"Capacity Building and Strengthening Institutional Arrangement"

Workshop: "Sustainable Development"

EIA Environmental Indicators for Sustainable Development

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To select the indicators directed to an EIA study, we should specify that it includes the following stages:

1. Cognitive picture of programmatic, planning and environmental reference (ascribed to the global context and to the environmental elements)
2. Sensitive analysis of the environmental context for changes introduced by the projects to realize
3. Analysis of the foreseeable impacts on the environmental elements
4. Study of the mitigative and compensative interventions of the residual impacts
5. Monitoring of the adopted mitigative and compensative interventions

The most suitable tool for the characterization of the five stages of an EIA study, is the “Indicator”.

The indicators will have a different sense, aim and use, for every stage to which they refer.

1

The indicators concerning the first cognitive stage

will be very detailed, because the in-depth knowledge of the environmental context in which we work, in order to let us not ignore all characterizing elements

2

The indicators concerning the intermediate stage of evaluation of the probable impacts

we will consider also all those variables that at the moment aren’t interested, but could be in the future (the possible impacts can also concern the economic sphere and the spatial-temporal ambit)

3

The indicators concerning the intermediate stage of mitigative and compensative measurements

These indicators will have a narrow character and will consider only the aspects of the directly involved environmental elements

4

The indicators concerning the last stage of monitoring

These indicators will be relevant to the control, but they will consider only those aspects directly concerning the impacts, omitting all the other elements that haven't been involved

In the following some examples of indicators are listed, divided into environmental elements (8) and activities characterizing the sustainable development (3); moreover into the five categories of DPSIR

For every indicator, the user shall compile a card of characterization.

In the following, we have reported an example of the card of the indicator "Atmospheric concentrations of NO_2" relevant to Atmosphere, Air quality.

The DRIVING FORCES (*) considered for all the environmental elements, are:

- human activities
- infrastructures: road, port, railway and airport
- existing vehicles
- n. parkings
- n. industries
- n. homes
- agricultural areas
- resident population

(*) *see following pages*

Environmental elements	Categories DPSIR				
	D (*)	P	S	I	R
Atmosphere Meteorology		•emission •desertification	•temperature •rain •wind •fog		
Water environment		**•water per capita consumption** **•water withdrawal for agricultural, industry and drinkable use** **•unloading into the rivers**	**•rivers** **•drainage** **•flow** **•downflow** **•speed** **•banks and bed of the river** **•chemical and physical parameters** **•drinking possibility**	**•bathing possibility** **•not drinking possibility** **•decrease of the flow**	**•population served by purification plants** **•population connected to the sever system** **•forest and hydraulic settlement** **•canalization of the rivers** **•banks** **•dykes**

Environmental elements	Categories DPSIR				
	D (*)	P	S	I	R
Atmosphere Air quality		•emission of green house gas •emission of acidified substances •emission of carbon monoxide •daily flow of private and/or public vehicles	•concentrations of ozone •concentrations of nitrogen bioxide •overcoming of normative limits	•n. of patients (for typology of pollution) •n. of dead men (for typology of pollution) •change of wealth of flora and fauna	•regulations •territorial planning •controls on polluting sources •specific measures in matter of air quality •working monitoring centrals •monitored air pollutions

Environmental elements	Categories DPSIR				
	D (*)	P	S	I	R
Soil and subsoil		•density of population •builded houses •water withdrawal for drinking use •quarries •mines •dumpings	•altitude •gradient •superficial erosion •landslides •morphologic types:coastal, fluvial, vulcanic •faults •stratum	•lowering of the stratum •not wooded areas •population at risk	•seismic planning •plantation (reafforesta-tions) •surface changed into biological agriculture

Environmental elements	Categories DPSIR				
	D (*)	P	S	I	R
Vegetation and ecosystems		•forest cuts •fishing activity •hunting pressure •waterproofed surface	•wealth of flora •wealth of fauna •wooded surface •present habitats •humid areas	•threat for vegetable species •wooded fires •threat for animal species •fragmenta-tion of habitats	•wooded territory subordinate to management •protected areas •interdict areas for fishing and hunting •special protection areas •urban green areas

Environmental elements	Categories DPSIR				
	D (*)	P	S	I	R
Noise		•acoustic emissions •flow of transports •n. of demands for authorization for new houses, industries and services	•exposed population •overcoming of limits •controlled sources	•illnesses that trace to noise •variation of economic value of the building	•plans for the acoustic areas •interventions of reclamations by noise

