"Capacity Building and Strengthening Institutional Arrangement"

Workshop: "Sustainable Development"

Environmental indicators for sustainable development communication at local level

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Environmental sustainable development

Principle founded on the concepts of:

Vertical or temporal equity

↓

extended to
generation relations

↓

To meet the needs of present generations without jeopardizing the possibility to satisfy needs of future generations

Horizontal or geographic equity

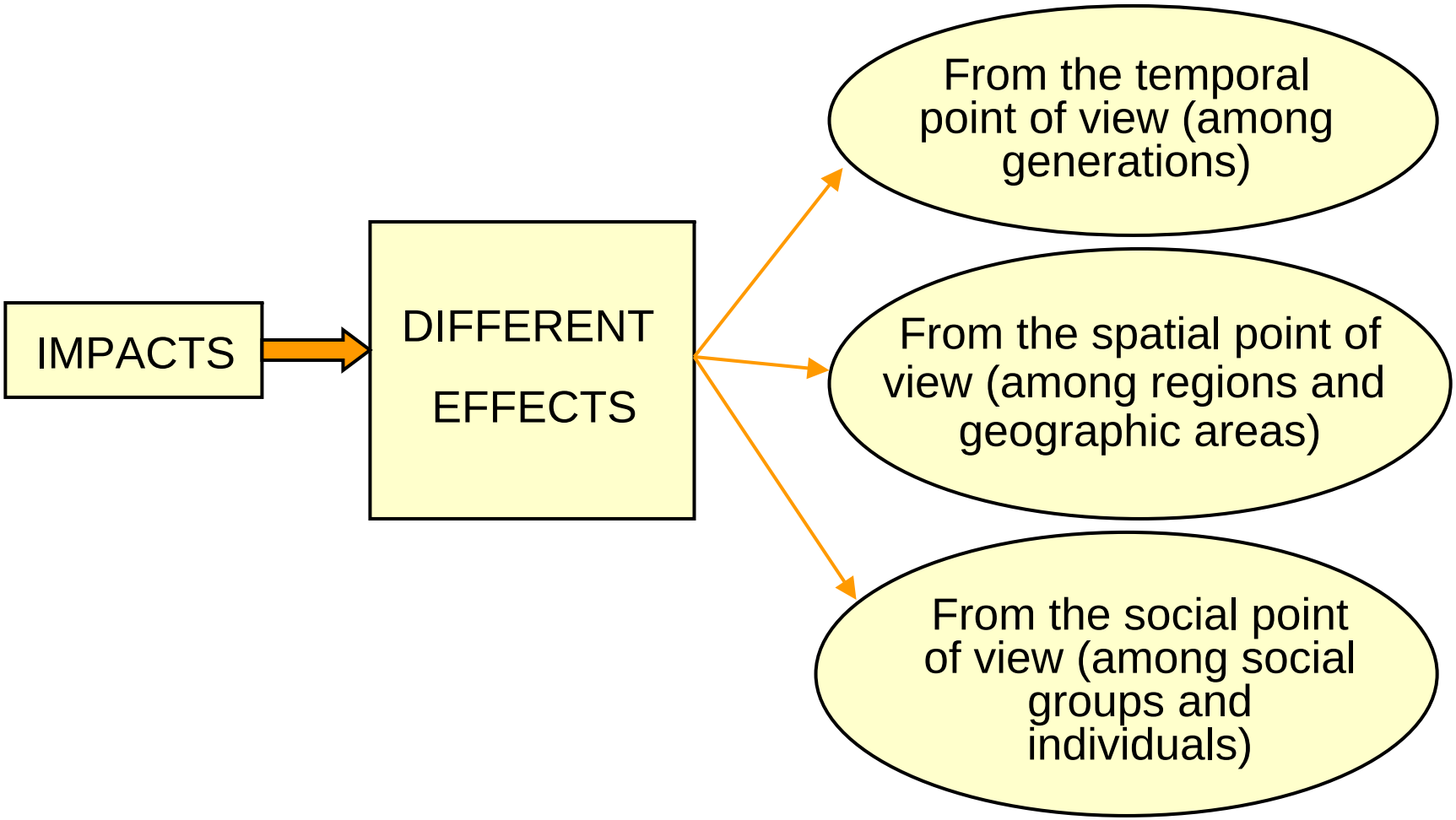
↓

extended to
contemporary relations

↓

To meet the primary needs of everyone and to be in a position to pursue the aspirations of everybody for a better quality of life

