SAHEL AND WEST AFRICA Club Secretariat

Security and environmental variables: The debate and an analysis of links in the Sahel

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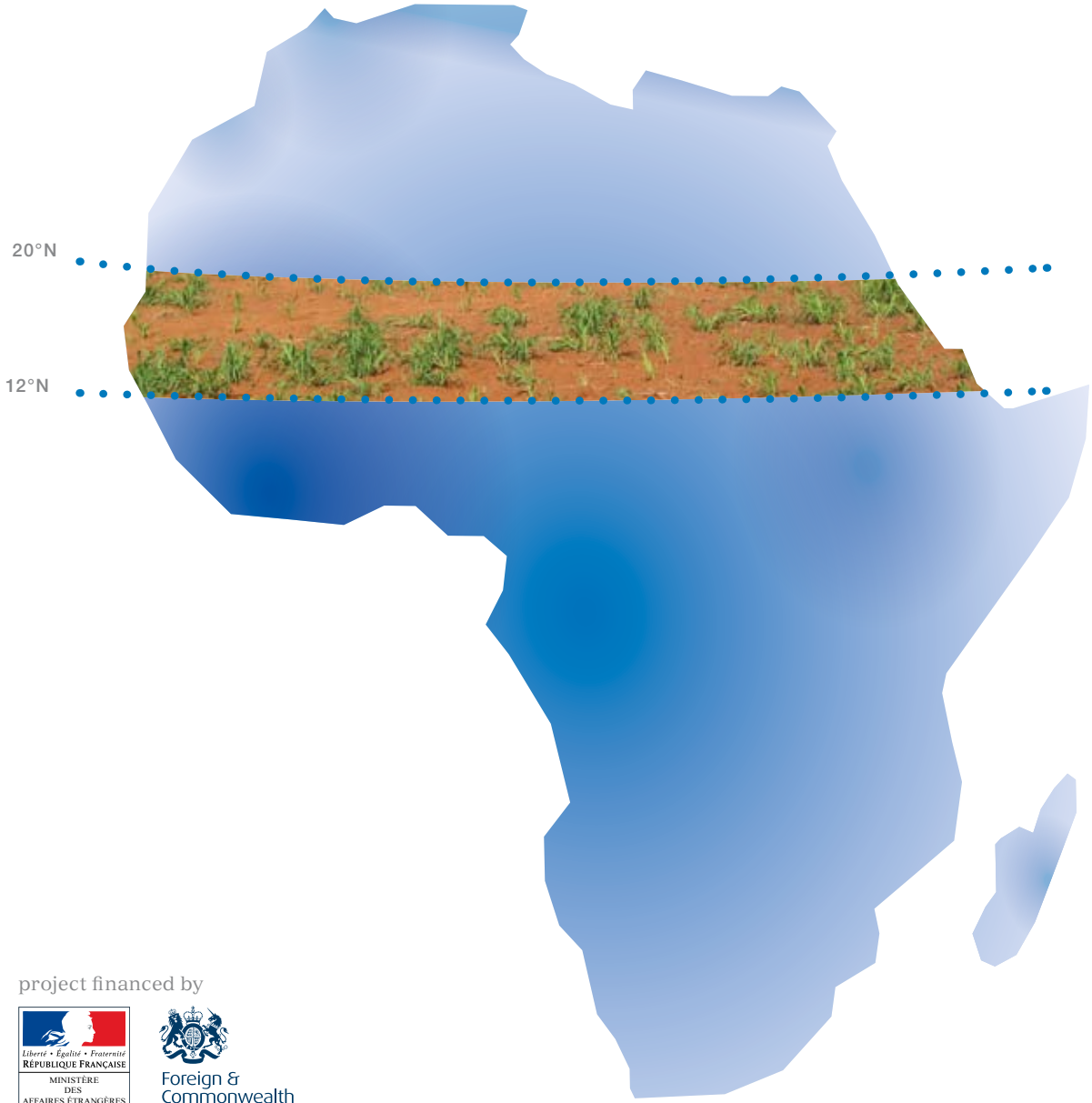

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Contents

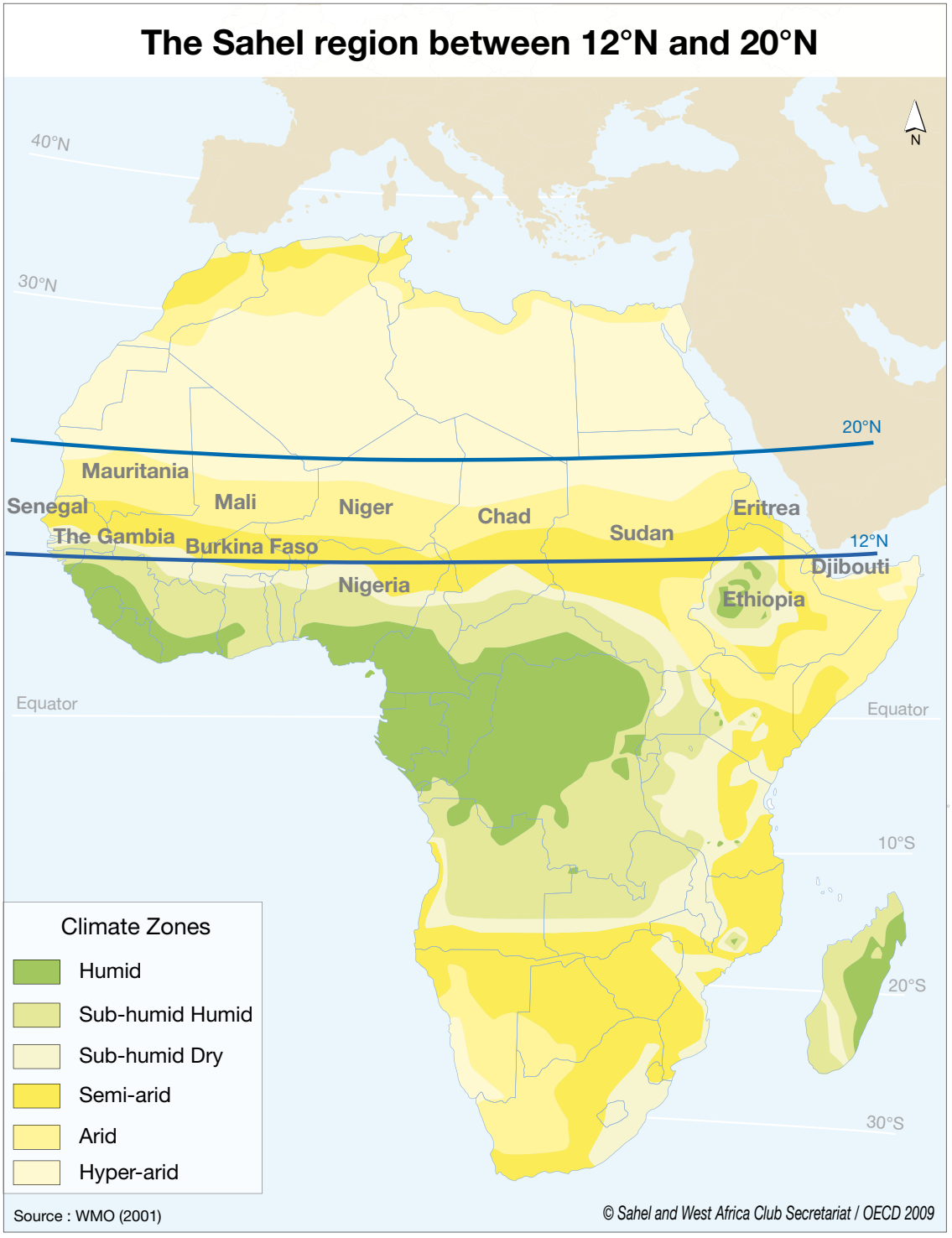


Figure 1.

