Box 2

FONDATION POUR LES ÉTUDES ET RECHERCHES SUR LE DÉVELOPPEMENT INTERNATIONAL

Assessing vulnerability to climate change

Climate change is one of the greatest challenges facing humanity. *The majority of the investments made up to the present day to combat climate change have focused on measures to mitigate its effects on a global scale. One of the decisions of the Paris Agreement in December 2015 was to seek a balance between mitigation and adaptation over time, with financial resources channelled to supporting low-carbon growth and helping the most vulnerable countries to adapt to the effects of climate change. In these countries, the effects of temperature changes on health, livelihoods, food production, water availability and security are already being felt. And Africa is one of the most vulnerable continents to climate change. Projections for the area point to a trend of regional warming with longer dry seasons. Rising temperatures, reduced water supplies and biodiversity loss are adversely impacting agricultural production, on which a large proportion of people in Africa depend, and the ensuing rural exodus is fuelling the already acute social tensions.*

Vulnerability to climate change is often analysed using indicators that measure its impacts. *These indicators, which have proliferated over recent years, are intended to help political stakeholders, donors and international negotiators to identify the most vulnerable countries in order to plan the best suited approach to their adaptation. The majority of these indices have been developed on a national scale, which facilitates country-to-country comparisons.*[1]

Their development is based on the IPCC's (the International Panel on Climate Change) three key aspects of vulnerability – exposure, sensitivity and adaptive capacity – otherwise referred to as resilience. *Exposure pertains to the nature, magnitude and rhythm of climatic variations to which a country is – or will be – exposed, according to IPCC scenarios. Sensitivity refers to the size of the effects – both negative and positive – of climate stimuli in a given country. And adaptive capacity concerns the intrinsic ability of a country's authorities to adapt in order to mitigate the impacts of climate change.*

Due to the complexity of existing indicators of climate change vulnerability, it is difficult to couple them with a clearly defined public policy objective. *First, the indicators group together a large number of variables that combine physical, social, economic and even political dimensions. Furthermore, the methods used to develop the indicators can lack transparency, which can make it difficult to replicate the results obtained, while the statistics employed may not be of sufficient quality. Variables are often imprecisely defined and updating them on a regular basis can prove problematic due to a lack of availability. For example, when an indicator of precipitation is cited, its measurement is often obscured and it can be difficult to know if it refers to the total amount of rainfall, number of rainy days, or rainfall intensity. Lastly, the social data used in these indices come from household surveys that are subject to significant measurement errors, particularly in developing countries.*

1 *For example the Disaster Risk Index of the United Nations Development Programme (UNDP, 2005), the quantitative assessment of vulnerability to climate change index of the International Crops Research Institute for the Semi-Arid Tropics (ICRISAT, 2009) and the University of Notre Dame's Global Adaptation Index.*

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1| The Physical Vulnerability to Climate Change Index (PVCCI)

In view of the limitations identified in the existing indicators, ***Ferdi created a Physical Vulnerability to Climate Change Index (PVCCI), based exclusively on geographic and climatic variables****. It was developed using an extremely broad sample of 191 developed and developing countries, enabling multiple comparisons. In contrast to the indicators referred to above, it was primarily conceived as a criterion for the allocation of funds for climate change adaptation, particularly concessional sources of adaptation financing. Given that it does not include social and political determinants of resilience, the index is exogenous, reflecting factors that are beyond a government's influence, and cannot be manipulated. It can therefore be used as a criterion for fund allocation alongside more traditional criteria such as per capita income.*

The PVCCI distinguishes between risks of progressive shocks and risks of intensification of recurrent shocks *and gives equal weight to both in the composite indicator (see Diagram). Risks related to progressive shocks correspond to the rise in sea level (higher risk of flooding for countries with a significant part of their territory in low-elevation coastal zones) and also trends of increasing temperatures or declining rainfall (higher risk of desertification in arid countries).*

Risks related to the intensification of recurrent shocks are measured on the basis of trends in rainfall shocks, temperature shocks and cyclone intensity. *These risks are more significant to countries that are exposed as a result of their aridity, temperature and extreme cyclonic activity. The size of the shocks and exposure to the shocks (denoted by the greyed-out boxes in the diagram below) are assessed for each of the five risks.*

For the purpose of simplicity, each PVCCI component is normalised following the min-max method. The scores of the PVCCI and its components range from 0 to 100 and increase according to vulnerability. The quadratic average is preferred to the arithmetic average for aggregation in order to limit substitutability between components. Thus, a country in the Sahel confronted with a high risk of increased aridity and a small island faced with a high risk of intensification of cyclonic activity can both be accorded a high PVCCI.

2| Where do the Franc Zone countries stand in terms of the PVCCI?