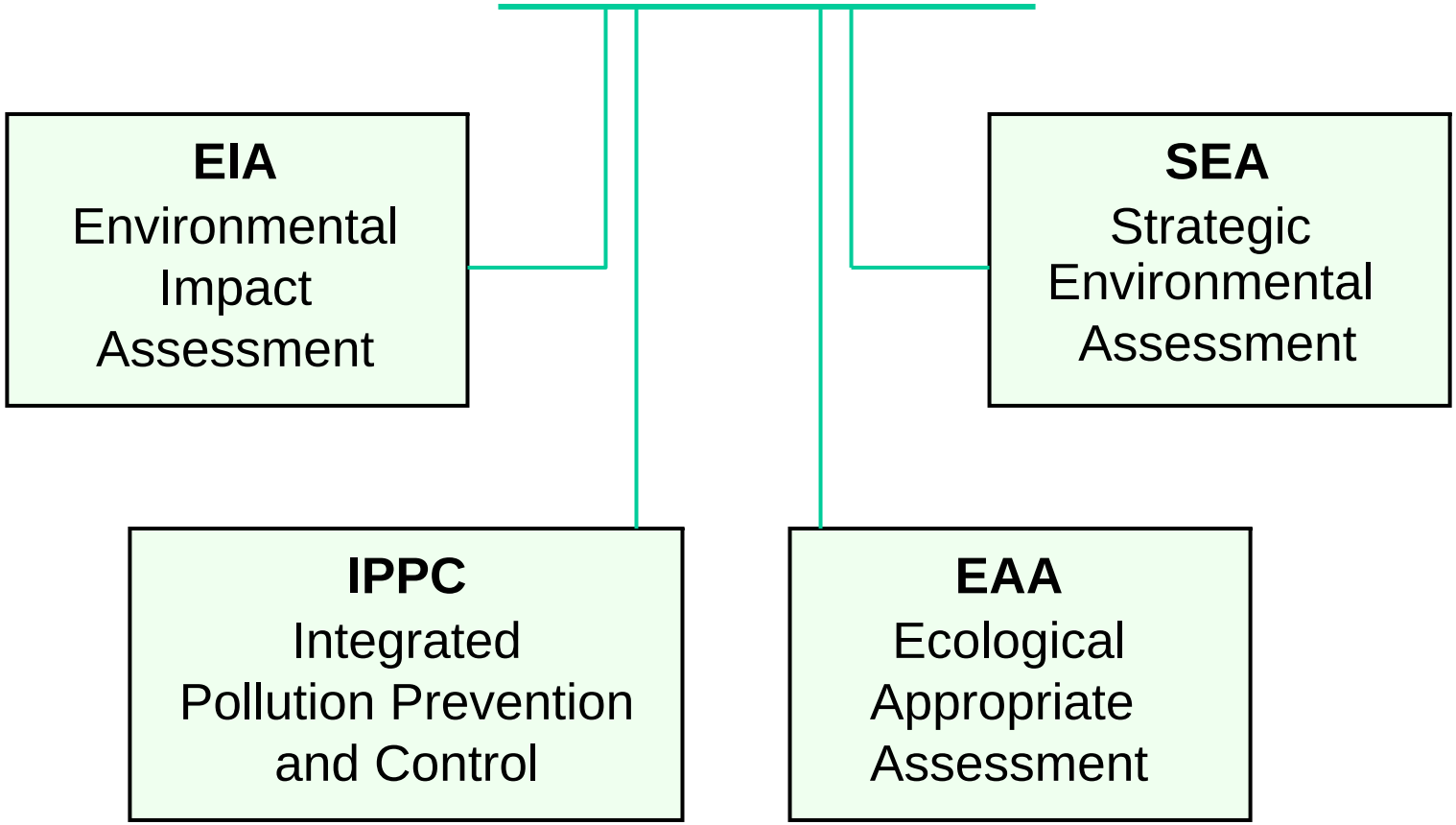
The environmental sustainable development doesn't exist without equity. In fact the environmental impacts (negative and/or positive) have the next effects:



