

“Capacity Building and Strengthening Institutional Arrangement / Data Yearbook”

Workshop: “Environmental Indicators and their use for
indicator-based reporting activities”

Working Group Exercise n°3

Composite Indicators

A short review for the building of aggregated
environmental indicators.

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Exercise A

To find the factor of normalization, for the followings indicators, in comparison to the context (multiple answers are admitted)

	Indicators	Unity of measure	Factor of Normalisation	Normalized indicator (unity of measure)
1	Generation of the municipal wastes	Ton (t)	Resident population	Municipal wastes generation per-capita (kg/ab)
2	Generation of the construction and demolition wastes	Ton (t)	Employees' number in the building sector; Urbanized surface (ha)	Wastes C&D generation for employed (kg/employer); Production wastes C&D for unity of urbanized surface (t/ha)
3	Separate collection of municipal wastes	Ton (t)	Generation of Municipal wastes	Percentage of the MWs collected(%)
4	Agricultural use of fertilizers (fertilizers and corrective)	Ton (t)	Fertilized Surface SAU	Distribution for agricultural use of fertilizers in comparison to the fertilized surface (or SAU) (kg/ha)
5	Greenhouse gas Emissions (CO ₂ , CH ₄ , N ₂ O, HFCS, PFCS, SF ₆)	Mtep of equivalent CO ₂	Greenhouse gas emissions produced in the base year	Greenhouse gas Emissions (Es. 1995=100)
6	Urbanization and infrastructures	Hectare (ha)	Total territorial surface	Percentage of the urbanized surface, occupied by infrastructures and nets of communication (%)
7	Population exposed to the noise	number of inhabitants	Resident population	Resident population Percentage of population exposed to the noise (%)
8	Forest surface	Hectare	Total territorial surface	Indicator of woodiness (%)
9	Used agricultural surface	Hectare	Total territorial surface	Percentage of the SAU (%)

Exercise A

	Indicators	Unity of measure	Factor of Normalisation	Normalised indicator <i>(unity of measure)</i>
10	Vehicle Park	Number	Population; Population over 18 years	Car number for inhabitant
11	SO _x Emissions in the chemical industry	Gram (g)	Production of the chemical sector	Specific emissions of the productive trials in the chemical industry (g/t)
12	Production of hazardous and non hazardous wastes (created of the productive activities)	Ton (t)	GDP	Generation of the wastes for unity of GDP
13	Surface crossed by the fire	Hectare (it has)	Forest surface	Percentage of the surface crossed by the fire (%)
14	Quantity of Municipal wastes landfill disposal	Ton (t)	Quantity of the Municipal wastes generated	Percentage of the municipal wastes landfill disposal (%)
15	Water collecting to drinkable use	Meter cube (m ³)	Resident population	Use of per-capita drinkable water (m ³ /ab)
16	Surface protected terrestrial areas	Hectare (ha)	Total territorial surface	% protected territory
17	Surface turned to national park	Hectare (ha)	Protected terrestrial surface	% of the surface turned to national park on the protected surface

Exercise B

Give the following indicators, to define if they require of a normalization or a standardization in base to the goal that is wanted to

	Indicators	Unity of measure	achieve Aim	Response
1	Generation of the Municipal wastes	Ton (t)	Territorial comparison of the phenomenon	Normalisation in comparison to resident population
2	Management of the municipal wastes	Ton (t)	Territorial comparison of the phenomenon	Standardisation
3	Agricultural use of fertilizers (fertilizers and corrective)	Ton (t)	To compare the use of the fertilizers among regions	Normalisation in comparison to the fertilized Surface SAU
4	Desertification	Kilometer (km)	To evaluate the desertification phenomenon in different territorial circles	Normalisation in comparison to the territorial surface
5	Air quality indicator	Micrograms/meter ³ (μ/m^3)	To evaluate pollution phenomenon of more environmental matrixes	Standardisation
6	Urbanization and infrastructures	Hectare (ha)	To compare the extension of the urbanized territory and that occupied by infrastructures present on the regional territory	Normalisation in comparison to the total territorial surface
7	Desertification	Kilometer (km)	To evaluate the general effects of the climatic changes	Standardisation
8	Capacity of the water courses	Meters cubes to the second (m^3/s)	To evaluate the phenomenon of the river functionality	Standardisation
9	Forest surface	Number	To evaluate the management of the forest patrimony	Standardisation
10	Agricultural firms that agree to eco-compatible measures	Number	To compare the adhesion of the agricultural firms to eco-compatible measures to regional level	To Normalise in comparison to the number of total agricultural firms

Exercise C

Gives the following cases to define which is the more appropriate method of standardisation

1) It wants to show the trend of an indicator related to a determined environmental phenomenon for which it is likely that it assume inferior values than to those in a determined year.

R1) Method distance to a target

2) You have only one value of the indicator.