The Franc Zone countries appear to be less physically vulnerable on average to climate change than the other African countries, while the average for African countries differs little from that of other developing countries. Sudan, Djibouti and Mauritania are classified as the three most vulnerable countries on the continent, while Sao Tome and Principe is Africa's least vulnerable country. While the Franc Zone countries (WAEMU and CEMAC nations and Comoros) are, on average, less exposed to climate change than the other African countries, there are significant disparities between them. For example, three Franc Zone countries in the Sahel belt (Niger, Chad and Mali) figure among the ten most vulnerable countries in Africa.

The fact that the average PVCCI for Africa is no higher than for other countries elsewhere may seem to deviate from current opinion, notably that of the IPCC, that considers the continent to be particularly vulnerable, but this is essentially because the PVCCI only captures observed physical vulnerability based on recent past trends, while disregarding long-term projections and excluding resilience factors. One of the advantages of the PVCCI is also that it enables the user to clearly differentiate by country and, if necessary where the methodology allows, at an even more detailed level. As for resilience, it can be incorporated into the allocation formula but in different ways depending on whether the resilience is structural (condition of human resources) or related to current policies.

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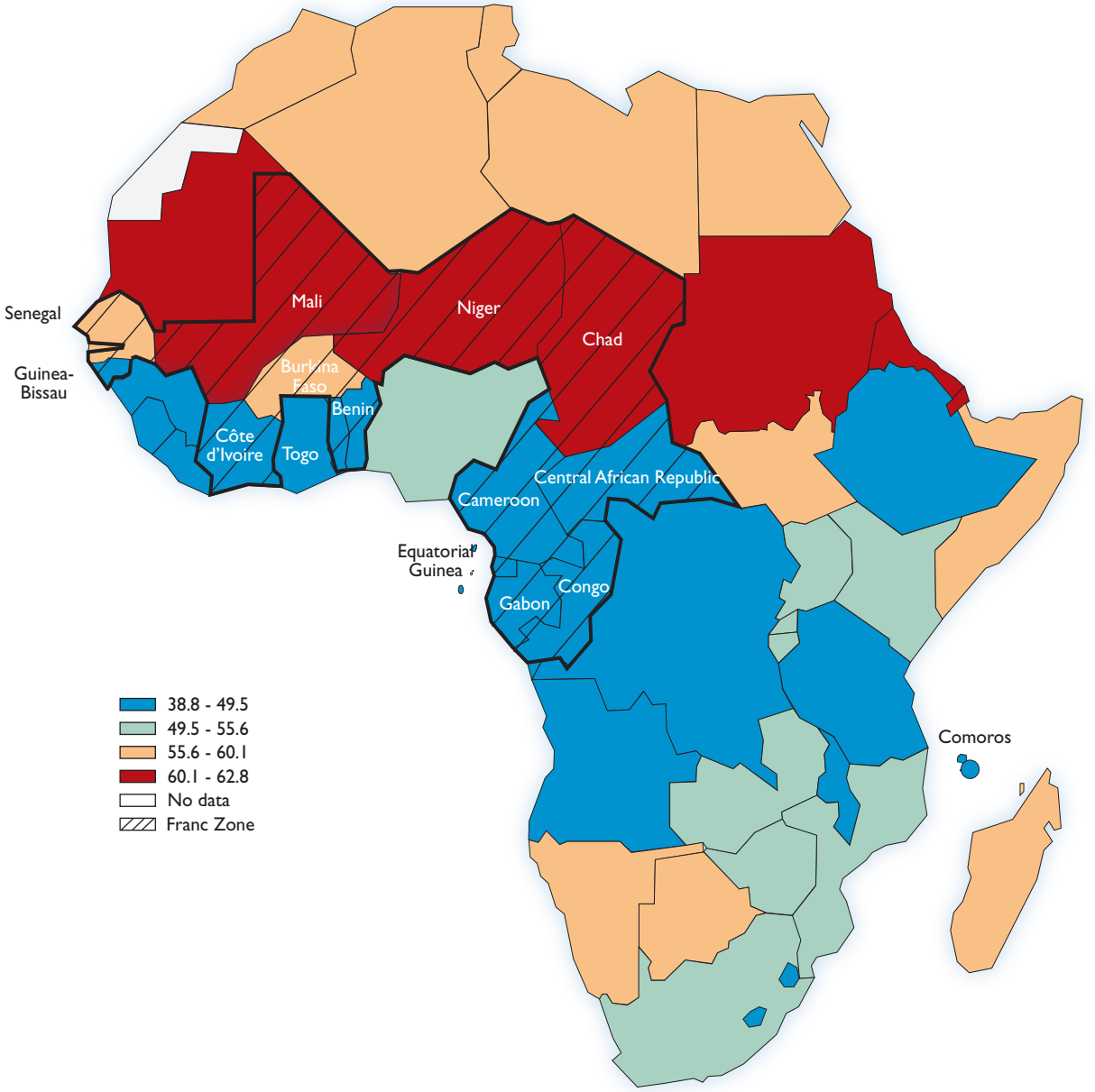
Map The Physical Vulnerability to Climate Change Index of african countries



Source: Ferdi.

