For instance, it is mentioned in the context of effective adaptation action (Article7/Par. 5): "Parties acknowledge that adaptation action should follow a country-driven, gender responsive, participatory and fully transparent approach, taking into consideration vulnerable groups, communities and ecosystems, […]" (UNFCCC, 2015). However, once again, despite making reference to "those that are particularly vulnerable to the adverse effects of climate change", it does not give specific elements for the identification of the most vulnerable groups or countries, other than pointing to SIDS and LDCs as an example of those particularly vulnerable.

Today, the donor community proclaims that climate finance is supporting the most vulnerable in their efforts to respond to climate change. Considering that the UNFCCC has remained ambiguous in its definition of vulnerability so far, several authors have looked into how vulnerability has been more precisely defined and applied within adaptation finance.

2.3.1 GCF

Established in 2010, the GCF represents what promises to become the most important institutional mechanism for administering climate finance (Vanderheiden, 2015), including adaptation finance. The fund is an operating entity of the Financial Mechanism of the UNFCCC and started approving projects in November 2015, which makes it still a relatively new fund. It has its own governing instrument "with an independent Secretariat and a 24-member Board staffed by representatives of developed and developing countries to oversee its operation" (Vanderheiden, 2015). The GCF operates under the guidance of the COP, including on criteria that relates to eligibility and allocation of funds (Ferreira, 2017). Its main priority regions are LDCs, SIDS and African countries, for which the majority of the adaptation funding is dedicated as a way to support most vulnerable regions. In addition, the fund's main goal makes a clear reference to vulnerability, in

regards to “taking into account the needs of nations that are particularly vulnerable to climate change impacts” (Green Climate Fund, 2019a), which indicates that there should be an existing consideration of vulnerability for GCF projects.

It is up to the project proponents to articulate how the project is addressing specific vulnerabilities through the proposed activities. In their preparation of a climate rationale, project proponents should “clarify the causal connections between the proposed activity and the context-specific climate risks, impacts and vulnerabilities” (Church & Hammill, 2019). This rationale should provide information that includes details on vulnerability and risk assessments (Church & Hammill, 2019). Recently, the GCF has established a three-step recommendation to support the articulation of the climate rationale. The first two steps concern vulnerability. More specifically, the GCF recommends “identifying the anticipated climate changes and their impacts and vulnerabilities on affected populations” and “clearly articulating how the proposed activities address these impacts and vulnerabilities” (Church & Hammill, 2019). While helping to put forward the importance of vulnerability for the projects, this guidance only came in 2018, when several projects were already approved. Moreover, it can be observed that there are still no clear criteria chosen to evaluate the extent to which vulnerability is being well justified and considered by project proponents. Accordingly, recent research argues that the GCF “should incorporate an objective income criterion to guide the equitable allocation of adaptation finance among diverse developing countries” (Ferreira, 2017), in addition to the vulnerability criterion, due to its limitations of broadness and subjectivity.

In the same vein, some critics have emerged regarding GCF’s approach to allocating funding to the poorest and most vulnerable. First, in order to access funding from the GCF, organizations have to get accredited by the Board, but the accreditation is only granted once particular standards are met. While this practice is sound to ensure that the received funding is well managed, “not many national organizations – particularly in the developing world – have the organizational capacity to meet the requirements” (Mostafa et al., 2016), resulting in capacity being prioritized over vulnerability for the allocation of adaptation funds. Second, the requirement to provide co-financing can be seen as a barrier for the poorest countries in accessing funding (Mattar, Kansuk, & Jafry, 2019). In

fact, the ability to provide co-financing is limited by factors such as weak institutions and limited expertise, and yet not being able to provide co-financing decreases countries' chances in obtaining financing, when it is those exact limitations that make countries vulnerable to climate change (Mattar et al., 2019).

Finally, a broader concern relates to the fact that the GCF seems to be moving away from the UNFCCC principles and processes, especially the principle of common but differentiated responsibilities[3], which can serve as a basis for assigning national financial amounts to be contributed to the GCF and thus ensuring it is fairly sustained for the long run (Vanderheiden, 2015). Instead, the GCF currently relies on voluntary contributions, which do not provide guaranteed levels of financial support and in consequence threaten GCF's important role of supporting vulnerable countries and communities for the years and decades to come.

2.3.2 Other adaptation finance flows

While this study focuses on the GCF, it is important to understand the literature around the consideration of vulnerability in the allocation of the rest of adaptation finance, especially given that the GCF is relatively new and that it is itself shaped by earlier financing mechanisms. Overall, there are some contradictory findings, with some indicating that vulnerability is taken into account to a certain extent in the allocation of adaptation finance, while others find that there is no relation between the two. However, a broader summary is that vulnerability is not a decision factor in the allocation of adaptation finance, and when there is a connection between the two, it is limited to the exposure to climate risk while not taking into consideration the lack of adaptive capacity, even though this is the source of underlying vulnerabilities to climate.

First, looking at both multilateral and bilateral flows, a first analysis examines the fast-start financing period[4] (2010-2012) which was a considerable milestone for the delivery of climate and adaptation finance. Lessons learned from this period indicate that finance for "adaptation has not been highly correlated with recipient countries' vulnerability as

[3] All states are responsible for addressing climate change yet not equally responsible of it (Encyclopaedia Britannica, 2019)
[4] Donors' collective agreement to provide $30 billion in climate finance for the period 2010-2012

measured by prominent indices" (Nakhooda et al., 2013). Similarly, research from the Stockholm Environment Institute "highlights an apparent disconnect between high levels of vulnerability to climate change and the allocation of adaptation finance by both bilateral and multilateral donors" (Saunders, 2019), the former being however more responsive to vulnerability than the later (Saunders, 2019).

The lack of connection between vulnerability and bilateral adaptation finance is also confirmed by analysis looking at adaptation-related ODA in 2013, for which "just 9% […] targeted countries with the highest levels (the upper quartile of countries) of vulnerability to climate change" (Strawson et al., 2015). Yet, bilateral finance is how the majority of adaptation finance is being delivered. On the other hand, additional findings point to a different direction : Betzold and Weiler reveal that countries that are more exposed to climate risks receive more bilateral adaptation aid, meaning that donors take into account the physical aspect of vulnerability (2017). Similarly, Weiler et al. (2018) conclude that vulnerability is partly taken into account, as part of the analysis of bilateral adaptation aid from 2010 through 2015: while physical vulnerability seems to be a criterion for adaptation aid allocation, adaptive capacity on the other hand is not.

Numerous authors also discuss vulnerability for the Adaptation Fund. The justification of vulnerability is done by project proponents in project proposals, but the "definition of vulnerability remains broad and currently does not allow for a prioritization in the allocation of funds" (Horstmann, 2011). This is confirmed by analysis looking at 39 adaptation funding project proposals from 2011, which concludes that "patterns are clearly in contradiction with the final goal of the Adaptation Fund Board to mainly support countries that are particularly vulnerable to climate change" (Stadelmann, Persson, Ratajczak-Juszko, & Michaelowa, 2014). It is stipulated that this could be due to the fact that vulnerable countries "may have less capacity to develop advanced project proposals" (Stadelmann et al., 2014). Persson and Remling also support these findings through their own analysis of 48 project proposals submitted in June 2012: "the Adaptation Fund Board has not prioritized countries from the most vulnerable quartile and indeed has approved relatively more countries from the least vulnerable quartile" (2014). These results are slightly nuanced by an additional analysis of 27 project

proposals which shows that although there is little evidence for a prioritization of most vulnerable countries and communities, proposals tend to focus on the vulnerability components of exposure and sensitivity, rather than the lack of adaptive capacity which concerns underlying causes of vulnerability (Remling & Persson, 2015). This exemplifies "the focus on projected climate impacts rather than on non-climate conditions"(Remling & Persson, 2015), which could lead to maladaptation given that deeper vulnerabilities to climate remain unaddressed.

Third Chapter: Methods

Both quantitative and qualitative research designs are employed to achieve the goals of this study. The guiding piece which is the conceptual framework brings together the three main components of climate vulnerability[5], with the broader implicative elements from the climate finance landscape and the links to sustainable development. The analysis covers approved adaptation projects so far by the GCF Board, representing a total of 55 projects (as of November 2019). Projects will continue being regularly approved.

The regional distribution of all 55 adaptation projects can be seen in Figure 2 below. All 55 projects are considered in the quantitative analysis, while 20 projects are selected for the qualitative analysis, based on the same distribution from Figure 2, to have a sample that is representative of the bigger context (see Figure 3). In fact, when rounding up the percentages from Figure 2, we obtain for the qualitative analysis 10 projects from Africa (50% of the 20), 8 from the Asia-Pacific (40% of the 20), and 2 from Latin America and the Caribbean (10% of the 20), (see Annex for full list of project names and numbers).