R2) No Method

3) You have 8 annual values of an indicator for a 10 year-old temporal range (the data for two years are missing).

R3) Method max and min, Method distance from the average

4) You have a time series of 7 years of an indicator which has had a swinging trend in the period and based on existing environmental conditions, the necessity of an increase of such values is drawn.

R4) Method max and min, Method distance from the average

5) You have the value of an indicator for a determined year and the expectation it is that such indicator assumes lower values.

R5) No Method

6) You have a time series of 12 years of an indicator related to one determined phenomenology that has as goal the 30% reduction in comparison to the lowest value gotten during the last 10 years.

R6) Method distance to a target

7) You have a time series of 15 years of an indicator for which a 70% reduction is wished in comparison to the value assumed in the first year of the series.

R7) Method distance to a target

8) You have a series of 5 years of an indicator that has had in the considered period a 30% increase in comparison to the initial year of the series.

R8) Method max and min, Method distance from the average

9) You have the value of an indicator for the year x and of a normative that ask a 30% reduction in comparison to the year $x-5$.

R9) No Method

Exercise D

On the basis of this fact-sheet indicator: to define the standardisation method more appropriate. *It's possible that indicator could ask for a normalisation before being standardized.*

SEPARATELY COLLECTED WASTE

DESCRIPTION: *The indicator measure the quantity of municipal wastes collected in the separately way in the year of reference.*

UNITY OF MEASURE: *Tons/year (t/y); percentage (%).*

DATA SOURCE: APAT

PERIODICITY OF UPDATING : *Annual*

PURPOSE AND LIMITS: *To verify the achievement of the target of separately collected waste fixed by the art. 24 of the D.Lgs. 22/97.*

OBJECTIVES FIXED BY THE NORMATIVE ONE: *For the separately collected waste of the Municipal wastes the D.Lgs. 22/97, art. 24 paragraphs 1 fixes the followings objective: "In every optimal territorial area have to be guaranteed a separately collected municipal wastes equal to the following least percentages of wastes products: to) 35% within 2003."*

STATE AND TREND: *The separately collected wastes, also recording a discreet increase from the 19,2% of 2002 to the 21,5% of 2003, it doesn't achieve the objective fixed by the D.Lgs. 22/97 for 2001 (25%).*

Exercise D

On the basis of this fact-sheet indicator: to define the standardisation method more appropriate. *It's possible that indicator could ask for a normalisation before being standardized.*

Tab.1: Separately Collected Waste (1999-2003)

1999		2000		2001		2002		2003	
Quantity of MW generation n	Quantity separately collected waste of MW	Quantity of MW generation n	Quantity separately collected waste of MW	Quantity of MW generation n	Quantity separately collected waste of MW	Quantity of MW generation n	Quantity separately collected waste of MW	Quantity of MW generation n	Quantity separately collected waste of MW
t*1000		t*1000		t*1000		t*1000		t*1000	
28.360	3.708	28.960	4.181	29.410	5.115	29.860	5.740	30.064	6.451

Solution

It's necessary make a normalisation using the generation of the MW (Municipal Wastes)

Method of standardisation: Distance to a target

$$z = \frac{X_i}{X_{ob}} \quad \text{if } X_i \leq X_{ob}$$

$$z = 1 \quad \text{if } X_i > X_{ob}$$

Exercise D

Tab.1: Separately Collected Waste normalised (1999-2003)

1999	2000	2001	2002	2003
Percentage of separately collected MW	Percentage of separately collected MW	Percentage of separately collected MW	Percentage of separately collected MW	Percentage of separately collected MW
%				
13,1	14,4	17,4	19,2	21,5

Exercise D

Tab.1: Separately Collected Waste standardised(1999-2003)

1999	2000	2001	2002	2003
Standardised Value				
Range [0-1]				
0,37	0,41	0,50	0,55	0,61

Exercise E

Following are brought the fact-sheet indicators “*Separately collected waste*” and “*Landfill disposal, in total and by type of waste*”. Besides the principal information of the phenomenons are given inside the tables A and B. Verify the “sustainability” of the urban wastes management in the period 1999-2003 and under the hypothesis that the “separately collected waste”, really, is started to recovery, and that the two indicators contribute in equal measure to monitoring the sustainability of the process of management, an integrated index useful to the purpose is built.

DESCRIPTION: The indicator measure the quantity of separately collected municipal wastes in the year of reference.

UNITY OF MEASURE: Tons/year (t/y); percentage (%).

DATA SOURCE: APAT

**SEPARATELY
COLLECTED WASTE**

PERIODICITY OF UPDATING: Annual

PURPOSE AND LIMITS: To verify the achievement of the target of separately collected municipal wastes fixed by the art. 24 of the D.Lgs. 22/97.