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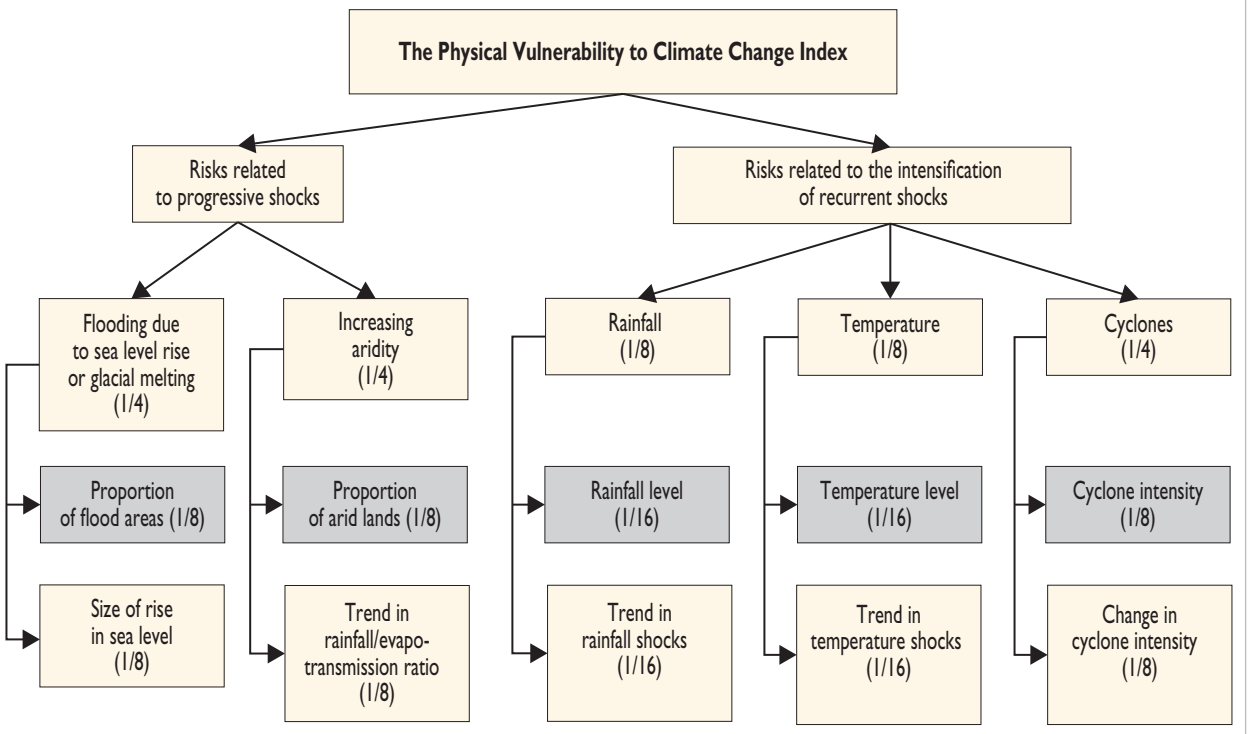
Diagram Structure of the Physical Vulnerability to Climate Change Index (PVCCI)



Source: Ferdi.
Note: The boxes corresponding to the last two rows of the diagram refer to exposure components (greyed-out) and shock-size components, respectively.

Certain Franc Zone countries, particularly those in the Sahel belt, are exceptionally exposed to the risks of low rainfall and higher temperatures, but in general, they are less exposed to the risk of low rainfall than the other African countries; only five – Niger, Chad, Mali, and to a lesser degree, Senegal and Burkina Faso – appear to be highly vulnerable. However, rising temperatures threaten the Franc Zone countries more than the other African countries. Risks related to temperature shocks effect Mali, Burkina Faso, Senegal, Cameroon and Togo in particular.

The Franc Zone countries' exposure to risks related to a rise in sea level or cyclonic events is minimal. On average, African countries – and even more so, Franc Zone countries – are less exposed to these risks than other developing nations. The exceptions in the Franc Zone are Guinea-Bissau, which is at risk from rising sea levels, and Comoros, which is exposed to the risk of cyclonic events.

In conclusion, due to its simplicity, clarity and transparency as well as the exogenous nature of its components, the PVCCI would appear to be a suitable indicator for aid allocation. Used in conjunction with other structural vulnerability criteria, the index can be applied to determine the distribution of concessional adaptation funds among the countries concerned. Various studies and numerous allocation simulations have taken this approach.[2] Based on this type of model, the Franc Zone countries of the Sahel should receive a high level of adaptation aid per inhabitant due to their serious physical vulnerability to climate change and their low per capita income.

2 *Guillaumont (P.), Simonet (C.), Closset (M.) and Feindouno (S.) (2017), "An index of physical vulnerability to climate change: which are the most vulnerable countries?", Ferdi,* Working Paper, *to be published.*