

# analyses

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## For a better understanding of adaptive capacity to climate change: a research framework

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### HIGHLIGHTS

**THE SCIENCE OF ADAPTIVE CAPACITY** This paper is based upon the assumption that few frameworks exist that analyze in detail the processes and determinants of adaptive capacity. Consequently, scientists still have an immature understanding of what adaptive capacity is and of the extent to which different communities are characterized by different capacities to adapt. This induces difficulties in identifying realistic adaptation strategies and projects.

**A (FALSE) GENERALLY ACCEPTED IDEA** It is generally maintained that a low level of development systematically induces a low level of adaptive capacity. This text argues that this viewpoint is biased because adaptation to climate change is not solely determined by economic and technological capacities.

**AN INNOVATIVE FRAMEWORK** The proposed framework is based upon four main fields of investigation: (i) the influential factors of adaptive capacity and their interactions, (ii) the relevant spatial and temporal scales of adaptive capacity, (iii) the links between adaptive capacity, vulnerability and the level of development and (iv) the theoretical links between adaptation and sustainability.

**ADAPTATION PATHWAYS** The text finally argues that a better understanding of adaptive capacity determinants will allow addressing the various dimensions of adaptation to climate change (process, state, strategy) and help building adaptation pathways. These adaptation pathways are part of sustainable development pathways.



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## **Abstract**

It is generally accepted that there exists a systematic link between a low level of adaptive capacity and a low level of development, which thus implies that the poor inevitably have low adaptive capacities. We argue here that this viewpoint is biased because adaptation to climate change is not solely determined by economic and technological capacities. Many other characteristics of a community can play a major role in its ability to react to and anticipate climate changes (e.g. the territorial identity or the social relationships). From our point of view, this limited view of adaptive capacity is related to a relative immaturity of the science of adaptation, a discipline that analyses the processes and determinants of adaptive capacity. This can be explained by the fact that there are currently few existing frameworks for studying adaptive capacity. This paper consists in a proposal for a research framework which is based upon four main fields of investigation: *(i)* the influential factors of adaptive capacity and their interactions, *(ii)* the relevant spatial and temporal scales of adaptive capacity, *(iii)* the links between adaptive capacity, vulnerability and the level of development and *(iv)* the theoretical links between adaptation and sustainability. These four fields of research should bring new knowledge on adaptive capacity and feed a more general reflection on the adaptation pathways for dealing with climate change.

## **Keywords**

Research framework, adaptive capacity, climate change, adaptation and development pathways.

## Introduction

When seeking to act in favour of adaptation, one of the central issues arising, whatever territorial scale is considered, is that of determining the priority of populations to be targeted for support policies. While different populations have correspondingly different approaches to adaptation, the fact remains that they all are target groups. However, authorities have a limited ability to simultaneously implement solutions for all, and we are therefore forced to consider “priority” groups and not simply “target” groups. This raises several questions that are difficult to answer objectively: which groups are most vulnerable to expected climate change effects; is the adaptive capacity of a particular group too low, or is it sufficiently developed to meet the challenges; and, indirectly, what types of support (social networks, insurance systems...) should the adaptation strategy of a specific group be based upon? Answering these questions would appear to be a prerequisite to the identification of appropriate and realistic solutions. However, the hypothesis put forward here is that scientific knowledge on the determinants of adaptive capacity is not sufficiently developed or mature enough. It therefore seems appropriate that work on this issue should be directed towards the identification of areas of practical research, which this article proposes to do. As a first step, this text will show that a common approach to linking a consistently low level of development and low adaptive capacity to climate change carries serious limitations for both reflection and action. The heart of the paper then focuses on a presentation of the four main fields of research that we consider as being the foundation for understanding adaptive capacity. Finally, we will broaden the discussion to examine the significance of understanding adaptive capacity in order to

improve the analysis of adaptation through a three dimensional view of adaptation (process, state and strategy). This may indeed provide a framework for the consideration of “adaptation pathways” and then, beyond this, of development pathways. Thus, we will link together methodological research fields (on adaptive capacity) to broader issues dealing with the implementation of adaptation, thus positioning our reflections on adaptation within a dynamic approach.

## 1. Defining the problem: From a stereotypical belief to the questions that it raises

### 1.1. Elements of the definition of adaptive capacity

In the context of the struggle against climate change (CC), the problem of the identification of “priority” groups is complicated by the fact that it is difficult to determine which populations will be the most affected. Generally, if we set aside from the discussion the uncertainties of climate change impacts, vulnerability (V) and adaptive capacity (AC) are considered to be inversely proportional – a low level of V results in good AC and vice versa. Scientists have thus established that V is a function of both the system’s exposure to natural hazards and its AC (IPCC, 1995, Kelly & Adger, 2000). On occasion the system’s sensitivity<sup>1</sup> is also integrated, but from our point of view the distinction between AC and sensitivity remains rather imprecise or, at least, is rarely explicitly defined. We can however find various definitions of AC, which

1. The definition of sensitivity according to the IPCC (Intergovernmental Panel on Climate Change) is the degree to which a system is affected, either adversely or beneficially, by climate-related stimuli. The effect may be direct (e.g., a change in crop yield in response to a change in the mean, range, or variability of temperature) or indirect (e.g., damages caused by an increase in the frequency of coastal flooding due to sea-level rise).

more or less reads like the one proposed by the IPCC: while adaptation to CC indicates “the adjustment of natural or human systems in response to present and future climatic stimuli or to their effects, in order to mitigate the damage or to exploit beneficial opportunities”, the AC represents “the ability of a system to adjust to climate change (including climate variability and extremes)”. Another definition that appears to be of particular interest, partly because it does not refer specifically to CC – which is not the sole factor of change to be taken into account in terms of adaptation –, is that of G.C. Gallopin: “Adaptability or adaptive capacity of human systems can also be defined as the capacity of any human system, from the individual to humankind, to increase (or at least maintain) the quality of life of its individual members in a given environment or range of environments” (2006: 300). It indeed seems essential to remember that the ultimate purpose of adaptation to CC, if it involves the reduction of the system’s sensitivity to natural hazards and the increase of its resilience (Adger *et al.*, 2005; Schipper, 2009), is the improvement or the maintenance of the quality of human life, which also partly involves the preservation of biodiversity and of the environment in general. Therefore adaptation must be considered in terms of wider ambitions, namely those of sustainability. Thus, the vast majority of authors on the subject point out that AC depends on social, political, economic, cultural, institutional and environmental factors, for example, and on different territorial, community and temporal scales. K. Vincent, for example, states that: “at the country level [adaptive capacity] not only reflects the ability of financial resources, but crucially the degree of organization and institutional capacity for targeting those resources effectively to the areas and groups of people that are the most vulnerable. At the household level, whether or not a person can adapt to climate change depends on such factors as their knowledge base, which may enable them to anticipate change and identify new or modified livelihood opportunities; and their access to further resources required to achieve this” (2007: 12). Other authors write that “adaptive capacity is context-specific and varies from country to country, from community to community, among social groups and individuals, and over time.

*It varies not only in terms of its value but also according to its nature”* (Smit & Wandel, 2006: 287). However, beyond this general theoretical framework the question remains of what characterizes the “nature” of AC.

## 1.2. A hasty simplification and unresolved issues

Beyond this wide vision of the determinants of AC, there remain very few studies that, for example, seek to go further in exploring the mechanisms behind socio-cultural or institutional attributes that affect AC in one way or another. As a result, the shortcut is often made to link vulnerability with a low level of development, based on the assumption that the latter includes other determinants. Consequently, the established formula to describe the relationship between V and AC [ $V = f(e, AC)$  where  $e$  is the exposure to hazards] involuntarily encourages a very reductionist vision, according to which the poorest communities are most vulnerable to climate change because they have the weakest ACs. We can for example read: “Developing nations are generally deemed to be most vulnerable to climate change (and other forms of adversity) largely because they lack adaptive capacity. In particular, they lack economic resources and human capital needed to implement technologies to cope with climate change” (Goklany, 2007: 773). We consider that this assertion is problematic because it does not translate the complexity of the real situation.