The Sahel between 12°N and 20°N

We defined the Sahel region as the area of Africa lying between 12°N and 20°N. This area shares two climatic characteristics: one rainy season per year and August as the month of highest precipitation.

The area covers all or part of 12 countries from the Atlantic coast to the Red Sea: Mauritania, Senegal, The Gambia, Mali, Burkina Faso, Niger, Nigeria, Chad, Sudan, Ethiopia, Eritrea and Djibouti

List of acronyms

CEWARN	Conflict Early Warning and Response Mechanism
ICJ	International Court of Justice
IPCC	Intergovernmental Panel on Climate Change
JEM	Justice and Equality Movement
OECD	Organisation for Economic Co-operation and Development
PNAS	Proceedings of the National Academy of Sciences
SICCS	Security Implications of Climate Change in the Sahel region
SLA	Sudan Liberation Army
SWAC	Sahel and West Africa Club
UNFCCC	United Nations Framework Convention on Climate Change

Introduction

For the purpose of this study, the security implications of climate change were defined as all factors affecting global stability, of the Sahel region and its states. The concept of stability is understood to mean more than just the absence of violent conflicts and includes a wide range of risks and vulnerabilities directly or indirectly related to security.

This multidisciplinary work falls into three fields of research: climatology, geography and social sciences. It aims to analyse the links between climate change and security issues through a cross-analysis of findings. Today's global political and environmental context, which emphasises vulnerability, the climate and security concerns, explains the project's choice of geographical region. Although the seven climate change-related threats outlined in the Solana report (2008) are the starting point for our analysis, it incorporates a number of other sources and draws on the few case studies available to build its argument.

A review of past conflicts in the Sahel (Salliot, 2010) describes contexts, triggers and aggravating factors highlighting climate and/or environmental ones. An analysis of this review, a comparison with the Hadley Centre's analysis (UK Met Office Hadley Centre, 2010) and the scientific literature on climate change/security interactions reveal important features for prioritisation and design of development policies and adaptation and early warning mechanisms. The formulated policy recommendations should be integrated and discussed in the dialogue between OECD countries and the Sahel region.

1 How the project fits into existing theoretical analyses and the environmental security concept

Two schools of thought dominate and frame efforts to consider the environment's role in international relations[1]. In the first, the environmental dimension broadens the scope of international studies; for the second, the environment puts a new spin on traditional political and economic issues.

The project *'Security Implications of Climate Change in the Sahel'* (SICCS) focuses more on the type of relations defined in the second school of thought, using examples from the Sahel region. *"This school is based on the premise that, because of their source or their gravity, environmental problems can be a hazard to a state's national security. It would actually be affected to various degrees depending on whether such problems trigger social unrest, political instability, economic difficulties, threats to territorial integrity, diplomatic tension or even open warfare. [The studies] are therefore interested in the conflict dimension of interstate relations as they crop up in political, economic, diplomatic and military confrontations stemming from environmental antagonism, be it local, regional or global in nature"* (Frederick, 1993).

At this point it is worth introducing the concept of environmental security (the underlying concept expressed in the SICCS project's name). The concept gained ground starting in the 1960s and is now an integral part of government policies. Several facts

1 Climate change is seen in the argument as an environmental variable.

can help explain why policy and environmental issues became closely associated and the development of the environmental security concept:

- A number of studies identified socio-political causes, specifically poverty, underdevelopment and waste of human and financial resources, behind older concerns such as desertification, arable land erosion and deforestation (Frederick, 1993). More recently, climate change concerns combine with the older, broader environmental concerns. However, even before trying to clarify relationship between these variables, the interactions among all environmental factors and between environmental and socio-political factors already promise to be complex and multi-dimensional.
- The end of the two blocs and the emergence – alongside purely military security – of a socio-political context in which *'quality of life'* is considered part of national security prompts states to treat *"environmental questions as national security issues"* (Frederick, 1993). The concept of security introduced here is thus essentially national. One explanation is that although awareness is international, the mechanisms for managing environmental issues are still primarily national, due to the lack of multilateral regulatory mechanisms and authority to intervene. *"The precariousness of existing environmental management mechanisms adds an element of uncertainty into the international system, spurring states to closely monitor their environmental interests themselves. As a result, it is through the prism of their own national security that states analyse the impact of global environmental problems and the government behaviours likely to improve matters or make them worse. In such a situation the concept of environmental security assumes as much importance as states are willing to give it."*

This partially explains states' sometimes disconcerting tendency (from a researcher's point of view) to condense both national and international environmental issues to their potential to undermine the security of their populations. Indeed, security considerations surpass territorial boundaries. For example, potential climate-related migrations originating in a Sahel country can, in the political discourse, turn into a threat to OECD countries. Such *'leaps'* also arise from a tendency to ignore analyses of the mechanisms involved in migration itself. Existing case studies (Findley, 1994) tend to show short-distance, relatively localized migration during severe droughts and adaptive migration strategies for more gradual climate events (aridification). Although quantitative and qualitative studies are still too few, case studies can look at various scenarios and counterbalance certain preconceived notions without ignoring the fears expressed.

Another reason for the *'securitisation'* of the climate change debate resides in the willingness of some actors to put climate change onto the agenda of policy priorities to promote strong action on future mitigation and adaptation. The argument that climate change impacts will be strongest in areas considered particularly vulnerable due to their low adaptive capacity[2], like the Sahel, reinforces a sense of urgency.

Hence, depending on the schools of thought cited earlier, environmental security can be a dependent variable (a globalist view of inter-state relations) or an independent one (Homer-Dixon, 1999), in which case the state's security is a dependent variable. By focusing more on the second school, Frederick M. highlights two types of links relevant to our analysis: *"The first deals with environmental problems as the main insecurity factor. The scenarios are based either on confrontations arising from local or regional ecological conflicts (trans-border pollution, overexploitation of a common resource, etc.) or on*

2 Low adaptive capacity is explained through a series factors such as: overburdened governments, economic and political fragility, poverty, etc.

a transformation of power relationships within a region – or among several regions – as a result of major environmental disturbances (climatic changes, desertification, ecological accidents and the like). The second deals with environmental problems as an ancillary insecurity factor. In such cases, environmental antagonisms threaten a state's national security indirectly, by exacerbating pre-existing political, economic, social or military tensions or conflicts or by adding a new dimension to them" (Holst, 1989).