To pursue the aims of environmental sustainable development, we must consider the following:

1. To anticipate and prevent
2. To apply the principle of the precaution
3. To consider the sources and the targets of the impacts
4. To keep the capital of the natural resources at present level or nearby
5. To verify the efficacy of the actions and mitigations connected to economic development

Tools used in the analysis of environmental sustainable development :



ENVIRONMENTAL IMPACT ASSESSMENT

The EIA procedure ensures that environmental consequences of projects are identified and assessed before authorization is given.

The public can give its opinion that is taken into account in the authorization procedure of the project.

The public is informed of the decision afterwards.

The EIA directive (EU legislation) was introduced in 1985 (85/337/EEC) and amended in 1997 (9711EC).

The EIA directive outlines:

- Which project categories must be submitted to an EIA
- Which procedure must be followed
- The content of the assessment

STRATEGIC ENVIRONMENTAL ASSESSMENT

The SEA procedure ensures that environmental consequences of plans and programs are identified and assessed during their preparation and before their adoption.

The public (stakeholders) and environmental authorities can give their opinion; all results are integrated and taken into account in the course of the planning procedure.

After the adoption of the plan or programme, the public is informed about the decision and the way in which it was taken.

The EIA directive (EU legislation) was adopted in 2001 (2001/42/EC), after a first proposal in 1996 that was amended in 1999.

The SEA:

- Contributes to more transparent planning by involving the public and by integrating environmental considerations
- Helps to achieve the goal of sustainable development

INTEGRATED POLLUTION PREVENTION AND CONTROL

The IPPC procedure aims to the reduction or, as far as possible, to the elimination of the pollution by intervening at the source and ensuring a cautious management of the natural resources in the observance of the principle “the person who pollutes, pays”.

The IPPC directive (EU legislation) was approved in 1996 (96/61/EC).

The IPPC:

- Identifies the objects of the prevention, for some categories of industrial activities (energy activities, production and transformation of metals, industry of minerals products, chemical industry, management of waste, and so on…)
- Foresees the reduction of the emission into the atmosphere, water, soil, and waste

ECOLOGICAL APPROPRIATE ASSESSMENT

The EAA (*italian acronym*) procedure submits plans and projects, which can have an important effect on the sites of “Rete natura 2000”.

The EAA procedure consists of four main stages:

1. Screening: it identifies the possible important incidence
2. Appropriate assessment: the analysis of the incidence and the identification of the possible measures of mitigation
3. Analysis of the alternative solutions
4. Definition of the measures of compensation.

The EAA procedure was introduced in 1992 with the article n. 6 of “Habitat Directive” (92/43/EEC).

The EAA:

Constitutes the tool to ensure the attainment of a balanced relation between the satisfactory preservation of habitats and the sustainable use of territory.

The indicators

The description and evaluation of the elements that characterize an environmental programme, call for methodical use of the INDICATORS.

Before analysing the characteristics of the indicators, we consider some definitions of the term “indicator”:

1. “Synthetic representation of a complex reality, the best peculiarity or the whole peculiarities that allow to understand a particular phenomenon”
2. OECD (Organization for Economic Cooperation and Development) – 1994: “Value derived from the parameters; it furnishes the information about a phenomenon; its meaning goes over the priorities directly associated to the value of the parameter”
3. “Model that allows to monitor and to communicate information”

The indicators can be relative to every stage of the procedure of environmental programme (feedback at all levels of the environmental procedure):