It is certainly not our intention here to assert that CC does not seriously threaten populations in the poorest countries; such populations are at risk largely because they often already face serious problems of access to resources (water, food...), a situation that CC is very likely to exacerbate. However, it seems that the relationship between V and AC, such as it is usually regarded, leads to neglecting two other factors: firstly, that developed countries will also have to cope with impacts that are potentially very damaging for their development, which also make them relatively vulnerable; and secondly, that there is no evidence to suggest that communities of developing countries lack ability to adapt, or that, conversely, industrialized countries do have this ability. The history of mankind has indeed shown that diverse adaptations have concerned different societies in different contexts (Diamond, 2000; deMenocal, 2001). Besides, we cannot consider

at present that the most advanced countries in terms of economic development have demonstrated remarkable and irreproachable adaptations to environmental constraints. Therefore the underestimation of the capacities of poor communities, and the overestimation of those of developed countries, seems profoundly unproductive, because this limits the AC issue to a strictly economic and technological dimension. However, as demonstrated for example by N. Brooks, W.N. Adger and P.M. Kelly (2005) by a comparison of around sixty countries having a development ranging from low to modest, vulnerability is not directly correlated to the national wealth, which implies that the capacities in economic and technological terms cannot be sufficient to explain all the dimensions of the ability to respond to a crisis and to anticipate the next. Economic and technological capacities only represent one part of the solution (Adger *et al.*, 2009), a part that can sometimes be minor. Surprisingly, this deterministic view of AC (as well as V) endures, even though it conflicts with a holistic theoretical approach. This reality should not be attributed, as it is sometimes written or said, to the bad faith of scientists and international authorities deliberately seeking to “re-translate the dogmatism of the North/South relationship into this new field of adaptation to CC”. In fact, this divergence can be explained by the considerable complexity involved in going from a theoretical holistic approach to a very pragmatic way of addressing the issue and finding concrete solutions. While such a statement is not specific to the area of adaptation to CC<sup>2</sup>, we can however explain it by the fact that research on this subject has actually only emerged during the 1980s and consequently the science on this topic is relatively immature. Moreover, because of the rapid rise of the theme of CC as a new global problem, it is mainly in the sphere of international discussions, including within the UNFCCC<sup>3</sup> framework, that this issue of adaptation has been raised and inducements for action have been searched for. In this context, the issue has been

addressed at the national level, because the aim was to determine as quickly as possible (IPCC reports have always rightly supported the requirement for urgent action) the origin of funds dedicated to adaptation and their redistribution modalities. For this second perspective, the need to compare countries has arisen, and in the absence of established scientific data based on a holistic approach allowing the reliable determination of AC levels of the world’s different populations, the discussions were naturally based on the relationship between V and national wealth (GDP) (Vincent, 2007). Indeed, this represented a quantifiable, measurable approach, for which there was some background, and that allowed a rapid definition of clear options. This process, although justifiable at the scale of international action, contributed to the establishment of the idea that adaptation is primarily a matter of economic and technological efforts, and consequently it can be considered that the poorer a community is, the lower its AC and the greater its vulnerability to CC. A narrow view of the problem has therefore gradually emerged, systematically linking the ability to adapt solely to the level of development. However, this relationship is not always obvious. If V is a function of exposure level and AC, AC schematically depends on both the type of hazards that a society faces (Brooks *et al.*, 2005)<sup>4</sup> and its degree of resistance to impacts, which clearly refers to socio-cultural, economic and political characteristics (Bankoff *et al.*, 2004; Adger, 2006; Berkes, 2007; Magnan, 2009). Thus, a territory with a low risk of exposure to natural hazards could potentially struggle to resist a “new” risk, whereas a society accustomed to managing its development according to frequent and diverse natural hazards – which may be one of the reasons for a low level of development – could appear more able to integrate the effects of CC than the former example. J. Smithers and B. Smit (1997) underline that while some societies are well adapted to the political and economical realities of the modern world, which is the case for the so-called developed

2. The statement also applies for example in similar forms regarding the implementation of integrated management in coastal areas, (Billé, 2008) or the identification of social capital indicators (Pelting & High, 2005).

3. United Nations Framework Convention on Climate Change

4. The elements that come into play to explain resistance and/or anticipation are not necessarily the same, neither facing different natural hazards (e.g. flooding and landslides), nor facing different risk types (e.g. natural, geopolitical and health hazards...).

countries, their development logic has been progressively disconnected from their natural environments, which makes them vulnerable societies to CC as this translates into impacts on natural resources. Following this logic, it is not unreasonable to think that where societies are regularly exposed to natural hazards, the experience of the risk may provide a certain ability to respond to a changing climate and, in fact, a high level of exposure could “coexist” with good AC. One must however remain cautious, because adaptation has an anticipatory dimension that logically implies the implementation of risk prevention and/or crisis management plans (Schipper, 2009), which could remain more difficult to achieve in countries that face other priorities such as food security or political stability.

It is clear from this brief analysis that a great complexity exists that accentuates the difficulty in identifying “priority” populations, but that shows that broadening the understanding of adaptation and adaptation strategies beyond these solely economic aspects is essential. Similarly, it is reductive to consider that technological efforts are the sole option for adaptation, because social links, for example, can constitute an important cohesive force in terms of both crisis response and anticipation. Thus, while it is obvious that a “no regrets” option is to make populations that are less well off economically a priority for action, it is not however sufficient for the more ambitious objective of fighting against CC. Indeed, on the one hand, the latter aim requires a long-term approach (which should not however exclude addressing short term issues); and on the other hand - regarding the diversity of expected impacts on ecosystems and on economic and political reasoning from the local to the international level - it is clear that this problem affects us all in different ways. It would therefore be very hazardous to assume that the indirect effects of CC on the functioning of presently developed societies do not need to be seen as a priority for action at the moment, or that ultimately we could address such issues as they occur. The only certainty that we have today is that passively waiting is a bad strategy. Our view is therefore that, rather than basing a discussion solely on the estimated levels of vulnerability, which are themselves simplified

to ultimately represent only the exposure to natural hazards, it would be more constructive to rely on the existence or absence of AC. The value would then not necessarily be in a comparison of countries, but rather in the identification for each of them, and their territorial components, of what the barriers are to adaptation and how to induce policies and actions. This does not contradict the logic governing international negotiations on climate<sup>5</sup>, but is in fact complementary to them, as it aims more at the practical implementation of adaptation (strategies, programmes, projects). If this approach seems appealing, it immediately raises the following question: how do we appreciate the AC of a territory? At this stage we think that the scientific research is not yet mature enough to provide objective and scientifically based answers to this question, which is partially explained by the lack of a structured framework and tools to analyze the determinants of AC. The precise objective of the two following sections is to propose a research framework.

## 2. Four fields of research to improve understanding of adaptive capacity

The purpose of this section, which constitutes the main body of the text, is to present a methodological approach for the analysis of AC. Four main fields of research (Figure 1) were identified as relevant to ultimately improving the understanding of adaptation mechanisms. By deliberately excluding a specific territorial scale (country, region, small local community...), for each of these areas we will explain the key underlying issues.

### 2.1. Factors influencing AC (Field I)

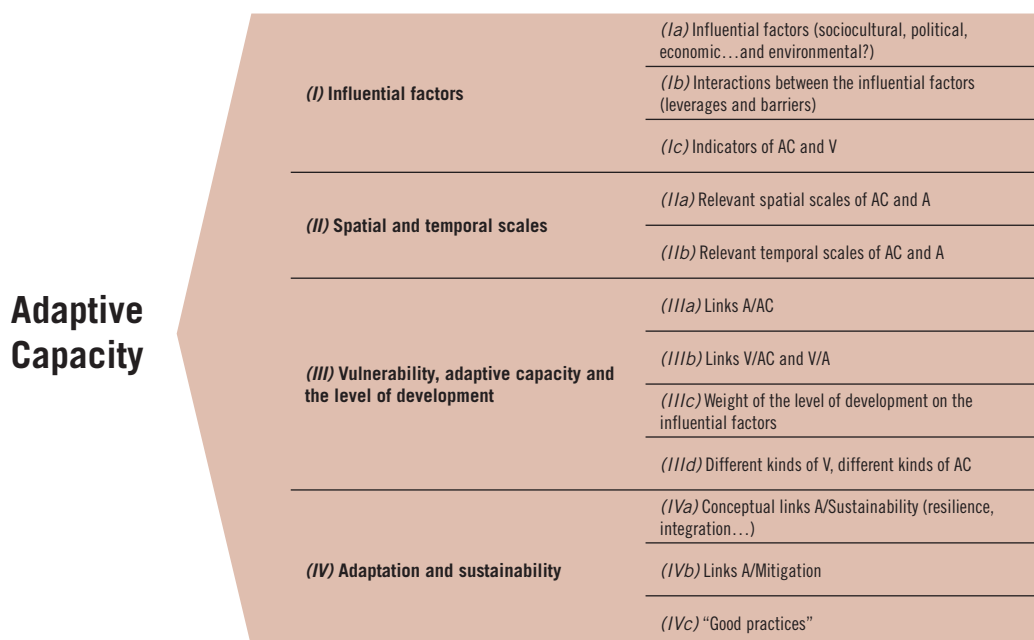
#### The issue

What factors influence the AC of a territory or of a society, and how do they do so? *“There is no common understanding of what is meant*

5. Within the climate negotiations, once more, the association between V and a low level of development may allow a simplification of the problem, which is necessary for advancement (because, as urgency is de rigueur in the fight against CC, the negotiations cannot “wait” for scientific progress; these two processes are evolving in parallel and will hopefully meet one day) and in any event presently leads to a “no regrets” redistribution of global funds.



