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Flood risk and imprudence of planning in Extremadura, Spain

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ABSTRACT

The natural risks of flooding inherent to Mediterranean climates is a well-known fact, but one difficult to gauge and rarely accurately in terms of space, quantity and degree. Fortunately, in Spain the national Cartographic System for Flood Areas (SNCZI) partially compensates for the deficit, calculating the probability of these natural phenomena. The present paper describes the number, location and characteristics of the homes exposed to flooding in Extremadura. The methodology used in the study reveals in great detail the clandestine homes built on land not apt for urban development (via scans and visual detection techniques using the available series of ortho-rectified aerial photographs), particularly those at flood risk (determined by SNCZI cartography). This reveals deficiencies in risk management and land use. Also, the information leads to the conclusion that current action from the Administration is ineffective in preventing any risk of flooding, and that the risk is known, but ignored.

1. Introduction

Human settlements have been historically linked to locations with pre-existing water sources (Segura, 2001). The spatial proximity to these water sources constitutes an inherent risk to certain urban settlements, exposing them to the eventual appearance of extreme weather conditions. Flooding is the most common natural disaster in the world (World Bank, 2012) and especially relevant to more local scenarios.

Due to highly variable weather conditions, Mediterranean climates in Spain are classified as risk areas (Olcina, 2008). Under this definition a considerable part of Spanish territory is considered vulnerable or at risk. Extremadura, in the centre-west of Spain, is an example, although the official data on artificialization (Observatorio de la Sostenibilidad, 2016) does not reflect its clandestine residential development. However, a recent study (Jiménez, 2018) discovered that urbanizing rural areas has been very much an issue in this region of Spain, requiring immediate action.

In regards to the general context, the perception of risk is a primitively latent condition. Thus, risk awareness only occurs when there is knowledge of the threats. Risk can appear as a function consisting of three elements: exposure, probability and vulnerability (Kron, 2005; Jongman et al., 2012). Thinking along these lines, in an area prone to flooding, with no built-up areas, probability still exists, but there is no exposure, and therefore no risk (Fedeski and Gwilliam, 2007).

In the concrete case of natural risks, lacking information about exposure means there is no perception of risk. This is apparent in Extremadura with homes clandestinely built in rural areas with no official records of their existence.

The lack of information and action means flooding is still the leading natural risk in the country (Hijós and Zueco, 2004; Camarasa-Belmonte and Soriano-García, 2012; Consorcio de Compensación de Seguros, 2016). The map created by the State via the National Mapping System of Flood Areas (SNCZI) regarding this particular topic is of no use if not complemented with information on the current built-up area in the flood zone. The absence of intersecting information and data points makes it difficult nigh impossible to adjust current urban circumstances to hydrological reality (Escartín, 2016).

The maps of the last quarter of the 20th century (Olcina and Díez-Herrero, 2017) have favoured the possibility of dividing up territory in time of major anthropic influence over fluvial dynamics (Baena et al., 2016). This cartography is based on the degree of flooding potential, and the probability of occurrence and recurrence. As a result, said map

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can only be described a map of probabilities and not risk, as it does not take into account exposure to extreme weather and how vulnerable the buildings built in secret actually are.

The local action is prompted by international regulations (UN/ISDR, 2005), which lately warns (UN/ISDR, 2018) about the negative consequences of rapid urbanization unplanned. In Extremadura, this command/recommendation was implemented via the Special Plan for Civil Protection from Flooding in the Autonomous Community of Extremadura (INUNCAEX); an instrument put into action through Decree 57/2007 issued on the 10th of April (DOE-44, 2007). However, the manner in which this information is handled is also absent from territorial and urban planning instruments. In fact, the figures used to represent said information don't include risk maps, which complicates correctly zoning the area. In addition to the previous, existing documentation is out-dated and ineffective (Campesino et al., 2018). Insufficient funds available to regional and municipal government is an obstacle to solve this problem.