1. Definition of the targets
2. Realization of cognitive starting frame
3. Accomplishment of plans or programs
4. Permanent assessment of progresses to estimate the point of accomplishment and positive or negative impact to achieve the target
5. Check of the targets
6. Analysis of the causes and effects
7. Monitoring, check and possible adjustment of the targets; possible updating of plans and programs

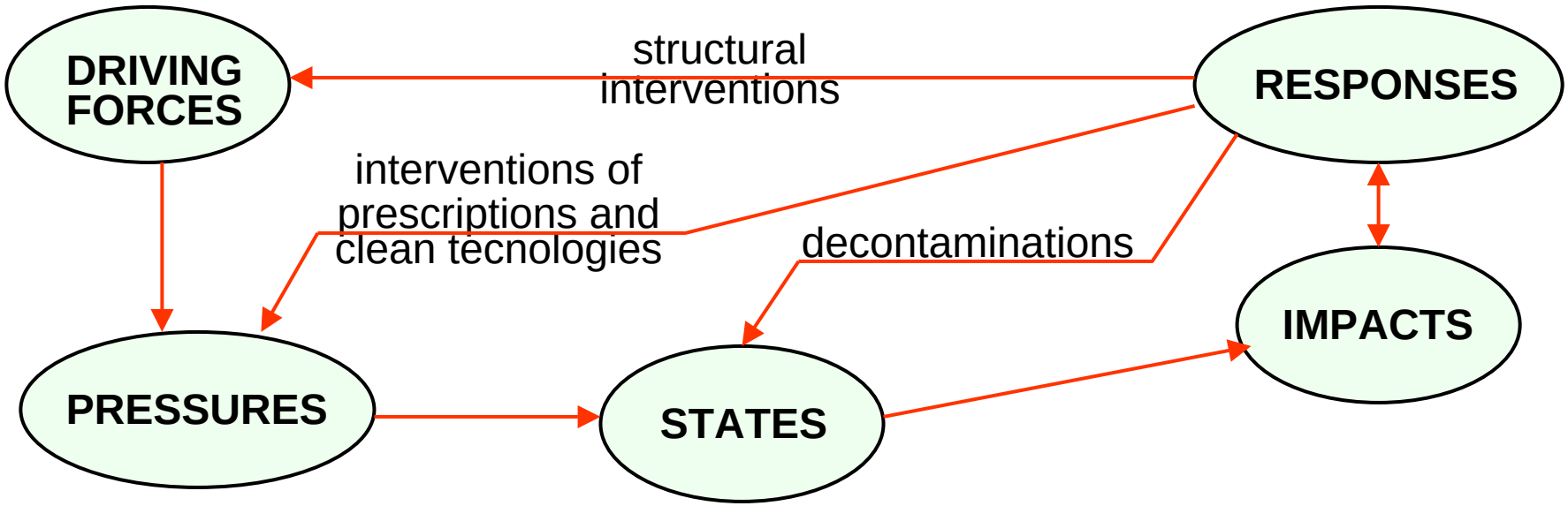
An indicator can be:

1. A fair number (neither few, because insufficient to characterize the context to represent, nor too much, because dispersive or misleading)
2. Absolute (expressed in absolute quantity with their own units of measurement) or relative (expressed with quantity refered to other unity of measurement)
3. Rappresentative (they can contain important and directed informations)
4. Scientifically valid
5. Comparable with the regulations
6. Simple, intelligible and not ambiguous
7. Usefully applicable in time
8. Applicable in uniform way in multiple places
9. Founded on certain data and documents
10. Founded on easily available data and with reasonable costs
11. Valid and continuously verifiable

In Europe (EEA* and EUROSTAT**) the environmental indicators are usually represented through DPSIR model (evolution and integration of the scheme PSR by OECD***):

DRIVING FORCES, PRESSURES, STATES, IMPACTS, RESPONS

According to the following connections:



* EEA: European Environment Agency
** EUROSTAT: Office of Statistic of European Community
*** OECD: Organization for the Economic Cooperation and Development

The model is based on the concept of “randomness”:

the anthropic activities exercise PRESSURES on the environment and lead modifications into the quality and quantity of the natural resources (STATE).