Figure 1. A research framework for studying adaptive capacity.



AC = Adaptive capacity; A = Adaptation; V = Vulnerability

by the term [adaptation to climate change], let alone how the prospects for adaptation might best be analyzed" (Smithers & Smit, 1997: 300). This statement remains true even a decade later, because beyond the recognition of various spheres of influence (environmental, political, economical, cultural, technological...), the identification of specific determinants remains delicate for two main reasons. The first is due to the identification of factors of influence. Indeed one can search for factors that are either specific to the context of study or more general (Brooks *et al.*, 2005; Smit & Wandel, 2006). The advantages of the first approach correspond to the drawbacks of the second, and vice versa. Indeed, some factors that are relevant at a given scale may not make sense at higher territorial levels (because they are inappropriate), as well as overly general factors cannot account for local situations (because they are too "broad"). In our view, the relevance of the approach lies in the amalgamation of these two visions - determining factors that are broad enough to be transferable from one case to another, but precise enough to allow thorough practical application. Factors that are too general do not actually promote precise research on the field (Smit & Pilifosova, 2003; Vincent, 2007).

The second reason behind the difficulty in identifying factors of influence is that, regardless of what they are, they interact to cause cumulative and/or counteractive effects. The analysis of the interaction between these factors therefore also requires some development. Beyond the individual consideration of these determinants, in which configurations do these factors become a disincentive/inducement for adaptation? What negative feedbacks/synergies are involved? How can they be identified and reduced/promoted? The primary interest of such issues is to facilitate the identification of the characteristics and mechanisms which, for a given territory or society, constitute disincentives and inducements for the implementation of policies, programmes and projects of adaptation to CC.

**Sub-fields of research**

**(I.a) Identification of factors of influence**

The adoption of a broad view on the issue of adaptation ability amounts to an analysis of the importance of diverse features of the system under consideration in order to establish AC. In an attempt to go beyond the identification of large spheres of influence (economical, political, socio-cultural...), but at the same time

using them as a starting point, we propose at this stage to retain four general factors<sup>6</sup>: the living conditions, the socio-cultural cohesion, the politico-institutional framework and the degree of economic diversification.

**The living conditions** – If understood broadly as applied to the whole system under consideration, the living conditions allow an initial picture of the situation to be drawn, and therefore favour the establishment of a development framework in which other determinants of AC come into play. At this stage it is important to state that there is no intention to judge the level of development of a territory or society, because this would equate to the stereotype described above, which this research is trying to work against. However, the capacity of a society to respond to disturbances and to act in anticipation relies partly on the ability of individuals to integrate these constraints into their habits and lifestyle choices. Yet, this depends in turn on initial characteristics that can be schematically grouped into various categories: demography (growth rates, densities, age structure...), housing (housing types and occupancy), education<sup>7</sup> (adult literacy, youth education, access to diplomas...), employment (which refers notably to household income), access to public and private transport (networks, availability of vehicles...), energy supply methods (referring to the challenges associated with these sources), or socio-sanitary aspects (health status of populations, capacity of healthcare structures...).

**The socio-cultural cohesion** – The second factor that we can mention is socio-cultural cohesion that is based both on the social relationships within a group and on the sharing of a cultural and/or territorial identity among its members. The question is then: how does socio-cultural cohesion work in favour of an ability to adapt? The answer refers to the mechanisms of human

solidarity, in both the management of known crises (reactive adaptation) and in the implementation of anticipation plans (proactive adaptation). However, as in the case of ‘living conditions’, it is important to be vigilant regarding how to link socio-cultural cohesion with AC. Indeed, as J.-M. Callois reminds, social cohesion is not always a guarantee of sustainability. If real benefits are to be expected (capacity of collective action, emotional support between individuals, sharing of goods and resources, social control of non civic behaviour...) “*strongly embedded social traits may lead to very closed society*” (Callois, 2006: 6). Strong social networks may thus ultimately affect innovation and economic dynamism, both individually and collectively; “*(...) social cohesion can maintain an acquired situation [which] can lead to a shift in terms of productivity, adaptation to the external environment, from which can result an economic and social ‘catastrophe’ that will be much bigger in future*” (Callois, 2006: 6). This refers to two key considerations. The first concerns the ‘thresholds’ that are specific to each group, beyond which the socio-cultural cohesion negatively affects the AC, and the adjustment of the group to endogenous and exogenous stresses of various types (environmental, but not only). The second element refers to the imperative to question ourselves regarding the ability of societies to adapt to CC, not only taking into account the changing climate itself, but also by comparing these changes with the likely socio-economic developments (Smithers & Smit, 1997; Vincent, 2007). Finally, we will underline here that another reason for regarding the manipulation of the socio-cultural cohesion factor with caution is that social relationships have an impact on the social dimensions, but also economic and environmental ones, and their consequences can be both favourable and harmful for the stability of the system (territory or society) (Pelling & High, 2005; Callois, 2006). In other words, they are both causes and consequences of other features and mechanisms of society, and therefore have a more or less direct influence on other AC determinants. This point is developed within the framework of the sub-field (*I.b*).

**The politico-institutional structure** – This third factor of influence refers to mechanisms that govern the functioning of the territory. It reflects the fact that a territory consisting of

6. It should be noted here that the order of presentation of these four factors is not guided by any will to show a hierarchy that reflects an alleged increase or decrease of influence on AC as a whole. Thoughts on this subject are not sufficiently developed at present for the identification of such a hierarchy of influence, if indeed it exists and can be established.

7. It must be stressed upon here that the relationship between education and AC must be viewed with caution, because a high level of education does not inevitably induce a precise knowledge of all the risk types that threaten a territory, and all the responses that can be adopted. Panic movements in major cities provide an example.

districts with few links between them will a priori tend to see a reduced manoeuvrability<sup>8</sup> compared to those of an area whose functioning is also based on the connection of networks. The key notion raised here is that of ‘territorial coherence’, which complements to some degree the socio-cultural cohesion. As for other factors, the concepts of networking and cohesion can be double edged. Bearing this in mind, the idea of ‘territorial coherence’ seems important for the understanding of the degree of fluidity in decision-making and in the implementation of collective actions at different timescales. However, this fluidity – or flexibility – ultimately builds up the core of the adaptation principle<sup>9</sup>. Thus, a relatively simple hierarchical organisation, characterized by a limited number of hierarchical levels, can be characterised by certain flexibility in decision making and by a level of responsiveness in application that may prove essential in an adaptation process. Indeed, some responsiveness is a part of the ability to adapt. Similarly, a complex hierarchical organisation, while able to demonstrate an ability to consider and to implement management plans for natural hazards, for example, can also be characterized by too much red tape (e.g. administration) that negatively affects the overall flexibility (Tainter, 1988; Diamond, 2000). This point reminds us that the analysis of AC must be carried out on an objective basis, without value judgments that would lead to the consideration of some organisation patterns as being a priori more apt than others to adapt to variability such as climate change. Indeed, beyond the political and institutional forms and the reasons that motivate them<sup>10</sup>, “*the most important element is the functioning of institutions and the temperament of leaders*” (Callois, 2006: 3).

8. We refer here to the term ‘manoeuvrability’ used by J. Smithers and B. Smit (1997), for example, to underline that in terms of adaptation to CC, “the preservation of future options is as important as the immediate response” (138).

9. The terms fluidity and flexibility refer to the idea of adjustment that is mentioned in the official definition of adaptation by the IPCC, and hence the idea of an evolutionary and adjustable approach to the adaptation strategies that should be promoted (Burton, 1997; Smit & Pilifosova, 2003; Magnan, 2010).

10. The current politico-institutional structures have part of their roots in more profound features of society, as shaped through time (Blaikie et al., 1994). This explains why a particular organisation may face internal logic that can make it difficult to adopt new operational modes that would be more in harmony with the objectives of CC adaptation.