The lack of action against clandestine urbanization in Extremadura on the part of local government has bred a sense of impunity and spread the contagion of irregular urban growth (Jiménez et al., 2017). The process, stretched out over time, has contributed to forming highly consolidated illegal urban settlements, some of them in flood risk areas. A real risk in this region. In fact, Extremadura has been hit by flooding, with an especially traumatic event that occurred on the 6th and 7th of November 1997, in the city of Badajoz which left dozens of fatal casualties and tremendous financial loss, among them numerous homesteads (Fig. 1).

All things considered, the present study is organized into the introduction you have just read, and transitions into an explanation of the risk factor in urban planning in Spain in general, and Extremadura in particular. The following are the basic aspects of the methodological approach intended as a means to discover incongruities and pitfalls in the aforementioned planning, as well as providing an exact number of homes built on land not apt for urbanization, at risk of flooding and their location. Lastly, the results of the study will culminate in conclusions of a propitious nature for Extremadura, being equally valid for other geographical areas. The effectiveness of the results is determined by how they resolve a deficit that governments cannot largely due today to budget restrictions. The novelty of the results is that they make it possible to alter paradigms, in other words, move beyond talk about probability of flooding in Extremadura, to confirm the presence of risks in the territory.

2. Regulation and instrumental integration of risk factors

Avoiding risk is not only legitimate but also mandatory by law. The seed of concern over the risks in urban planning germinated in Spain under the Law of Population Expansion issued in 1864 (Olcina, 2004). The regulatory body included the need for physical environment studies in planning. Much later, this need become obligatory in the Basic guiding principles of the Planning for Civil Protection from Flood Risks has already established land-use classification as stated in article 2 (BOE-A-1995-3865, 1995).

Fig. 1. The effects of flooding in the city of Badajoz (1997). Source: Diario Hoy Extremadura (J.V. Arnelas).

Subsequently, Law 6/1998, issued on the 13th of April regarding land use regulations and valuation (BOE-A-1998-8788, 1998), specify the mandate by determining the need classify areas with inherent natural risks as land not apt for urbanization.

The current legislation (BOE-A-2015-11723, 2015BOE-A–1, 2015BOE-A–1, 2015BOE-A-2015-11723, 2015BOE-A–1, 2015BOE-A–1, 2015BOE-A-2015-11723, 2015BOE-A–1, 2015BOE-A–1, 2015BOE-A-2015-11723, 2015BOE-A–1, 2015BOE-A-2015-11723, 2015BOE-A–1, 2015BOE-A-2015-11723, 2015), also makes a statement regarding land use incompatible with the existence of natural risks, among which flooding is mentioned specifically. Article 21 (text included in article 12 of the initial land use Law 8/2007 issued on the 28th of May) states that part of the basic circumstance of any rural land:

> "In any event, land preserved by territorial and urban ordinance inherent to the processes of urbanization, which should include as a minimum, (…) those with natural or technological risks, including flooding or any other grievous circumstance, and any other legislation governing territorial and urban ordinance may foresee".

To define this in spatial terms, urban planning must include a Environmental Sustainability Report (ESR) which must contain a map detailing natural risks (article 22) (BOE-A-2015-11723, 2015BOE-A–1, 2015BOE-A–1, 2015BOE-A-2015-11723, 2015BOE-A–1, 2015BOE-A–1, 2015BOE-A-2015-11723, 2015BOE-A–1, 2015BOE-A–1, 2015BOE-A-2015-11723, 2015BOE-A–1, 2015BOE-A-2015-11723, 2015BOE-A–1, 2015BOE-A-2015-11723, 2015). The mandate is the result of other prevailing legislation, such as the terms stipulated in Royal Legislative Decree 2/2001 issued on the 20th of July which restates the Water Law (BOE-A-2001-14276, 2001). Thanks to this, no urban plan will be approved without the agreement of the Hydro-graphical Confederations (article 25.4).

Thus, INUNCAEX detect the risk in Extremadura, and the planning classifies land accordingly. However, the maps product of regional studies are too vague[1] to get an accurate reading of the risk (in terms of scale and degree), and that said reading have an equivalent counterpart in plans that classify and categorize urban development on a given piece of land. In contrast, SNCZI mapping (much more accurate in locating risks) is useful.

