

Assessing public health benefits through green infrastructure strategies in medium-sized cities in Spain. Case study: La Coruña.

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Introduction

The last UNFPA statistical data show up that over the 50% of the world's population has lived in urban areas since 2010. Although it's true that cities offer multiple opportunities (job, knowledge, culture,...) also it is true that they have a negative aspect in everything related with the fast pace of life, the lack of leisure areas, the social incohesion and the public health. Among the different alternatives that may be suggested to try to minimize this problem and look for more healthy cities, inside a global sustainability framework, stands out green infrastructure (GI). As we know, green infrastructure, regardless of their different conceptual approaches and contexts, discussed deeply by many authors (Benedict and McMahon, 2006; Sylwester, 2009), is a strong multiscale planning strategy whose use is booming in the international panorama. Undeniably, both GI and its various components as green corridors, parks, gardens, etc ... have a strong nature of multifunctionality that is supported by numerous scientific and technical studies (Fabos, 1995; Tzoulas *et al.* 2007) and form a complex system that produces multiple benefits, including public health (PH).

Through a case study of La Coruña city (northeast of Spain, Fig.1) (LCG), we have analyzed as the approach of GI on a municipal and provincial scale may be the suitable solution to numerous existing problems in medium-sized cities, with a high population density and with some appearance peculiarities, geographical siting and psychology barriers, connecting it with the benefits that are generated to public health in a double aspect: prevention and economical saving.



Figure 1. La Coruña (location; physiognomy.)

Background and Literature review

We are aware that the rapid urbanization has caused numerous changes in public health and in social welfare because the nature has been replaced with modern environments, holding the population up to complicated situations. This fact is aggravated in more overcrowded cities with little public space where the incidence of diseases is greater owing to a lack of space to practice sports, heat island effect, greater level of pollution, etc. It's the case of cities as LCG which don't

offer, in general, some appropriate surroundings for the inhabitants above all because they lack suitable areas that cause numerous and valuable ecosystemic benefits that work synergistically like palliative of diseases and systems of public health prevention.

A rising body of scientific evidences suggests that the contact with green spaces (GS) in its different typologies improves the health visibly, perhaps, by the biofilic feeling, term coined by Erich Fromm. A study of Maas et al. (2006) shows a positive relationship among the number of green spaces in the environment where people live and their health perception. Other studies show up that the residents of areas with a suitable GI are more long-lived, do more physical activity and are healthier. If we remember the definition adopted by the WHO: “health is a state of complete physical, mental, and social well-being and not merely the absence of disease or infirmity”, we can deduce a direct connection with the green planning of the cities because the health is considered as a phenomenon not only somatic (biological) and psychological, but also social.

It is important keep in mind that one of GI benefits is to protect the populations vulnerable to factors that cause the diseases, that is, the primary preventive intervention (PPI) of a public health system that is applied before the disease occurs, in the end the most effective of all them, in economic savings and fighting against diseases. This perspective appears from the PH origins and has been considered by its founders as Virchow. Therefore, we share the ideas of Kuppuswamy (2009) who indicates that exists a clear need of evaluate the potential economic implications of the GI linked to health effects and the budget of health services facilitating interdisciplinary studies for urban planning.

The advantage of the use of territorial planning approaches that is aimed at the hybridization between grey and green infrastructure is evident, on an urban scale, in numerous studies and theories that pursue the use of technical and scientific guidelines to make an urbanism and nicer environments, or in words of Mohsen Mostafavi, an ecological urbanism, landscape urbanism according to Charles Waldheim or James Corner approaches, looking for “landscape in the city and the city in the landscape” and, in a landscape planning and design more coherent in the conceptual line of the greenways (Fabos, 1995) and green infrastructure (Benedict and McMahon, 2006). The result of this perspective, in short, and by definition is multiscalar (municipality, region, state...) and multifunctional because it generates different types of benefits such as a) minimize the effects of climate change: temperature regulation, fixation of CO₂, VOCs and O₃, b) regeneration territories; c) conservation of biodiversity and wildlife, d) improving interaction, inclusion and social cohesion (Forest Research, 2008), e) economic growth and investment. But perhaps one of the most important is the aim of this paper: f) public health and well-being, GI is key for improvement both physically and psychologically, recognition based on a body of evidences that shows that it can improve the life quality, psychological health, welfare, increase life expectancy, etc. Many studies show that the use of vegetation is suitable to fight these diseases such as asthma and to minimize the presence of sunburn and skin cancer by lowering the temperature. Tzoulas *et al.* (2007) studied the implementation of GI and public health in its different variants (cardiovascular, immune, respiratory, digestive, skeletal, stress, positive emotions, attention and cognitive ability). In particular, it is associated with relaxation and to combat depression and promote general health (Stigsdotter, 2005). Furthermore, Ribeiro and Dias (2010) argue that the benefits generated by green corridors can strongly contribute to place the urban landscape on the right track to improving the quality of cities and therefore its competitiveness. Another important point in this topic is the location and accessibility; there are different studies and experiences that relate directly the size, quality and location of green areas

