DEFINING THE AREAS OF REHABILITATION, REGENERATION AND RENEWAL IN CASTELLÓN DE LA PLANA (SPAIN). USING A GEOGRAPHICAL INFORMATION SYSTEM IN URBAN PLANNING

1. INTRODUCTION

The 11th Global Sustainable Development Goals (SDG) of the United Nations for the 2030 Agenda (UNO, 2015) state that cities must be inclusive, safe, resilient and sustainable. It would be desirable to prioritize vulnerable areas for the urban interventions undertaken in consolidated cities because economic resources are usually limited. In this work, the Urban Vulnerable Areas in the city of Castellón de la Plana were defined to include them in the development of this city's New Land-Use Plan. A Geographic Information System (GIS) tool was used to represent data on maps as it permits the presentation, management and update of the collected data for the decision-making process when urban interventions are undertaken.

2. METHODOLOGY

The work consisted in a previous desk review on the use of urban indicators to evaluate vulnerable areas in the city. Afterward, the city's urban evolution was studied by an analysis of the historical events and demographic issues, which influenced the current urban structure. Then available information was acquired to select indicators and to adapt them to the city. The delimitation of vulnerable areas was based on a diagnosis of the urban environment through the indicators, which were represented and georeferenced in plans by the QSIG software (www.qgis.org/es/site/).

3. BACKGROUND

The Bruntland Report (1987) defines the term *Sustainable Development*. This concept has been consolidated in the last few decades and is a key aspect in urban planning. The 11th SDG of the UN focus on sustainable cities and communities for the 2030 agenda, and consider a more social focused view, including sustainability, but also inclusion, safety and resilience. Within this new

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framework, the *Urban Vulnerability* concept takes into account the most vulnerable population sectors in urban environments.

Agenda 21 (1992) proposes using indicators to evaluate, control and monitor three sustainable development dimensions: environmental, economic and social. Sustainability indicators provide synthetic information about a complex reality and allow its description and analysis. An urban indicator is a variable that has been socially endowed with an added meaning that derives from its own scientific configuration to synthetically reflect a social concern in relation to the environment, and to insert it coherently into the decision-making process [9].

Some authors have worked in Spain on Urban Vulnerability: Alguacil [1] defined it as the *Process produced by the combination of multiple dimensions of disadvantage in which any possibility of upward social mobility, which overcomes the social condition of exclusion or comes close to it, is considered extremely difficult to achieve. It is accompanied by a perception of insecurity and fear for the possibility of downward social mobility, and worse current living conditions.* Later in 2011, this author added that *urban vulnerability is supported by two concepts: Residential Exclusion and Social*. Antón *et al*. [3] presented urban vulnerability as a *Complex and continuously evolving process which implies the structural incapacity of some groups and individuals to solve their housing needs*. Some works done in Spain that have evaluated Urban Vulnerability are (Table 1):

Table 1. Some relevant works on Urban Vulnerability in Spain

Author	Year	Location	Indicator categories
Hernández-Aja A. Ministry of Development and Instituto DUYOT.	2001, update 2011	Spain	Socio-demographic, Socio-economic, Residential and Subjective Vulnerability
Egea *et al.*	2008	Andalusia	Social Level, Demographic and Families' Situation and Livability Conditions
Catalonian Government: Law for Neighborhoods of Catalonia	2011	Catalonia	Urban Regression and Lack of Facilities and Services, Demographic Problems, and Economic, Social and Environmental Problems.
Temes R.	2014	Madrid	Socio-demographic, Economic, Building Features and Urban Features indicators

The analysis of all these works shows that no universal methodology exists to apply indicators. In all cases, the selection of indicators and their adaptation to the considered area constitutes a previous stage before making the evaluation.

Most of these studies use Geographical Information System (GIS), which is a very useful tool to represent results and to make the decision-making process easy as all the data need to be georeferenced [12]. Some examples for using GIS in urban contexts show the usefulness of this tool from different perspectives: e.g., for land use [4], transportation planning [10] or energy use aspects [6-7].

