Best practice

Risk and vulnerability assessment of the Metropolitan area of Rome

Municipality of San Benedetto del Tronto – PP2

Title of the Case study	CASE STUDY – RISK AND VULNERABILITY ASSESSMENT OF THE METROPOLITAN AREA OF ROME
General data	
Promoter	Roma Tre University – Department of Architecture (formerly dep. Of Urban Studies), research group "Politiche e strategie urbane per l'adattamento climatico", guided by prof. A. Filpa, prof. S.Ombuen
Timeframe	2013-2014
Target area and scale	Municipality of Rome
Brief description	The Climate Vulnerability map of Rome represent the main output of an academic research made by the University of Roma Tre in collaboration with ENEA-UTMEA. The research was aimed at testing a quick yet efficient and reproducible procedure that can provide – swiftly and with limited resources – a clear framework of the main climate vulnerability issues of a city, in order to support policy makers in understanding adaptation needs and priorities, with particular reference to their spatial distribution. The methodology implemented is derived with adaptations and simplification from the one used in Climate Change and Territorial Effect on Regions and Local Economies, developed by the ESPON 2013 Programme (ESPON, 2011)[1]. It applied the main concepts of the vulnerability assessment - Exposure, Sensitivity, Impacts, Adaptive Capacity, Vulnerability - as framed and defined by the IPCC 4thAR (2007)[2]. Significant adaptations were also applied due to the unavailability of geographical data at the required scale/resolution, some detail is provided below. All the process was perfomed using GIS tools and in particular making use of the overlay mapping technique to combine different information layer. One or more maps were produced to represent each component of the vulnerability diagram. The main research steps were: 1. Identification of the spatial units to which refer the vulnerability variables in order to appreciate infra-urban differences. 2. Exposure analysis: selection of 3 relevant climate phenomena - heat wave, rainwater flood, river flood -, calculation of exposure indices basing on proxy data and elaboration of phenomenon-specific maps. 3. Sensibility analysis: calculation of Sensitivity Index as a function of socio-demographic and urban fabric characteristics and elaboration of a Map. 4. Impact Analysis: calculation of 3 phenomenon-specific impact indices, as a function of the related exposure and the aggregate sensitivity.

[1] The ESPON research was issued in 2011 and mapped the climate vulnerability of Europe based at subregional scale (on NUTS 3 level areas) analyzing the impacts of a certain IPCC scenario on different systems (physical, economic, social, environmental, cultural).

[2] It means that some differences regarding the concepts definition and terminology can be detected respect to the main Joint SECAP reference, that is the GIZ-EURAC *Vulnerability Sourcebook 2017 - Risk supplement* , that was drafted in accordance with the *IPCC 5thAR (2014)*.

	5. Resilience analysis: calculation of 3 phenomenon-specific resilience Indices and elaboration of maps. Resilience depends on the characteristics of the urban structure – mostly related to urban greening and forestry - that can mitigate climate change impacts. 6. Vulnerability assessment: calculation of 3 phenomenon-specific and aggregate vulnerability indices as a function of impacts and resilience and elaboration of maps. To each step and for each factor, data distribution of the considered variables were classified, normalized and combined applying simple algorithms: weighted average was used to calculate the indices pf exposure, sensitivity and resilience; multiplication was used to calculate the indices of impact and vulnerability. An aggregate Vulnerability Map resulting from the sum of the others was produced to summarize the research and to visualize the most fragile urban sectors. The research group continued working on the topic and some adjustments to the methodology were attempted at the neighbourhood scale.
Contribution of the Case study to the Joint_SECAP guidelines for Vulnerability and Risk assessment	
Modules of the guidelines relevant to the case study	*Please select one or more Modules that you think the Case study gives a significant contribution to (i.e. through methodologies, methods, tools…). Refer to the Joint_SECAP Guidelines for further information on Modules:* M1 PREPARING THE RISK ASSESSMENT (describes the context of the assessment - processes, knowledge, institutions, resources and external factors –, identifies its objectives, expected outcomes and scope, and defines tasks, responsibilities and time planning) ☑ **M2 DEVELOPING IMPACT CHAINS** (identifies and clusters impacts and risks, identifies hazard and intermediate impacts, vulnerability and exposure of the system) ☑ **M3 IDENTIFYING AND SELECTING INDICATORS** (identifies and select indicators for hazards, vulnerability and exposure) M4 DATA ACQUISITION AND MANAGEMENT (regards the collection, quality check, storage and management of data) M5 NORMALIZATION OF INDICATOR DATA (provides normalized data for each indicator in a standardized value) ☑ **M6 WEIGHTING AND AGGREGATING OF INDICATORS** (evaluates the influence of the indicators on the respective risk component, assigns different weights, aggregates individual indicators into composite indicators of the risk components hazard, vulnerability and exposure) M7 AGGREGATING RISK COMPONENTS TO RISK (aggregates the risk components into a composite risk indicator) ☑ **M8 PRESENTING THE OUTCOMES OF YOUR RISK ASSESSMENT** (describes how to elaborate the risk assessment report, taking into account both the objective and the target audience of the assessment)
Descriptio	*Please provide a detailed description of how the Case study contributes to the modules selected*

