Measurement procedure and tool	Estimation from statistical data.
Scale of measurement	nr/ha
Data source	
Required data	Model/Statistical Data
Data input type	Quantitative
Data collection frequency	
Level of expertise required	Low
Synergies with other indicators	
Connection with SDGs	3
Opportunities for participatory data collection	
Additional information	
References	

6.15.2 Area and population exposed to flooding

Project Name: URBAN GreenUP (Grant Agreement no. 730426)

Author/s and affiliations: Raúl Sánchez, Jose Fermoso, Silvia Gómez, María González, Jose María Sanz, Esther San José

CARTIF Foundation. Parque Tecnológico de Boecillo, 205, 47151, Boecillo, Valladolid, Spain

Area (Ha) and population (number of inhabitants) exposed to flood risk	**Natural and Climate Hazards**
Description and justification	The areas and population exposed to flooding will be compared before and after the installation of the NBS to know if the intervention has influence in mitigating effects from flood risks. Flood hazard maps cover the geographical areas which could be flooded according different scenarios in terms of the return period. For each scenario studied the following

	elements shall be taken into account: the flood extent, water depths or water level, flow velocity. On the other hand, flood risk maps show the potential adverse consequences associated with flood scenarios referred to potential significant flood risks areas and expressed in terms of: number of inhabitants potentially affected; type of economic activity of the area potentially affected; and special installations (Annex I to Council Directive 96/61/EC of 24 September 1996, concerning integrated pollution prevention and control (1) which might cause accidental pollution in case of flooding and potentially affected protected areas identified in Annex IV(1)(i), (iii) and (v) to Directive 2000/60/EC) Other information which the Member State considers useful such as the indication of areas where floods with a high content of transported sediments and debris floods can occur and information on other significant sources of pollution.
Definition	This KPI can evaluate the increasing on green areas and its relation with the flooding risks. This indicator has been mainly defined for a floodable park but it could also be applied to scale the impact of other types of NBS on areas and population exposed to flooding.
Strengths and weaknesses	The calculation of this KPI is complex and requires specific knowledge and/or the use of a specific tool. However, the output of this KPI is valuable information regarding people’s security.
Measurement procedure and tool	No sensor devices are required; however, GIS software or other specific software (i.e., Iber software) is required. A numerical model for hydraulic simulations will be applied to assess this KPI for the situation after the implementation of the NBS that is pretended to be studied. Main steps to build and run a hydraulic simulation in Iber software is shown below (extracted from Iber user´s manual) and Bladé et al. (2014): Create or import a geometry of the study Area; Assign a series of input parameters (bed roughness, turbulence model and other hydraulic parameters); Build a numerical mesh; Run the computation and Results visualization. The procedure may be different depending on the software used. For the evaluation of this KPI after the implementation of the NBS´s, different maps, tables and graphs extracted from the post-process interface of Iber software as well as demographic data from studied area will be the base to develop flood hazard maps and flood risk maps and thus, obtain the following data:

	• Area (ha) exposed to flooding: This value represents the surface of land expressed in hectares (ha) that is flooded for the different scenarios considered (10, 100 and 500 years return period). • Population (inhab) exposed to flooding: This value represents the number of citizens living in parts of land that are flooded for the different scenarios considered (10, 100 and 500 years return period). Finally, the higher decrease in both area (ha) and population (inhab) exposed to flooding when comparing the values prior and after to the implementation of the NBS considered, the greater potential benefits in mitigating flood risks will be achieved.
Scale of measurement	City
Data source	
Required data	Digital land cover maps from CORINE land cover project; demographic data from the studied area; and size and topography from digital elevation models (DEM) of each intervention.
Data input type	GIS data
Data collection frequency	Yearly
Level of expertise required	Expert
Synergies with other indicators	Abortion capacity of green surfaces, bioretention structures and single trees, run-off coefficient in relation to precipitation quantities.
Connection with SDGs	This KPI is directly related with SDG 16 and SDG 11 and indirectly is related with SDG 15 (soil loss processes contributes to desertification).
Opportunities for participatory data collection	This is not a KPI open to participatory collaboration.
Additional information	
References	URBAN GreenUP Deliverable D2.4 - Monitoring program to Valladolid. https://www.urbangreenup.eu/insights/deliverables/d2-4---monitoring-program-to-valladolid.kl URBAN GreenUP Deliverable D3.4 - Monitoring program to Liverpool https://www.urbangreenup.eu/insights/deliverables/d3-4---monitoring-program-to-liverpool.kl

URBAN GreenUP Deliverable D4.4 – Monitoring program to Izmir https://www.urbangreenup.eu/insights/deliverables/d4-4--monitoring-program-to-izmir.kl

URBAN GreenUP Deliverable D5.3: City Diagnosis and Monitoring Procedures https://www.urbangreenup.eu/insights/deliverables/d5-3-city-diagnosis-and-monitoring-procedures.kl

Iber software. http://iberaula.es/space/54/downloads

Bladé, E., Cea, L., Corestein, G., Escolano, E., Puertas, J., Vázquez-Cendón, E., Dolz, J., Coll, A., 2014.

Iber: herramienta de simulación numérica del flujo en ríos. Revista Internacional de Métodos Numéricos para Cálculo y Diseño en Ingeniería, Volume 30, Issue 1, 2014, Pages 1-10, ISSN 0213-1315, DOI: 10.1016/j.rimni.2012.07.004

Flood hazard map and flood risk map, respectively, of Pisuerga and Esgueva rivers as they flow through the city of Valladolid for a 100 years return period flood.