**The degree of economic diversification** – If the first part of this text cautioned against the over-estimation of the importance of the economic factor on AC, the fact is that it remains an influence. More specifically, and given that the economic capacities of the population are taken into account within the “living conditions” factor, it seems that in terms of system flexibility, of its ability to adjust to ongoing and future changes, attention should be focused on the level of economic diversification. Indeed, in some cases, the presence of several economic pillars can offset the consequences of a disturbance in one of the key sectors, and beyond this provide an opportunity for the deployment of a multi-branched adaptation strategy. On the one hand, this complicates the prioritisation that must be defined for each sector, because it is necessary to avoid negative feedback from one sector to another which would constitute maladaptation. On the other hand, it gives the system a range of economic opportunities on which it can act to limit or even avoid disruptions. Conversely, if the territory’s economy is built on a single economic sector, then the risks of the system as a whole being affected by a disturbance (punctual or gradual) are particularly important, since its flexibility will be highly constrained. Moreover, too much economic specialisation may limit the range of jobs and skills, which in turn restricts the range of options for reaction and innovation. We therefore support the idea that diversification of the economy reinforces AC. However, the question arises once again of the existence or not of a “threshold of diversification”: do multiple activities have a declining influence when a certain degree of fragmentation of economic sectors is reached, and when there is no strong sector that characterizes the area anymore? In other words, is it inevitable that a territory has a number of highly dominant sectors in order to have sufficient economic capacity for adaptation? The comparison of very different situations, from both developed and developing regions, should help answer this question, and would also probably show that there is no perfect economic model for adaptation, but rather a variety of configurations which all have advantages and disadvantages in terms of AC. Again, it seems important to remember that no moral determinism should prevail in the scientific analysis of AC.

Finally, if these four factors seem relevant, the approach remains open to other options including that of the influence of environmental characteristics on the AC of a given territory. One can indeed consider that ecosystems that are more or less vulnerable, more or less diverse... do not influence the AC directly, but rather affect V through the “exposure” component. In this case, the environmental characteristics provide a framework for AC, but do not directly affect it. Conversely, we can assume, in the same way W.N. Adger, N.W. Arnell and E.L. Tompkins (2005) do, for example, that AC encompasses the triple facility to reduce the sensitivity of the system, to modify its exposure and to increase its resilience, in which case the environmental characteristics fully contribute to the AC. This relationship requires exploration.

#### (I.b) Interactions between these factors, identification of disincentives and inducement of adaptation

The analysis of interactions between factors of influence constitutes a second sub-field of research that complements the preceding one, in that each of the determinants identified previously, firstly, does not act in isolation from the others, which explains why negative feedback as well as synergies can operate; and secondly in that they do not always act in the same way depending on the context. The aim is then to identify which feedback effects are at work, that is to say what are the mechanisms that impede the AC (disincentives to adaptation) and which ones reinforce it (the inducements on which to base the adaptation strategies). As a matter of fact, the process of seeking to understand and strengthen the AC cannot avoid this delicate stage, as a solution in a particular territory or sector can be an excellent adaptation initiative, whereas once it is placed into another context, it proves to be a form of maladaptation. A first line of research should therefore deal with the ambiguity that characterizes the influence of one determinant from one situation to another, so as to clearly identify the way in which a given factor acts in a given context. While economic diversification can be favourable towards a consolidation of the AC of territory X (multiplication of sources of income and employment), it can also expose the global economy of the territory Y to multiple sources of stress, which may harm the overall

stability of Y and, ultimately, reduce its AC. In another set of circumstances, the existence of strong social relationships (which are part of a socio-cultural cohesion) may have at the same time and on the same population some effects that are both stabilizing and weakening. Concerning the example of the ‘socio-cultural cohesion’ factor, we can also suggest another area of research that seeks to link the various factors of influence to reveal synergies and negative feedback effects. J.M. Callois states that *“nothing guarantees that a strong organizational capacity within a territory will be of benefit to all the territory’s inhabitants”* (2006: 6), in other words, a strong politico-institutional structure does not automatically guarantee efficiency in terms of collective action, because the effects of expansion may emerge within the population’s constituent groups, with a deleterious effect on the territory’s AC in the face of climatic changes that will affect the whole population. Similarly *“if [social] networks are too closed in on themselves, new information will not circulate, and there will be a risk of difficulty in maintaining an economic performance in a changing and competitive context”* (2006: 6), which will eventually sever the territory from its opportunities for economic diversification. Other ‘contradictions of influences’ must be raised which can only emerge as a result of practical experience. Thus, the theoretical framework will gradually build upon itself as it progressively confronts the practical situation, and vice versa. This is particularly true regarding the overlapping influences of different AC factors. Overall, this sub-field must highlight how important it is for adaptation to CC to succeed in finding a ‘compromise’ between these various influential factors, through a ‘balance of development’ which is itself evolving. It then makes it possible to propose methods for avoiding negative feedback and promoting synergies, thus managing to find this point of ‘compromise’ or ‘balance’. It is in the opinion of the author that adaptation strategies must be built on this nuanced and pragmatic basis.

#### (I.c) The development of indicators

At this stage, it is important to consider the identification of a ‘formula for equilibrium’ between these different factors. This configuration will provide a structural framework for efforts to strengthen the AC. Indeed, all of

these factors could form the basis of a methodological evaluation grid of the AC, which requires a further search for relevant indicators and criteria that are able to describe each of these factors pragmatically, that is to say, to use concrete data collected on the field to describe the nature of a factor (statistics, interviews, surveys, observations...). This approach, involving the use of indicators, appears useful to describe and quantify situations. It does not come, however, without several problems, one of which is that it is based on a view that is often described as deterministic, whereas in fact the combination of all the influential factors and their interactions, as said before, is specific to the studied context. Yet, the construction of an analytical grid based on indicators and criteria does not inevitably involve the levelling out of contextual features from one case to another. Our position has more to do with the use of this analytical grid as a working framework that can be reproduced in different case studies, providing a grounding that is as objective as possible for each case study. Here we fully agree with the idea developed by B. Smit and J. Wandel (2006) according to which research on V and AC is based on indicators that will certainly raise interesting points in terms of the analysis of V and AC, but is often limited to the measurement of V – and eventually AC – without improving the understanding of determinants and underlying processes. This clearly limits the impact of such approaches, which are quite cumbersome to implement, because their only use, after having identified specific levels of V or AC, is to determine where the most vulnerable zones and/or populations can be found. While the numerical and mapping work is undoubtedly of value, it is unfortunate that it is not often used, through the measurement of criteria and indicators, to identify what factors increase or weaken V and AC.

## 2.2. The spatio-temporal scales of adaptation (field II)

This issue underlies the factors of influence. Indeed, making reference to different determinants and their multiple interconnections means that “*the coping range [= adaptive capacity] is location-specific, group-specific and time-specific*” (Smit & Pilifosova, 2003: 14). The current problem is that beyond these general

observations, there are few studies that practically explore these various dimensions of adaptation for a single case study. Similarly, the importance of the connections between these different approaches (local-global, short-long term) is put forward, but never proven, so we never really know whether one approach is more relevant than others in terms of adaptation, if ever relevant altogether. These questions are important insofar as within them lies the relevance of one specific adaptation strategy or adaptation project. The underlying issue is as much to avoid maladaptation (an option that is relevant at one level but counter-productive at another) as to identify the most robust options (valid for a wide range of developments).

This section proposes to examine further the issue of the scales of mechanisms of adaptation to CC, differentiating in particular between spatial and temporal dimensions, and then combining them. The third dimension, which is of communal nature, referred to by B. Smit and O. Pilifosova (2003), is not specifically addressed within the frame of research that we suggest, but we think is tackled through spatial and temporal dimensions, but also through the other research fields (mainly I and IV).

### The issue

The issue of adaptation methods, and therefore of the characteristics on which they are based, is not independent from the question of scales. What spatial and temporal scales are relevant for the discussion about adaptation? And beyond this, on which interactions between scales (spatial, temporal and spatio-temporal) should decisions and actions be based?

### Sub-fields of research

#### (II.a) Spatial scales of adaptation

The intention here is to address the spatial dimension(s) of adaptation. While the local scale is relevant for the implementation of sustainability and adaptation solutions, it is clearly insufficient in itself because it requires some connection to regional, national and international scales. Conversely, decisions made at national and international scales are required, in order to be relevant and realistic, to take local issues (environmental problems, social inequalities, stakeholder relationships...) into account. The issue here relates to the territorial levels, above or below which the objectives and types

of adaptation are no longer relevant and must be replaced by other goals and other forms of adaptation. The overall design therefore refers to the complementarity of spatial scales in adaptation strategies. Therefore, while any adaptation strategy must take into account this multi-scale dimension, various approaches related to different scales should not necessarily have the same importance in the overall strategy, that is to say, in the way that adaptation is planned and implemented. Depending on the considered objectives and stakeholder types, some scales of operation may be preferred to others, thus constituting preferred access points that will allow the system as a whole to adapt. To sum it up, while the different spatial scales of adaptation are complementary, they are not always equivalent in terms of their value for the implementation of adaptation. As a result their order of importance will vary naturally from one situation to another depending on the targeted objective of adaptation. The challenge then lies in reaching an intersection between the objectives of different stakeholders, both public and private, for the same project, which in this instance is adaptation to CC. Note that this type of compromise is found in a similar way in other areas such as environmental management or the reduction of socio-economic inequalities.