n of the contribution of the Case study to the Joint_SECAP guidelines	*above, i.e. by explaining the methodological approach adopted, the methods and tools used, etc. The lines corresponding to the modules that are NOT been selected above shall be left blank:* **M1: ---** **M2 DEVELOPING IMPACT CHAINS:** In the case study, the risks to which refer the vulnerability assessment were selected without involving the stakeholders, according to the phenomena that the climate models and projections available at provincial scale had identified as probable. So as regards the exposure analysis, 3 risks connected to 2 documented climate trends were considered: risk of heatwave expected as a consequence of the increase in summer temperatures, risk of rainwater and river flooding expected as a consequence of the increase in precipitation intensity. Nevertheless the risks were not explored in terms of impact chains and their definition remained very generic. A more accurate definition of the risks (as the "Risk Supplement of the Vulnerability Sourcebook" suggests) is advisable. **M3 IDENTIFYING AND SELECTING INDICATORS:** In the case study a limited number of variables were combined to produce the main indices used in the assessment. Most Indicators derive from open access database such as census data, land cover, etc. Overcoming the different terminology used by the case study due to referring to IPCC AR4 instead of IPCC AR5, the case study suggests the use of the following indicators: *Hazards:* - thermal observation (derived by satellite images - MODIS) to represent the heat wave; - civil protection register of past events, to represent the rainwater flood; - flood bands defined by the Basin Authority, to represent the river flood. *Exposure:* - population density (derived by census data) - land cover classes (to summarize function, continuity and density of the urban fabric, derived by Regional Land Cover/Corine database). *Vulnerability/Sensitivity component:* - percentage of child and elderly population (derived by census data); - soil sealing (derived by EEA database) *Vulnerability/Adaptive capacity component:* - proximity to green infrastructures (percentage of perimeter adjacent to to green/wooded urban areas - , elaboration on land cover) - presence of vegetation (estimated by using the NDV Index derived from satellite images - LANDASAT). **M4: ----** **M5: ----** **M6 WEIGHTING AND AGGREGATING OF INDICATORS:** The case study uses simple algorithms: weighted average to combine the indicators and calculate the components of risk, multiplication to calculate the risk values. The researchers assigned the weights based on brainstorming. This, indeed, may represent a methodological weakness. It's worth to mention that while the sensitivity is expressed by a single index, the exposure, the impact, the resilience and the vulnerability (according to the AR4 definitions) are expressed by

	phenomenon-specific indices. For instance, the case of resilience that in the case study is considered as related to urban greening and forestry (in the AR5 conceptual framework such a concept could be an aspect of vulnerability), this applies because factors such as the proximity to green infrastructure or the percentage of permeable soil act differently against a heat wave, a rainwaterflood, or a riverflood. **M7: ---** **M8 PRESENTING THE OUTCOMES OF YOUR RISK ASSESSMENT:** Maps constitute the main output of the case study. GIS tools can be very useful to organize and present the information in a spatialized way. To do this the identification of spatial units, to which refer the analysis on spatial and statistical data, is an essential step. In the case study, the target area, defined by the administrative boundaries of Rome Municipality, has been subdivided into Spatial Units (SUs)in order to better appreciate infra-urban differences in climate vulnerability. The SUs approximately correspond to a neighbourhood and identify parts of the city that are homogeneous in terms of function, density and building characteristics. They have been identified using the land cover patches (residential, commercial and industrial) and the road network. The Joint SECAP target areas are significantly smaller and probably infra-urban differences in climate vulnerability are not so relevant, nevertheless, identifying a limited number of homogeneous urban sectors to refer the data is advisable.
References	
Website(s)	*Please include the link to the official website and/or other webpages where information on the Case study can be found:* ---
Bibliography	*Please include references to books, papers or articles providing relevant information on the Case study:* - *IT – La carta della vulnerabilità climatica di Roma 1.0. FILPA A, & OMBUEN S (2014). In URBANISTICATRE, 5 (pp.47-58). ISSN: 1973-9702 (http://www.urbanisticatre.uniroma3.it/dipsu/wp-content/uploads/2015/01/U3_quaderni_05_filpa_ombuen.pdf)* - *IT* – La Carta della vulnerabilità climatica di Roma 1.0. A. Filpa (2014). In *QUALITÀ DELL'AMBIENTE URBANO X RAPPORTO Edizione 2014 - Focus su le città e la sfida dei cambiamenti climatici, (pp.187-198) ISPRA 54/2014.* ISBN 978-88-448-0686-6 *(http://www.isprambiente.gov.it/files/pubblicazioni/statoambiente/FocussuLecittelasfidadeicambiamenticlimatici.pdf)* - *EN - Annex 5 - Case Study Annex (2018). In C. Rosenzweig, W. Solecki, P. Romero-Lankao, S. Mehrotra, S. Dhakal, & S. Ali Ibrahim (Eds.), Climate Change and Cities: Second Assessment Report of the Urban Climate Change Research Network (pp. 659-774). Cambridge: Cambridge University Press. doi:10.1017/9781316563878.029 (https://www.cambridge.org/core/books/climate-change-and-cities/case-study-annex/5620A546E607FD0CBFFB2ADE3216421C/core-reader)*

Images	*Please include pictures or graphs you deem relevant to illustrate the Case study:* ***Map of aggregate vulnerability***