Additionally, the problem in Extremadura is rooted in the obsolescence of its urban planning. Of the 147 municipal areas that have been studied, only 45.58% of them were approved after the implementation of State law governing land use in 1998; and of these only 27 municipalities have adapted to match autonomous urban planning legislation released in 2001.

At least legislation improvements in Extremadura offers a guarantee a posteriori. Laws provides measures (included torn down of dwellings) that could be taken to restore the land to its original state at any given moment, especially if there are potential risk to human health (article 28.3) (BOE-A-2001-13042, 2001).

Therefore, the main problem is not in the legislation or planning, but in the lack of disciplinary control and the scarce public participation in planning, so often well implemented in other countries (Rouillard et al., 2014), has certainly contributed to the situation. This participation, which is induced in other countries by the relationship between vulnerability and critical scenarios related to social marginality and shortage (Abbas et al., 2016), is not possible in Extremadura because vulnerability is associated with the illegal occupation of spaces for leisure. In this region, transversal societal participation only makes an appearance in generating the problems in question, and not in the solutions. In this context, communities prioritize the right to property over risk, due to the low perception of their real exposure and vulnerability. This implies a greater quantitative relevance of the phenomena, nonetheless still far less than in large urban spaces, such as Latin American cities (Hernández and Vieyra, 2010) and coastal areas of Spain (López and Pérez, 2017).

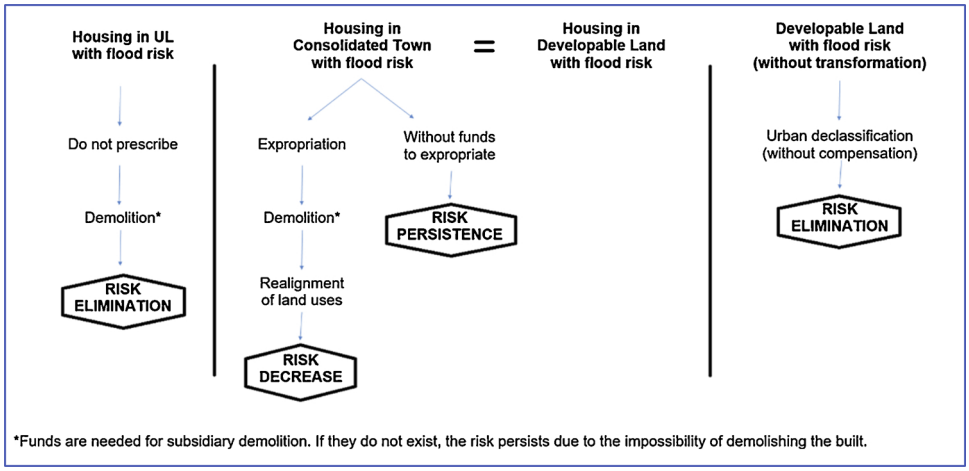

Fig. 2. Diagram depicting feasible legal solutions in the face of flood risks for homesteads in the territory classified according to different urban land use. Source: own elaboration.

Besides, there are three other main factors that make it difficult to eliminate the vulnerability in Extremadura. First, the success of the dispersed urban model and the productive change of the rural environment. In this case, Law 45/2007 issued on the 13th of December governing sustainable development or rural areas (BOE-A-2007-21493, 2007) emphasizes that hydraulic planning must "take action to protect against the advent of flooding" (article 25) and "must de-incentivize disperse urbanization, particularly in rural periurban areas" (article 33). However, there are no real results. The leisure urbanization dispersed has caused an abandonment or reduction of primary sector in Extremadura. Therefore, flood damages affect mostly homes, with less significance of the remaining consequences. This contrasts with other areas of the planet, where the importance of the primary sector and the need for housing (first residence) encourage the creation of proprietary strategies by the owners (Abbas et al., 2018).

Secondly, scarce funding limits approval of new plans and updating those that have already been approved. Lack of funds also affects demolitions and constitutes one of the main obstacles in reducing or eliminating the risk of flooding (Fig. 2).