The society replies to this modifications through the environmental policies of general or sectorial economy (RESPONSES).

The latter, through anthropic activities, link up again to the PRESSURES.

In the following, we report the characterization of the categories of the scheme DPSIR:

Driving forces

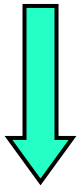
Primary generative causes (agriculture, industry, transports, and so on…)

Economic sectors, human activities that produce factors of impact:

1. they single out the existing relations between factors responsible of pressures and the same pressures
2. they help the persons who decide to identify external negative sources, where and when to intervene, in order to reduce the environmental problems.

Pressures

Emissions in atmosphere, waste outputs, water wastes, water withdrawals, and so on…



Emissions of residues or subtraction of resources, waste:

1. they single out the variables directly responsible of the environmental deterioration
2. they single out and quantify the causes of the alterations in the environmental condition.

States

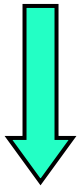
Air quality, water quality, soil quality, biodiversity, and so on…

Physical, chemical, biological qualities of different environmental components that are sensitive to the factors of impact:

this indicators outline and describe the conditions of the environment, permitting an evaluation of the degree of deterioration.

Impacts

To health, to ecosystems, to economy, and so on…



The changes of the state produced by the factors of impact on the quality of the ecosystem, health, functions, and so on….

These indicators make explicit the relations of cause-effect between pressures and states.

Responses

Laws, plans, programs, prescriptions, and so on…

Actions and countermeasures undertaken to oppose the actions of driving forces; interventions of decontamination aimed to reclaim situations of unsustainable environmental and sectorial policies, legislative initiatives, planning actions , and so on…

These indicators express the operational efforts that the society has done to improve the quality of life and environment.

The European Environmental Agency has identified four macro-categories of indicators:

1	Indicators of description	They measure the present conditions of current situation
2	Indicators of performance	They confront current situation with the prearranged objectives
3	Indicators of efficiency	They show the improvements by measuring the used resources and the emissions
4	Indicators of global welfare	They measure the participation, education and capacity building

At world level, a lot of check-lists of indicators of environmental sustainable development have been got ready:

1

USA: core-set UN-CSD (United Nations – Commission of Sustainable Development) – 1993:

Originally were foreseen 134 indicators, then reduced to 58, divided into 15 themes:

1. Equity
2. Health
3. Education
4. Home conditions
5. Security
6. Population
7. Atmosphere
8. Soil
9. Oceans, seas and coasts
10. Fresh water
11. Biodiversity
12. Economic structure
13. Models of consumption and protection
14. Institutional structure
15. Institutional ability

2

WHO: World Health Organization – Project “Health cities indicators” - 1999

It defines 52 indicators divided into four groups:

1. Public health
2. Health service
3. Environmental indicators
4. Social and economic indicators

3 EEA: European Environmental Agency - 1996

It uses 20 indicators to characterize the periodic report about the state of european environment

4 EUROSTAT: Statistical Office of the European Communities: Project ESEPI (Environmental Pressure Indicators) - 1999

It foresees 10 themes:

1. Atmospheric pollution
2. Climatic change
3. Loss of biodiversity
4. Sea environment and coastal areas
5. Rarefaction of ozone state
6. Excessive use of resources
7. Dispersion of toxic substances
8. Urban environmental problems
9. Waste
10. Water pollution and water resources

5 ECI: European Common Indicators - 2000

It identifies 11 indicators:

1. Citizens' satisfaction with the local community
2. Local contribution to global climatic change
3. Local mobility and passenger transportation
4. Availability of local public open areas and services
5. Quality of the air
6. Children's journeys to and from school
7. Sustainable management of the local authority and local enterprises
8. Noise pollution
9. Sustainable land use
10. Products promoting sustainability
11. Ecologic stamp

At italian level, the most representative and used check-lists are:

1

Yearbook of italian environmental data; realized by two italian non-governmental organizations (NGOs).