#### (II.b) Time scales of adaptation

Following the same logic, the aim now is to address the timescale and rhythms of adaptation. Adaptation is most often understood in terms of its anticipatory dimension, and its inherent long-term outlook, because it refers here to the subject of CC which places the long-term at the core of the debate. However, the adaptation strategies that will prove effective (or not) over a long period of time (several decades) will need to be considered and sometimes implemented as soon as possible. In the same way, options that address current challenges can also tackle future issues. This is especially true given that it is impossible to make a clear distinction between natural hazards inherent to current climate variability and those specifically related to CC<sup>11</sup>. Indeed,

*“societies and economies function and evolve within the capriciously fluctuating climatic environment, and examples of adaptation to climate are all around us. They are embedded in building construction, transportation systems, agriculture, leisure activities, and many other elements of daily life which are somehow structured or designed to take account of prevailing climatic conditions. Thus, the concept of adaptation relates as much to current climatic variability as it does to long term climatic change”* (Smithers & Smit, 1997: 130-131).

We may therefore speculate on whether the opportunities that warrant development should themselves be long lasting. Short-term options (air conditioning or snow guns, to use the classic examples), while they are immediately effective, may indeed prove to be counterproductive in the long term (conflicting with mitigation efforts or are inadequate for future conditions). However, must they be avoided a priori? Not necessarily, because they may paradoxically constitute a stage within a strategy concerning the evolution of a development pattern that is more spread out over time (change in economic structure, for example). An evolutionary vision of adaptation is supported here, that is to say, one in which the foundations change over time according to the changing contexts and also because the choices made today induce a gradual development of AC. Therefore, it is on the complementarity of time scales that the relevance of adaptation strategies must be based. It is ineffective to envisage only the long term without considering current issues (which are equally part of adaptation), and the inverse is also true. But, in the same way as for spatial scales, all time scales cannot be addressed jointly and with equal intensity using the same adaptation strategy. One of the reasons for this, for example, is that long-term investments may be in conflict with more immediate economic needs. Thus, a compromise must again be found, which means favouring one type of policy/action over another, and this compromise will vary from one context to another and also evolve within a single context. This consideration of the logic that leads, from an adaptation to CC perspective, to the favouring of a particular time scale - the same applies for spatial scales - seems inevitable in the sense that it is erroneous to believe that we can systematically, and in one step, embrace all the time scales.

11. Schematically, climate variability refers to a variation of climatic components (temperature, precipitation...) around an average, while CC refers to a change to these averages.

### (II.c) Relationships between spatial and temporal aspects

In fields *II.a* and *II.b* we highlighted the fact that adaptation and AC have two dimensions: one multi-scale and one multi-temporal. These dimensions are actually intrinsically linked and again, synergies and antagonisms can occur. According to this view, an adaptation strategy can be considered as a patchwork of options (at different territorial levels and with objectives over different time scales) rather than as the current search for a unique solution that will remain relevant regardless of the climatic changes and their impacts. This viewpoint seems particularly applicable to circumvent climatic uncertainties, especially because the set of different options can provide the development scheme with a certain degree of flexibility. However, the ability to “juggle” the diverse options and to correctly link them in time – in order to avoid one counteracting another – is fundamentally dependant on the AC, through elements such as the acceptability of collective policies to individuals or the coordination of institutions, for example. This refers to the broader concept of territorial governance with the idea, which is always in the background, of reaching a compromise between different issues and different ways to address them.

## 2.3. Vulnerability, adaptive capacity and level of development (field III)

### The issue

This field is based on the stereotypical assumption explained in the first part of this text. What relationships actually exist between V, AC and the level of development? Are “poor” communities always the most vulnerable? Do wealthy communities from developed countries demonstrate other forms of vulnerability? And do they always show better adaptability than the former?

### Sub-fields of research

#### (III.a) Relationship adaptation/adaptive capacity

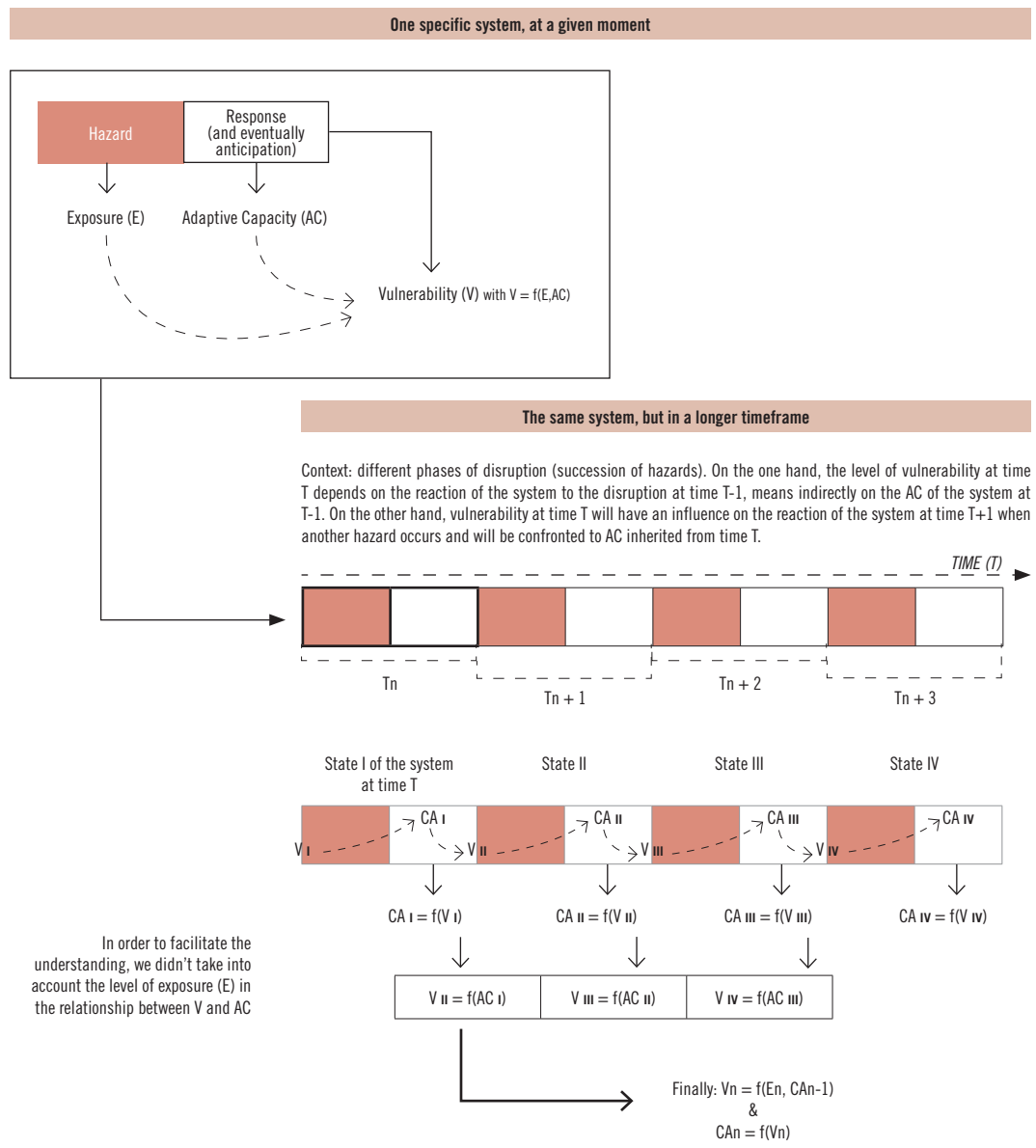
Does a strong AC inevitably imply that a particular territory will be considered able to adapt? Yes, providing that the AC does not weaken over time, exposing the territory to the consequences of CC. This echoes the changing conception of the issue of adaptation, in the

sense that the AC at a time T cannot provide a guarantee of the AC at a time  $T_{+1}$ . Indeed, it can only provide such a guarantee if the policies and mode of development in general favour the strengthening of the AC, that is to say, they do not weaken the characteristics of the territory which, at a time T, were strengths and attributes that supported adaptation. At this point we intersect with the ideas from *field II.c* to show that AC is a feature of a territory or a society which necessarily changes, but is not sufficient in itself to explain adaptation. Without a strong political will to initiate a process of adaptation, what then is the point of being able to adapt? This refers back to the idea that the analysis of AC is relevant in the sense that it reveals an adaptation potential, rather than a real ability to adapt. This is what makes it a companion for decision-making because it raises the necessary basis for the identification of the compromise that is to be established between spatial scales, time scales, different objectives, different stakeholders..., compromises that depend on political and social choices.