OBJECTIVES FIXED BY THE NORMATIVE ONE: For the separately collected municipal wastes the D.Lgs. 22/97, art. 24 paragraphs 1 fixes the followings objective: *"In every optimal territorial area have to be guaranteed a separately collected municipal wastes equal to the following least percentages of wastes products: to) 35% within 2003."*

Year	Kind of data	t*1000
1999	Separately collected waste	3.708
	Generation	28.364
2000	Separately collected waste	4.181
	Generation	28.959
2001	Separately collected waste	5.115
	Generation	29.409
2002	Separately collected waste	5.740
	Generation	29.864
2003	Separately collected waste	6.340
	Generation	30.034

Tab.A: Quantity of municipal wastes generated and separately collected waste (1999-2003)

DESCRIPTION: It represents the quantity of wastes landfill disposal. It is given for typology of wastes.

UNITY OF MEASURE: Tons/year (t/y)

DATA SOURCE: APAT

PERIODICITY OF UPDATING: Annual

PURPOSE AND LIMITS: To verify the progress in the approach to the objective of reduction of the use of the dump as method of disposal of the wastes, as foreseen by the D. Lgs 22/97, furnishing an indication about the effectiveness of the politics of wastes management.

OBJECTIVES FIXED BY THE NORMATIVE ONE: In Italy, the Directive 1999/31/CE have been taken in with the D. Lgs 13 January 2003 ns. 36 related to the dumps of wastes. The law establishes the operational and technical requisite for the landfill disposal, defining the procedures, the constructive criterions and the formalities of management of such fittings with the purpose to reduce the impact on the environment. With the purpose to reduce the use of the landfills it is required that the percentage of the municipal wastes landfill disposal in comparison to the produced quantity is not superior to 50%.

Year	Kind of data	t*1000
1999	MW landfill disposal	21.745
	Generation	28.364
2000	MW landfill disposal	21.917
	Generation	28.959
2001	MW landfill disposal	19.705
	Generation	29.409
2002	MW landfill disposal	18.848
	Generation	29.864
2003	MW landfill disposal	17.996
	Generation	30.034

Tab. B: Quantity of municipal wastes produced and quantity landfill disposal (1999-2003)

Solution Exercise E

To evaluate that the trend of the phenomenon “Urban wastes Management” is in sustainable way, is necessary to resort to the aggregation of the two indicators. Then the footsteps to be completed are:

1. to normalize both the indicators in comparison to the generation of the municipal wastes;
2. to standardize both the indicators in comparison to the objectives fixed by normative using the method of standardization reported to the distance to the target;
3. to aggregate the two indicators standardize through arithmetic mean.

STEP 1

to normalize both the indicators in comparison to the production of the municipal wastes

Tab. 1: Percentage of separately collected waste and landfill disposal in comparison to the production of the municipal ones (1999-2003)

Year	Kind of data	%
1999	% separately collected waste	13,07
	% MW landfill disposal	76,66
2000	% separately collected waste	14,44
	% MW landfill disposal	75,68
2001	% separately collected waste	17,39
	% MW landfill disposal	67
2002	% separately collected waste	19,22
	% MW landfill disposal	63,11
2003	% separately collected waste	21,11
	% MW landfill disposal	59,92

STEP 2

to standardize both the indicators in comparison to the objectives fixed by normative using the method of standardization reported to the distance by the objective;

Method of standardisation for MW separately collected waste :

Distance from the target

$$z = \frac{X_i}{X_{ob}} \quad \text{if } X_i \leq X_{ob}$$

$$z = 1 \quad \text{if } X_i > X_{ob}$$

Method of standardisation for MW landfill disposal :

Distance from the target

$$z = \frac{X_{ob}}{X_i} \quad \text{if } X_i \geq X_{ob}$$

$$z = 1 \quad \text{if } X_i \leq X_{ob}$$

STEP 2

to standardize both the indicators in comparison to the objectives fixed by normative using the method of standardization reported to the distance by the target;

Tab.2: Values standardized of the separately collected waste and of the quantity landfill disposal of the municipal wastes (1999-2003)

Year	Kind of data	%	objective	standardized value
1999	% separately collected waste	13,07	35	0,37
	% MW landfill disposal	76,66	50	0,65
2000	% separately collected waste	14,44	35	0,41
	% MW landfill disposal	75,68	50	0,66
2001	% separately collected waste	17,39	35	0,5
	% MW landfill disposal	67	50	0,75
2002	% separately collected waste	19,22	35	0,55
	% MW landfill disposal	63,11	50	0,79
2003	% separately collected waste	21,11	35	0,6
	% MW landfill disposal	59,92	50	0,83

STEP 3

to aggregate the two indicators standardized through arithmetic mean.

Tab. 3: Trends of the index "Municipal Waste Management" (1999-2003)

Year	Index
1999	0,51
2000	0,54
2001	0,63
2002	0,67
2003	0,72

The trend of the phenomenon "Municipal Waste Management" it is in positive evolution even if it hasn't reached the objectives fixed by the normative one yet.