It groups together 100 indicators into 11 themes:

1. Social and economic dimension
2. Energy
3. Mobility
4. Agriculture
5. Industry of tourism and services
6. Waste
7. Climate and atmosphere
8. Water resources
9. Natural heritage and biodiversity
10. Urban environment
11. Environmental policies

2

Yearbook of environmental data - APAT

It identifies 247 indicators grouped together into 3 theme areas and 19 chapters:

Environmental conditions	Productive sectors	Conservation and protection
•Atmosphere •Biosphere •Hydrosphere •Geosphere •Waste •Ionizing radiations •Not ionizing radiations •Noise •Natural risk •Anthropogenic risk	•Agriculture and forestry •Energy •Transports •Tourism •Industry	•Environmental quality of organizations, businesses and products •Monitoring and control •Promotion and diffusion of the environmental culture •Environment and welfare

3

Guide-lines for the Strategic Environmental Assessment – Structural funds 2000-2006 – MATTM (Ministry for Environment and Protection of the Territory and the Sea) - 1999

This document was predisposed by general direction of EIA; it represents a source of information for the population and the report about the environmental state, with the collaboration of Ministry for Cultural Activities, ANPA (presently APAT) and Regions.

From the whole analysed documentation (coming by the different institutions which work at world, european and italian level), we have reported some examples of list and characterization of indicators through some type-cards:

1. Type-scheme derived by “Manual of Indexes and indicators for the water” ARPAT (Regional Agency) - ANPA 2002

2. Type-scheme that are used for evaluation to submit projects for financing with structural funds 2000-2006

3. Type-scheme derived by “Sfida project” 2002 (Directed System to integration of the environmental dimension).

1

Scheme for the characterization of the Indicators (by “Manual of Indexes and indicators for the water” ARPAT-ANPA 2002)

Title (the name of the indicator)
Typology of the application
DPSIR
Description
Method of measurement
Object of the indicator
Connected indicators
Unit of measurement
Geographic level of detail
Document of reference
Normative reference
Key words
Geographic covering of data
Period of reference of data
Method of elaboration
Problems of aggregation of data
Source of data
Usable internet address
Notes, observations and comments

2

Tables of indicators for structural funds

TABLE N. 1 → INDICATORS OF PRESSURE (DIVIDED INTO ENVIRONMENTAL MAIN THEMES)

TABLE N. 2 → INDICATORS OF PRESSURE AND STATE

TABLE N. 3 → OBJECTIVES, PRIORITIES, INDICATORS OF THE SERVICE, FINALITIES OF THE INTERVENTIONS

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	■		■				■
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			■		■	■	■
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)							
Landscape 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	

Waste	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	
Nature and biodiversity	Density of infrastructures bound to the system of transports	• Map of principal habitats • Map of nature
	Areas used as intensive agriculture	
	Built areas	

Water	Extraction of water: for area, per capita, for sector	• 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
	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)	

Sea and coastal environment	Capture of fish for species	• 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
	Flows of nitrogen and phosphorus into sea (europhyzation)	
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
Landscape and cultural heritage	Transformation of natural and historical-cultural environment	• deteriorated areas with potentiality of landscaped requalification

The main used sources to find the data, are:

1. Ministry of Defence
2. CORINAIR (Coordination Information air)
3. CNR (Natural research Council)
4. ASL (local Health Business)
5. ARPA (Regional Agency for Environmental protection)
6. OMS (World Organization of Health)
7. Ministry of Environment
8. ISTAT (Statistic Institute)
9. ANPA – APAT (Agency for environmental protection and technical services)
10. Provincial Observatories
11. Municipalities
12. Regions
13. National Technical Service
14. Corine Land Cover
15. IRSA (Institute of research for the waters)
16. Ministry of Health
17. Ministry of Industry
18. Oil Union
19. National Institute of Geophysic
20. Maps of the risks
21. 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 biodiversity	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 biodiversity corverction	Nature and biodiversity	8. increase of the wooded covering	8. increase of 15% in the areas "y", "z" and around the towns a, b, c
To ensure proper processes for reutilization of the produced refuses	Waste	9. increase of the percentage of the urban recycled waste	9. increase of 15% of urban recycled waste in the metropolitan areas a, b