Thirdly, political motivation also plays a fundamental role. In this aspect politics manifests clearly in measures that do not require financial support, such as the declassification of urban land to land not apt for urban development or the strict application of the law. Regarding conditioning factors set by Spanish legislation in risk management in the planning stage, a method has been created that is aware of the very real risks in Extremadura and to date, the lack of attention to said risk.

3. Methods and materials

SNCZI mapping has entirely dominated the methodological process, even to the extent of choosing the study area. Once all flooding areas in the country were estimated using Ministry criteria, the present study used the exterior perimeters to select the land affected at a municipal level within the township of Extremadura. Therefore, the spatial information is material (validated at a governmental level and referenced in public policy) to this study and not considered a method.

From this first step the study area was then determined to a 782.86 km^2 area distributed among 147 municipal points in Extremadura. In relative terms this means 1.88% of the territory managed by 37.89% of the township authorities among other administrative agents.

Ministerial mapping estimates 4 return periods (10, 50, 100 and 500 years) each of which has its own probability of occurrence which was determined using the formulas below (Eq. 1) and expressed in the following terms:

Eq. 1. Calculation for the probability of flood occurrence.

Where:

Pfo = probability of flood occurrence

T = number of years in the return period

N = number of years passed

$$Pfo = 1- [1-(1/T)]^N \quad (1)$$

These parameters yielded an example table determining the probability of surpassing caudal flow in a given year within a period of N consecutive years. Looking at Table 1, the terrain included in an area with a 10-year return period will, with 100% probability, flood in the timeframe of a century.

Based on the classification of the underlying reason for these risks as proposed in the Basic Planning Guidelines for Civil Protection against the Risk of Flooding (BOE-A-1995-3865, 1995, pp. 4849), and the addition of a first category – this latest addition supported by the level of detail in SNCZI mapping – we designated four risk categories for buildings in the area:

- Extreme Risk (ERA): isolated buildings in areas with 10-year return periods.
- High Risk (HRA): isolated buildings in areas with 50-year return periods.
- Significant risk (SRA): isolated buildings in areas with 100-year return periods.
- Low Risk (LRA): isolated buildings in areas with 500-year return periods.

Once the study area was determined, researchers then proceeded with georeferencing and vectorization of urban planning schemes for land use in urban planning instruments used by the townships with any level of flood risks. The researchers first started with documents in PDF or TIFF format (scans of the original plans with no spatial references to

Table 1
Probabilistic relationship between the existence of floods and the estimated return periods.

Probability of occurrence (%)						
Years passed	1	2	5	25	50	100
10-year return period	10	19	41	92.8	99.5	100
50-year return period	2	4	9.6	39.7	63.6	86.7
100-year return period	1	2	4.9	22.2	39.5	63.4
500-year return period	0.2	0.4	1	4.9	9.5	18.1

integrate them into GIS software) positioned according to certain benchmarks (construction, pathway networks, tree coverage etc.) represented in the plan and then contrasted with reality (orthophoto mosaics). Assumptions included the homogenization and simplification of all land not apt for urban development (LNAUB) into two classes: Common LNAUD (LNAUB with less restrictions governing its transformation) and protected LNAUD (the most legally protected LNAUB preventing human alteration).

This particular step also serves to examine the level of effectiveness of each figure in territorial and urban planning, such as its capacity for proposing measures that integrate risk management, or a lack thereof. This capacity was determined by simply categorizing the typology of these plans, and their age.

Superimposing cartography depicting probabilistic calculation (provided by the Ministry) and mapping for land use management (urban and territorial) the researchers detected areas that present greater discrepancies between the capacity for use estimated by the authorities governing current urban planning, and that estimated by Ministry for threat level.

These fundamental discrepancies are evident in the spatial coincidence between areas classified as urban land or land apt for urban development, and areas designated as probable flood risks (reaching a maximum potential in areas with a 10-year return period). Looking at it from a contrasting perspective we find assumptions in which, faced with existing risks, urban classification is more restrictive regarding the construction of new homes. The previous notwithstanding, this coincidence cannot only be due to the risk of flooding (information as yet unknown due to the lack of studies of the area pertaining in particular to current territorial and urban planning ordinance, and the previous inexistence of SNCZI mapping), and may be due to the presence of other elements requiring protection for environmental (such as the surroundings of watercourses) or productive reasons.