4. CASE STUDY

Castellón de la Plana is a medium-sized coastal city in east Spain with some 170,000 inhabitants, and is located at a 39° 59' 11'' north latitude and a 0° 2' 12" east latitude, south of Barcelona. Castellón de la Plana was conceived as a city

in the 13th century and was formed by small groups of detached and spread out Muslim farmsteads that formed what was then a Middle Age village. The city was later surrounded by a defensive wall, where the historic city centre now stands, which remained until the beginning of the 19th century. In 1837, the city built a new rhomboid-shaped defensive wall, including suburbs and many gaps. In 1885, the first urban plan for the city's outskirt areas was devised and walls were completely demolished at the end of the 19th century. The first General Urban Plan (PGOU in Spanish) was drawn up in 1925, with three urban areas: inner area, first expansion area and new expansion area. However, this plan failed when the Spanish Civil War began in 1935. A new plan was approved when this war ended in 1939, which included the new squares and avenues that shaped the city. Next a PGOU was approved in 1963 according to the National Land Law of 1956, but it was not effective. Due to the growing demand of new dwellings, the compact growth and integrated green areas concept was lost, and rapid demographic growth led to a disproportionate increase in the height of buildings and, therefore, to increased building density. The urban layout in the 1980s and 1990s underwent major transformations. The PGOU further structured the already structured territory, with new big urban plans for residential use, as well as single-family or multi-family houses, in the surrounding areas of the city. Currently, the PGOU of the city is being written and the new version will come into force shortly.

This work defines the Urban Vulnerable Areas in the city of Castellón de la Plana. This report aims to detect the most vulnerable areas in the city to be prioritized in urban planning processes. Together with other complementary reports on mobility, acoustic conditions, etc., they will be used to assess the city in new Land-Use Plan development.

5. SELECTION OF MEASURABLE INDICATORS AD HOC TO THE CASE STUDY

The selection of measurable indicators *ad hoc* to the case study was done according to three main stages: a desk review of the urban vulnerability indicators used in previous studies; information collection; categorization and selection of indicators *ad hoc* to the case study.

Figure 1 shows the stages followed in the study.

The desk review led to an initial list of 92 indicators used in international and national sustainable certification tools.

Information availability and format, and adaptation to the specific features of the city, allowed us to rule out some of the initially selected indicators.

Two different classes of indicators were set up: Characteristic indicators (C), which evaluate vulnerability directly, i.e. *population over 65,* or *constructive quality;* Informative indicators (I), those that define better profile vulnerable areas, but do not indicate vulnerability themselves. They were grouped into four categories: urban, building, socio-demographic and socio-economic vulnerability. Finally, two levels were set up: Level N1, with 29 indicators, resulted in a first snapshot of the city's vulnerability, and represented the census sections on the GIS maps for each indicator. However, a census section is an administrative border and does not necessarily coincide with a homogenous urban area. Therefore, level N2 permitted a better geographic definition of the vulnerable area, where data were disaggregated to the cadastral reference

scale. In this case, a more detailed analysis was needed for the resulting 35 indicators. Some visits to areas were organized to, for example, check *sidewalks accessibility*. Besides, some participatory processes with citizens were undertaken to detect their real problems. This permitted the detection of subjective aspects besides technical features. Some focus groups with vulnerable people were asked about the specific problems in their areas: elderly people, young people and women. A datasheet was built for each indicator to define it and to explain the threshold adopted to evaluate vulnerability. Table 2 shows the selected indicators.

