Methodology for evaluating vulnerability to climate change in environmental impact assessments

Methodology for evaluating vulnerability to climate change in environmental impact assessments

**Information Paper submitted by Argentina**

***Summary***

The objective was to implement a qualitative methodology for climate change risk analysis to be incorporated into the initial environmental impact assessments carried out for infrastructure works. The methodology involves determining the exposure, threats and vulnerability in order to establish the risks involved and finally propose adaptation measures to minimise the impact.

***Introduction***

The impacts of the risk of damage due to climate change are a growing concern as they reduce the predictability of future infrastructure needs and increase the vulnerability of populations and assets worldwide. In this regard, Resolution 1 (2016) states that one of the aims of the guidelines is "where appropriate, assist proponents to give consideration to the possible implications of climate change for proposed activities and their associated environmental impacts". For these reasons, the objective of being able to establish a methodology that allows the incorporation of a climate change risk analysis into its environmental impact assessments was set.

***Methodology Guidelines***

To establish the methodology, the definitions and guidelines established by the IPCC (IPCC 2014) were followed. This Methodology was designed in this first stage to be applied mainly to infrastructure projects, but it is expected to be extended to all types of activities in the future. Among the many methodologies that exist, we take as a basic reference “Hagenlocher, M., Schneiderbauer, S., Sebesvari, Z., Bertram, M., Renner, K., Renaud, FG, Wiley, H. & Zebisch, M. (2018). Climate Risk Assessment for Ecosystem-based Adaptation: A guidebook for planners and practitioners.”

The methodology is based on the determination of the components of the risk of damage due to climate change: Hazard, Exposure and Vulnerability. Based on these concepts, a risk assessment was designed that allows the consideration of the potential for damage due to climate change of a particular project. At this stage of development, we propose a qualitative approach to determine the nature and scope of disaster risk through the analysis of possible threats and the evaluation of existing conditions of exposure and vulnerability that in concert could cause damage to people, property, services, livelihoods and the environment.

***Qualitative methodology***

The methodology used is based on the information and specific knowledge about the project design provided for the preparation of the preliminary environmental impact assessment and the scientific knowledge available on climate change in Antarctica:

* ***Environmental Factor***: environmental variable that has an impact on the activity being assessed.
* ***Observed impacts***: Refers to (already observed) changes in the physical environment or in the wildlife resulting from climate change, added to existing climate variability, that have significant deleterious effects on the composition, resilience or productivity of natural or managed ecosystems, or in the functioning of socio-economic systems, or in natural and human health and well-being from extreme weather and climate events, and from climate change.
* ***Threats***: natural or man-made phenomena that have the potential to cause harm to people or property.
* ***Exposed values***: elements of the analysed activity that could suffer damage due to the threats of climate change.
* ***Risks***: “The potential for consequences where something of value is at stake and where the outcome is uncertain (...). Risk results from the interaction of vulnerability, exposure and hazard (...)” (IPCC 2014a, p. 40). A climate risk is the potential for specific climate-related consequences (climate shocks) that can affect assets, people, ecosystems, culture, etc.
* ***Hazard***: Potential occurrence of a physical event or trend of natural or human origin, or a physical impact that can cause loss of life, injury or other negative effects on health, as well as damage and loss in property, infrastructure, means of subsistence, provision of services, ecosystems and environmental resources.
* ***Vulnerability***: attributes of exposed elements that can increase (or decrease) the potential consequences of a specific climate hazard. In accordance with Wilches-Chaux (1993), we consider the following vulnerabilities useful for analysing climate change risks in Antarctic activities:
  + ***Natural Vulnerability***: Human beings and their constructions have certain conditions of temperature, humidity and other environmental variables for which they were designed.
  + ***Physical Vulnerability***: This refers especially to the location of human constructions in risk areas, and to the deficiencies of their physical structures in terms of their ability to “absorb” the effects of these risks.
  + ***Technical Vulnerability***: This refers to inadequate construction techniques in risk areas. Although this vulnerability could be included within Physical Vulnerability, its expressions are so specific that they warrant a separate sub-section.
* ***Adaptation***: Process of adjustment to the actual or projected climate and its effects. In human systems, adaptation aims to moderate or avoid harm or to take advantage of beneficial opportunities.

***Example of Use***

The first use case was in the evaluation of the installation of a field of solar panels at the Marambio Base. Based on the changes in the observed and expected climate on Seymour Island, it was possible to determine in a specific way that a clear positive trend can be observed in the increase in the average annual average temperature. However, although Seymour Island is located in the continuous permafrost zone, with ground temperatures close to –5°C and a thickness of approximately 200 metres (Silva Busso, Sánchez and Fresina, 2000), the observed and expected changes in temperatures have significant effects on the dynamics and thickness of the active layer of permafrost (top layer of permafrost that thaws in summer and refreezes in autumn).

Climate change is a phenomenon that has the potential to cause damage to property, and in this specific case, the increase in temperatures in the Seymour Island area will expose the structures of the photovoltaic plant to the threat of greater melting of the permafrost, which will thaw to a greater depth risking decreased support for the pillars buried in the ground.

Tabla

Descripción generada automáticamenteTable1: risk matrix for the installation of the solar panel field

In this way and in order to take into account the threats of climate change for the proposed activity, the threats, risks, exposed values, hazards and adaptation measures to be taken into account to reduce vulnerability are described in Table 1 of the photovoltaic plant during its useful life. Based on the impacts already observed and future scenarios, it is expected that the infrastructure of the solar panel field (buried pillars) will be exposed to the threat of increased thermal erosion of the permafrost, which will in turn cause an increase in the depth of thawing in the area of the pillars and therefore these will be left entirely buried in the active (thawed) layer and as a consequence the entire structure may become unstable or suffer partial collapse.

***Conclusions***

In order to comply with the requirements of Resolution 1 (2016) - Guidelines for Environmental Impact Assessment in Antarctica, a qualitative methodology was established in this first stage that allows adaptation measures to be obtained in preliminary environmental impact assessments with the aim of reducing the vulnerability of infrastructure projects due to exposure to and hazards deriving from climate change.

***Bibliography***

Annex, I. Guidelines for Environmental Impact Assessment in Antarctica.

GIZ and EURAC 2017: Risk Supplement to the Vulnerability Sourcebook: Guidance on how to apply the Vulnerability Sourcebook's approach 2017: Risk Supplement to the Vulnerability Sourcebook.

GIZ, EURAC & UNU-EHS (2018): Climate Risk Assessment for Ecosystem-based Adaptation: A guidebook for planners and practitioners, Bonn: GIZ.

IPCC 2014a: Climate Change 2014: Impacts, Adaptation, and Vulnerability. Part A: Global and Sectoral Aspects. Working Group II Contribution to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change. Cambridge University Press.

Hagenlocher, M., Schneiderbauer, S., Sebesvari, Z., Bertram, M., Renner, K., Renaud, FG, Wiley, H. & Zebisch, M. (2018). Climate Risk Assessment for Ecosystem-based Adaptation: A guidebook for planners and practitioners.

Silva Busso, A., Fresina, M., & Sánchez, R. (2000). Characterization of the hydrogeological behavior of Marambio (Seymour) Island, Antarctica. In I Joint Congress on Groundwater (p. 292).

Turner, J., Bindschadler, R., Convey, P., Di Prisco, G., Fahrbach, E., Gutt, J., Hodgson, D., Mayewski, P. & Summerhayes, C. (2009). Antarctic climate change and the environment. SCAR

Wilches-Chaux, G. (1993). La vulnerabilidad global. Los desastres no son naturales, 11-44.