Both approaches introduce a subtle distinction into the causal link between climate, environmental and security factors, a distinction which is supported by the analysis of security events in the Sahel. Based on an outline of those events and the theoretical choices made, the second approach, interpreting environmental security as independent variable, seems the most relevant, at least for the orientations arising from our analysis.

2 Climate change in the Sahel[3]: What impacts and on which environmental variables?[4]

The Hadley Centre's analysis of Sahel climate projections highlights two key points:

- The large climate variations observed in the 20th century make it impossible to identify the impact of climate change.
- The disagreement of climate models is particularly pronounced over the Sahel region.

The latter is especially true of precipitation, where models do not even agree on the direction of change. According to the Intergovernmental Panel on Climate Change's (IPCC) Assessment Report 4 forecasts for 2020 to 2050 for the months of June through August, precipitation will decline in coastal countries (Senegal and Mauritania) and increase in the Ethiopian mountains.

However, a comparison of the different model projections shows that they do not agree on a large swath of the Sahel (see figure 2). The Hadley Centre predicts a fairly similar picture over West Africa and more precipitation in the centre and on the eastern tip of the Sahel, including during the warmest months.

In the first half of the 20th century, precipitation first increased slightly in the Sahel region. Starting in the 1950s and until the end of the 1980s, the trend abruptly reversed and precipitation levels fell steadily. During the period from the late 1960s to the late 1980s the Sahel experienced an unprecedented and severe long lasting drought. Not only did precipitation reach its nadir, the geographical boundaries of the wet area retreated further south, especially during the 1984 drought when almost the whole Sahel was affected (figure 3). In the last few years, however, a partial recovery of rainfall in the Sahel has been observed. On the whole, though, West Africa is not threatened in the medium term by a lack of renewable water[5], even if localised problems may arise.

3 Article 1 of the United Nations Framework Convention on Climate Change (UNFCCC) defines climate change as "a change in climate which is attributed directly or indirectly to human activity that alters the composition of the global atmosphere and which is in addition to natural climate variability observed over comparable time periods". The scientific community does not make the same distinction, defining climate change as the combined effect of human activity and natural variability.

4 Climate variables are a type of environmental variable. However, in light of the SICCS project statement and to clarify causal chains, the two variables will be referred to separately in the analysis.

5 Out of the 12 countries covered by the study, only Sudan consumes more than 20% of its total annual renewable water resources (63%).

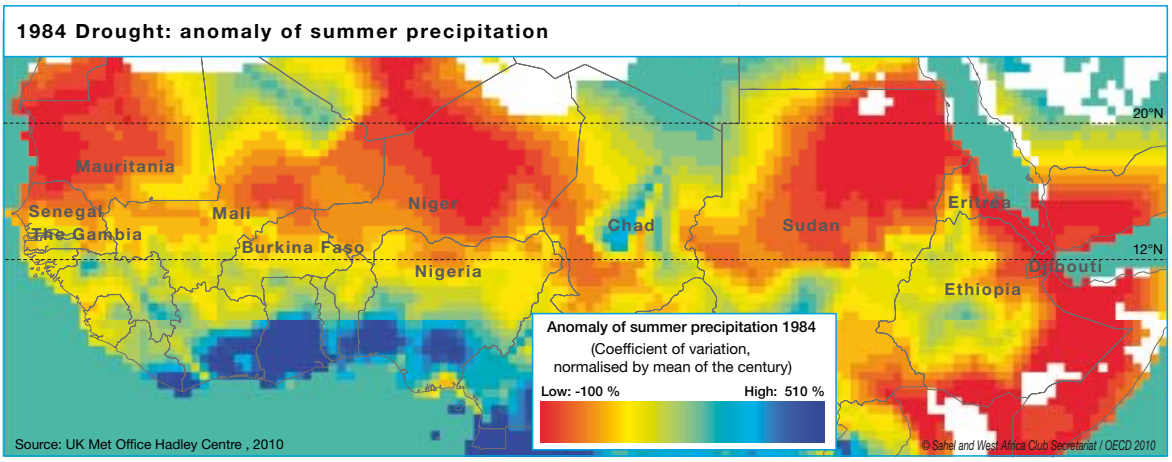


Figure 2

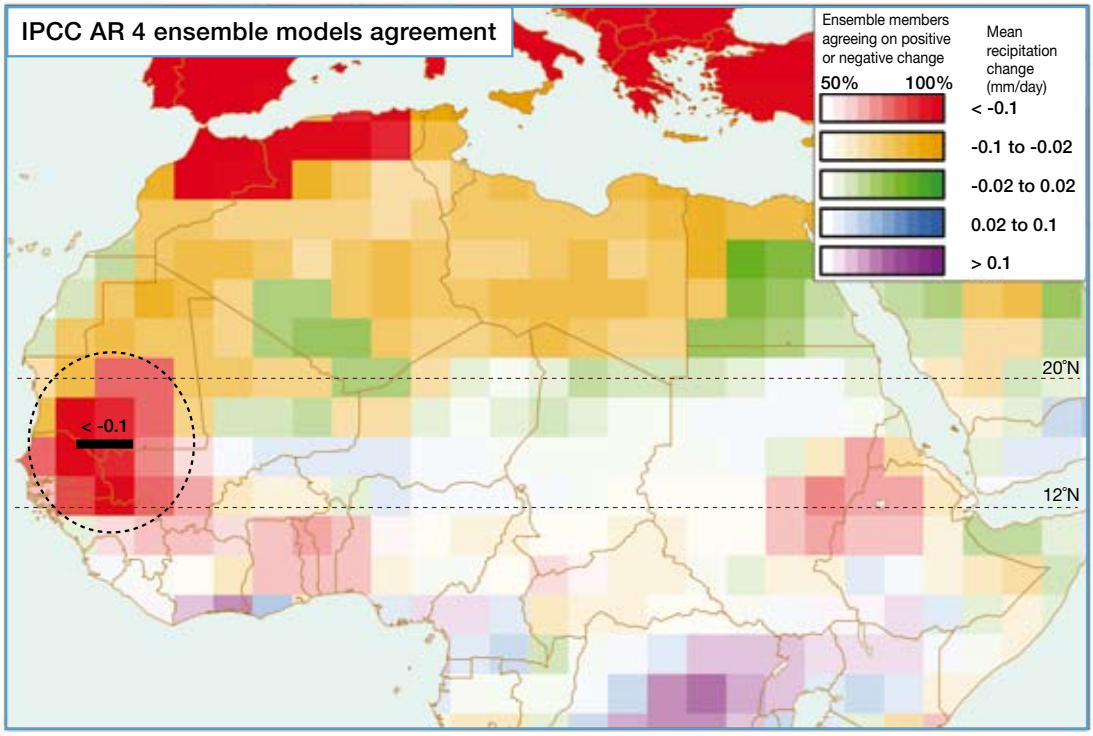
1984 Drought: anomaly of summer precipitation