improvements in quality of life and public health (Maas et al., 2006). All these benefits represent convincing arguments that can serve as base for change proposals in the territorial planning and to add new natural elements like thousands of trees, as happened in New York (Wells, 2012).

The implementation of GI strategies at municipal level represents a competitive benefit of comprehensive planning more effective that reinforces the areas character, improves the connectivity and the cohesivity, the biodiversity, minimizes the fragmentation and works in more rational parameters of ecological coherence and of preservation, part of these proposals has been analyzed by different authors like Ribero y Barao (2005). By other hand, moreover, it includes strategies for the protection of the heritage, of the population identity, to avoid deterioration processes of urban landscape, of *urbanización*, term coined by the Spanish geographer Frances Muñoz who combines the two Spanish words *urbanización* (urbanization) and *banalización* (trivialize). Through all these perspectives, we put forward a thesis that GI can contribute significantly to improvement of public health and quality of life, with the consequent economical saving, for that, the accessibility of all population to this kind of spaces must be guaranteed.

Goals and objectives

The main purpose is to explore, conceptualize and show, through LCG case study, that GI is a necessary planning strategy for improving competitiveness and quality of life and are key to reduce public health problems in its double aspect, prevention and economical saving. As objective it is considered the suitability of integrating these approaches in medium-sized cities with a high population density and with singular characteristics of appearance, size and types of green spaces such as the city of La Coruña. An incorporation that allows to suggest strategies to guarantee the accessibility of all the citizens to green spaces and guarantee the ecological connectivity.

In the same way, it is studied the possibility of suturing and giving continuity to this green local strategy with the candidacy of "Mariñas coruñesas e Terras do Mandeo" for World Biosphere Reserve by Unesco, because it represents a hub with natural value and the opening of Northern Spain ecological network which covers from Pyrenees to the Atlantic Ocean.

Methods

The methodology involves the analysis and estimation of the current state of the green system and the new masterplan of La Coruña. The analysis is drawn from different perspectives: continuity of the system of green spaces, areas of influence, spatial distribution, type, accessibility and harmonization with European standards.

A SWOT analysis to evaluate the different variables that should be taken into account in the proposal of GI planning and a territorial analysis of green spaces distribution were used. To study the thesis that the green corridors and the GI are very important to the improvement of the PH, it was evaluated, by means of the GVSIG program, its applicability to La Coruña city in terms of accessibility, defined using a maximum distance of 300 m to some green area of a minimum size determined as a reference, measure proposed by the CE (ECI, 2003) and recommended by ANGST of Natural England and different studies like Wendel-Vos et al. (2004) among others.

The minimum size selected is 5000 m² (dismissing those areas in median strips and hard to access places) because, besides to be the dimension recommended in Europe, fulfill the appropriate conditions to do different physical activities like walking or jogging for a minimum of 30 minutes, the recommended daily value of exercise to fight against diabetes, cholesterol, etc, enjoying a natural environment unconnected with urban life.

Also, potential ecological networks, that allow to improve the accessibility, hubs (of natural, historic or social value) and connection points with the most agricultural periurban areas, offering spatial continuity of green mass, were identified. The approach is enriched with the incorporation of viewpoints emanated from the analysis of green strategies in other cities of Spain.

