NATIONAL TECHNICAL UNIVERSITY OF ATHENS
RURAL AND SURVEYING ENGINEERING
GEOGRAPHY AND REGIONAL PLANNING
Physical Geography & Environmental Impact Assessment Laboratory

FIG Commission 3 Workshop

on

"Spatial Information for Sustainable Management of Urban Areas"

Germany, February 2009

«Environmental sustainability for urban areas in Greece: The role of natural capital indicators»

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SUMMARY

The concept of sustainability typically encompasses social, economic, political and environmental components. This paper focuses on the measurement of factors that help predict whether a region is moving toward or away from environmentally sustainable paths.

''Environment'' is defined as natural capital, where natural capital includes our natural resources – the physical amounts of renewable and non-renewable resources, our ecosystems that sustain life and provide a wide range of goods and services, and land. Measurement of natural capital is the challenge, especially for an urban area and involves collection of natural capital data and derivation of indicators from that data. As noted by Segnestam (2002, p. 3), indicators can be a more useful analytical tool than the data from which they are derived. They assist in the assessment of conditions and trends, facilitate informed discussion among diverse groups within the community because indicators are often easier to understand that the statistics that underlie them, and provide input into the policy process. Examples drawn from different jurisdictions help illustrate issues that an urban area will face in deciding how to adopt, implement, and interpret its environmental sustainability indicators and use these indicators to assist in decision-making about alternative development options for the community. Indicators help communities identify important tradeoffs they may face in all sorts of decisions that affect sustainability, including land use, transportation infrastructure and fiscal policies, to name a few.
The aim of this project is to measure the sustainability of an urban area using the environmental indicators according to the quality of the existing natural environment. Towards that direction, this project takes as a case study a greek municipality that's is situated in the south part of Athens, is called municipality of Glyfada

1.0 INTRODUCTION

The concept of sustainability typically encompasses social, economic, political and environmental components. This paper focuses on the measurement of factors that help predict whether a region is moving toward or away from environmentally sustainable paths.

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The aim of this project is to measure the sustainability of an urban area using the environmental indicators according to the quality of the existing natural environment.

Towards that direction, this project takes as a case study a greek municipality that's is situated in the south part of Athens, that is called municipality of Glyfada. This project is an on going project between the national technical university of Athens and the municipality of Glyfada.

There are **guiding principles** that provide the basis from which effective and sustainable decisions can be made. According to those principles there are specific **goals** that should be achieved. For each goal specific **Indicators** have been developed to measure progress toward meeting the goals.

The principles, the goals and the indicators that are presented here are still undergoing process because more data should be taken into consideration. This new data should describe the integrated profile of the natural environment and its impacts due to human activities. Attention should be paid to the priorities set forth by the local government.

2.0 DERIVATION OF INDICATORS FOR NATURAL CAPITAL: A CONCEPTUAL FRAMEWORK

Natural capital is becoming the conceptual foundation for measurement of the role that the natural environment plays in sustaining communities.

Internationally the United Nations Environmental Program, Organization for Economic Cooperation and Development, European Environmental Agency, Environmental Ministries in the Netherlands, UK, Sweden and other countries frame environmental programs and indicator measurement in a natural capital context

There are a number of conceptual frameworks proposed to help structure natural capital indicators in a way that facilitates interpretation and helps make them relevant for community decision-making.

This is the 'driving force, pressure, state, impact, response' or DPSIR framework. Figure 1 lists the components and provides examples of each.

Driving forces are the human activities (social,economic, political) that contribute to the increase or decrease in natural capital. These could include how much of our renewable and non-renewable natural resources we consume (water, energy), how many kilometers are driven per year, or output from pollution-intensive industries.

Pressures translate the driving forces into specific impacts on natural capital. Households and industries that discharge toxic materials into the air, water, land (e.g. pour waste oil into the sewer, flush antibiotics down the toilet, discharge raw sewage into the ocean) are examples of pressures or environmental stressors. The pressures can then be quantified into an increase or decrease **the state** of natural capital: the quantity and quality of the region's natural capital. Impacts translate the change in natural capital back into effects on nature, humans and other species, and the ability of the community to continue to produce goods and services.