Environmental elements	Categories DPSIR				
	D (*)	P	S	I	R
Radiations (ionizing and not ionizing)		•radio and television transmitters •expansion of the electric lines	•overcoming of the regulations •exposed population •percentage (%) of time spended at the exposure	•illnesses that trace to radiations	•observatories

Environmental elements	Categories DPSIR				
	D (*)	P	S	I	R
Landascape		•use of the soil •occupation of the soil •use of the matters •level of the building expansion	•geomorpho-logic elements •hydrogeo-logic elements •vegetation •agricultural and industrial elements •urbanization •historical elements •perceptive state	•fragmenta-tion of the territory •neglect of areas •fall of the economic value •loss and/or deteriora-tion of the historical properties	•town planning •protection planning •restrinctions •planning permissions

Besides listing the indicators about environmental elements, they will considered some examples of indicators about important activities characterizing the sustainable development

	P	R
Transports	•level of motorization •registration of the vehicles •total transfers •divided transfers for typology	•supply of public transport •pedestrian precinct •limited traffic areas •urban traffic plans
Energy	•energy consumption •occupied areas for energy plants	•renewable energies •use of green petrols •energy plans
Refuses	•production of urban refuses •production of special, toxic and bad refuses	•differentiated waste disposal •differentiated typology of removal •removal refuses plans •recovered energy by removal refused plants •recovered matters

Among the various schemes for the characterization of the indicators, we have choosen the more suitable for the use in EIA

Identified elements	**Category**
	Sector
	Typology
	Unit of measurement
	Local purchasers
	Institutional purchasers
	Sources
Normative references	**Normative references**
	Objectives/standards
Description and importance for the policy	**Description of the indicator**
	Importance for the local policies
Connections with other indicators	**Among categories**
	Among sectors
	Among indicators
Bibliography	**Web sites**
	Bibliography of reference

In following, we report the scheme (described in the previous slide) for the characterization of the indicator: “Atmospheric concentrations (NO_2)”

Identified elements	Category	Environmental
	Sector	Atmosphere
	Typology	State
	Unit of measurement	Computed annual average; 98% percentile; µg/mc (microgram per cubic metre)
	Local proponents	Municipalities, provinces, regions
	Institutional proponents	Ministry of Environment, Canada Environment, ICLEI, OECD, UK Departmental Environment, UN-CSS
	Sources	Municipality, Province

Normative references	Normative references	DPR 203/88 “Accomplishment of the directives CEE 80/779, 84/360, 85/203, that concern rules in the matter of air quality, with regard to specific polluting agents, and polluction produced by industrial plants
	Objectives/ standards	Limit: 98% percentile of the hourly detected values during one year: 200 µg/mc ; guide-value: 50% percentile of the hourly detected values during one year : 50 µg/mc

Description and importance for the policy	Description of the indicator	It measures the concentrations of nitrogen dioxide (NO2) in atmosphere. The emissions of this pollution are caused by mobile and fixed sources; particularly by combustion processes at high temperature: vehicular traffic, energy consumption and industrial concentration; during metheorologic conditions of stability and of strong insolations it contributes to the formation of photochemical smog. It can reacts with the water giving rise to nitric acid, which causes the phenomenon of the acid rains. The last are irritating for the mucous membranes and gives rise to pathologies of the respiratory apparatus (alterations of the pulmonary functions, chronic bronchitis, pulmonary emphisema and asthma).

		The air pollution damages, besides human health, also vegetation, building materials, monuments and so on. It is closely connected to the density of urban population and the environmental policies.
	Importance for the local policies	It can be an indicator of the vehicular traffic management and of control of industrial emissions within the municipal territory. Some parameters influence the indicator: a) the presence of plans of moderation of traffic b) the increase of green and pedestrian areas c) the political choises of investment on the system of public transports and on the substitution with electric and methane motor vehicles.

Connections with other indicators	Among categories	Demography: demographic density Health: respiratory illnesses
	Among sectors	Mobility: level of motorization; pedestrian precincts and ZTL (areas with limited traffic); transfers by public transports, public transports with low emissions Soil: urban reutilization
	Among indicators	Atmosphere: NO_2 limits overcomings (nitrogen dioxide); atmospheric emissions of NO_2; working monitoring stations; stoppage of circulation of vehicles; controls of emission; controls of industrial sources.

