

Annex 1 of the final Guide

# HOW TO CALCULATE THE INDICATORS



«Soil is an asset of common interest to the community, even if it is mainly privately owned, and if not protected, will undermine the sustainability and long-term Europe<sup>1</sup> competitiveness »

<sup>1</sup> European Directive No. 2004/35/CE

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## FIRST GROUP OF INDICATORS: LANDE CONSUMPTION RATE

### Indicator 1: Percentage of used territory on the space in reference

Calculation Method: urbanized surface/artificial up to a given date/brought to the knowledge for total reference (to the Province, the Department, the Council) in %

$$\text{Formula: } C = \text{SU}/S$$

C = Used territory

SU = urbanized or artificial surface (buildings + sport grounds, quarries, docks)

S = Surface for total reference (surface which is surveyed)

### Indicator 2: The intensity with which territory has been used

Calculation Method: used territory within the period of two given dates as reported under urban territory during the year in reference given in percentages.

This calculation requires the measurement of used territory in two different dates

$$\text{Formule: } I = 100 - (C2 * 100 / C1)$$

I = intensità del consumo di suolo

C1= superficie di suolo consumato [ data 1 ]

C2= superficie di suolo consumato [ data 2 ]

### Indicator 3: Average annual rate in the increase of territory consumption

Calculation Method: annual territory consumption expressed in % of consumed territory over a specific period.

This calculation requires the measurement of used territory in two different dates in order to be able to calculate the annual variation

$$\text{Formula: } T_i = 100 * [(C2 - C1) / (a * C1)]$$

T<sub>i</sub> = average growth rate

C2: value/measurement of consumed territory on the date N+n+1+n+2

C1: value/measurement of consumed territory on date N

A: difference (in number of years) between the two measurements

### Indicator 4: Consumption of fertile soil

Calculation Method: Fertile soil consumed in a given period in absolute value to the surface in reference of fertile soil, brought to the knowledge (at departmental level, the Province, the Council, etc) expressed in %

$$\text{Formula: } C_{sf} = \text{SU}_{sf} / S$$

C<sub>sf</sub> = Consumed fertile soil

SU<sub>sf</sub> = surface of consumed fertile soil urbanized/artificial (buildings + parking, routes, etc.)

S = surface of fertile soil in reference

It is possible to refer to their proper definition of fertile soil according to the characteristics of their legislation.

In order to identify consumed fertile soil, it is necessary to compare the relative data of consumed surface with that of fertile soil. The intersection of data represents the consumed fertile soil.

#### Indicator 5: Consumption of territory by altitude in %

Calculation Method: consumption of territory by altitude expressed in height and in %

The metric parts are of 100m (eg: 0 – 100m, 100 – 200m, 200 – 300m)

$$\text{Formula: } F_x = \sum CS \text{ in } F_x$$

$F_x$  = altitude for a definite part

CS in  $F_x$  = consumed territory of a part with a definite height

In order to identify the consumed territory it is necessary to unite the data relative to the consumed territory with that of altitude. The sum of both values will generate the answer to consumed territory by metric calculation.

#### Indicator 6: Consumed territory by inhabitant

Calculation Method: the relationship between the surface of consumed territory and the population resident on that territory expressed in  $m^2$ /inhabitant or in ha/inhabitant

It is fundamental that the relative data of consumed territory carries the same date (or the nearest possible date) as that of the resident population. Ex: if the date of consumed territory falls under 2006, then one has to calculate the population in that area as of 2006.

$$\text{Formula: } Cab = CS/hab$$

Cab: consumed area by inhabitant

CS: consumed area ( $m^2$ , ha)

Hab: number of inhabitants (num)

#### Indicator 6 b: Consumed area in square metres by inhabitant supplementary between two dates

Calculation Method: the relationship between the increase in consumed territory and the demographic population

$$\text{Formula: } CSAbS = (CS2 - CS1)/(ab2 - ab1)$$

CSAbS: consumed territory by supplementary inhabitant

CS1: consumed territory on period 1

CS2: consumed territory on period 2

ab1: number of inhabitants on period 1

ab2: number of inhabitants on period 2

#### Indicator 7: Indication of environmental protection (%)

Calculation Method: consumed territory in  $m^2$  and protected territory (according to the norms) referred to as the surface in reference.