#### (III.b) The relationship between vulnerability/adaptation and vulnerability/adaptive capacity

The previously described analysis should enable the enhancement of understanding on the relationship between V and AC and notably, by exploring in greater depth and according to different spatial and temporal scales, how the strengthening of AC can deliver a reduction of V to CC, and whether this inversely proportional link can be always be anticipated. Indeed, as suggested earlier, in certain situations a low level of V can hide a low AC. In this context, will the improvement of AC critically constrain V at a low level? The evolutionary dimension of AC as well as V introduces the idea that there is a circular relationship between V and AC (Figure 2) and that, ultimately, the link between the increase of AC and a reduction of V will be revealed over time. It also shows that depending on the circumstances and contexts of study, we can address the issue of AC either directly or by entering through the analysis of V. This second option may often seem preferable because many studies of V already exist for many territories, which can constitute a working basis.

Figure 2. The iterative relationship between vulnerability and adaptive capacity.





**(III.c) Importance of the development level**

Through the analysis of the importance of the level of development on the various factors that influence AC (*field I*), this sub-field complements the previous two. If the latter have a more conceptual scope, the virtue of this sub-field is that it has to be based on the analysis and comparison of current case studies. This exercise is made relevant through the comparison of territorial levels of the same magnitude as well as territorial levels of different hierarchical levels. Thus, we also bring new elements for discussion in the *field II.a*. This field will ultimately provide very concrete arguments to counter the stereotypical belief expressed in the first part of this text.

**(III.d) Different types of vulnerability, different types of adaptation**

All this work should show that there is not one single form of V to CC or only one type of AC, but rather a range of configurations that do not involve all the influential factors in the same manner, and that do not equally refer to the same spatial and temporal scales. If a typology of situations is established, the objective is to demonstrate that there are different ways to be vulnerable to CC and different ways of being able to adapt. According to the initial objectives of our work and those of this text, this approach results from a strong scientific commitment to analyze the statement: “*adaptive capacity is context-specific*” (Smit & Wandel, 2006: 287) from a viewpoint that is more pragmatic (by providing field work) and nuanced (contribution of conceptual work). This leads us to hypothesize that it is not always wise to systematically attempt to compare situations that are too different, such as the V of the United States of America and that of the island of Mauritius, for example. In some contexts, however, such as those of international negotiations or the development of national public policies, the comparison approach has its virtues, precisely because it provides the necessary framework. But one should also be aware of its limitations. Again, this should put into a different light the debate on the stereotypical idea that communities from developing countries have lower AC than those of industrialized countries, and indirectly that the latter are less vulnerable to CC. The consideration of a variety of forms of V and AC modalities indeed implies

that contexts, that are sometimes extremely different, must be addressed from viewpoints, policies and tools that are themselves also different, all this being based on spatio-temporal approaches whose relevance may by nature vary greatly from one context to another.

**2.4. Adaptation and sustainability (field IV)****The issue**

An increasing amount of scientific studies show that the effects of inertia that are characteristic of the atmospheric system will induce a change in the current climatic conditions regardless of the efforts undertaken today in terms of reducing the emissions of greenhouse gases (Rahmstorf, 2007; Parry *et al.*, 2008, Solomon *et al.*, 2009). At the same time, we know that for reasons that are mainly related to climate modelling work, uncertainties about CC effects at the local scale will remain significant for at least the next decade (Terry & Braconnot, 2008; Knutti, 2008). It is therefore appropriate to consider adaptation to CC no longer as a simple option, but in fact as one of the essential aspects of sustainable development (Smit *et al.*, 1999; Dovers, 2009; Magnan, 2010). One could even go further by stating that, on the one hand, considering the emergency for action in the fight against CC, and on the other hand the need to develop a global and systemic approach to the consideration of adaptation (at the crossover between different issues and objectives), the attempt to adapt constitutes a real driver<sup>12</sup> for the implementation of sustainability. Nevertheless the question remains regarding how to embed the logic of adaptation into that of sustainability, thereby raising the subject of mainstreaming. One *modus operandi* is to consider the linkages (synergies and antagonisms) between adaptation and other key mechanisms of sustainability. This area belongs in a theoretical and conceptual approach, but we support the idea that it is essential for refining the more pragmatic analysis proposed in the previous three areas.

**Sub fields of research****(IV.a) Conceptual links between adaptation/sustainability**

The objective here is therefore to examine the link between adaptation and other key terms

12. An opportunity?

of sustainability. We can for example highlight the following areas:

- Adaptation, *flexibility* and *resilience*: a first step of the reasoning consists in asking to what extent the resilience promotes system flexibility, the latter being at the heart of AC. A second stage aims more at the link between adaptation and resilience: what differences and convergences can be identified between the mechanisms of resilience and those of adaptation? Following which argument can we then support the potential complementarity between adaptation and resilience? Then, how can this be translated into political strategies and actions?
- Adaptation and *integration*: integration is a process that aims at achieving the convergence of the components of a system around common goals, components that can initially have more or less compatible interests. Can we adapt without integrating? Is it possible to continue with a “formula for integration” without adapting it? In other words, the purpose here is to compare the global and systemic approach that is indispensable for adaptation with that required by the issues of sustainability, in order to demonstrate to what degree adaptation can be a driver for sustainability;
- Adaptation and *precaution/anticipation*: what fundamental differences are established between the adaptation strategy and the precautionary principle? Ultimately, is it not the purpose of both of them to anticipate future developments without knowing if they will occur? Should we combine adaptation and precaution? Is adaptation merely the ability to anticipate? To what extent would solving current problems (of environmental protection or improvement of living conditions, for example) participate in adaptation?
- Adaptation and *innovation*: if both adaptation and innovation seek to reveal new ways of living today while also looking ahead to the future, is innovation necessarily an essential element of adaptation? In other words, can we adapt without innovating? This complements the previous questioning regarding the respective importance of the gap that must be “filled in” and the new initiatives in the general adaptation approach. One of the main goals of the enquiry is to show what

types of actions can be implemented today (because they are known but not yet realized) and which ones require innovation;

- Adaptation and *development*: to what extent can adaptation be considered as an inducement for development, and development as an inducement for adaptation? How do adaptation strategies integrate into and/or differentiate from development processes? Clearly, the purpose here is to question the *mainstreaming* approach, by distinguishing its advantages and its limitations, the latter often being neglected.

Together, all these areas must also allow the strengthening of the link between adaptation and *uncertainty*, particularly by bringing new elements of thought on the way to integrate climatic uncertainty into the current and future development strategies. Thus, these elements of knowledge on common mechanisms of adaptation and sustainability will provide arguments in favour of the message that climatic uncertainty should not constitute an “alibi” to wait and do nothing.

#### (IV.b) The link between adaptation/mitigation

This field of reflection, which is already the subject of much research, is of paramount importance for the implementation of adaptation, in the sense that strategies for adaptation to CC cannot be separated from the issues of reducing greenhouse gas emissions, and furthermore, mitigation efforts impose constraints, and will continue to impose an increasing number of constraints, on the functioning of societies and thus indirectly their AC. Thus, thoughts on adaptation should necessarily take into account this link between adaptation and mitigation, and the key question is: between the issues of adaptation and mitigation, what synergies must be encouraged and what counterproductive feedbacks must be avoided in the context of pragmatic strategies to fight against CC and, more generally, to build sustainable development? We find here the underlying issue of relevant spatio-temporal scales (*field II*).