Impacts measure how resource use and/or pollution affect health, plant and animal species abundance, agricultural output, materials, and the economy's ability to produce goods and services. Responses indicate how society reacts to environmental pressures, impacts on natural capital, and resulting impacts on society and the economy. Examples are the policies, public and private investment in infrastructure,

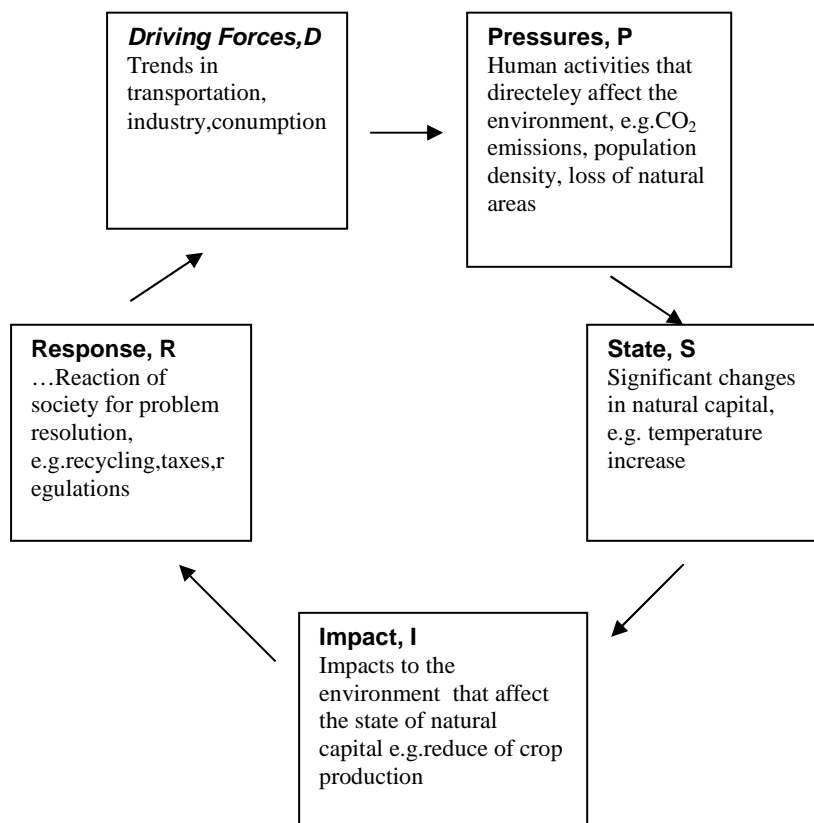Akrivi Leka, Angelos Siolas,Costas Cassios
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and personal decisions (e.g. defensive measures such as increased noise barriers taken to offset environmental degradation) taken by individuals or, in concerted action, by communities. Decision-making by the community, of course, involves political processes as stakeholders discuss and debate potential tradeoffs (e.g. costs, effects on outputs, impact on different groups in society, and so on) created by the environmental impacts. The **response** component thus links environmental indicators with social, economic, and political impacts. The arrows from responses to drivers,pressures and natural capital are to signify the extent to which the responses modify the behavior of drivers, reduce pressures and improve the state of natural capital.

Indicators for many of the drivers, pressures, and state of natural capital can be collected by various agencies at the local, regional, provincial, and national level.

Figure 1 The DPSIR framework

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2.1 SELECTION CRITERIA FOR NATURAL CAPITAL INDICATORS

At a minimum, indicators should have a meaningful and consistently measured link to natural capital, tell us where we have been, how we are doing now (are things better, worse or unchanged?), and where we might be going (e.g. levels are still less than a target,but improving)

The indicator must tell us whether we are moving toward a more or less environmentally sustainable community. This requires a clear statement and understanding of the relationships between drivers, pressures, natural capital and impacts.

A pragmatic approach is to develop indicators iteratively, by selecting those that at the time seem to be most directly linked to the components of DPSIR and to discard, adjust, and add new ones over time, as information becomes available and greater understanding of the links emerges.

2.2 DEVELOPING AND SELECTING NATURAL CAPITAL INDICATORS

Criteria help identify candidate DPSIR indicators for natural capital for a metropolitan area. But there are still likely to be dozens, if not hundreds of indicators that would satisfy all the criteria.

In general indicators should be:

1. Representative for the objectives of the program
2. Easy in the control, the measurement and their interpretation,
3. Economically effective,
4. Comprehensible by everybody (someone without a scientific background),
5. Independent from the presence, absence or situation of a unique type,
6. Sensitive in the environmental conditions,

7. Foreseeable, precise in limits of a small variability,

8. Comprehensive, relative and suitable for use in the ecosystems

9. To be considered as a sequence, indicative of the general environmental conditions

3.0 MUNICIPALITY OF GLYFADA – BASIC CHARACTERISTICS

The suburb of Glyfada stretches along the Saronic Gulf coast often referred to as the "AthenianRiviera". Municipality of Glyfada extends from the Saronic Gulf to the foothills of Hymettus.