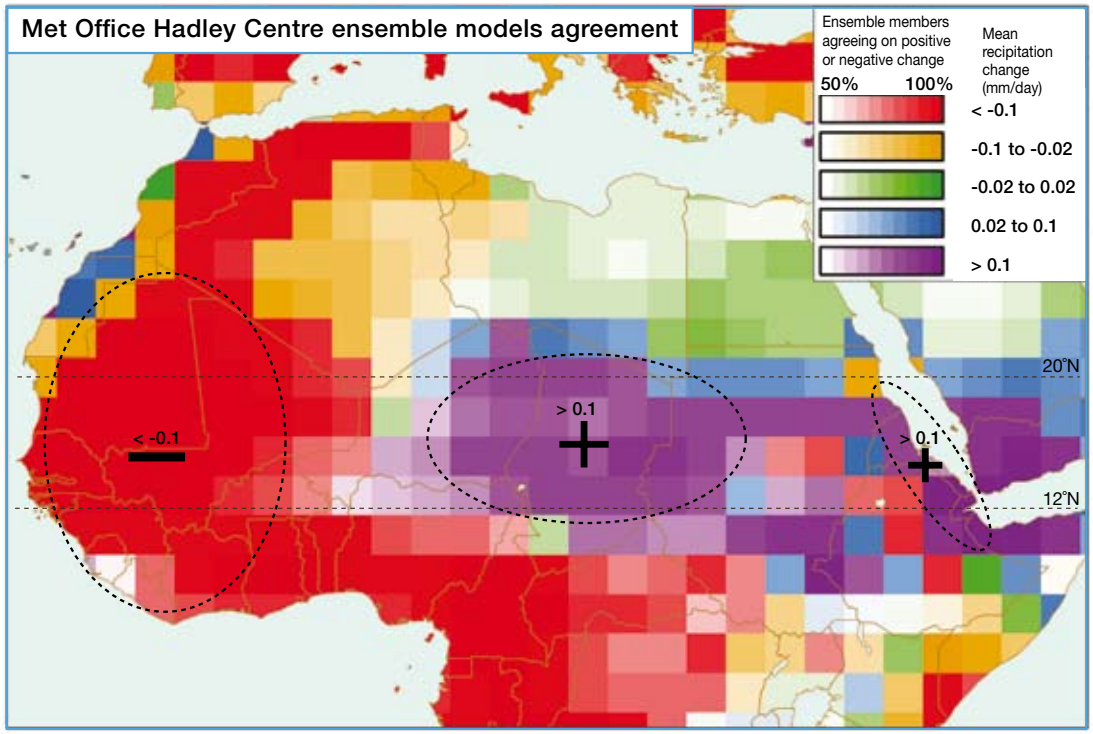
Projections for temperature tend to be more uniform among climate models and suggest an increase, especially for summer. This warming is likely to be higher than the global average, with temperatures increasing between 3 and 4 degrees by the end of the century with respect to the last twenty years of the 20th century. Geographically, the greatest warming (~4 degrees) occurs over land, and in particular in the western side of the Sahel. Over the coast and close to the southern edge of the region the increases are expected to be smaller but still substantial (~3 degrees). In addition, it is virtually certain that extremely hot seasons will become more frequent in the future.

The IPCC also acknowledges the limitations of research on extreme climate events and natural disasters. There is no consensus among models whether extremely dry or extremely wet seasons are likely to become more common. However, the thermodynamic argument suggests a general increase in the intensity of high-rainfall events.

Climate model projection 2041– 2070: agreement vs. disagreement

These maps illustrate agreement of model projections (more than 50% of models in ensemble) for difference (mm/day) in summer (JJA) precipitation between 2041–2070 and 1960–1990 across IPCC Assessement Report 4 and Met Office Hadley Centre ensembles. The colour indicates the strength of the signal (variation in precipitation), while the colour-intensity indicates the consistency across the ensemble (agreement). For example, deep red colours indicated where close to 100% of models agree on a precipitation reduction of more than 0.1 mm/day, dark green indicates where nearly 100% of models agree on no change. White colours indicate areas where models disagree on the direction of change (50% of models indicate increase in precepitation and 50% decrease).





Source: UK Met Office Hadley Centre, 2010

Figure 3

Climate model projection 2041 – 2070

In addition to temperature trends, that of rising sea levels seems to be unanimous across different models. Current global projections put the rise at about 30 to 50 cm between 1990 and 2100 (Nicholls, 2007). In Africa, three areas are especially vulnerable, from the standpoint of both population density and ecosystems, one of which includes the West African coast. The areas most vulnerable to a rise in sea levels or extreme events originating in the ocean (extreme tides) are the most populated and in many cases the most urbanized ones (excluding the Mauritanian coasts). The direct impacts of sea-level rise are submersion and coastal erosion, larger flood-prone areas and an increase in the salinity of estuaries and coastal groundwater.

The Sahel region must face the challenge of variability and uncertainty. Were the major droughts of 1973 and 1984 already signs of climate changes? What about the 2007 floods? Insufficient analyses are available and climate forecasts and their consequences are too uncertain to accurately predict the risks or indeed opportunities associated with climate change. With the exception of higher temperatures experts are unable to identify the cause-and-effect link between climate change and a certain number of variables.

Given the absence of robust long-term projections, adaptation to climate variability remains a major issue in the Sahel. The above observations illustrate our decision to distinguish in our analysis between occasional climate shocks and more gradual climate developments, which would have different security impacts. Likewise, it seems instructive to consider variables other than the ones usually mentioned as resulting from climate change, such as higher temperatures and sea levels and natural disasters, to assess the way climate and security interact. This decision is motivated by the Hadley Centre's findings and enables us to:

- Distinguish the types of response to and the intensity of the impacts of a climate shock versus more gradual climate change.
- Nuance the interactions among non-climate variables involved in triggering a conflict or tensions.
- Illustrate our argument by examining not only the interactions of climate change with security events, but also of environmental variables such as erosion, water access and resource scarcity, which are themselves directly influenced by climate.

3 Direct and/or indirect links between climate, environmental and security variables

Many studies have produced charts of hypothesised links of climate change and security. We do not aim to create yet another new theoretical chart, but to identify climate variables and their recurrence in aggravating or triggering episodes of tension in the Sahel and to discuss whether the correlation some charts imply between socio-political and environmental variables (themselves influenced by climate variables) and security is warranted.

It can be easy to lose one's way in the raft of studies positing links between climate change and security. The diversity of both their approach and the chains of causation hypothesised easily illustrate just how difficult and ambiguous the exercise is.

As Buhaug et al (2008) stress, the subjective nature of a state's judgment of attacks on its national security leaves matters open to interpretation. In his team study, Kaplan (1994)

talks about massive migrations degenerating into conflicts as a result of deforestation and erosion, epidemics or even reduced water supplies. Homer-Dixon (1999) enumerates the security impacts of climate change, listing genocide, guerrilla fighters, insurrections and terrorism. The IPCC Assessment Report 4 is more moderate in its claims, stressing climate change's links with societal factors and security repercussions.