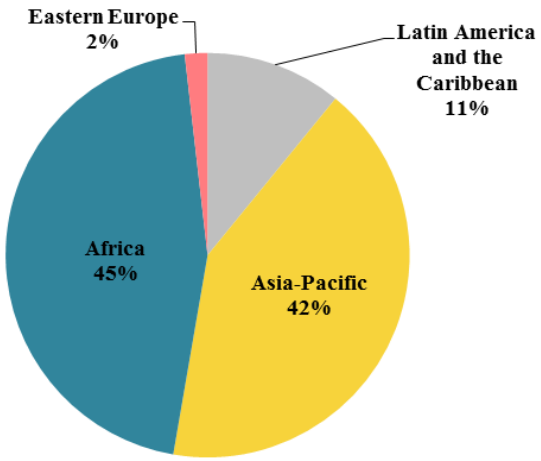

Figure 2: Regional distribution of GCF adaptation projects (based on the number of projects)

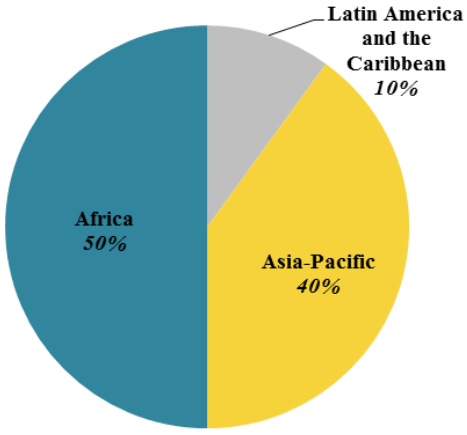

Figure 3: Regional distribution of the 20 projects of the qualitative analysis

[5] From the IPCC Forth Assessment Report (2007).

3.1 Conceptual framework

3.1.1 Vulnerability

The conceptual framework of this research has the three components of climate vulnerability[5] (exposure, sensitivity and adaptive capacity) as the core elements guiding the analysis (see Figure 4). When considered together, exposure and sensitivity represent the potential climate impacts on ecosystems, communities or countries. Vulnerability is itself strongly tied to climate change adaptation: a higher degree of adaptation increases adaptive capacity and can reduce the potential impacts from climate change.

3.1.2 Climate finance

Taking action for climate adaptation depends in turn, usually, on the funding available for it, and therefore on the conditions and the context surrounding climate finance (and its subset adaptation finance). This is specified by the UNFCCC and the Paris Agreement, for example, but also by the ongoing climate negotiations that make the climate finance landscape continuously evolving. The GCF as an operating entity of the Financing Mechanism of the UNFCCC is also strongly influenced by the politics related to international climate change.

3.1.3 SDGs

The UNFCCC is itself regulated by the UN, whose broader goals of sustainable development are at the center of its activities. These include SDG goal 13 that is specific to climate change. It is also well acknowledged by the 2030 Sustainable Development Agenda that action on climate change will also contribute to most of all other SDGs given the strong links between climate and development. When taking a look at the broader context that shapes each of these elements and that establishes various linkages, adaptation finance ends up being closely connected to climate vulnerability.

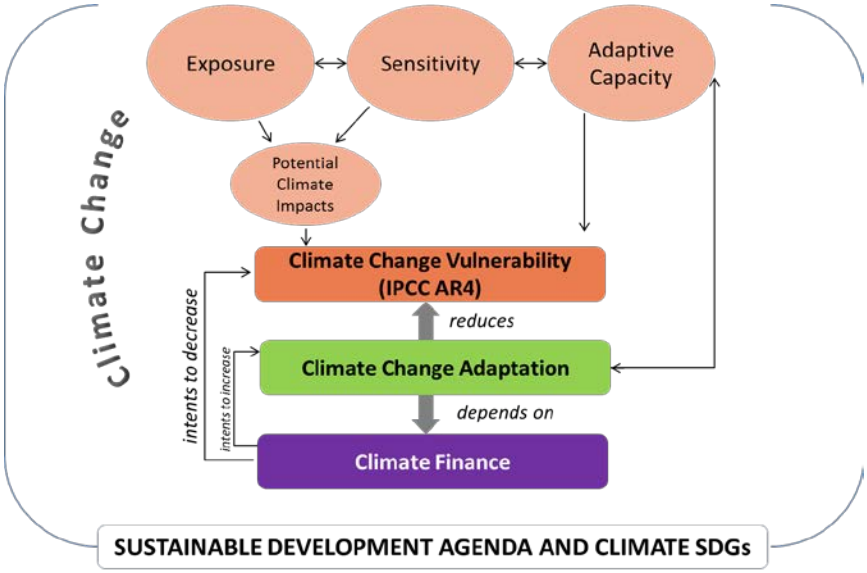

Figure 4: Conceptual framework of the study

3.2 Quantitative design: correlation analysis

The first part of this study's analysis is a quantitative research design, and more specifically a correlation analysis, which is often used to examine the degree to which two variables are related (Lunenburg & Irby, 2008). It allows understanding the strength of the relationship between the two variables, using available statistical data. Often, statistical software is used to determine whether a relationship is present, strong, or weak. In this study, the relationship between vulnerability and adaptation funding received from the GCF at the country level is explored, using Excel's Data Analysis ToolPak.

3.2.1 Data collection

Data for the correlation analysis comes from secondary sources. Information on each project is available on the GCF public website. It includes specifics such as project name, project number, priority area, beneficiary countries, amount of financing from the GCF and financial instrument. The available information allowed determining how much adaptation finance each country is receiving from the GCF. By the time this research was conducted, the GCF had so far approved $1.3 billion for 55 adaptation projects overall, out of a total of $5.6 billion for 124 projects (Green Climate Fund, 2019b).

As a first step, absolute amounts of adaptation funding per country were estimated. Where a project targets several countries, per country funding was estimated by dividing

total funding by the number of beneficiary countries. Then, adaptation funding per capita was calculated for each country. In fact, per capita funding allows to better compare the data across countries since the impact of funding varies with population size (it can be assumed that the impact of the same amount of funding will be greater in a country with 150,000 people than in a country of 120 million people). Per capita adaptation funding was determined by simply dividing absolute adaptation funding by the country population size in 2018, using information from the World Bank.

Several indices attempt to measure climate vulnerability at the country-level to facilitate country-to-country comparisons, and to address the difficulty in identifying countries that are most vulnerable to climate change given the complex nature of vulnerability as seen previously in Chapter Two. Out of the several available vulnerability indices relevant to adaptation, two are selected for this study. Their data is free and accessible on their websites.

One of the most recurrent indices for climate vulnerability is the Notre Dame-Global Adaptation Index (ND-GAIN), which "shows a country's current vulnerability to climate disruptions" (Chen et al., 2015). ND-GAIN assesses vulnerability using "six life-supporting sectors: food, water, health, ecosystem services, human habitat and infrastructure" (Chen et al., 2015) which are represented by six indicators that represent three cross-cutting components" (exposure, sensitivity and adaptive capacity), (Chen et al., 2015). Each of the three components are further defined in the "*Country Index Technical Report"*, and the definitions suggest consistency with the IPCC AR4's conception of vulnerability (see Annex I). In fact, ND-GAIN uses IPCC's AR4 framework on vulnerability, as confirmed by a recent report from the Food and Agriculture Organization of the United Nations (Jacobs & Al-Azar, 2019). The conception of vulnerability from IPCC's AR4 is the one that serves as the guiding piece of this study's conceptual framework. As such, the selection of this index ties in appropriately with the other parameters of this study. Several recent scientific publications have used ND-GAIN as part of their research, which brings some validation to the index's methodology. For example, Betzold and Weiler used this index in the book "*Development Aid and Adaptation to Climate Change in Developing Countries*" (2018).

The index was also used for analysis in "*A global assessment of adaptation investment from the perspectives of equity and efficiency*" (Chen et al., 2018) and in "*Climate Vulnerability and Human Migration in Global Perspective*" (Grecequet et al., 2017). ND-GAIN allows users to separately download data for each of the sub-indices of interest for this research: exposure, sensitivity and adaptive capacity. Values range from 0 to 1, with higher values indicative of higher vulnerability levels.