There is a satellite overview of the study area:
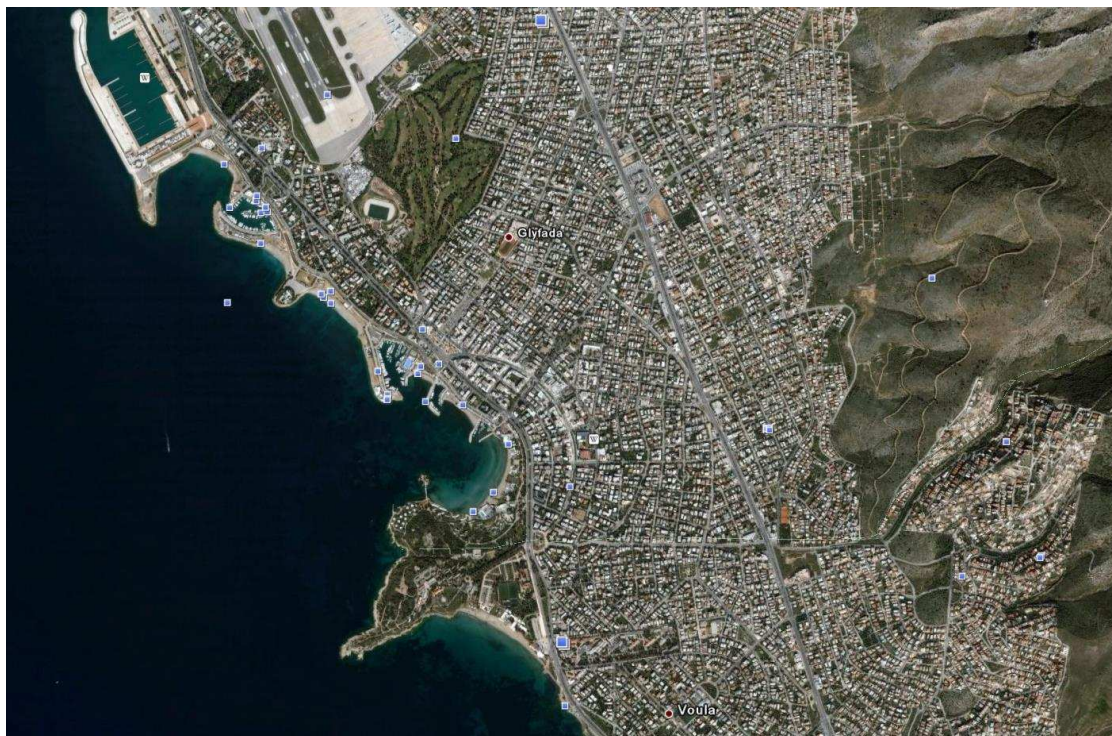
Figure 2 **Municipality of Glyfada**

Contemporary "Glyfada" was occupied historically by the Municipality of Exoni. The area was characterized by a rural economy until 1900. In fact, fishing and agriculture were the primary elements of the development of this area-an area amongst the richest in Attica.

At the beginning of the 20th century the town had already changed its name to "Glyfada", a name given because of the presence of salty water wells typical of this area. The first buildings appeared after 1920 and later the exploitation of the beautiful beach began, the town starting to change into a seaside resort. In 1945 this area became an independent Municipality. Today the Municipality of Glyfada has a population of 100,000 residents. Glyfada is a 30 minute drive from the Domestic and International terminal of Athens Airport and 20 minutes from the centre of Athens. The distance in kilometres from the centre of Athens by car (or bus) is 15 km and 12 km from the port of Piraeus. The ancient temple of Poseidon at Sounion is 45 kilometers away.

Apart from seaside of the Saronic Gulf and the rolling shoulders of the mount Hymettus, some of the best sandy beaches in Attica ideal are found there

The land uses are mainly residential with some commercial parts (centre of Glyfada, along the Vouliagmenis highway and Posidonos highway, the 2 main high ways that cross over the municipality of Glyfada

Some of remarkable sightseeing "the remains of the Byzantine Church, the municipal "sculpted theatre of Exoni" and the municipal "Melina Merkouri Theatre.