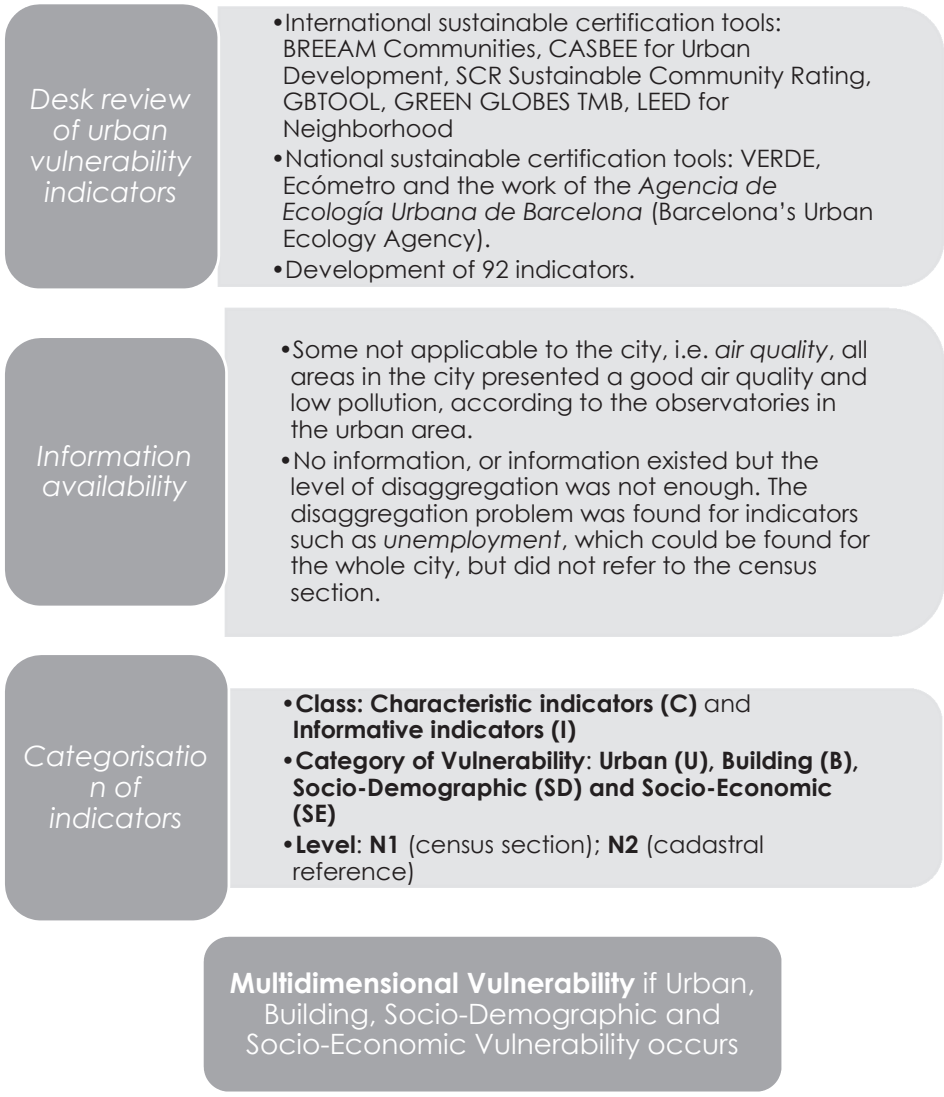

Fig. 1. Selection of indicators

Table 2. Selected indicators for categories

Vuln.	Level 1. N1	Level 2 N2
URBAN	I1.U.01. Land occupation I1.U.02. Green areas I1.U.03. Proximity to public transportation I1.U.04. Vacant lots I1.U.05. Day sound level I1.U.06. Night sound level	I2.U.01. Land occupation I2.U.02. Proximity to public transportation I2.U.03. Vacant lots I2.U.04. Abandoned buildings I2.U.05. Accessibility in public space I2.U.06. Balance between residential and commercial activity
BUILDING	C1.E.01. Energy performance C1.E.02. Accessibility C1.E.03. Conservation C1.E.04. Constructive quality I1.E.05. Acoustic quality I1.E.06. Renewable energy	I2.E.01. Energy performance I2.E.02. Accessibility I2.E.03. Conservation I2.E.04. Constructive quality I2.E.05. Acoustic quality I2.E.06. Renewable energy
SOCIO-DEMOGRAPHIC	C1.SD.01. Overcrowded dwellings C1.SD.02. Population 65 years and over C1.SD.03. Immigrants C1.SD.04. Population below 15 years I1.SD.05. Aging 65/15 I1.SD.06. Social housing municipality I1.SD.07. Social housing region I1.SD.08. Vulnerability of children I1.SD.09. Social services assistance I1.SD.10. Children's education I1.SD.11. Noise and complaints I1.SD.12. Social mediation services I1.SD.13. Housing	I2.SD.01. Overcrowded dwellings I2.SD.02. Population 65 years and over I2.SD.03. Immigrants I2.SD.04. Population below 15 years I2.SD.05. Aging 65/15 I2.SD.06. Social housing municipality I2.SD.07. Social housing region I2.SD.08. Vulnerability of children I2.SD.09. Social services assistance I2.SD.10. Children's education I2.SD.11. Noise and complaints I2.SD.12. Social mediation services I2.SD.13. Housing I2.SD.14. Streets and weather-related problems I2.SD.15. Traffic I2.SD.16. Others
SOCIO-ECONOMIC	C1.SE.01. Social subsidies C1.SE.02. Dependence subsidies C1.SE.03. Level of education I1.SE.04. Absenteeism from school	I2.SE.01. Social subsidies I2.E02. Dependence subsidies I2.SE.03. Level of education I2.SE.04. Absenteeism from school I2.SE.05. Tax base I2.SE.06. Cadastral value