Results

The need to improve the green planning of La Coruña (LCG)

In Europe there are numerous initiatives and recommendations for GI implementation at different scales (Mazza *et al.*, 2011; Nauman *et al.*, 2011), and day by day applied in more scenarios with different characteristics, with more or less success due to the existence of barriers, often surmountable, of technical, financial, physical and legal nature, or simply because of a lack of deep knowledge of this philosophy. The case of the city of LCG, the most urban of this autonomous community, is an interesting case of medium-sized city (310,000 real inhabitants) with a high density (6417 inhab./km²) that shows singularities in size, appearance (peninsula), typology of green spaces, urban peculiarities, that lend a special character to the city and, also, problems when it comes time to can improve its structure and to suggest a strategic change of planning and management of its green system.

The city has very good transport infrastructures, by land (N VI y A9), sea (traditional harbor and new foreign harbor) and air (Alvedro airport) but it has a very little municipal area (37, 83 Km²) which prevents its spatial growth and causes the mass situation, in fact is one of the cities with greatest population density of Spain, which has increasing fivefold from 1900. The analysis of the current situation and of the historic evolution shows up that a territorial development of integration with the part most natural hasn't been followed.

The new master plan (PGOM), which raises these approaches although some what away from the more academic line, represents an interesting starting point with interesting proposals as Parque Alto, although, as a constructive criticism, only gives some limited proposals superficially from a perspective more comprehensive and complex in the GI conceptual line (connectivity, multifunctional, public health, accessibility,...).

Another important handicap perceived in La Coruña is that the marked rural character of Galicia, in general, and of the periurban areas of the city, in particular, by other hand, a great advantage which would be able to serve as a link with the more urbanest parts, has stressed the psychological perception of the GI different parts enormously, which means that the population doesn't understand the approach of this kind of territorial planning.

In the same way, this green system seems interesting to be sutured with adjacent areas, taking advantage of the possible declaration of a World Biosphere Reserve of "*Mariñas coruñesas e*

Terras do Mandeo", UNESCO candidate, which includes neighboring municipalities, as it would mean giving continuity to the ecological network in northern Spain and open it to the Atlantic.

Spatial analysis

The first analysis relating to the situation of GS in LGC supplies us with the details to know if the citizens' needs are well covered and the zones whose green system need be improved. To this end, an analysis with influence zones of 300 m (dismissing those areas located in median strips and hard to access places) was carried out. After GIS analysis, we identified the weak points where would be precise to make proposals (Fig.2) to guarantee the accessibility of all the population.

The results emanated of the current situation show that there is a ratio of $8,2\text{m}^2/\text{hab.}$, very close to the ratio proposed by WHO, although on the international level exists quite controversy, for example, Abercrombie suggested $16,2\text{m}^2/\text{hab.}$ in his plan to London (1943-1944). Currently, developed countries are adopting a general standard of green space of 20m^2 park area per capita. If this standard is adopted, we have a lot of hard work ahead of us.

It is estimated that the spatial distribution of green areas is adequate, although the most are small GS. For this reason, it is proposed that the critical points were analyzed based on results of GIS analysis (Fig. 2), in spite of they are also important because, as Fu y Zhao (2010) pointed out in their study, sometimes they are more frequently used to rest and to do exercise since, in certain situations, the residents prefer near small areas than far and big zones.