#### (IV.c) “Good practice”

Finally, to develop research that is useful for decision-making and action, it is important to acquire a critical eye for what is “good practice” in order to complete the analysis of the circumstances surrounding the implementation of

adaptation to CC. The term “good practice” appears regularly in various documents, including the “guides for good practice” because it is reassuring and provides a valuable example. However, it seems that good practice has not yet been sufficiently mastered to fully enable it to fulfil this function of providing an example, and therefore to be used correctly. Indeed, because the principle of good practice is to adhere closer to the realities of a given situation, good practice can only be contextualized. Therefore, transferring a good practice from one context to another requires readjustments, precisely because the overall conditions change. This therefore requires distinguishing between good practices themselves (the specific action identified in a particular place) from the principles of good practices (the general logic behind the action), because our thoughts must be based on the latter. The objective merges with those of the other areas of research proposed here, namely the identification of principles of adaptation to CC. This approach requires an applied research based on rigorous fieldwork, which is itself based on precise analysis grids (to ensure objectivity from one case to another, and comparability between different situations). This can be done at different spatial scales (national instances, local cases...) and on various subjects (territories, economic sectors, population groups...). Beyond the identification of forms of organisation and management methods that work in favour of adaptation to CC (for example, a tourist building that is set back from the coastline), this field requires work on the relationship between stakeholders that are involved more or less directly in the adaptation process. Several questions can then be addressed: what are the prerogatives of international organisations, states, local communities, local populations...? What balances are to be built between public and private intervention? How can the different visions and goals be reconciled? Once again, we find here the central idea of compromise that was discussed in *field I* (factors influencing AC) on which must ultimately be based the characterisation of what is meant by “good practice”, at the intersection between environmental and human issues. However, the bases of this compromise are themselves necessarily contextual. Ultimately, *field IV* in its entirety should provide

input for more conceptual thinking about the factors that influence AC (*field I*) as well as the relevant spatio-temporal scales (*field II*). One of its aims is therefore to establish a number of guidelines (“recommendations”) on which to base the identification and implementation of pragmatic strategies for adaptation to CC.

### 3. From adaptive capacity to adaptation pathways

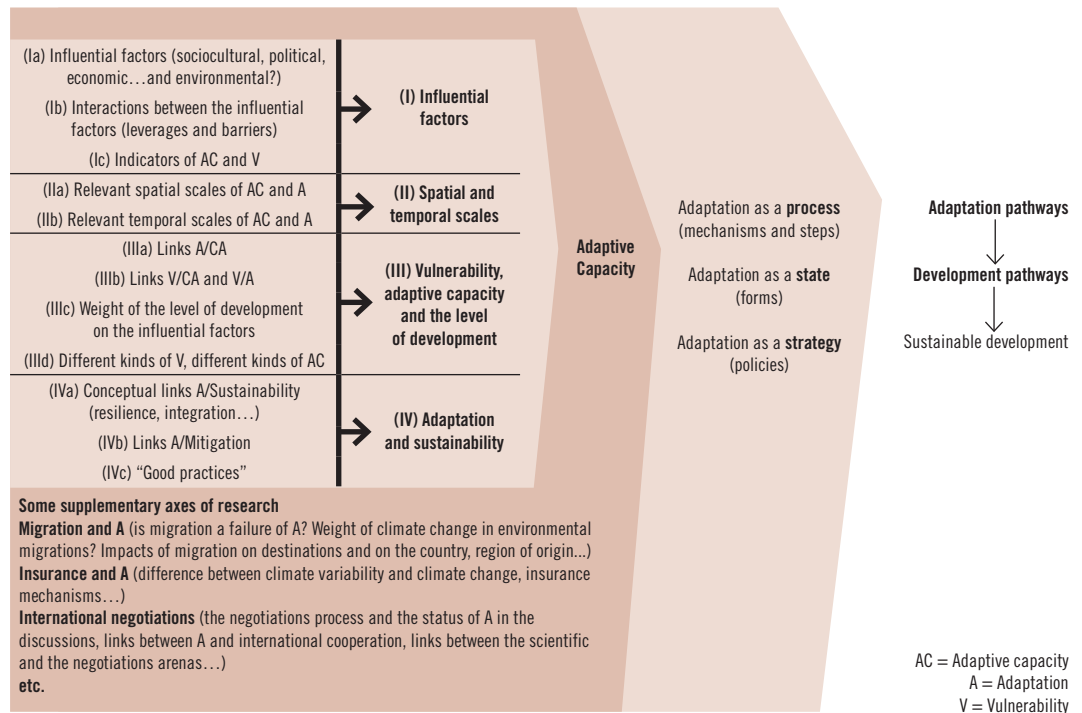
The four research fields developed in the previous section are useful in the sense that they allow a better understanding of the various dimensions of AC to CC. Therefore, their general value is to lay the foundations of knowledge to subsequently place the analysis of AC and its logic in the wider field of adaptation to CC, then in that of sustainable development (Figure 3). To make this link, a three-step approach is proposed here that goes beyond AC as the object of study to focus more on adaptation in general and the bridges that exist between adaptation to CC and sustainable development. The goal here is to propose a general theoretical framework within which specific analysis of AC is included, in order to more easily enable the positioning of knowledge, which is sometimes very accurate and specific regarding AC (the influence of a particular factor compared to another in a specific case study, or an example of “good practice”...), within a broader scientific context.

The three steps mentioned here address (i) the three main aspects according to which we can decipher what is meant by adaptation, (ii) the necessarily changeable nature of adaptation patterns that actually describe the “adaptation pathways”, and (iii) the inclusion of these trajectories of adaptation in the broader set of “development pathways”. We argue that the question of trajectories (of adaptation, of development) constitute an angle of approach that is appropriate for addressing sustainability in the long term, because it encompasses precisely this idea of change in continuity.

#### 3.1. The three dimensions of adaptation (process, state, strategy)

It seems to us that by addressing the issue of AC and adaptation to CC, three aspects of what we call adaptation must be distinguished. We

**Figure 3.** From adaptive capacity to adaptation pathways and development pathways: a theoretical framework.



can indeed find in adaptation a *process*, a *state* and a *strategy* (see Figure 3). Whereby, adaptation as a *process* equates to adaptation in the course of action or not; adaptation as a *state* is whether something means to be adapted or not; and adaptation as a *strategy* is a willingness or not to adapt.

**Adaptation as a “process”**

The adaptation *process* refers to the *mechanisms and steps* of adaptation, that is to say, to the logic that is specific to the system and which explains the development of the various forms that adaptation can take (projects and policies, e.g.). It is based on the factors that influence the AC of the system and their interactions (see Figure 1), and it applies to various spatial and temporal scales. Thus, and according to the necessarily global and systemic characteristic of adaptation, the *process* aspect includes both environmental and anthropogenic dynamics that characterize the studied territory. Finally, note that the *process* aspect specifically refers to the idea of making changes to the development patterns that are to be promoted. The notion of flexible strategies reappears here, being at the core of the system’s ability to adapt, and it shapes the adaptability of the latter in a changing context, particularly under the influence of CC.

**Adaptation as a “state”**

Adaptation as a *state* refers to the *forms* of adaptation in practice, in diverse spheres and at different spatial scales. This can include forms that are tangible (projects, groups of associations, a national adaptation plan...) or not (an interest group, a change of practice...). Adaptation as a *state* reflects the fact of being adapted or not to the natural and human environment at the moment we make an assessment. This refers to a certain unit of time, i.e. to the fact that the adaptation *state*, or the fact of being adapted, is intrinsically linked to a specific timescale. In other words, while it is possible to say that society is adapted (or not) to current climate variability, it seems impossible to say a priori whether this society would be adapted (or not) to CC. Indeed, CC is an expression of certain conditions that inevitably change and which are not known in advance. Therefore, a society that has adapted to the climatic conditions at a time T may no longer be at a time T<sub>+1</sub>, while the reverse is also true. These variations are based precisely on the AC of such a society and on its ability to induce changes. Thus, ideally, a society will maintain its state of adaptation, and it is only with hindsight that we will be able to say, by considering the long term view, whether its adaptation was

successful or not. Without further examination of this topic, we simply note here that the discussion on relevant time scales refers to the idea of changeable mechanisms of adaptation and therefore the *process* aspect. It thus appears that the first two aspects, as well as the following one, are complimentary, and it is precisely for this reason that this framework is an interesting tool for the analysis of adaptation in general.

#### Adaptation as a “strategy”

Finally, a third aspect of adaptation is *strategy*, i.e. a policy. Adaptation then refers to a logic that is no longer a *process* or an action in the precise sense of the word (*state*), but rather to an intention to act, and this action is being put forth through modes of territorial and societal management, development planning... This includes both the concept of intention and the concept of anticipation and consideration of present and future issues. Once again, the inevitably changeable characteristic of adaptation is put forward and contrary to the *state* aspect, adaptation understood as a *strategy* involves mixing together different time scales, as well as it implies the consideration of multiple spatial scales. Obviously, this division may seem somewhat artificial, as *process*, *state* and *strategy* maintain relationships of causality, which can also be manipulated in different directions. These aspects are more connected than they are distinct. However, the need to dissociate them, even artificially, is real because, beyond providing input into conceptual thinking on adaptation to CC, this exercise can help the understanding of scientific knowledge on adaptation and AC by different interlocutors, leading eventually to a better understanding of the logic of adaptation in general. Indeed, different interlocutors have their own cultures and address the issue of adaptation according to this cultural filter, i.e. through one of the three aspects identified here, but rarely all three at once. Very schematically: national politicians will tend to enter the subject from the perspective of *strategy*, thereby referring back to aspects of policies for which they are responsible; a farmer will also refer to action, but will be constrained by short-term logic and will not necessarily take into account the *strategy* aspect, but will above all consider adaptation

as a *state*; a philosopher will probably focus more on *process* aspect of adaptation. We thus support the idea that distinguishing between these three aspects of adaptation can improve the representation of scientific knowledge at different territorial scales and give them a real societal utility. We can notably specify that the development of relevant – because they are contextualised – adaptation strategies can greatly benefit from this three part analysis, because it allows, through segmentation, firstly to identify all the components of a territory/society that are involved in adaptation (including through AC), secondly to bring out different ways and different types of tools (policies, regulations, social...) to implement adaptation. The challenge then is to link these components.