Among the IPCC's results, Buhaug et al. dwell on three processes by which climate change can lead to social instability and conflict: rising sea levels, resource scarcity and natural disasters. These processes affect social stability through three risks: infrastructure destruction, increased health risks and loss of livelihood. However, Buhaug et al. stress adaptive capacity component, which depends on the suddenness of the climate event and the context of the country affected, a major criterion in the ability to respond to a conflict situation. This argument is notably made by Homer-Dixon and we will revisit it in our own analysis. The work of H. Buhaug et al. focuses in particular on armed conflicts. Their conclusions call for extreme caution in making connections between armed conflicts and climate change, due to a lack of historical perspective and supporting statistical data. For instance, a graph drawing a parallel between temperature and the number of armed conflicts shows a rise in the first variable and a decline in the second since the 1990s. The proposed analysis for the Sahel region considers security events other than armed conflicts only, such as tensions among agro-pastoralists, border tensions, the fall of governments and humanitarian and food crises. H. Buhaug et al. identify three natural processes through which climate change could impact security: increasing scarcity and variability of renewable resources, sea-level rise, intensification of natural disasters. The risks associated to these processes are, destruction of infrastructure, increased health risk and loss of livelihood. We will retain these risks for our analysis by hypothesizing that they can lead to tensions without degenerating into armed conflict.

The 2008 Solana report prepared for the European Council discusses threats related to climate change in terms of international and not just national security (having direct impacts on European interests). It identifies seven climate change-related threats, also stating that they do not necessarily degenerate into armed conflict:

- Conflict over resources;
- Economic damage and risks to coastal cities and critical infrastructure;
- Loss of territory and border disputes;
- Environmentally-induced migration;
- Situations of fragility and radicalisation;
- Tensions over energy supply;
- Pressure on international governance.

Climate change is posited as a threat multiplier which *"exacerbates existing trends, tensions and instabilities"*. These threats and *"forms of conflict"* cover all countries. The transmission mechanisms proposed to explain climate change's impacts on the threats involve three parameters: rising sea-level, higher temperatures and natural disasters. In many cases, environmental variables that depend on climate change, such as desertification and dwindling water reserves, are cited as factors influencing threats.

An initial reading shows that the Solana report does not refer to any prospective or retrospective studies, case studies and statistics that were used to identify the threats. Although climate change is a fairly recent factor, a number of the climate and/or environmental parameters cited as consequences of climate change, such as droughts and resource scarcity, have been around for some time. Africa is identified as one of the most vulnerable continents and therefore, with climate change, it is likely to cause

growing international insecurity. The Solana report consequently proposes many solutions following this line of argument.

Buhaug et al. also decipher the three main single or combined climate change effects, using a checklist of socio-political factors commonly recognized as conflict triggers. The authors cite many references in the literature for their essentially theoretical demonstrations with some illustrative examples and present causal mechanisms through which environmental variables can impact security. For instance, the *'poverty and political instability'* socio-political factor is assigned through food insecurity and loss of livelihoods.

The many different dynamics involved in climate change and security and the nature of their relationship – causal, reciprocal, related, etc. – complicate projections and scenarios. In addition, the threat to security from climate change depends strongly on the specificities of each country and other contextual factors. The particular relationships among those variables create as many potential crisis catalysts as there are different climate and socioeconomic environments.

By analyzing the mechanisms of selected security events in the Sahel region and whether they correspond to climate shocks such as a drought, our analysis attempts to suggest a way to broaden the range of recommendations, taking into account both security and environmental concerns of EU countries, beyond the ones in the Solana report.

Using examples from the Sahel, the next section aims to determine whether conclusions can be drawn that differ from those of the environmental security theories. In addition, this section will, although using the relations proposed by the environmental security theory relativise both, relations and degree.

4 Decoding security events in the Sahel based on climate parameters[6]

In the Biafran War, Nigeria (1967 – 1970), what started out as a basically socio-political and economic conflict grew worse in terms of loss of human life for environmental reasons (resource access and low soil fertility). The environmental variable became a factor in the way tensions played out mainly due to the populations' great vulnerability.

The environment also had a role in precipitating the border conflict between Burkina Faso and Mali (1985 – 1986 Christmas War). The cumulative effect of the drought cycles of the 1970s and early 1980 and the major drought of 1984 intensified pressure in the grazing areas near the border. However, the resource claims seem fitting into a more traditional schema of military conflicts, and thus military security, than environmental security concerns. Indeed, a territorial claim was the core focus of negotiations. The same is true of the border dispute between Cameroon and Nigeria. The tension arose due to the receding of Lake Chad caused by environmental factors and a poorly defined border, a matter eventually resolved by the International Court of Justice (ICJ). This incident did not degenerate into a conflict.

Hence, the threat identified by Solana – loss of territory/border disputes – seems more as the result of a lack of border delimitation or demarcation in Africa. This is an existing threat that has to be resolved, but can not be attributed to a climate change consequence. Moreover, to lower the risk of border disputes, the African Union has introduced a

6 The following section is based on an analysis carried out within the SICCS project on Salliot (2010).

programme to settle existing border disputes, to demarcate borders and promote cross-border cooperation.

Riven by territorial and political disagreements, the issue of a south with superior oil and agricultural resources became a major factor in the South Sudan conflict (second war, 1983 to 2005). Gradual aridification was coupled with the 1984 drought and El Niño between 1997 and 1998. These climate shocks seemed to aggravate both the duration and hardening of the conflict. A dual relationship emerged: first, climate, economic and political variables combined to cause the war, with the latter two playing a dominant role; and second, a worsening of economic and political variables driven by adverse climate. This conflict rooted in a power struggle to appropriate resources within a geographical entity not recognized by all parties was exacerbated by climate variables, yet remained a military or civil conflict that our analysis will not retain as resulting from climate variables.

Tensions between farmers and pastoralists in Burkina Faso's Comoé province (1986 and 1995) were driven by a combination of factors including demographic pressure on fertile lands (settlement and sedentarisation of pastoralists as a result of the drought), co-existing economic modes and changes in livelihoods, soil degradation caused by human activity, land policies and weak regulatory mechanisms. Environmental variables seem to be interwoven with other variables without any real way to establish a dominant role for one or the other. The same is true of triggering events, of which two – the dry season and livestock thefts – are commonly cited. However, aside from persistent food and economic insecurity, it is hard to draw any conclusions about the nature of the relationship between the two '*trigger*' events (SWAC/OECD, 2010a) or to estimate the degree of causation.

Alongside demands for autonomy, banditry and political differences, climate seems to have been a factor in heightening tensions between the Tuaregs and the Malian and Niger governments. The 1984 drought sparked a few clashes and led to the opening in 1989 of refugee camps, later accused of providing shelter for certain opposition forces. However, it is not possible to define a horizontal relationship between the different factors triggering the rebellions. Climate and environmental variables appear as secondary in the rebellion, despite the omnipresence of the former in the region's geographical context.