3.1 MEASURING SUSTAINABILITY IN GLYFADA MUNICIPALITY

It has been developed guiding principles that provide the basis from which effective and sustainable decisions can be made.

a. The Concept of Sustainability Guides in City Policy

Glyfada municipality is committed to meeting its existing needs without compromising the ability of future generations to meet their own needs. The long-term impacts of policy choices can be considered to ensure a sustainable legacy.

b. Protection, Preservation, and Restoration of the Natural Environment is a High Priority of the City

Glyfada municipality is committed to protecting, preserving and restoring the natural environment.City decision-making will be guided by a mandate to maximize environmental benefits and reduce or eliminate negative environmental impacts. The City will lead by example and encourage other community stakeholders to make a similar commitment to the environment.

According to the principles above the following **goals** should be achieved:

1. Significantly decrease overall community consumption, specifically the consumption of non-*local*, *non-renewable*, non-recyclable and non-recycled materials, water, and energy and fuels. The municipality should take a leadership role in encouraging *sustainable procurement, extended producer responsibility* and should explore innovative strategies to become a *zero waste* city.

2. Within renewable limits, encourage the use of local, non-polluting, *renewable* and recycled resources (water, energy – wind, solar and geothermal – and material resources)

3. Develop and maintain a sufficient *open space* system so that it is diverse in uses and opportunities and includes *natural function/wildlife habitat* as well as

passive and *active recreation* with an equitable distribution of parks, trees and pathways throughout the community.

4. Implement land use and transportation planning and policies to create compact,*mixed-use projects*, forming *urban villages* designed to maximize affordable housing and encourage walking, bicycling and the use of existing and future public transit systems.

5. Residents recognize that they share the local ecosystem with other living things that warrant respect and responsible stewardship.

For each goal specific **Indicators** have been developed to measure progress toward meeting the goals. As it mentioned before indicators are tools that help to determine the condition of a system, or the impact of a program, policy or action. When tracked over time indicators tell us if we are moving toward sustainability and provide us with useful information to assist with decision-making.

It should be mentioned that this project is an on going project between the national technical university of Athens and the municipality of Glyfada.

The principles, the goals and the indicators that presented are still in process because it should be taken into consideration the profile of the natural environment, the impacts on it by human activities and the policy priorities of the mayor .

The following table is a proposal of a set of indicators for the sustainable status of the natural capital of a metropolitan area and possibly can be used for municipality of Glyfada:

Natural Capital	Indicator	Direction	Availability
Air Quality			
Drivers	Nr of vehicle km driven	Less is better	1
	Fossil fuel comsumption by sector	Less is better	1
Pressures	Emissions of carbon monoxide, sulphur and nitrogen oxides,particulates	Less is better	1
State	Ambient air quality for above pollutants (CO2, Sox, NOx, PM10)	Less is better	1-2
Impact	Nr of cases of pollution – related disease	Less is better	3

	Residents who live within 0,7 km of major emission sources	More is better	1
	Material damage	Less is better	2
Responses			1
	Access to public transit	More is better	1-2
	Incentives to drive less (e.g.parking fees)	More is better	1-2
	Access to alternative energy sources	More is better	1-2
	Total renewable energy use (also report by sector)	More is better	3
Water Quality			
Drivers	Water consumption by sector	Less is better	2
	Use o fertilizers by households/agriculture	Less is better	3
	Use of toxic compounds by industry	Less is better	2
Pressures	Emissions of toxic compound to water	Less is better	2
State	Drinking water quality		1
	Oxygen levels in water	More is better	2
	Local vs imported water	More is better	2
Impact	Number of cases of water born disease	Less is better	3
	Habitat contamination	Less is better	3
	Beach closures due to pollution	Less is better	1
Responses	Water quality regulations	More is better	2
	Water pricing	More is better	2
	Level of sewage treatment	More is better	1
Land Quality			
Drivers	Residential, Commercial, industrial land uses		1-2
Pressures	Loss of natural areas		3
	Solid waste disposal by sector (to landfill, recycling, composting – tons)	Less is better	2
	Density of buildings	Less is better	2
	Loss of agricultural land	Less is better	2
State	Ambient land quality		3
Impact	Loss of aesthetic values	Less is better	3
	Loss of habitat and species	Less is better	2
	Erosion, Siltation of Waterways	Less is better	2
	% of population and	More is better	2

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	households within 0,5 and 1 km of park		
Responses	Protection of green spaces	More is better	2
	Zoning		1
	New construction vs building renovation	Less is better	3
	Total number of certified buildings in the area as a percent of new construction	More is better	2
	Percent of residential, mixed-use projects that are within 0,3 km of *transit nodes*	More is better	2
	Percent of new or replaced, non-turf, public landscaped area and non recreational turf area planted with regionally appropriate plants	More is better	3
	Municipal expenditures on waste services	More is better	2
	Nr of square meters of public open space (beach, park)	More is better	1
	Nr of trees by neighbourhood	More is better	2

Table 1 : Natural capital indicators for drivers, pressure, state of natural capital, impact, and responses (DPSIR) framework for a metropolitan area

3.3 PITFALLS IN INDICATOR DEVELOPMENT AND USE

For the integrated approach of this paper, some common pitfalls that can be done in order to develop a set of indicators should be mentioned.