### 3.2. Adaptation pathways

#### From the three dimensions of adaptation to adaptation pathways

Consistent with our dynamic vision of adaptation, the intersection between the *process/state/strategy* dimensions introduces another idea, that of *adaptation pathways*. By *adaptation pathways* we mean the path taken by a territory (whatever the spatial scale considered) to attempt to adapt to CC (including climate variability). The pathway concept thus underlines the imperative to consider adaptation strategies in a dynamic, and certainly not static, manner. In other words, rather than trying to determine the current forms of adaptation that will address future challenges without requiring modification, it is better, according to the principle of adaptation pathways, to attempt to identify major guidelines that allow a great amount of elasticity – the concept of flexibility – from the perspective of the implementation of adaptation. Indeed, it seems more relevant today to build sound *strategies* for adaptation based on a correct understanding of the adaptation *process*, rather than simply relying on idealistic visions of the future (the “supreme” state of adaptation) without knowing how to reach them. Thus, given the fact that the three dimensions presented above combine to characterize adaptation, and if we agree that behind the term adaptation is the idea of an adaptation pathway, we can then assume that for a given system, the *adaptation*

*pathway* is a function of the adaptation *process*, the successive *states* of adaptation and the adaptation *strategies* of this system. This can be formulated as follows:

$$(A_t) = f (A_p, A_f, A_s)$$

where  $A_t$  represents the *adaptation trajectory*,

$A_p$  represents adaptation as a *process*,

$A_f$  represents adaptation as a *state*,

and  $A_s$  represents adaptation as a *strategy*.

With the concept of *adaptation pathways*, we therefore stress the need to focus more on the movement rather than the final result, which cannot be clearly identified since, by definition, the future is uncertain. Incidentally, we underline here the fact that the dynamic approach directly addresses the problem of the unconscious use of climatic uncertainties as an excuse for inaction. Similarly, this dynamic approach refers back to the previously mentioned idea that an adaptation solution at a given moment can constitute maladaptation over a longer timescale and therefore can only participate in the adaptation of a territory in the long term if it constitutes a part of a more ambitious chain of policies and actions. However, it is this chain that gradually builds the adaptation pathway of a given territory. Eventually, given the fact that in future CC will not be the only driver for change<sup>13</sup>, we can extrapolate the logic of the theme of adaptation to CC to that of sustainable development, mainly by building a link between adaptation pathways and development pathways.

#### Adaptation pathways as components of development pathways

A *development pathway* refers to the route taken by a territory (whatever the spatial scale considered) in the implementation of its development and, according to an anticipatory approach, sustainable development. In the same way as for adaptation, the notion of pathway clearly highlights the fact that the formula for developing a territory at a given

time must necessarily be based upon dynamic and developing foundations. Indeed, if we consider at a given moment that this formula is sustainable, in reality it only corresponds to a relative balance of the territory at a given moment. This balance reflects the compromises made at time T between environmental and human components that are endogenous and exogenous to the system. As this context is itself changing, the basis for the compromise will also change, and therefore so will the formula for equilibrium. The gradual change from one compromise to another, from one equilibrium to another, creates a movement that characterizes the development pathway. Furthermore, we can also identify within the term “sustainable” the same three dimensions as those identified for adaptation, namely that sustainability is at the same time a *process*, *state and strategy*. If we use the previous demonstration and replace the word “adaptation” with “sustainability”, it would help to understand why engaging in adaptation is a relevant way to build sustainable development. Therefore, we can consider adaptation pathways as essential components of sustainable development pathways. Essentially this enables a connection to be made between thoughts on the specific theme of adaptation to CC to broader issues that do not address CC specifically, or do not make specific reference to the mechanisms and forms of adaptation.

#### Conclusion

This text was primarily intended to provide a new basis for the analysis of societies' AC to CC. At the origin of this approach is the stereotypical observation that communities from developing countries have a lower AC than those of developed countries. However, we think that the systematic belief in a direct causal link between low levels of development and modest AC is not always true or objective. Indeed, this belief induces a very biased vision of adaptation, according to which adaptation would only be an issue of economic and technological opportunity. However, other societal dimensions can have a significant influence on the ability to adapt to change in general, and to CC in particular. For example, we can cite cultural aspects and social relationships, or even the politico-institutional territorial structure. Thus,

13. Current environmental degradation and socioeconomic mechanisms of globalization, for example, will also create difficulties for the future of human societies and given the difficulty and time required to eliminate these specific problems, they will remain problematic for several decades at least. CC partly accentuates these difficulties.

questioning this stereotypical belief leads to the assertion that knowledge on what constitutes the basis of a particular society's AC is not yet sufficiently developed to give weight to this scientific field. This has implications on the way adaptation is considered, whether regarding the strategies for implementation or the political choices to be made at different spatial and temporal scales. There is therefore a real need to propose new avenues of research to better structure scientific reflections on AC. This text focuses precisely on this objective and is based on a conception of adaptation that is both dynamic and comprehensive. Dynamic, firstly, because adaptation to CC should not be considered as an ideal objective with fixed borders that should be reached out through a progression and over a relatively long period of time (several decades), but more as a progressive state that will never stabilize. Indeed, adaptation implies a balancing between elements that characterize a system – in our case a territory – and also with those that define its environment. However, the stabilized state of a system at a given moment inevitably implies a change in the latter, as well as surrounding conditions that are necessarily changing. Therefore, this notion of equilibrium must itself be evolving, which explains why adaptation can only be dynamic and why this ability to constantly evolve constitutes the heart of the climatic challenge<sup>14</sup>. Equally, the necessary equilibrium for the qualification of a level of adaptation implies a broad understanding of the determinants that facilitate or constrain the achievement of this balance. It is therefore important to take into account both environmental and anthropogenic characteristics, and to do so in diverse areas (economic, socio-cultural, political...). Therefore, addressing the themes of adaptation to CC undoubtedly requires a comprehensive and systematic consideration of the objects of study, which in our case are territories. Based on this assumption that AC is not solely a function of the development level, and by adopting a comprehensive and systematic vision of adaptation, we have presented in

this text an innovative framework for research on AC. Schematically, and without repeating previously mentioned details, this analytical framework is based on four major research fields (see Figure 1) which deal respectively with (i) the influential factors of AC, (ii) the relevant spatial and temporal scales for the analysis of AC, (iii) the link between V, AC and the level of development, and finally (iv) the links between adaptation and sustainability. The value of these fields is that when being put together, they offer an approach that is both conceptual and applied and which, beyond its purely scientific interest, allows results to seep into the various spheres of action and decision that are implied in adaptation to CC.

This research framework therefore has an ambition of a certain societal utility, to facilitate this we have proposed that this framework, which is focussed on the analysis of AC, should be included in a much broader theoretical framework, making the link between adaptation to CC and sustainable development. We have thus proposed to distinguish adaptation into three main aspects. These aspects, *process*, *state* and *strategy*, refer respectively to: the mechanisms of adaptation; to the fact of being adapted or not at a given time and in various forms; and to the adaptation policies as such, which reflect an intention to adapt. The specific analysis of AC can enable, among other things, specific and concrete knowledge to feed this three dimensional vision. Furthermore, this vision allows the characterisation, for a given system, of adaptation pathways, i.e. the path taken by the system as it progressively attempts to adapt to CC. However, this route relies on both adaptation mechanisms (*process*), on a series of forms of adaptation that are more or less viable (*state*), and on management and planning reasoning (*strategy*). Finally, and given the current importance of climatic threats on the future fate of humankind, it seemed appropriate to position adaptation pathways within a broader context of the implementation of sustainable development. The concept of *development pathways* therefore constitutes an achievement of this theoretical framework within which is contained the research framework on AC that we have proposed. ■

14. The issue of evolution rhythms is also included.

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## For a better understanding of adaptive capacity to climate change: a research framework

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# IDDRI

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