The second selected index for this analysis is the World Risk Index (WRI) 2019, developed by Bündnis Entwicklung Hilft in cooperation with the United Nations University, indicating the disaster risk for 180 countries in the world. This index gives information on countries' exposure, susceptibility, coping capacities and adaptive capacities. Information on vulnerability is determined from the last three components (see Annex I for further information). The WRI goes in the direction of climate vulnerability as described in the IPCC AR5, which "puts more emphasis on the concepts of risk and resilience, placing vulnerability next to hazards and exposure as a defining category" (GIZ, 2017). WRI's information on vulnerability consists of the same three components as in the AR5 (susceptibility, adaptive and coping capacity), and together with exposure to natural hazards, as a separate indicator, the level of risk is estimated. In addition, "the index has first been developed for geological and hydro-meteorological hazards but has now been extended to a version that captures solely climate-related hazards and slow-onset events, excluding geological hazards" (Muccione et al., 2017). The use of this index brings the variety needed for this study to be more comprehensive, with one index being more reflective of the conception of vulnerability from the IPCC AR4, while the second index fits better with the conception of vulnerability from the IPCC AR5. Thirdly, the WRI has also been used in peer-reviewed publications. For example, it was used by Muccione et al., for "*Differentiating regions for adaptation finance: the role of global vulnerability and risk distributions*" (2017). The WRI supports the elaboration of the annual WorldRiskReport, which describes a priority topic and case studies to better inform on the implications of risk levels for more practical uses. Higher values of the index represent a higher degree of the indicators' strength.

3.2.2 Data analysis

Dependent and independent variables

Correlation analysis is conducted using a dependent and independent variable. In this study, the independent variable is the level of vulnerability as reported by the respective index or sub-index (ND-GAIN and WRI). The dependent variable is the logarithm transformation of per capita adaptation funding per country from the GCF, in US dollars. In fact, after estimating per capita adaptation funding for each country, this data was carefully observed and showed some extreme values. For example, the top recipient country of Tuvalu has a per capita adaptation funding of $3,167, while the median for all countries is of $1.4. It is important to look into extreme values because "correlation coefficients can be substantially affected by a few deviant observations" (Treiman, 2009). It can be observed that all high extreme values concern SIDS (the top 10 recipient countries of per capita adaptation funding are SIDS). This can be explained by the small-country-bias, the idea behind which countries with lower population size tend to receive more per capita allocation of development assistance. As these extreme values are reflective of the reality, it is important to keep them for the analysis. However, they can have a significant influence on the analysis' results, as suggested by Treiman above. As such, the winsorizing technique is used in this study, to mitigate the effect of most extreme values on the analysis. In practice, winsorizing means that the values of the most extreme observations are replaced with the value of the next highest data point. 5% of the observations are winsorized (3 out of 52 observations), as at this level the data is not affecting accuracy. Winsorizing helps reducing the skew of the dependent variable data, but it can be observed that the data remains with a high positive skew due to the extreme values that remain for some of the rest of the observations (for all observations, the mean is of $44 while the median is of $1.43). We therefore replace the dependent variable by its logarithm, which is a type of transformation used to reduce positive skewness (Boston College, 2019). Using the logarithm transformation allows to tame outliers by pulling in the high numbers, in addition to making patterns more visible (Lane, 2019).

Statistical software

Excel, and more specifically its Data Analysis ToolPak, is used to organize and analyse the data. First, data is collected and organized using some fundamental Excel functions

that facilitated the initial work on the data set. For example, the function 'log' allowed to easily transform the dependent variable in its logarithm, and the possibility to generate scatterplots was a useful tool to visualize the data and get a sense of any discernible relationship. Then, the Analysis ToolPak allowed generating summary statistics for a set of data, including correlation coefficients and significance levels which are needed for this study.

Correlation measure

For each index and sub-index, the correlation coefficient (r) is computed to provide information on the existence of a potential relationship, its direction (positive or negative) and its strength. r ranges from -1 to +1, with +1 representing a perfect positive relationship, meaning that as one variable increases in value, so does the other. A value of 0 means that there is no relationship between the two variables. As next step, the probability that the observed correlation occurred by chance must be evaluated, by conducting a significance test. The common significance level of 0.05 is selected (the odds that the correlation is a chance occurrence is no more than 5 out of 100). The ANOVA table generated by Excel shows the p-value, which to be statistically significant should be equal or less than 0.05. It is also possible to note if there is statistical significance of the correlation by looking at the table "*probability levels of the correlation coefficient*", in which one can see the minimal value that the correlation coefficient should be to be statistically significant, depending on the total number of observations (see Figure 5). It should be noted that two-tailed probabilities are used for this study because there is no strong prior theory to suggest whether the relationship between vulnerability and adaptation funding would be positive or negative.

One-Tailed Probabilities[a]

N	.05	.025	.01	.005	.0005
5	.80	.88	.93	.96	.99
6	.73	.81	.88	.92	.97
7	.67	.75	.83	.87	.95
8	.62	.71	.79	.83	.93
9	.58	.67	.75	.80	.90
10	.55	.63	.71	.77	.87
11	.52	.60	.69	.73	.85
12	.50	.58	.66	.71	.82
13	.48	.55	.63	.68	.80
14	.46	.53	.61	.66	.78
15	.44	.51	.59	.64	.76
16	.43	.50	.57	.62	.74
17	.41	.48	.56	.61	.73
18	.40	.47	.54	.59	.71
19	.39	.46	.53	.57	.69
20	.38	.44	.52	.56	.68
22	.36	.42	.49	.54	.65
24	.34	.40	.47	.51	.63
26	.33	.39	.45	.50	.61
28	.32	.37	.44	.48	.59
30	.31	.36	.42	.46	.57
40	.26	.31	.37	.40	.50
50	.23	.28	.33	.36	.45
60	.21	.25	.30	.33	.41
80	.19	.22	.26	.29	.36
100	.17	.20	.23	.26	.32
250	.10	.12	.15	.16	.21
500	.07	.09	.10	.11	.15
1000	.05	.06	.07	.08	.10

[a]One-tailed means the probability of a specific plus or minus correlation or greater. For the probability of an absolute correlation or greater, double the one-tailed probability.

N = number of cases. For partial correlation holding k variables constant, use N = N* − k, where N* is the number of cases for partial correlations.

Figure 5: Probability levels for the correlation coefficient ("Statistical significance of correlations," 2019)

3.3 Qualitative design: content analysis

The second part of this analysis is a qualitative research design. Content analysis can be "used to determine the presence of certain words or concepts within texts or sets of texts" (Colorado State University, 2004). In this study, content analysis allows determining the presence of factors that relate to climate vulnerability and more specifically to its components of exposure, sensitivity and adaptive capacity, as defined in this study's conceptual framework, in 20 adaptation projects from the GCF. Specifically, this allowed evaluating the consideration of each of the three components in the projects' documents.

3.3.1 Data collection

The GCF makes publicly available all project proposal documents, which contain comprehensive information on each project, including on the context of the target region and/or country and the beneficiary communities and systems. The content of 20 project

proposals was examined (36% of all GCF adaptation projects). For this study, a coding frame supported the content analysis. Coding is necessary to help identify relevant text segments and classify them accordingly. The grouping of elements under each code allows observing patterns and point toward certain interferences.

First, text was reviewed using a deductive coding approach (Drisko & Maschi, 2015), meaning that text was selected and categorised through the use of predetermined framework (top-down approach), which is in this case the IPCC definition of vulnerability from its AR4. Thus, the three vulnerability components (exposure, sensitivity and adaptive capacity) were the three categories, for which relevant text segments were identified. For example, for project proposal 004 (project: Climate-Resilient Infrastructure Mainstreaming in Bangladesh), one section reads:

> "Moreover, existing infrastructure in Bangladesh remains vulnerable to the impacts of climate change: Prolonged heat waves and intense precipitation put road pavements under stress and overload urban drainage systems; more severe tidal surges and floods may erode road bases and bridge supports; higher wind speeds of storms and cyclones impact on building structures – just to mention a few of them." (GCF, 2015).

Using the three codes of exposure, sensitivity and adaptive capacity, the following data was collected from the text above.

Exposure	Sensitivity	Adaptive capacity
- Prolonged heat waves - Intense precipitation - Floods - Tidal surges - Storms and cyclones	- Road pavements under stress, drainage systems overloaded, building structures impacted	- Infrastructure vulnerable to climate change

Second, as segments under each of these categories are being identified from several project documents, sub-themes start emerging as well, and this allows using the inductive approach (bottom-up) to establish a set of sub-codes for each of the three main categories. For example, for the same example above, some sub-codes that are emerging are:

- Exposure: temperature increase; precipitation; flooding; extreme weather events
- Sensitivity: fragile structures and systems
- Adaptive capacity: physical capital (i.e. infrastructure)

The choice of a sub-category is reinforced as more project documents refer to the same kind of themes under each main category. Sub-codes were evaluated, modified, and added throughout the research process. In fact, flexibility is important to be able to revise the sub-codes as needed, in order to end up with sub-codes that are most representative of the examined data.