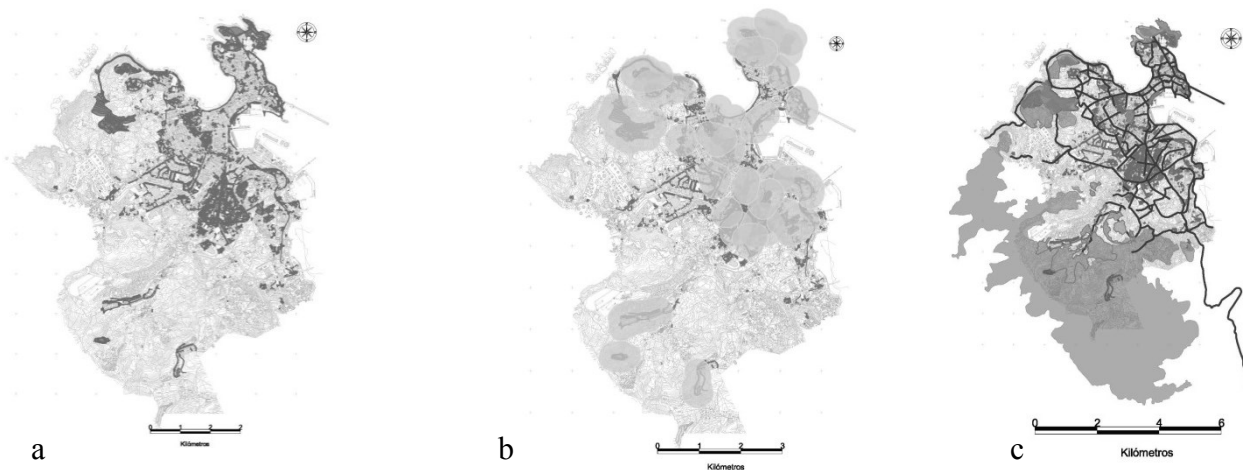


Figure 2. (a) Spatial distribution of green areas in La Coruña. (b) Accessibility analysis to green spaces with $S > 5000\text{m}^2$ and distance $< 300\text{m}$. Critic zones identification. (c) Green corridors network, Parque Alto of PGOM 2012 and proposal of hubs (natural, historic and cultural) incorporation and connections.

The spatial distribution of parks and gardens system is very broad although the most part of them (177) are microspaces smaller than 1000m^2 (Table 1), in fact, almost the 100% of the residences have access to green zones (any type and size) within a radius of 300 meters, but few of them have access to parks of minimum dimensions ($>5000\text{m}^2$). Large parks exist only in the most perimeter zones, parks that have been designed *ex novo* using either old military installations, thanks to which, in certain way, a great natural biodiversity has been kept and it was possible to outline a 205.000m^2 park (San Pedro Park) or old municipal areas like Bens Park (600.000m^2), old municipal landfill, or Saint Margarita Park, old urban camping (50.000m^2).

Different areas, that would be able to work perfectly as hubs (Fig.2), have been identified and classified in three typologies: a) natural: Parque de los Rosales. Parque de la Torre de Hércules. Paseo marítimo del Portiño. Punta Herminia; b) Historic Gardens: Méndez Nuñez (1867). Jardín de San Carlos (1834). Plaza de Azcarraga (circa 1896) and c) Cultural: Parque de la Torre de Hércules (World Heritage) and Castro de Elviña. These cores would be able to be part of the backbone of the spatially interconnected new system, linked by means of corridors and offering new spaces and opportunities to be in touch with nature.



Figure 3. San Pedro Park (old military battery), Bens Park (old municipal garbage dump), and surrounding area of the Torre de Hércules (World Heritage).

One factor hugely important besides the quantity is the quality, in that sense, the municipal government is generous because it is one of the city councils of Spain that invests the most ratio of euros/m² in its management and the result is very positive in population opinion.

Table 1: Distribution of green spaces surfaces at La Coruña.

Units	Size interval (m ²)	Total S (m ²)	High quality S. (m ²)	Medium quality S. (m ²)
177	<1000	54.094	47.776	6.318
85	1000≤x<5000	193.370	157.817	35.553
19	5000≤x<20000	184.385	124.129	60.256
23	x>20000	1.078.969	515.439	563.530

Regarding green corridors, the new PGOM proposal has been analyzed and it has been complemented with new contributions more realist with GI concept, sometimes it is not possible because of the city urban typology. By other way, the preliminary spatial analysis would allow to join the potential GI of La Coruña with the area proposed to be declared Reserve Biosphere by the UNESCO (Fig. 4).

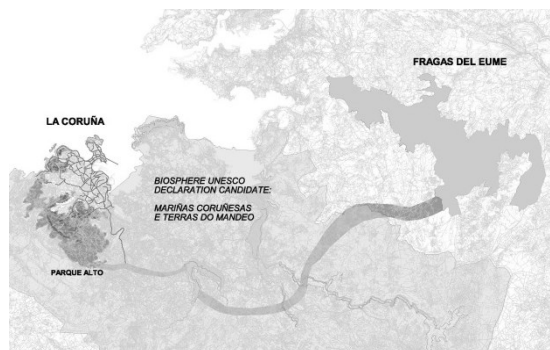


Figure 4. Potentiality of city spatial connection with the peripheral agricultural zones and network of protected spaces in Spain

Analysis of other experiences in Spain

Different experiences carried out in Spain were analyzed, characterized by a large casuistry owing to the historic evolution, the morphology, physical environment, population, budget, etc, and three of them were selected by its similarities or by provide inspiration for La Coruña.