3

Scheme derived by “Sfida project”

Every card of information is organized into four principal sections:

1	2	3	4	5
Basic information	Space-time covering	Productions	Access	Notes
•Denomination •Themes •…….	•Territorial covering •Historic series •…….	•Producing agencies •Methods of survey •…….	•Type of access •Internet place •Cost •……	

The card (Sfida project) of data is divided into 5 sections:

Basic information	**Denomination**
	Source
	Themes
	Contents
	Owner (corporation)
	Office of reference
	Reference Web sites
Space-time covering	**Territorial covering**
	The greatest level of territorial detail
	The other levels of territorial detail
	The greatest scale of representation
	The other scales of representation
	The last year of updating
	The last typology of updating
	Historical series: the last year
	Historical series: duration
	Periodicity
	Temporal aggregations

Production	Producing corporations
	Type of representation
	Georeferenced system
	Methods of survey/elaboration
	State of advancement
	Type of support
	Type of file
Conditions of access	Type of access
	Web site access authorization
	Type of file
	Available near…
	Cost
	The year of the last publication
Notes	Notes about the card of data
	Notes about the cataloguing
	Present in the informative system “Sfida”
	Comments

Example of catalogue of data and indicators

A Region of North of Italy, together with the European Union, has experimented an informative tool containing the information on data and indicators with the relevant descriptive cards.

The catalogue contains a set of metadata, the best information about indicators, that have been registered according to some standardized formats on Internet.

Its name is “Sfida Project”, 2002 (Directed System to integration of the environmental dimension).

The structure is tree-like and can be consulted easily on Internet; it is subject to a dynamic process of expansion.

In the following slides we have highlighted the structure of this informative tool, because it can be used as example of set of metadata to adapt to any local reality.

Principal shortages that influence the availability of the data:

1	Lack or inadequacy of monitoring nets
2	Necessity of revision of the present nets
3	Insufficient level of disaggregation of the data
4	Lack of some fundamental themes
5	Lack of historical successions
6	Very much inhomogeneous data
7	Lack of an adequate flow of data
8	Fragmentation of the sources of data
9	Necessity of correlation with the other themes

ENVIRONMENT	TERRITORY	ACTIVITIES
Water	Infrastructures	Agriculture, breeding and fishing
Protected areas	Occupation	Handicraft
Air	Population	Industry
Climate and meteorology	Residential system	Service industries (excepted tourism)
Ecosystems	Use and covering of soil	Tourism
Energy		Transports
Landscape		Education
Cultural heritage		Health
Radiations		Recreational activities
Waste		
Noise		
Soil and subsoil		

Year of updating

Availability

Type of representation

Year of reference

Through the card, the user can value:

a) The aim
b) The objective
c) The characteristic time of answer
d) The territorial scale of representation
e) The whole information necessities to select it (or not) for a specific site

Through an interrogative mask, the user can identify (among the listed indicators):

a) The indicators relevant to the sectors of greater interest
b) The indicators ascribed to the specific years
c) The indicators ascribed to the level of territorial details

The data are represented on thematic maps.

An example of the map “cultivated areas: valuable zones”:

Example of construction of database for the indicators:

The construction of database

The collection of sustainable indicators (social, economic and environmental) has been set up by selecting the possible proposed sources according to three principles:

- The urban and local dimension of the proposed indicators
- The updating frequency of the set of indicators
- The level of authoritativeness of institutionals purchasers

The services of database → The database can be tested as a matrix with more keys of reading:

1) The importance for the policies	2) The periodicity of the basic information	3) Characteristics
Subject to the regulations	Systematic statistical survey	N. of recurrences in the database
Strategic elements of assessment	Occasional elaborations	Degree of importance for the policies
Accessory information	Production of local origin	Periodicity of the basic information

This is the homepage of Project “Sfida” (Italiy)