3.3.2 Data analysis

Once information was scanned for the 20 projects, the result was a summary table with the three main codes as columns (‘exposure to’; ‘sensitivity’; and ‘adaptive capacity’), and associated rows of the respective project name and number. The summary table allowed reviewing result information and finalizing the sub-themes by regrouping all the different text segments together through a color scheme. In addition, throughout the coding process, it is important to have a justifiable and consistent coding system. As such, once the data was collected, the summary table was reviewed, to ensure segments fitted the definition of each of the main codes. Each sub-code was also defined in order to delimit with more precision which elements do fit in it, and which have a less evident fit.

Then, a separate table was made to indicate the presence of each of the sub-themes for each project (see Annex III). This process allowed identifying most recurrent sub-themes for each of the three main categories, as well as the less common vulnerability factors taken into consideration. Special attention was also given to the presence of any patterns, or on the contrary, to the presence of differing interpretations of vulnerability. Other questions that arise is whether some project documents better discuss vulnerability considerations compared to others, and if there is one component that stands out among the three in the project documents. Overall, the aim of this part of the research was to establish the apparent linkages between the various codes to arrive at main themes and conclusions.

It is important to highlight that data analysis of the qualitative research design results was done jointly with the analysis of the quantitative research design, as these two parts come together as one and should ultimately complement each other to better answer this study's research questions.

3.4 Limitations

There are a few important limitations to keep in mind for the results from both the quantitative and qualitative analysis. First, the correlation analysis examines vulnerability only at the country level, while it has been established that the level of vulnerability varies within each country as well. For example, "some effects will impact only a certain area in a given country, while others will have the same impact in the neighboring countries of a particular region" (Closset, Feindouno, Guillaumont, & Simonet, 2017). Noting this limitation, it can still be argued that using countries as a unit of analysis is appropriate in the UNFCCC and broader climate finance context because individual countries are Parties to the UNFCCC, and the allocation of funding often targets individual countries as well. Second, the use of the two indices of vulnerability also comes with a few limitations for each of their respective methodologies. For example, ND-GAIN does not have data available for all the countries needed in this study. Missing data is often limited to 2-3 countries depending on the sub-index but it results in the country being excluded from the analysis. More generally speaking, there are many normative, conceptual and methodological assumptions for the design of a vulnerability index (GIZ, 2017). "It becomes obvious that no single index can capture the multiple dimensions of vulnerability completely, but can only provide a preliminary assessment" (GIZ, 2017). Regarding the examined GCF project proposals, while the GCF makes publically available all project proposals that it has retained, it does not provide information on which proposals were not selected for funding, and therefore this does not allow for a comparison between the two. On that account, this study was conducted once there were a significant amount of adaptation projects approved, to allow for a reasonably diverse sample to support this research. Lastly, GCF project documents can range from approximately 60 to 110 pages each, which limited the opportunity to go back to them and review all sections for the purposes of confirming that all relevant segments were

coded. The review process therefore focused on the segments that were originally coded from the first round of reading.

Forth Chapter: Results

Results from the qualitative analysis of the 20 selected projects show that overall all projects make mention of various exposure, sensitivity and adaptive capacity factors to justify the vulnerability context. This suggests that overall, there is a fair consideration of each of the vulnerability components in GCF adaptation projects, although some projects seem to incorporate vulnerability to a further extent compared to others (see Annex III for the qualitative analysis summary table). However, from the quantitative analysis, results do not allow confirming that there is a relationship between the country's level of vulnerability, as measured by the ND-GAIN and the WRI indices, and the allocation of adaptation funding from the GCF (see Figure 6 for the summary table of the correlation coefficients and associated p-values of the quantitative analysis).

[6]It can further be noticed that adaptation funding per capita varies quite a lot, ranging from $0.02 (India) to $3,128 (Tuvalu), which can be explained by differences in population sizes, as mentioned in Chapter 3. In addition, most vulnerable countries recipient of GCF adaptation finance, as ranked by the indices are, in order, Mali, Madagascar, Uganda Benin and Burkina Faso (according to the ND-GAIN), and Mozambique, Madagascar, Mali, Uganda and Burkina Faso (according to the WRI). Although there are some differences due to the different methodologies in place for the two indices, the fact that the same 4 countries are identified as part of the top 5 most

	Per capita adaptation finance (log)	p-value	Number of observations (n)
ND-GAIN: Vulnerability	0.00	1.00	50
ND-GAIN: Exposure	0.15	0.28	52
ND-GAIN: Sensitivity	-0.05	0.74	48
ND-GAIN: Adaptive Capacity	-0.06	0.66	50
WRI	0.15	0.30	49
WRI: Exposition	0.17	0.23	49
WRI: Vulnerability	-0.24	0.10	49
WRI: Susceptibility	-0.21	0.15	49
WRI: Coping	-0.34	0.02	49
WRI: Adaptation	-0.16	0.26	49

No correlation and p-value > 0.5
Very weak correlation and 0.10 < p-value < 0.35
Weak correlation and p-value = 0.10
Moderate correlation and p-value < 0.05

Figure 6: Summary table from the quantitative analysis

[6] Data in Figure 6 is rounded up.

vulnerable countries by both indices brings some consistency to this study.

4.1 Exposure

First, for the exposure category, it can be observed that the same five hazards are recurrent in the majority of the projects. Most frequent is the use of increased temperature in almost all examined proposals (19 out of 20), closely followed by factors of drought/aridity/desertification, and precipitation (both of which are mentioned in 18 out of 20 project documents). A very common exposure element is also the increased frequency and/or intensity of extreme weather events, which are sometimes specifically referred to as cyclones or El Nino events. In fifth place – which still concerns 80% of the examined proposals - is the exposure to flooding, for which it can be observed that there is at times a causal effect with the precipitation levels. These five hazards are quite repetitive among all the 20 project documents, given the high frequency for each. In addition, exposure to sea level rise is also a significant hazard that is present in more than half of the project documents. It is often mentioned with the presence of induced salinity and coastal erosion, which logically occur together. Interestingly, while being a main exposure element in projects that take place in SIDS, as expected, sea level rise is equally mentioned for other coastal countries as well (i.e. Senegal, Bangladesh, Gambia). Other exposure factors that were identified include, in order of frequency: wind (4), seasonal variations (3) and ocean acidification (2). Figure 7 below presents the main sub-themes for the exposure category, with the frequency value.

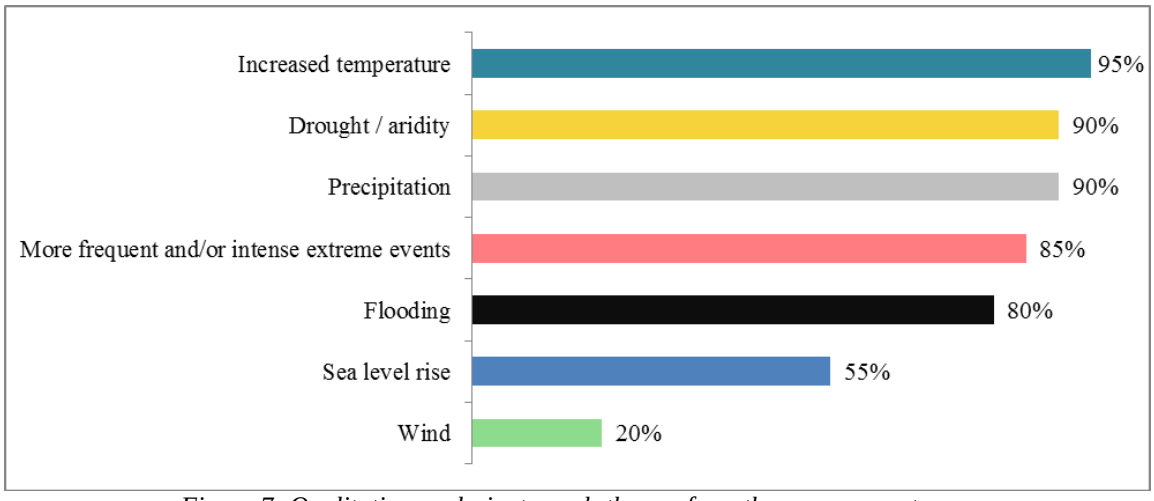

Figure 7: Qualitative analysis: top sub-themes from the exposure category

As for the quantitative analysis, both selected indices have a sub-indicator for exposure, allowing examining if there is statistically significant relationship between the level of exposure and the amount of per capita adaptation finance received, for each country benefitting from adaptation support from the GCF. For both indices, the correlation coefficient is weak and does not meet the statistically significant level of 0.05. As such, it cannot be concluded that there is a correlation between the level of exposure of a country and the amount of adaptation finance it receives from the GCF.