Table n. 1 "Indicators of pressure" (divided into environmental main themes)

ENVIRONMENTAL MAIN THEMES	INDICATORS OF PRESSURE	SECTORS						
		AGRICULTURE AND FORESTS	FISHING	INDUSTRY	ENERGY	TOURISM	TRANSPORTS	DOMESTIC/ CONSUMERS
Climate changes	Emission of CO_2 (carbon dioxide)			■	■		■	■
	Total emission of greenhouse effect gases	■		■	■			■
Reduction of stratospheric ozone	Production and consumption of CFC (chlorine-fluorine-carbide) and HCFC (hydro-chlorine-fluorine-carbide)			■				
Acidification	Emission of SO_2 (sulphur dioxide)			■	■		■	■
	Emission of NO_x (nitrogen oxide)			■	■		■	
	Emission of NH_3 (ammonia)	■						
Tropospheric ozone and oxidants	Emission of CO (carbon oxide)	■		■	■		■	
	Emission of COV (volatile organic compound)	■		■	■		■	
	Emission of NO_x (nitrogen oxide)	■		■	■		■	
Chemical substances (pesticides, heavy metals, POP)	Emission of heavy metals			■			■	
	Emission of POP (persistent organic pollution)			■			■	
	Consumption of pesticides for agricultural uses	■						
Waste	Total production of refuses for sector	■		■	■		■	■
	Total and per capita production of urban waste					■		■
	Production of dangerous waste	■		■	■	■	■	■
	Import and export of dangerous waste	■		■	■			
Nature and biodiversity	Density of infrastructures bound to the system of transports	■		■			■	
	Areas used for intensive agriculture	■	■			■	■	
	Built areas	■		■				■

Table n. 1 "Indicators of pressure" (divided into environmental main themes)

Water	Extraction of water: for area, per capita, for sector	■		■	■	■		■
	Consumption of water per capita	■		■	■			■
	Emission of heavy metals into water: Hg (mercury); Pb (lead); Cd (cadmium)			■				
	Emission of nutritious substances into water (nitrogen and phosphorus) by sources	■		■				■
	Emission of organic material (BOD-Biochemical Oxigen Demand- kg/per capita)	■	■					■
Sea and coastal environment	Capture of fish for species		■					■
	Flows of nitrogen and phosphorus into sea (eutrophyzation)	■				■		■
Deterioration of the soil	Quarry and extractive activities			■	■	■		
	Extraction of hydrocarbon			■	■			
	Areas occupied by dumping			■		■		■
	Use of soil: change from natural area to built area			■		■		■
	Agricultural and pastoral area per altimetry zones	■						
	Deforested areas on the total of woodlands	■			■			
	Area of floodplain occupied by infrastructural construction	■						
Urban environment	Density of people in the towns					■	■	■
	Total and per capita production of urban waste					■		■
	Emission of CO (carbon), NOx (nitrogen oxide), particulate matter, heavy metals, VOC (volatile organic compound)			■	■	■	■	■
	Noise emissions			■		■	■	■

Table n. 1 "Indicators of pressure" (divided into environmental main themes)

Technological risks	Number of notified incidents: industry and transports			■			■	
	Plants with the risk of important incident (Seveso like)			■		■	■	
Natural risks	Number of episodes of natural calamities (earthquakes, eruptions, and so on)							
Landascape and cultural heritage	Transformation of natural and historical-cultural environment							■

Table n. 2 "Indicators of pressure and state"

ENVIRONMENTAL MAIN THEMES	INDICATORS OF PRESSURE	INDICATORS OF STATE
Climate changes	Emission of CO_2 (carbon dioxide)	Weather state (average temperature and rain)
	Total emission of gas at greenhouse effect	
Reduction of stratospheric ozone	Production and consumption of CFC (chlorine-fluorine-carbide) and HCFC (hydro-chlorine-fluorine-carbide)	Effective ultraviolet radiations
Acidification	Emission of SO_2 (sulphur dioxide)	Deposition of total acidified substances
	Emission of NO_x (nitrogen oxide)	
	Emission of NH_3 (ammonia)	
Tropospheric ozone and oxidants	Emission of CO (carbon)	Ozone at soil level and overcoming of the thresholds
	Emission of COV (volatile organic compound)	
	Emission of NO_x (nitrogen oxide)	
Chemical substances (pesticides, heavy metals, POP)	Emission of heavy metals	Concentration of heavy metals
	Emission of POP (persistent organic pollution)	
	Consumption of pesticides for agricultural uses	
Refuses	Total production of refuses for sector	• Number of treatment plants and removal of the waste (for typology, capacity and occupied area) • Quantity of treated and removed waste for typology of treatment/removal. Differentiated urban waste disposal for product fraction (paper, glass, aluminium, due medicines, and so on…) • Quantity of recycled and reused materials
	Total and per capita production of urban refuses	
	Production of dangerous refuses	
	Import and export of dangerous refuses	

Table n. 2 "Indicators of pressure and state"