Ethiopia has repeatedly been plagued by drought since the 18th century. The worst years in the 20th century were 1968–1969, 1972, 1976, 1984–1985–86, 1990, 1993, 1996 and 2002. Five food crises have been recorded: the famine in Tigray (1958), Way Lasta (1966) and Wollo (1973), followed by the 1984–1985 and 2001–2003 famines that have affected the whole country.

In 1973, a famine hit Wollo province, claiming the lives of 40,000 to 80,000 Afar herdsmen and Oromo farmers. In addition, Oromo farmers' land was confiscated in a move supported by classes close to the government. The famine undermined the government's legitimacy and in 1974, a group of dissident Derg soldiers overthrew Selassie. The Derg created a Relief and Rehabilitation Commission responsible for managing famines and abolished the feudal system of land ownership in March 1975. In 1976 insurrections broke out across the country and the head of state, Mengistu Haile Mariam, launched a crackdown (called the Red Terror) that lasted from 1977 to 1978. The episode contributed to a worsening of the economy. It was accompanied by measures that affected farming, including very low, government-set grain prices, *'travel permits'* to deter farmers from taking up non-agricultural activities, the collapse of government-run farms that employed a large number of seasonal labourers and a ban on grain wholesaling.

The 1984 and 1985 famine consisted of two simultaneous food crises, one in the south and a second, more severe one in the north. In the south the famine was associated with the insurrection of the Oromo Liberation Front and in the north the insurrection of the

Tigray People's Liberation Front and the government's counter-attack. The famine spread to the provinces of Eritrea, Begemder and northern Shewa. Although, Tigray experienced a significant reduction in rainfall in 1984 the two insurrections are considered among the famine's main causes. The 1983 harvests were among the best ever recorded in Ethiopia, with the exception of Tigray. In mid-1984 a new drought and famine affected large areas of the country's north. The shortage was made worse by the fighting in the province of Eritrea and nearby regions preventing supplies from getting through.

These events highlight the role of political and economic contexts in influencing and aggravating the impact of droughts and their potential in deteriorating into broader insecurity events. When Ethiopia experienced a serious food shortage caused by insufficient rain in the spring of 2008, for example, no political disorder resulted thanks to the rapid, co-ordinated response of the government and humanitarian organizations. Also, the 2005 food crisis in Niger did not lead to security tensions. Such climatic accidents do not systematically cause the eruption of or worsening of tensions and conflict.

Climate-induced environmental stress' influence on security seems indirect at most. An exception is however made for water, as a particular vital renewable resource although, in recent history no international water dispute has escalated to the level of violent conflict (Buhaug et al., 2008). Research on shared river basins shows a doubling in the probability of low-level conflict but the relationship is not significant for wars (Gleditsch et al., 2006). Also, water scarcity does not seem a significant factor in explaining conflicts. Besides, shared river basins and climate induced run-off variability increases the probability of cooperation between countries (SWAC/OECD, 2010b). Many river basin organisations promoting cooperation between member states exist in the Sahel.

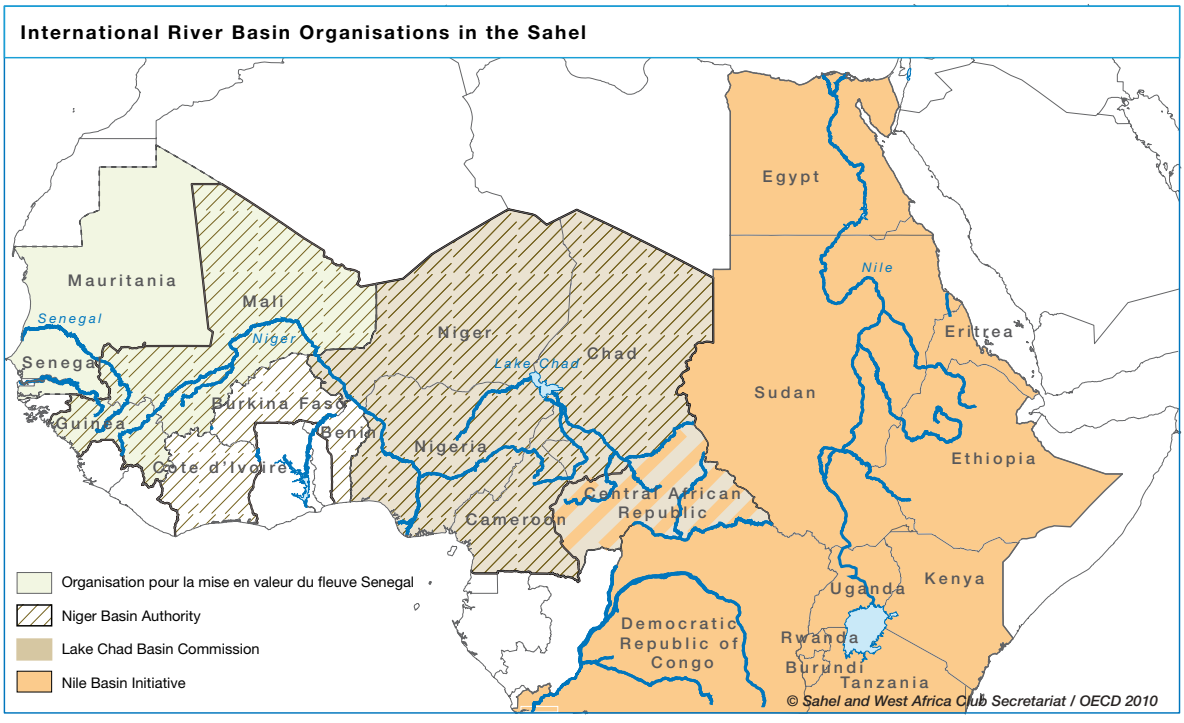


Figure 4

International River Basin Organisations in the Sahel

4.1 Climate change's three major effects

Resource scarcity cited as a consequence of climate change when expressed per capita may stem from two effects, acting in combination or alone: a decrease in volume of a resources due, for example, to low levels of precipitation; and/or higher demand driven by demographic growth (and/or higher per capita consumption). Initial observations suggest that there are more conflicts over control of resources – water, mines, oil – whether scarce or not and often result in military conflict or civil war.

Virtually all inter-state conflicts were triggered by border disputes. At the same time, they originated in the desire of one belligerent to control resources in a neighbouring territory. The resources may consist of energy as in the conflict between Chad and Libya for the Aozou Strip, or land and water as in the Senegalese-Mauritanian crisis, the border dispute involving Darak Island in Lake Chad and the Agacher Strip War. Lastly, they can be motivated by a desire to control a strategic position[7].