4.2 Sensitivity

Second, in the sensitivity category, the overall picture is a little different, as there are not as many recurrent sub-themes that come back in the majority of the project documents, when compared to the exposure category and there is a wider array of factors that shape sensitivity (see Figure 8). The most recurrent one, present in 75% of examined project documents, is the presence of a sector that is sensitive to climate change. This applies in project documents to agriculture when it is being rain-fed, or to water supply when it is being reliant on surface water, for example. The next two most important factors that shape sensitivity in projects proposals (in 70% of the cases) are the reliance on ecosystem services as a source of livelihood and the unsustainable use and/or management of natural resources. In fact, many of the communities targeted by the examined projects have subsistence agriculture as their source of livelihood or depend on other ecosystem services for their survival (i.e. fishing, wetlands). There are also various ways in which resources are being managed unsustainably, contributing to sensitivity, namely practices of deforestation, unsustainable water uses, land overexploitation or heavily localized grazing. More than half of the examined project documents (65%) also mention the fact that the sector and/or region in question in the project is an important contributor to the local economy and/or to the Gross Domestic Product, and that there is an increased pressure on the natural resources coming from demographic or economic activities (60%). Damaged ecosystems are also a considerable factor contributing to sensitivity, often going hand-in-hand with the presence of unsustainable management of resources. Other sensitivity factors include, in order of frequency: geographic features and topography elements (45%), especially in the case of SIDS which are often described as having low-elevation land, lengthy coasts and limited land availability; aspects relating to

the fragility of structures and/or systems (i.e. sensitivity of water drainage systems and buildings) in 45% of the cases as well; remoteness or distance (35%), which can be a barrier for communities given their isolation from economic centers. In addition, 30% of project documents describe some kind of concentration of assets in one area, which increases climate sensitivity (i.e. majority of economic and human activity on coasts), and the occurrence of a previous event from which the community is still recovering (i.e. cyclone, civil war) which makes the socio-ecological systems more sensitive to future climate events.

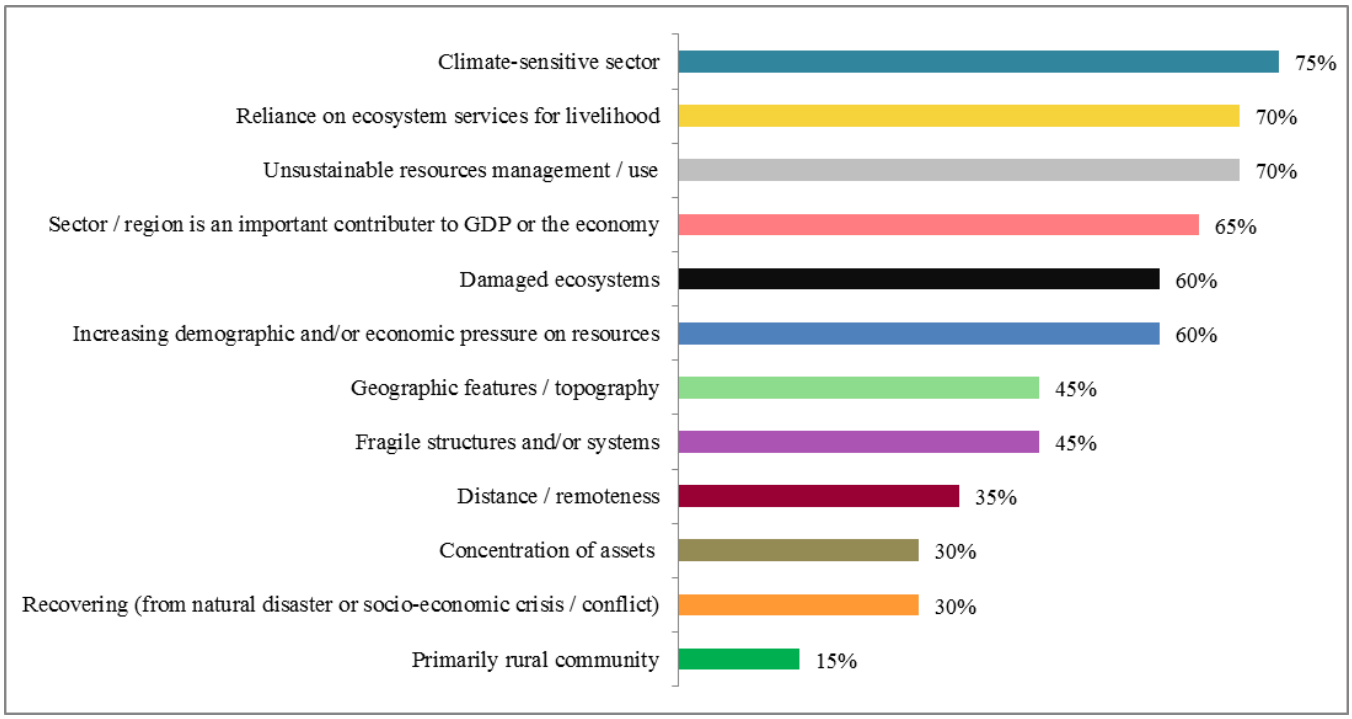

Figure 8: Qualitative analysis: top sub-themes from the sensitivity category

Regarding the quantitative results, once again, the correlation between the amount of adaptation finance received and the level of sensitivity is absent. The two correlation coefficients (using the ND-GAIN "sensitivity" measure and the WRI "susceptibility" measure) do not meet the statistically significant level of $p<0.05$, not allowing to reach a conclusion on the presence of any relationship between this component of vulnerability and the allocation of adaptation finance from the GCF.

4.3 Adaptive Capacity

When looking at the elements that describe the lack of adaptive capacity throughout the 20 project documents, six main sub-themes emerge (see Figure 9). Adaptive capacity elements can be understood as the main groups of assets.

Economic and financial assets relate to aspects of the country's and/or community's economy and market, including but not limited to income levels, budgetary resources, debt levels, economy size, market access, and the presence of economic inequality. All 20 project documents make a mention of their lack of economic or financial assets. More precisely, some recurrent rationales include the high cost of adaptation, poverty, or a high public debt.

Human and social capital and the **institutional framework** are both mentioned in 90% of examined project documents. The first relates to characteristics of the population and its knowledge, skills and networks. Some common barriers for human and social capital include knowledge gaps (often in the area of climate change and adaptation), limited human resources capacity and the lack of qualified professionals, an in a few cases gender inequality. Regarding the institutional framework, which can be further explained by the set of organizational structures, rules and the norms behind service provision, a few recurrent elements relate to the institutional fragmentation, the lack of consideration of climate change in the shaping of institutions and policies, governments' weak capacities and more generally the weak institutional architecture.

In addition, **physical assets**, consisting of tangible man-made assets, also emerge as a sub-category, due to the presence of elements that mostly relate to the lack of infrastructure and the associated equipment and services. Some examples are the absence of cyclone shelter coverage, the lack of adequate wastewater infrastructure, or a damaged infrastructure for water provision.

The lack of **technological assets** was also mentioned in more than half of the project documents. More specifically, this sub-category can be defined as the absence of technology such as automation systems, knowledge management systems, and other new technologies. In the case of the examined projects, this means the absence of climate-

related technologies, such as systems for early warning and disaster management, and the lack of tools for climate assessments and surveillance.

Lastly, although elements that relate to the **natural capital** were less present, they still represented a fairly influential sub-category. The natural capital refers to natural resources or ecosystem services – an indisputable asset for any country or community. Among analysed project documents, 45% mentioned elements such as degraded wetlands, limited access to land for cultivation, and limited replenishment of groundwater aquifers, representing barriers from the natural capital to an effective adaptive capacity.