Common pitfalls in developing and using indicators may include:

* Relying on aggregates (indices) without understanding the component parts. Some aggregation is desirable, but to focus attention on only a few aggregates may distort relationships or fail to show when some component of the index is telling us something different that the aggregate value.

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- Using what is measurable rather than what is important to measure. It is easier to use existing data than to collect new data, easier to do what others have done even if it is not necessarily relevant to one's jurisdiction. Not presenting sufficient numbers of indicators for each component in the framework so their interpretation is misleading. Indicators that are only presented as percentage deviations from a baseline, or, ones that use a comparison without presenting the absolute values may not give the whole story. For example, energy efficiency measured as decreases in energy use per unit output produced may show improvement over time while total energy consumption (and hence, environmental pressures from that consumption) continue to rise. It is fine to show energy efficiency, but total energy use should be an accompanying indicator.

- Basing conclusions on indicators generalized to measurement units other than the one being studied. For example, census tract data does not support conclusions about individuals/families. Ambient air quality data do not tell us where the particular pollutants come from and in what quantities. The indicator should fit the issue at hand. This is why, as shown in Figure 3, indicators should be found for all the components of the structural framework, not just those for the state of natural capital. Communities cannot determine what to do to improve environmental quality without identifying the drivers and what are the pressures and impacts.

- Putting too much faith in the indicator. Indicators cannot describe all the complexities of ecosystems and economic systems. We do not understand all the relationships between drivers, pressures, natural capital states, impacts, and what our responses will do to enhance the quality and quantity of natural capital. Indicators can be a helpful tool; they are only as good as the data from which they are derived and our state of knowledge about what this data means.

- Intentional misrepresentation and choosing indicators to support a pre-determined particular result rather than letting the indicators tell an unbiased story Concluding comments.

4.0 CONCLUSIONS

Natural capital indicators are a means by which communities can help understand the state of their environment, how it got to be where it is, and what might be done to make it better. They can show directions of change (things are getting better or worse) and raise awareness and stimulate responses to improve the environment if the indicators are relevant to the community. They need to be well crafted, in that in showing the state of the environment they also capture the relationships among all the components of framework linking drivers, pressures and impacts.

As noted by Redefining Progress and Earth Day Network (2002, p. 6) ''It is important to take as much or more time to develop and plan indicator series than to measure the indicators themselves.'' Indicators should inspire the community to take into account the quality and quantity of their natural capital in decision-making about sustainability. It must be remembered that environmental indicators are one input into community decision-making along with social, economic, and institutional indicators. They help assist in setting goals and policies to help sustain the quality of life in the community.

To accomplish these goals, natural capital indicators (and all measures) need to be presented in ways that help analyze the links between actors, actions, and outcomes. The community and its decision makers need to visualize and understand these links.

Indicators are not the end of the process, but the beginning. If they are not followed by substantive responses that are appropriate for the problems identified, they are useless. Decision makers must first commit to implement and sustain a system of indicators over time, then to follow up with an equally important commitment to do something about the evidence uncovered. There are far too many instances where efforts to understand the state of the environment were short-lived, data were

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collected for a few years, then stopped, and never integrated into specific policy-making for the environment.

Emphasis on environmental indicators re-emerged in the late 1990s, but again, there are risks that initiatives will not be continued. A similar story can be told for virtually all of the federal/provincial environmental round tables that were created in the 1990s and now no longer exist.

The state of our environment is a form of capital; it can yield essential goods and services over time, but only if we understand what is happening to these goods and services as a result of our activities, and if we sustain natural capital as part of society's total capital. The goal is to have natural capital indicators join with social, economic, and institutional indicators to help draw a more complete picture to assist communities in achieving their sustainability goals.

The basic aim of this project is to measure the sustainability of an urban area in Greece using the environmental indicators according to the quality of the existing natural environment. One of the basic problems that we face in this project is the lack of available data. In order to overcome this difficulty, we try to choose environmental indicators that are easily measured or estimated by a small group of people.

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