Nature and biodiversity	Density of infrastructures bound to the system of transports Areas used as intensive agriculture Built areas	• Map of principal habitats • Map of nature
Water	Extraction of water: for area, per capita, for sector Consumption of water per capita Emission of heavy metals into water: Hg (mercury); Pb (lead); Cd (cadmium) Emission of nutritious substances into water (nitrogen and phosphorus) by sources Emission of organic material (Kg of BOD- Biochemical Oxigen Demand- per capita)	• Quality of rivers (length of streams of good quality) • Concentration of organic matter in the rivers • Concentration of nitrogen, phosphorus and metals in the river and in the lakes • Concentration of nitrates in the underground waters • Index of the vulnerability of the aquiferouses • Availability and quality of drinking water • Number of plants of treatment of waste waters (capacity and typology of treatment) • percentage of treatment waste water treatment plants in operation • percentage of population connected to the sever system • percentage of industrial dumpings that flow into a system of reception
Sea and coastal environment	Capture of fish for species Flows of nitrogen and phosphorus into sea (europhyzation)	• geomorphologic characterization of coastal areas • concentration of nitrogen, nitric and ammoniacal phosphorus; dissolved oxygen and chlorophyll for the estimation of the trophic index in the coastal waters • percentage of declared bathing coasts

Table n. 2 "Indicators of pressure and state"

Deterioration of the soil	Quarry and extractive activities	• fertility (index of capacity of use of soils) • areas of subsidence • contamined areas
	Quarring of hydrocarbon	
	Area occupied by dumping	
	Use of soil: change from natural area to built area	
	Agricultural and pastoral area for zone of altimetry	
	Deforested areas on the total of woodlands	
	Area of floodplain occupied by infrastructural construction	
Urban environment	Density of people in the towns	• urban area used for the transports • quality of urban atmosphere, concentrations of SO_2, NO_2, Pb, benzene, ozone, and so on… • urban green areas • classification of noise areas (levels of noise pressure)
	Total and per capita production of urban refuses	
	Emission of CO (carbon), Nox (nitrogen oxide), particulated, heavy metals, COV (volatile organic compound)	
	Acoustic emissions	
Technological risks	Number of notified incidents: industry and transports	• areas at risk of important incident • density of population which resides in areas with seismic and hydrogeologic risk
	Plants with the risk of important incident (for example: Seveso)	
Natural risks	Number of episodes of natural calamities (earthquakes, eruptions, and so on)	• areas with landscaped archeological and monumental value • deteriorated areas with potentiality of landscaped requalification
Landscape and cultural heritage	Transformation of natural and historical-cultural environment	

Table n. 2 “Indicators of pressure and state”

The main used sources to find the data, are:

- Ministry of Defence
- CORINAIR (Coordination Information air)
- CNR (Natural research Council)
- ASL (local Health Business)
- ARPA (Regional Agency for Environmental protection)
- OMS (World Organization of Health)
- Ministry of Environment
- ISTAT (Statistic Institute)
- ANPA – APAT (Agency for environmental protection and technical services)
- Provincial Observatories
- Municipalities
- Regions
- National Technical Service
- Corine Land Cover
- IRSA (Institute of research for the waters)
- Ministry of Health
- Ministry of Industry
- Oil Union
- National Institute of Geophysic
- Maps of the risks
- Territorial plans of the landscape

Table n. 3 "Objectives, priorities, indicators of the service, finalities of the interventions"

OBJECTIVES	PRODUCTS	INDICATORS	FINALITIES OF THE INTERVENTIONS
To reduce the necessity of the urban transfers	Transports in urban environment	1. reduction of the number of vehicles from the centres of economic activity around the towns	1. reduction of 10% of the urban transfers in the centres "x", "y" and around the town "z"
To enlarge the territory subjected to protection	Nature and bio diversity	2. increase of the total surface designated for the purpose of the nature conservation 3. definition of managerial plans for protected areas 4. supplementary resources for the protection from forest fire	2. increase of 10% before 200X 3. for number "x" of sites of Nature Net 2000 before 200X 4. description, type and measure for the areas a, b, c
To ensure the peculiar uses of the water resource	Water and soil	5. keeping of the water table levels at the year "x" 6. reduction of the contents of nitrates in the rivers in the area "x" 7. increase of bathing areas in accordance with the directive 76/160/CEE	5. preservation of the levels of the year "x" 6. reduction of "x" in the rivers a, b, c 7. increase of 20% of bathing areas from area "a" to area "b"
Carring out the bio diversity convenction	Nature and bio diversity	8. increase of the wooded covering	8. increase of 15% in the areas "y", "z" and around the towns a, b, c