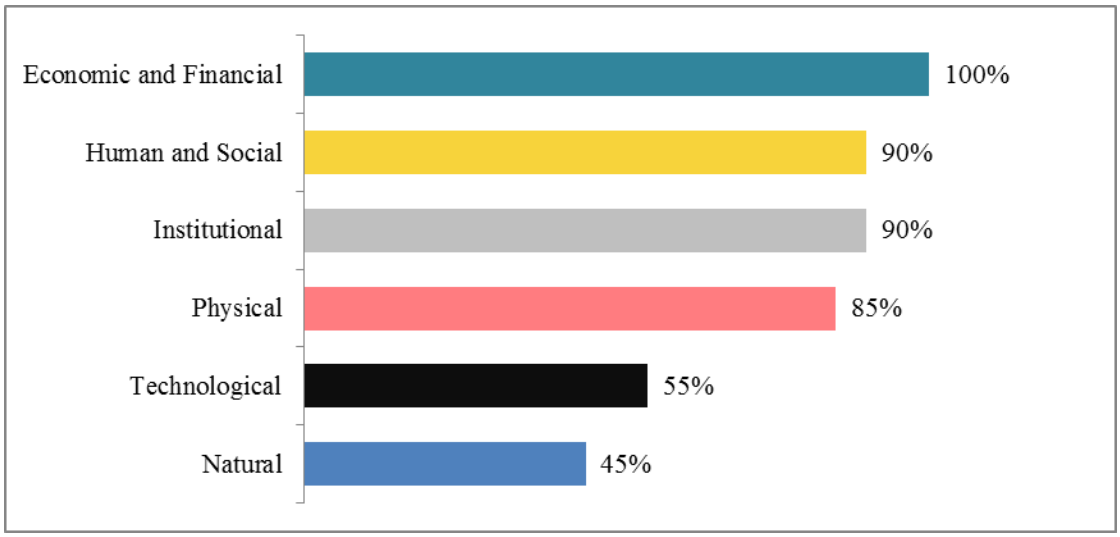

Figure 9: Qualitative analysis: sub-themes from the adaptive capacity category

With respect to the relationship between the level of adaptive capacity and the allocation of adaptation finance from the GCF, results from the quantitative analysis are inconclusive. First, adaptive capacity as measured by the ND-GAIN displays no correlation with the amount of adaptation finance: the correlation coefficient is very weak and the value is not statistically significant. Second, the level of adaptive capacity from the WRI index is further divided between the lack of ability to cope on one side, and the lack of ability to adapt on the other. While coping encompasses "various abilities of societies to be able to minimize negative impacts of natural hazards and climate change through direct action and the resources available" (Bündnis Entwicklung Hilft, 2019), adaptation refers to "measures and strategies dealing with and attempting to address the negative impacts of natural hazards and climate change in the future. Adaptation, unlike

coping, is understood as a long-term process that also includes structural changes" (Bündnis Entwicklung Hilft, 2019). As it can be observed in Figure 6, while there is no correlation between the allocation of adaptation finance from the GCF and the lack of adaptation abilities sub-index of the WRI, there is a relationship between the former and the WRI index measuring the lack of countries' coping capacities. In fact, this is the only instance in which the p-value meets the test of statistical significance (p-value = 0.02). However, surprisingly so, this correlation is a negative one, with a correlation coefficient of -0.34 meaning that as the lack of coping capacities increases, the amount of per capita adaptation funding received decreases (more financing appears to be going to countries with higher coping capacities). Thus, while analysis for adaptive capacity, similarly to the analysis for the vulnerability components of exposure and sensitivity, brings out the absence of any correlation with per capita adaptation funding received from the GCF, it further points to a negative relationship with one of the sub-indices of vulnerability, namely the lack of coping capacities.

Fifth Chapter: Discussion

5.1. The need of a more comprehensive and systematic view of vulnerability

This study's results bring to light the fact that so far, the allocation of GCF adaptation funding was not coherent with the level of vulnerability to climate change of the recipient countries, as measured by the ND-GAIN and the WRI, two elaborate indices established from a series of sub-indicators in consistency with the IPCC AR4 and AR5 conceptions of vulnerability. However, there is a reasonable consideration of climate vulnerability factors in the GCF adaptation project documents. This means that overall, these projects take into account vulnerability for the design of their activities, but the financing received for it is likely not targeting and prioritising most vulnerable countries. In summary, vulnerability does have a place in GCF adaptation finance, but relative vulnerability does not seem to be recognized as much as it should. This could be explained by the various dynamics that shape the allocation decisions of GCF's financial resources, including the existing accreditation standards that developing countries' national organizations need to meet, and that can simultaneously be a barrier to the most vulnerable of them, as discussed in Chapter 2.

In addition, the presence of factors that relate to the three main vulnerability components is spread out in different sections of the project documents, which makes it difficult to compare the consideration of vulnerability between projects. This is a symptom of a greater issue: the lack of clear criteria and structure to assess vulnerability in GCF project documents can indeed become a barrier to ensuring that adaptation projects effectively target the most vulnerable and address their needs. This same limitation emerged from some of the authors who looked at the Adaptation Fund: "the justification of vulnerability in project proposals could be made more systematic, for instance by requiring proponents to address specific dimensions of vulnerability" (Remling & Persson, 2015). This notion becomes even more significant when recognizing that adaptation projects do not always result in reduced vulnerability (despite considering it as part of the project design), specifically as there is a pressure for funds to demonstrate immediate results, which comes in the way of investing in long-term but slower activities that can truly have impactful changes in deeper vulnerability situations. In the same way, "studies of

adaptation to climate change have provided many insights but to date, have shown only moderate practical effect in reducing vulnerabilities of people to risks associated with climate change" (Smit & Wandel, 2006). The GCF could thus take greater measures in providing specific criteria to ensure that vulnerability is addressed consistently among projects and is evaluated rigorously by each project proponent. This would ultimately benefit most the beneficiary communities and countries by translating into more effective adaptation for beneficiaries and greater impact of the donors' financing. In the same vain, given that the assessment of vulnerability is not a new dilemma, vulnerability assessments have progressively emerged as a practical tool and have benefitted from several evolution stages throughout the last few years. In fact, more recent vulnerability assessments have come a long way from first and second generation vulnerability assessments, and "contribute to policy-making by recommending specific adaptation measures" (Füssel & Klein, 2006). Taking advantage from this progress in knowledge, the GCF could make vulnerability assessments to be a similar document as the current gender assessments and environmental and social safeguards reports, which are available to the public for each approved project.

Results also drew attention to the exposure and adaptive capacity factors that were present in almost all projects, namely increased temperature, drought and precipitation for the exposure category, and a lack of economic and financial assets for the adaptive capacity category. Since climate change, also known as global warming, directly concerns the warming of air and sea temperatures, it comes as no surprise that this is a common factor among almost all examined projects, as it is perhaps the source of all other exposure factors such as precipitation variability and ocean acidification. In addition, the high focus given to drought and precipitation could be explained by the fact that these occurrences have important repercussions on climate-sensitive sectors such as agriculture and water which are the core of most of the poorest societies in developing countries. Regarding the popular use of factors that relate to the lack of economic or financial assets in the project proposals, it seems that this comes as an answer to the aim of proving that the community or country truly needed financing from the GCF. Although this is an important factor to take into account, it seemed that it was taking over compared to the other justifications, when institutional and social barriers are equally

important to explaining vulnerability, as the lack of financial assets. As Turner warns, “a focus on wealth alone is a radical reduction of the multiple dimensions of vulnerability” (2016). Once again, this leads into suggesting that the GCF provides a stronger incentive for project proponents to comprehensively address vulnerability in projects in a coherent and structured way, to facilitate understanding of why certain vulnerability factors are more prominent than others.

It must be also noted that this study underscored the existing and recurring gap of looking at vulnerability mainly from the country perspective. In fact, while the GCF project documents give the space and opportunity to portray vulnerability for the specific target community and/or region, on several occasions the justification of vulnerability was still made at the country level. While it is understandable that vulnerability can be better compared at the country-level, priority should be given to the local conditions since vulnerabilities differ within the country and its regions. “Factors that influence vulnerability at the local level can vary significantly from place to place, depending on cultural, political, economic, and ecological characteristics and the institutional environment in which adaptation occurs” (Mcleod et al., 2015). Therefore, the more focused is the understanding of the underlying vulnerabilities of the local beneficiary groups, the better chances the project could have at effectively designing activities to reduce these vulnerabilities. Similarly, throughout the quantitative analysis the differences in the ranking of vulnerability of the same countries – some minor but other more significant – depict the limitation of assessing vulnerability on a country scale. As previous research points out, “a persistent observation when comparing the results of different indices is their strong divergence” (GIZ, 2017). Consequently, this study allows emphasizing, in line with the outcome of several other studies, that the country-level consideration of vulnerability is not an enough precise measure of such a complex notion.

Reflecting on the fact that there is a wide variety of interpretations of climate vulnerability in the examined project documents, and in the methodologies of the vulnerability indices as the source of variations of country rankings, attention must be drawn to the context in which the term vulnerability is currently used, including in international agreements. There is no question that vulnerability is an important concept

in a world where climate change unequally affects communities and systems, and thus it is understandable why the term is often referred to as a way to characterize the type of support that donor countries make available to developing nations, either through the GCF or as part of adaptation finance more broadly. Yet, there is agreement throughout the literature that there is a lack of definition of the term, at the risk of it becoming more of a trend word than the designation of a specific set of characteristics that help identifying those who should be prioritised to receive financial support. Now that the GCF, the newly established and most important international climate fund, continues approving significant amounts for adaptation projects, it becomes crucial more than ever to put in place a robust and reliable interpretation of vulnerability that goes beyond the current classifications of SIDS and LDCs.