No study has truly established a direct causal link between resource scarcity and the most violent form of insecurity, conflict. Even assuming a causal relationship between resource scarcity and parameters such as migration, poverty and violence, it is hard to confirm a direct link, much less the degree of correlation between the parameters listed and conflicts. As the examples from the Sahel show, resource scarcity appears alongside economic, social and political factors that in combinations could lead to conflicts. The impact mechanism is hence difficult to characterise and measure.

Natural disasters are either geologically or climate-related. Concerning climate-related natural disasters, two have the greatest impact on the situation of populations: floods and droughts. Although the first category is more frequent in regions further to the south of the area studied, such as Burkina Faso, floods sporadically affect cities such as Niamey in Niger. Despite the destruction of infrastructure, one cannot really cite any episodes of tensions as a result of floods.

As the examples in Ethiopia show, it is difficult to illustrate the link between drought and conflict, given the determining role played by economic and political factors. Although droughts[8] are recurring, their management is decisive. Some people even accused the government in place of exploiting the climate situation for its own ends during the 1984 and 1985 episodes.

Natural disasters typically cause large material destruction and loss of livelihood resources generating instant human suffering, temporary migration, etc. However, existence of pre-exiting tensions seems a determinant factor in prompting conflict dynamics.

Rising sea levels have not impacted crisis-triggering processes in the Sahel over the past 40 years. A third of the countries in the region studied are coastal and are concerned by the phenomenon. Creeping erosion can be observed on the Mauritanian and Senegalese coasts, yet the populations concerned seem to have adopted a process of adaptation fairly similar to the one that has existed for aridification for decades.

7 As in the case of access to Asmara Port in the war between Ethiopia and Eritrea from 1998 to 2000. Ibid.

8 The four main humanitarian crises in our analysis coincide with a sharp reduction in rainfall the year before their occurrence. In particular, the famines in Ethiopia in 1972–1973 and 1983–1984, the famine that broke out in south-eastern Sudan, northern Eritrea and north-eastern Ethiopia after El Niño came through in 1997 and the one in southern Niger in 2004–2005. SWAC/OECD, op. cit.

4.2 Multidimensional, non-quantifiable relations between climate, environmental, economic, political and de facto security variables

"The threat to a state's environmental security can be intentional or unintentional, direct or indirect and internal or external in cause" (Frederick, 1998). The complex dynamics involved in climate change and security and the nature of their relation render a generalisable qualification very complicated. Most theorists argue that climate change may increase the risk of armed conflict only under certain conditions and in interaction with several socio-political factors. Political instability, economic weakness, food insecurity, and mass migration are the most often cited ones. Hence, the threat to security from climate change depends strongly on the specificities of each country and other contextual factors creating as many potential crisis catalysts as there are different climate and socioeconomic environments.

Homer-Dixon (1999) argues *"that market failure, social friction, narrow self-serving coalitions, lack of capital, cognitive limits to ingenuity, and growing costs of research are more likely outcomes of climate change in the developing world. It is this ingenuity gap – or the inability to address resource scarcity by innovation – that eventually makes these countries more prone to instability and conflict. Lower economic productivity affects both state repressive capacity and public grievances by reducing the state's revenues, weakening its distribution capacity, and, consequently, lowering state legitimacy"* Buhaug et al. (2008). This argument underlines the complex links that are hypothesised in explaining the link between climate change and security.

However, so far there are no robust empirical foundations for a general relationship between climate change and security. The problems encountered are not only rooted in difficulties of establishing generalisable theoretical transmission mechanisms but also a relative absence of empirical studies. Particularly more analyses of small-scale localised conflicts are needed. Also data quality and quantity reduce robustness of statistical attempts in identifying causal relationships.

4.3 Sahel countries' dependency on agriculture and livestock production increases vulnerability

Sahelian societies are still predominantly rural and agricultural. The Ethiopian economy, for example, is based on agriculture, which accounts for 90% of exports and 80% of employment. It is both the country's leading economic activity and its main source of food. Year-to-year rainfall variability impacts economic growth and the marketing of agricultural products and can cause a sudden and important loss in livelihoods of populations that depend on rain-fed crops or flood-recession crops. The Sahel's arid and semi-arid regions are also home to large agro-pastoral communities. Herds are sensitive to periods of drought, which increase bovine epidemics, depress milk and meat production and alter herd migration patterns by shrinking pastureland and watering holes, which may strain good neighbour relations with nearby communities. Food crop production, predominantly rain-fed cereal production in Sahel countries, depends considerably on rainfall, together with other climate or environmental factors. Heavy reliance on agriculture and its natural dependence on climate, underscores the vulnerability of the region studied.

4.4 Differentiating climate shocks from gradual, persistent, longstanding environmental trends: adaptation strategies

Africa has passed through very different climate periods over its history. Before the end of the Ice Age (18,000 years ago) the continent was a virtual desert. A wet period then set in, between 12,000 and 5,000 years ago, greening nearly all of the arid regions and supporting the development of agriculture and livestock production in what is now the Western Sahara. The existence of an immense Lake Chad in the Middle Holocene period (over 6,000 years ago) attests to its historic fluctuations[9]. Africa's contemporary climate is practically the same as it was 2,000 years ago, with alternating drier and wetter phases. In the early 19th century, however, an arid period took hold on the continent, lasting several decades. The Nile River's flow dropped sharply and Lake Chad dried up. Africa has for decades been adept at changing and adapting, by diversifying farming methods (agro-pastoralism) and ways of life (temporary migration, urbanisation, etc.) and developing potential growth centres.

Thus, transhumant pastoralism[10] (70% to 90% of cattle production in the Sahel is transhumant) remains a production method well suited to certain Sahel-Saharan ecosystems. It has undergone significant transformations as a result of demographic growth, economic development, policy choices and environmental factors such as climate variations. The widespread adoption of agro-pastoralism, or the practice of combining agriculture and herding on one farm, arises from the farmer and herder strategy of limiting risks in the face of an unpredictable climate. Herders farm to limit grain purchases during the last few days of the dry season; by investing in livestock, farmers diversify and capitalise their revenue streams. This shift in practices is mirrored by a spatial shift in activities that reflects the changing outlines of the Sahel climate. Seeking the best pastures, nomadic herders travel varying distances, usually heading North, during the rainy season. Once the rainy season is over, they gradually make their way back to their villages, which still have pastureland and watering holes. The 1973–1974 and 1984–1985 droughts sharply altered the spatial patterns of migration and rangelands in the Sahel. Transhumance typifies the need to adapt to the changing natural environment. Climate changes, favourable or not, will modify the extent and quality of natural grasslands and will likely alter transhumant corridors in the region. However, herders will have to contend with growing pressure from agriculture, environmental constraints and occasional political risks[11]. Some will increasingly turn to agro-pastoralism or a sedentary or semi-pastoral system of livestock production. For the rest, mobility is still their core strategy.

Changes such as desertification and rising sea-levels are gradual and thus call for variable individual responses (seasonal or long migrations, change in activity, etc.). Likewise, policy or development responses can entail a medium-term strategy, including coastal protection, land reclamation and resource management[12].