This indicator indicates the percentage of consumed territory within the protected areas (natural parks, nature 2000, SIC etc.) within the interior of the zone in reference.

$$\text{Formula: } Ipa = Csa/S * 100$$

$Csa^{**}$  = consumed territory in protected areas established by an environmental protection decree

S = surface area of the zone in reference

**Indicator 8: Installation risks**

Calculation Method: relationship between the consumed territory in m<sup>2</sup> and buildings within the zones classified as potentially exposed to natural risks.

Indicates the rate of construction within territories classified by a decree as territory threatened by natural risks.

$$\text{Formula: } Cri = Cs / Ari$$

Cs= consumed territory

Ari= Surfaces exposed to natural risks

**Indicator 9: Technological Risk**

Calculation Method: relationship between consumed territory in m<sup>2</sup> and the buildings within the zone classified as potentially exposed to technological risks.

Indicates the rate of construction within territory classified by a decree as territory under technological risk.

$$\text{Formula : } Cri = Cs / Art$$

Cs = consumed territory

Art = surface exposed to technological risk

**Indicator 10: Pressure through Tourism**

Calculation Method: relationship between the tourism population – the maximum (only if all the beds have been simultaneously occupied) and the resident population.

The rate reflects the multiple factor due to the tourist population

this detailed data of number of rooms for the hotels and the number of campers for camping sites, has to be “converted” in number of beds or equivalent to number of persons in order to be usefully compared (camping: 3 persons by each camping zone, hotel: 2 persons per room; secondary residence: 5 persons)

$$\text{Formula: } pt = \text{popT}^*/ab$$

Pt: pressure through tourism

popT: maximum population (theoretically)

ab: residents

## SECOND GROUP OF INDICATORS: THE SPRAWL

### Indicator 11: Indicator of dispersion of buildings

Calculation Method: surface of consumed territory in areas not yet urbanized

$$\text{Formula: Sprawl} = \text{Csl}[\text{Ha}]$$

Csl = consumed territory in not urbanized areas

The definition of not urbanized areas according to the PTC of Turin corresponds to those zones essentially agricultural zones or to natural spaces or where the density of buildings is very sparse. The density of buildings in not urbanized areas is due to the model of GIS, as has been defined in the document Definitions sprawl. The methodology is indicative and the partners are not obliged to use that methodology but may use other methods of calculation.

### Indicator 12: Sprawl/Mix Incidence

Calculation Method: total surface of new urban cores within free zones (Outside Development Zones consolidated or dense and zones in transition connected to ODZ) in relation to the total surface of consolidated urban zones in a given period

$$\text{Formula: Is} = \text{Sprawl} / \text{Cs}$$

Sprawl = indicator of dispersed buildings

Cs = consumed territory

Indication of the contribution of new urban cores in non-urbanized sector in relation to the total growth of man made territory

## THIRD GROUP OF INDICATORS: FRAGMENTATION

### Indicator 13: Indicator of Urban Fragmentation (UFI)

Calculation Method: fragmentation due to the increase of built areas. Evaluation of the fragmentation of territory within urbanized areas which create a barrier; the higher the percentage of the index the more important the fragmentation

$$\text{Formule: UFI} = \sum L_i \times \sqrt{\frac{\text{Su}_i}{\text{Str}}}$$

L= maximum dimension of urban boundary (m)

Su- Urbanised territory (m<sup>2</sup>)

Str = territorial surface in reference (m<sup>2</sup>)

### Indicator 14: Indicator of infrastructural fragmentation

Calculation method: evaluation of the fragmented territory linked to urban infrastructure (high tension lines, highways and railway lines, etc.) plus the higher the index value the more important the fragmentation.

$$\text{Formula: IFI} = \frac{L_i}{\text{Str}}$$

L<sub>i</sub> = length of infrastructures (less the tunnels and the ducts) (m)

Str = territorial surface in reference (m<sup>2</sup>)

**Indicator 15: Density Indicator**

Calculation Method: relationship between the perimeter of an urban area and the surface of the area to the circle which has the same surface as the urban area in consideration.

Il coefficiente ideale si avvicina ad 1.

Formule: 
$$II_L = 2 \times \frac{\sqrt{\pi a_f}}{P}$$

P= perimeter in reference

Indicates the degree of fragmentation of the space in reference, due to the combined action of urban fragmentation and infrastructural fragmentation and provides a density coefficient.