Although three specific components of vulnerability have been scientifically identified by the IPCC, as laid out in the conceptual framework, the clear reference to each in examined projects remains limited: this contributes to the existing division between the scientific conception of vulnerability and the practical use of the term. It is argued by Muccione et al. that there is a "fundamental disconnect between science and policy when it comes to issues of global adaptation financing" (2017) and that "as the key scientific body informing the UNFCCC, the IPCC should build on their concept of climate risk, and provide a global-scale assessment that can serve as a basis for prioritizing adaptation funding" (2017). That said, recognizing that climate finance and adaptation finance are an increasingly critical debate for international climate policy, the UNFCCC has a responsibility in clarifying the role of its intergovernmental bodies for reconciling science and policy when it comes to climate vulnerability. There are important political challenges to defining vulnerability, as part of the UNFCCC, which can explain why the term has remained ambiguous in international agreements so far, and yet keeping the uncertainty around the interpretation of vulnerability will likely lead to more detrimental conditions, especially with the existing adaptation funding gap and the increasing needs of developing countries to finance adaptation action.

5.2. Financing adaptation for the most vulnerable and achieving the SDGs

The absence of an apparent relationship between relative vulnerability and the provision of adaptation finance from the GCF also has important implications for the broader context of development and the SDGs, given the interconnectedness of climate change and sustainable development. The most vulnerable to climate change are also those who face critical development challenges such as economic inequality, food insecurity or the lack of clean water and sanitation. As such, prioritizing adaptation finance for the most vulnerable inevitably supports those who require the assistance in terms of development as well. It can be further argued that any type of development assistance now has to have strong considerations of climate impacts as well, as the failure to build communities' resilience puts at risk all development gains achieved over the last decades. Thus, GCF's adaptation projects which aim to build adaptive capacity to climate change can be easily thought of as a necessity for successful sustainable development in the target countries. As argued by Strawson et al., "adaptation finance therefore has an important role to play in the SDG era by strengthening the resilience of the poorest people against shocks that would otherwise undermine progress in reducing poverty" (2015). Above all, "a distinctive feature of the 2030 Agenda for Sustainable Development is its emphasis on reaching the poorest and most vulnerable, as expressed in the Preamble and Declaration" (UN, 2019). As depicted in the conceptual framework, the 2030 Agenda for Sustainable Development sets the tone for specific ways to achieve sustainable development and effective adaptation to climate change is key to reaching SDGs.

There is however a broader inconsistency between the context in which developing countries pursue efforts for development and the need to develop sustainably while reducing the level of vulnerability to climate change. Neoliberalism, the dominant ideology in today's globalized world, has been set as the pathway to economic development by developed countries, that developing countries follow in footsteps. Yet, the pressures emanating from development following a neoliberal paradigm are contributing to increasing vulnerability to climate change. For example, in order to satisfy free trade conditions, farmers in developing countries need to make their production rentable by choosing to harvest one / only a few kinds of crops given the implied

economies of scale, which decreases agricultural diversity and puts the farmers at a greater risk. Equally, the intensive agricultural production state promoted by neoliberalism increases the stress on soil and other natural resources, which in turn become more sensitive to climate variations and impacts – contributing to higher vulnerability. Researchers have already cautioned that "very capital intensive models of agricultural development may, in some cases, make production systems less resilient by creating an unsustainable dependency on exogenous inputs and increasing the sensitivity of production to ecological and economic disturbances such as salinity, water scarcity and pests" (Leary et al., 2008). Moving forward towards genuine sustainable development is critical to reduce climate vulnerabilities, but it is challenged by prior ideologies that still shape today's world economy. Priority for development must be given to communities' sustainable livelihoods, and not to a profitable production that marginalizes smallholder farmers. This entails changing the world's economy perspective from long-standing neoliberal practices to renewed sustainable practices, such as fair trade, for a chance to achieve genuine sustainable development that is much needed in a world of increasing climate risks.

5.3 Implications on the study's hypotheses

Lastly, looking at this study's hypotheses, results from the qualitative and quantitative analysis as discussed above, lead to rejecting hypotheses 1, 2 and 4, and to fail to reject hypothesis 3 (H3):

> H3: Climate change vulnerability is not correlated with the provision of climate adaptation finance within the GCF, but the vulnerability components of exposure, sensitivity and adaptive capacity are well considered and justified within the projects.

For example, looking at the first component of exposure: while the presence of exposure elements is clear from the qualitative analysis, the quantitative analysis does not allow concluding that exposure is a determining factor in the allocation of adaptation finance from the GCF. The acceptance of H3 can be however nuanced by the fact that, as expressed above, the lack of structure and criteria of vulnerability limited the

examination of the quality of the consideration of each of the three components of vulnerability. The presence of each was confirmed by multiple factors in each project, but the quality of the justification factors was evaluated with some degree of ambivalence.

Sixth Chapter: Conclusion and Recommendations

This study examined the role that vulnerability, as scientifically defined in the IPCC AR4, has had in the so-far approved adaptation projects from the GCF – the largest international climate fund and key UNFCCC delivery mechanism for climate finance. Through a mixed research design, of both qualitative and quantitative analysis, results point to an inconclusive correlation between the level of climate vulnerability, as measured by two indices (namely the ND-GAIN and the WRI), and the provision of adaptation finance from the GCF at the country-level, but an overall good consideration and justification of vulnerability as scientifically defined through its three components – exposure (to climate stimuli), sensitivity (of the system to these stimuli) and adaptive capacity (of the system to adapt to climate change), (GIZ & CCA RAI, 2014). In summary, while vulnerability as a concept seems be considered in GCF adaptation finance, the relative vulnerability of countries does not influence how much finance is allocated to countries.

These findings have several implications on three main levels: for the GCF, the UNFCCC, and the countries (which are also the financing and technical partners of the GCF). First, a main recommendation for the GCF is to bring specificity to the concept of climate vulnerability, to allow project proponents to better determine vulnerability against clear criteria, and thus demonstrate that the design of the GCF is not replicating the same challenges that the Adaptation Fund faced in terms of applying the important conceptualization of vulnerability. Lessons learned from the Adaptation Fund, which operated for over a decade and played a key role in the delivery of multilateral adaptation finance, are important to be implemented in the GCF which although is still relatively new has now approved more funding for adaptation than the Adaptation Fund in total. This could be in part facilitated through the incorporation of vulnerability assessments for each adaptation project, at the same level as gender assessments and environmental and social safeguards reports are at present required.

Second, in the same vein, the UNFCCC also has the responsibility to help the GCF establishing in more robust terms what climate vulnerability refers to and how it should

be better assessed to inform a fair distribution of adaptation finance for developing countries, given their increasing financial needs for adaptation. In clarifying the role of its intergovernmental bodies towards this end, the UNFCCC could evaluate giving this task to the IPCC, given its scientific assessments reports that shaped the current definition of climate vulnerability. A further refinement of the term must be translated at the UNFCCC policy level, including applicability to the GCF.

Thirdly, a clearer message from the UNFCCC and the GCF on the need to emphasize and clearly formulate vulnerability while relating it to the proposed adaptation action will undoubtedly positively influence the consideration of vulnerability by projects proponents (countries seeking GCF financing). In fact, this requirement will encourage developing countries to build capacity of the understanding of climate vulnerability, which will over time likely also benefit other areas of their climate-smart development. It therefore appears to be in developing countries' best interest to also push for clearer guidance on assessing vulnerability from the UNFCCC and the GCF, as this clarification can benefit other national and local activities towards effective sustainable development. In the absence of such guidance, a main recommendation for countries is to anyhow prioritise the use of IPCC scientific definition of vulnerability in the design of all adaptation activities, to have benefits reach those who need it most. Incidentally, such a practice can heighten the importance of vulnerability within the UNFCCC: the change required can come from either the recipient or donor end.

Lastly, more broadly but most importantly, sustainable development, and the implied necessary climate action, must be elevated as the primary pathway forward for tomorrow's world economy, taking precedence on the neoliberal ideology that is currently deepening vulnerabilities to climate change in developing communities. Neoliberal policies' repercussions on climate vulnerability challenge the achievement of SDGs, and these important contradictions between current practices and future objectives must be raised and addressed at high-level political gatherings, including discussions at the UN, to initiate the needed transformation to reconcile the two. Vulnerability to climate change becomes ultimately a question inseparable from the present global policy model, which is in present circumstances driving up the cost of adaptation for developing

communities. For adaptation finance to reach those who need it most, on one hand, vulnerability needs to be emphasized and spelled out by the UNFCCC, including the GCF, urging developing countries to scrutinize and apply vulnerability as part of climate-smart and sustainable development. On the other hand, profound structural changes to the global economy need to be triggered by high-level political discussions if we are to achieve genuine climate-resilient sustainable development for the most vulnerable.