Vitoria has a number of inhabitants similar to La Coruña (243.298 inh.) although with a minor density, 840 inh/km². Its green planning represents the Spanish paradigm, evidence of that fact has been the appointment as “Green European Capital” (2012). Its green belt, 645 has, the result of an ambitious plan that was started at the beginning of the years 90 of the last century, is a group of periurban parks with a high ecological and landscape value connected strategically by means of corridors which, in part, has enabled it to reach the second place among the cities with the greatest quality of life in Spain in a recent study carries out in 30 Spanish cities, taking into account 11 relevant indicators. The same study shows that one of the biggest worries is the health.

This example interests us owing to its integral management, its protocol of public broadcasting, its social participative approach and its spatial singularity that can be used as guide for cities like La Coruña, and moreover, its policymakers are analyzing the integration of all the area that forms the highland belt in a group by means of Biosphere Reserve UNESCO Declaration of the whole area. One of the goals of this study is precisely to analyze the stitches of the green system of LVG with the possible appointment of Mariñas coruñesas e Terras do Mandeo.

Another interesting example is Valencia due to its high urban density (5.995,7 inh/km²), its metropolitan area is a territory of environmental and landscape excellence owing to the convergence of 4 great landscape. They try to make the protection and connection of the landscapes with urban surroundings and agricultural, cultural and natural spaces, in the same way that it would be able to put into practice in the hubs identified in our case. The last example is Murcia (430.571 inh) although it is a regional initiative, we have a special interest in the experience of its participation in European projects (Reverse y Surf-Nature) with relation to financial, technical and political alternatives to carry out GI initiatives.

SWOT analysis

Strengths:

1. Physical environment very suitable for territorial planning proposals of integration with the natural environment. Capacity of response very fast.
2. The city physiognomy allows the inclusion of Blue Infrastructure.
3. Possible planning with perimeter growth in more rural zones.
4. Sensibility to urban regeneration.

Weaknesses:

1. Ignorance in relation to green infrastructure concepts and principles. Lack of dialogue among departments originated by the absence of a global project and a clear leadership.
2. Singular territorial physiognomy. Complication in planning.
3. Urban typology (narrow streets, little free areas, etc.)
4. High urban density.

5. Disjointed historic planning.
6. Legal and financial framework

Opportunities:

1. Information and education. Social participation. Social consciousness raising.
2. Territorial planning joining the city closely to the most agricultural or natural environment.
3. Identification and presence of hubs with special historic, natural or cultural importance.
4. Savings of maintenance costs and derived from ecosystem benefits.
5. Public health and quality of life improvement. The impact evaluation of health is important and very useful to make decisions in politics evaluation.
6. Possible declaration of “Mariñas coruñesas e Terras do Mandeo” like Reserve of the Biosphere.
7. Potentiality of economic regeneration.

Threats:

1. Economic crisis.
2. Social pressure. Psychological barrier.
3. Particular interests.
4. New urban interventions took out of context.
5. The lack of methodologies that assess health benefits can affect its implementation.

Discussion and conclusion

Studies developed and currently underway highlight the need to integrate and implement these planning strategies in dense cities with similar physical characteristics to those of La Coruña as they involve improving public health, quality of life and landscape, functioning as a competitive advantage globally.

Synthesis of the preliminary research work, supported by the SWOT matrix and the geographical study, shows a strategic opportunity for the incorporation of GI in LGC that allows and guarantees the accessibility to green spaces bigger than 5000 m² located within a radius minor than 300 m, following the European recommendations with the consequent improvement of public health.

It shows the need for regional planning to enhance and strengthen supramunicipal spatial connectivity of the protected areas network in northern Spain and open it to the Atlantic. GI planning must be accompanied by an informative and educational campaign adapted to the psychological bias of the population, transmitting its concept and its varied benefits with the aim of changing the current concept that exists in Spain of “public equipment” to “green infrastructure”.

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