6. RESULTS

Finally, all the characteristic and informative indicators were calculated. The obtained values were standardized. To do so, an analysis of each indicator was carried out by comparing its value with the threshold value. However, the simultaneous interpretation of the results of multiple indicators is complex and makes decision-making processes difficult. Therefore, in order to adequately interpret the results, the cartographic representation of each indicator was done in the city by exclusively considering urban land.

The use of GIS to represent the results led to more than 500 plans, as indicators were represented separately and for the categories at each level. Figure 2 shows an example for the N1 *Building Density* indicator, where census sections are represented, and *Building Accessibility* is represented for level N2 by considering the cadastral reference:

Fig. 2. *Building density* in the census section of the city (level N1) and *Building Accessibility* in the cadastral reference in the Vulnerable Area (level N2), represented by QSIG

The application of 35 indicators allowed 17 Vulnerable Areas to be defined in the city, where the four categories of indicators are encountered, as shown in Figure 3.

Fig. 3. Vulnerable areas defined in the city

7. CONCLUSIONS

In this work, the most vulnerable areas in the city of Castellón de la Plana were defined after taking into account sustainable development principles.

Some indicators were applied to evaluate the city's vulnerability by considering different categories: urban, building, socio-demographic and socio-economic indicators. They were selected according to information availability, and were adapted to the city scale and to specific features.

Besides technical aspects, social aspects were taken into account and some participatory processes were followed to detect citizens' perceptions. As a result, 17 vulnerable urban areas in the city were identified after considering those areas in which all the indicator categories were present.

The use of GIS was vital to represent and interpret the results in order to design optimum solutions. More than 50 layers with more than 4 Gigabytes of information were used to manage the data of 108 census sections, which included 246,243 buildings (cadastral references). This permits a new database that can be managed for different purposes and can be updated. This constitutes a very valuable tool to help in decision-making processes when urban planning processes are being implemented.

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SUMMARY. Most cities present consolidated urban environments with existing urban patterns and old buildings. According to the 11th Sustainable Development Goals for 2030, "make cities inclusive, safe, resilient and sustainable" is a must to obtain Sustainable Cities and Communities. This implies finding a compromise solution among environmental, economic and social criteria. Aligned with the sustainability concept, vulnerability arises to include social criteria together with technical ones. This means that vulnerable areas must be prioritized to achieve inclusive societies. The authorities are a key factor when developing policies on urban planning. Moreover, other actors such as stakeholders, professionals and citizens must form part of urban development processes.

The objective of this study was to define and improve vulnerable urban environments in the city of Castellon de la Plana (east Spain) to contribute to update the current Land-Use Plan. To do so, quantifiable urban indicators to detect vulnerable areas were proposed, which have been adapted to the city's local characteristics by considering technical, economic and social criteria. Technical macrodata were collected, "in situ" detailed data were acquired, and participatory processes were implemented to collect and learn citizens' needs and requirements. Collaboration with authorities was also relevant to obtain consensual results.

Using a Geographic Information System (GIS) tool was crucial to represent and interpret the results on maps. The results show that a GIS tool is a powerful means to help in the decision-making process and to design optimum proposals for urban planning. GIS also permits data management and to keep data updated for future planning studies and interventions.

Key words: GIS, Participatory Processes, Urban Regeneration, Vulnerable Areas, Indicators