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Annex I

Definition of ND-GAIN index main components (Chen et al., 2015)

Exposure: The extent to which human society and its supporting sectors are stressed by the future changing climate conditions. Exposure in ND-GAIN captures the physical factors external to the system that contribute to vulnerability.

Sensitivity: The degree to which people and the sectors they depend upon are affected by climate related perturbations. The factors increasing sensitivity include the degree of dependency on sectors that are climate-sensitive and proportion of populations sensitive to climate hazard due to factors such as topography and demography.

Adaptive capacity: The ability of society and its supporting sectors to adjust to reduce potential damage and to respond to the negative consequences of climate events. In ND-GAIN adaptive capacity indicators seek to capture a collection of means, readily deployable to deal with sector-specific climate change impacts

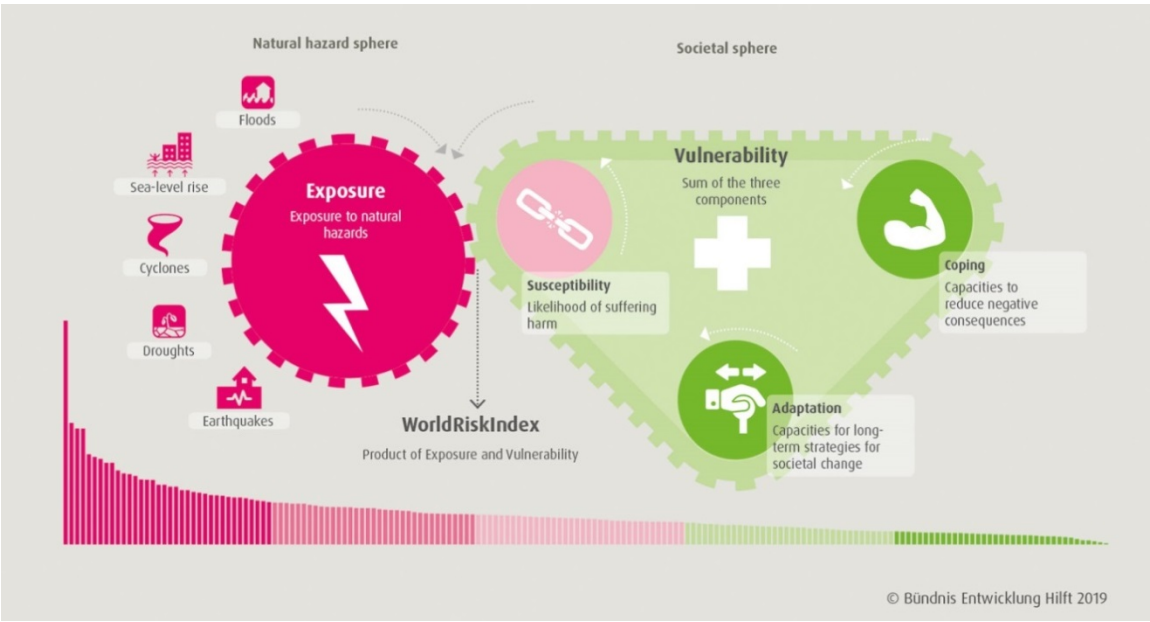
Definition and illustration of WRI main components (Bündnis Entwicklung Hilft, 2019)

Exposure to earthquakes, cyclones, floods, drought, and sea-level rise

Susceptibility depending on infrastructure, food supply, and economic framework conditions

Coping capacities depending on governance, healthcare, social and material security

Adaptive capacities related to coming natural events, climate change, and other challenges.



Annex II

List of GCF adaptation projects for the content analysis of the qualitative research design:

- FP004 - Climate Resilient Infrastructure Mainstreaming (CRIM)
- FP007 - Support of Vulnerable Communities in Maldives to Manage Climate Change-Induced Water Shortages
- FP011 - Large-scale Ecosystem-based Adaptation in the Gambia River Basin: developing a climate resilient, natural resource based economy
- FP012 - Africa Hydromet Program - Strengthening Climate Resilience in Sub-Saharan Africa: Mali Country Project
- FP014 - Climate Adaptation and Mitigation Program for the Aral Sea Basin (CAMP4ASB)
- FP015 - Tuvalu Coastal Adaptation Project
- FP016 - Strengthening the resilience of smallholder farmers in the Dry Zone to climate variability and extreme events through an integrated approach to water management
- FP018- Scaling-up of Glacial Lake Outburst Flood (GLOF) risk reduction in Northern Pakistan
- FP021- Senegal Integrated Urban Flood Management Project
- FP034 - Building Resilient Communities, Wetlands Ecosystems and Associated Catchments in Uganda
- FP035 - Climate Information Services for Resilient Development in Vanuatu
- FP037 - Integrated Flood Management to Enhance Climate Resilience of the Vaisigano River Catchment in Samoa
- FP041 - Simiyu Climate Resilience Project (Tanzania)
- FP042 - Irrigation development and adaptation of irrigated agriculture to climate change in semi-arid Morocco
- FP043 - Saïss Water Conservation Project
- FP049 - Building the climate resilience of food insecure smallholder farmers through integrated management of climate risks (the R4 Rural Resilience Initiative)
- FP053 - Enhancing Climate Change Adaptation in the North Coast and Nile Delta Regions in Egypt
- FP056: Scaling up climate resilient water management practices for vulnerable communities in La Mojana
- FP058 - "Responding to the increasing risk of drought: building gender responsive resilience of the most vulnerable communities"
- FP059 - Climate-Resilient Water Sector in Grenada (G-CREWS)

Annex III

Qualitative analysis summary table

	EXPOSURE										SENSITIVITY												ADAPTIVE CAPACITY					
	Flood	Drought	Sea level rise	Rainfall	More frequent and/or intense extreme event	Increased Temperature	Wind	Seasonal variations	Ocean Acidification	Species invasion, infestations	Climate-sensitive secti	Geographic features / topography	Reliance on ecosysten services for livelihood	Increasing demographic and/or economic pressure on resources	Unsustainable resourc management / use	Concentration of asse	Distance / remoteness	Sector / region is an important contributer to GDP or the economy	Recovering (from natural disaster or socio-economic crisis / conflict)	Damaged ecosystems	Primarily rural communi	Fragile structures and/ systems	Economic and Financia	Natural	Physical	Human and Social	Institutional	Technological
FP004	X	X	X	X	X	X	X	X				X										X	X		X	X	X	
FP007	X	X	X	X	X	X					X	X	X	X	X	X	X			X			X	X	X	X	X	
FP011	X	X	X	X	X	X	X				X		X		X			X		X			X		X	X	X	
FP012	X	X		X	X	X				X	X		X	X					X	X	X	X	X	X	X	X	X	X	X
FP014	X	X				X					X		X	X	X			X			X		X		X	X	X	X
FP015			X	X	X	X			X			X				X	X		X				X	X	X	X	X	
FP016	X	X		X	X	X					X		X		X		X		X	X		X	X	X	X	X	X	X
FP018	X	X		X	X	X		X			X	X	X		X		X	X	X	X			X			X	X	X
FP021	X	X	X	X	X	X						X		X		X				X		X	X				X	X
FP034	X	X		X	X	X				X	X		X		X			X		X			X	X		X	X	X
FP035	X	X	X	X	X	X			X		X	X	X	X	X	X		X		X			X	X	X	X	X	X
FP037	X	X	X	X	X	X	X					X	X	X	X	X	X	X	X	X		X	X		X	X		X
FP041	X	X		X	X	X	X	X		X	X		X	X			X	X					X	X	X	X	X	
FP042	X	X		X	X	X					X		X	X	X			X					X	X	X	X	X	X
FP043	X	X	X	X		X					X			X	X			X					X		X	X	X	
FP049		X	X	X		X					X			X	X			X		X			X		X	X		
FP053	X		X		X							X	X		X	X		X		X		X	X		X		X	X
FP056	X	X		X	X	X					X		X	X	X		X		X	X	X	X	X	X	X	X	X	X
FP058		X		X	X	X					X		X	X	X			X					X		X	X	X	
FP059		X	X	X	X	X					X	X						X				X	X		X	X	X	
TOTAL	16	18	11	18	17	19	4	3	2	3	15	9	14	12	14	6	7	13	6	12	3	9	20	9	17	18	18	11