9 Located in what is today the world's largest endorheic basin (with streams that end on land and do not empty into the sea), the lake occupies an area of 340,000 square kilometres (current size of Côte d'Ivoire) and reaches a maximum depth of 160 metres (less than 10 currently). It constitutes the world's fourth largest lake, behind the Caspian Sea and Lakes Baikal and Tanganyika.

10 Transhumant pastoralism can be defined as a system of livestock production characterised by cyclical, seasonal migrations that vary in range. The herds move between complementary ecological areas, guarded by a handful of people, with most of the group remaining sedentary. Sahel and West Africa Club (2007): *Élevage au Sahel et en Afrique de l'Ouest*. Decision-makers memo No. 3.

11 The tensions in northern Niger and Mali limit the rangelands of herders in those regions.

12 2006 National Adaptation Programme of Action (NAPA).

4.5 Health risks (desert locusts) correlated to precipitation variability

Climate is closely correlated with the geographical ranges of certain insect groups and with the appearance of new pest ranges. The desert locust (*Schistocerca gregaria*), for example, is spectacularly responsive and very adept at taking advantage of conditions conducive to its multiplication and expansion, such as unusual rains. A migratory species, desert locusts can also wing their way rapidly to favourable areas. The desiccation caused by higher temperatures and/or lower rainfall will impact the development and survival conditions of the desert locust, without eradicating it. On the other hand, better ecological conditions (moist soil and vegetation) may promote its spread. An increase in the number of unusual episodes of precipitation outside of or in addition to the normal rainy season would support reproduction and later gregarisation (swarming), worsening the risk this pest already poses to crops. Yet the desert locust's impact, though it has impacted harvests, has not initiated violent conflicts. Health risks are adding to the parameters that compose Sahel vulnerability.

4.6 Is the climate variable distinct from other variables that trigger crises? Do climate variables contribute to the recurrence of conflicts?

The endemic nature of tensions in the Sahel is often emphasised. Although a decline in armed conflict in recent years can be observed, many tension '*hotspots*' experiencing recurrent crises remain: ethnic and religious oppositions, tensions between farmers and herders, illegal trafficking, resource access (notably land), and weak governance. These tensions are the result of a combination of factors, whose persistence can contribute to a conflict's recurrence.

As iterated above, environmental factors are one among others in triggering, aggravating or determining persistence of conflicts that are predominantly of economic and political nature.

4.7 The Darfur conflict: duration and combination of climate, economic and political factors

Human casualties caused by famine, disease or violence are estimated at 400 000. In addition, observers speak of 1.8 million internally displaced people and 200 000 refugees caused by land expropriation and ethnic violence. Although the multiplication of incidents between nomadic herders and farmers caused by the drought cycle of the 1970s and '80s are not cited as underlying factors of the conflict, ancient divisions between communities over land distribution are in fact an integral part of these factors. In response to this, land tenure rights become a central issue in the September 2005 Abuja negotiations. Traditional land rights were predominantly held by agricultural communities and to a lesser extent by transhumant pastoralist communities. This equilibrium was rattled by climatic (droughts) and socio-economic factors (population growth, sedentarisation, increase in livestock population). Parts of the population are recruited by the government to fight the two rebel factions, the Sudan Liberation Army (SLA) and the Justice and Equality Movement (JEM). Limited access to resources along the transhumant migratory corridors (waterholes and pastures) in the north (Koutoum, Mellit in Kordofan) and in the south where land is

more fertile causes most of the clashes. In the past, essentially nomadic ways of life were anchored in a regulated system of circular migration.

Sedentarisation of nomadic communities heightens the pressure on land, with the latter also closely linked to the successive drought periods. Hence, climate variables are combining with land rights issues, resources, ethnicity, and governance. A further analysis of the conflict dynamics highlights links between all variables and a changing quality of each variable over time (e.g. trigger, aggravating).This observation, as much as the rest of the analysis, shows that the climate variable does not seem to be distinct from other factors. Indeed, the 'environmental pressure' indicator used by CEWARN[13] in its cluster reports shows in fact a very weak correlation with conflict.

The second observation, climate variables, on the same level as the other variables, require an adapted and coordinated strategy. Similar to policies aimed at improving governance or land tenure rights, priority responses have to be designed to integrate climate variables and reduce the region's vulnerability. These can be direct or indirect: improving access to short-term weather forecasts, agricultural intensification (e.g. irrigation) and/or facilitating traditional adaptation strategies of populations (migration).

5 Perspectives

The study of past security events in the Sahel and theories on the links between climate change and security show the difficulty of making operational proposals. Among them:

- Difficulty in measuring and qualifying the relation between climate variables and security (causality, systematic nature/robustness of relationship)
- Complexity of variables intervening in the relationship between climate change and security (environmental, political and economic variables; feedback-loops; dominant influence of political and economic variables on security and particularly on conflict)
- Focus by OECD countries on political rather than developmental aspects

A serious consequence of these limitations is that some recommendations seem biased and removed from reality. To address these issues, our analysis is based on a larger interpretation of the climate variable than just climate change and on the definition of environmental security proposed by Frederick, M. thus leaving aside the categories proposed in the Solana report. This allows for the definition of two potential areas of intervention that are presented in the policy paper of this project (SWAC/OECD, 2010c).

1. In his definition, Frederick says that environmental security *"For a state, it represents an absence of non-conventional threats against the environmental substratum essential to the well-being of its population and to the maintenance of its functional integrity"*. This definition reasserts the role and responsibilities of states, especially as there is currently no genuine international environmental law, despite concerns that are global in scope. In addition, this approach incorporates each state's perceptions of environmental pressure which, as we have seen, are highly subjective but figure in political choices and thus in national development strategies. This underlines the necessity for actions that are coordinated and regional but that have to be based on national policies until the development of binding international laws.

13 CEWARN is the Conflict Early Warning and Response Mechanism of the Inter-governmental Authority on Development.

2 *"A threat to a state's environmental security exists when a non-military action or series of events against its environmental substratum jeopardises the quality of life of its population and the state's ability to function in its main spheres of activity". "The environmental substratum, that is, the ecosystems, resources and natural cycles whose deterioration, unsustainable use or modification can jeopardise the environmental security of a state and, by extension, a region or the international community as a whole"* (Frederick, M. 1993). This definition illustrates the influence of socio-economic parameters on access to and utilisation of resources (such as tensions between farmers and pastoralists, inadequate land policies) and proposes a large spectrum of operational choices.

States must therefore invest in the welfare of their population. They also have to favour maintaining their functional integrity, criteria that remain the same regardless *"of the source – political, economic, social, military or environmental – of the threat to national security"*. This approach deems that *"environmental security must stand on its own: the other components of national security may play a role in it, but they must not be allowed to overshadow the challenges"*.

These theoretical choices explain that our analysis orients policy actions towards promoting the well being of populations, focusing on food security and livelihoods (via traditional channels such as migration, or diversification and change of livelihoods) and on, at the same level as the other, environmental variables (water and resource management, intra-seasonal climate predictions, etc.).

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