Once the phase described above was concluded a series of orthorectified aerial photographs provided by the National Plan for Aerial Ortho-photography (PNOA) implemented by the National Geographic Institute were scanned to detect and quantify the exact number of homesteads in these areas.

Considering that simply determining the probability of flooding is insufficient in mitigating the problem (Foudi et al., 2015), all exposed elements (homes) were assessed. In this manner, visual scans at scales never greater than 1:1000 were used to localize and then manually digitalize all the existing construction in flood areas classified as not apt for urban development (polygon topology in shapefile format). The methodology also allowed the researchers to verify the degree of urban transformation in areas apt for urban development and urban areas, and subsequently select those spaces where it would be optimum to reorganize or declassify urban categories (a reversal of the categorization as land apt for urban development).

Other methods such as the automatic detection of buildings using orthophoto mosaics or LIDAR images were not considered for the study as they do not provide concrete direct results for homes. These methods, aside from not differentiating usage in buildings, also present difficulties in implementing them due to the diversity of materials (with different spectral responses) used to build the roofs of said homes (Hermosilla et al., 2010) or due to the appearance of shadowy areas in high resolution spatial imaging (Perea et al., 2009). In conjunction with the previous, the application of LIDAR technology has the same issues and is of no practical use for the objectives of this study, although it has been tested with success in the creation and updating of other more general cadastres (Sánchez and Lerma, 2012).

Identifying residential use of land not apt for urban development was performed using the PNOA's own orthophotography, and Google Aerial photographs as well as Google's Street View.

The Google images serve to improve the visualization and digitalization of the homes in cases where the PNOA orthophotography were of less than optimum spatial resolution (varying between 0.25 and 0.50 m/pixel). The combination of these two sources allowed the researchers to verify residential usage of the homes in question by providing revealing indicators to that effect. These informative traits are clear and concrete. The orthophotography was taken in their majority in summer periods (and, therefore, periods of drought within the spatial context), meaning detecting green irrigated areas around the buildings is clearly contrasted against the dry backdrop of the remaining terrain, and informs the observer of habitation or recreational use. Allotments, garages, play areas and swimming pools especially are all complementary indicators. Thanks to Google Street View's images of building facades, dispelling all doubts as to the usage of these buildings.

Once the homes were detected and quantified and later integrated into a database, it only requires superimposing the new mapping on the existing maps for urban use (also created during the methodological process) and the probability of flooding.

Lastly, the analysis was complemented by determining precisely the legal situation of the detected homes; specifically for homes located in areas not apt for urban development. Said homes were subjected to an analysis to determine their legality (based on the adjudication of violations and/or criminal activity) to proceed in demolishing the building, and suppressing the risk of flooding, as well as determining any possible negligence on the part of the Administration (whether intentional or not) in authorizing their construction. To precisely determine these factors the study based the assessment on cartographic information regarding Urban Categorization Files issue by regional government counsel knowledgeable in these matters (regarding administrative authorization for the construction of homes in land not apt for urban development). The study also referenced the categorization of land not apt for urban development given that the homes illegally built on land designated as common land not apt for urban development constitute a crime enforceable 4 years after their construction, while on protected LNAUD there is no time limitation.

4. Results and discussion

4.1. Quantification and location of homes at risk of flooding

Although the official results of the cadastre of home construction are applicable and ultimately useful in estimating the risk of flooding when used in combination with SNCZI's mapping (Pérez-Morales et al., 2016), its main purpose is tax management, hence its topological failures (Navarro and Morte, 2013) and omissions (Fig. 3). A simple visual analysis of building cadastral cartography in land not apt for urban development shows that it is insufficient when what is to be avoided is the loss of human lives. In the case of isolated homes that have been built in secret in rural areas, their inaccuracy (in terms of quantity) prevents the application of the aforementioned resources.

The data obtained from the process shows us that in Extremadura there are 1781 homes built on LNAUD at risk of flooding. In quantitative terms the number does not represent a serious problem for an area spanning over 41,679.50 km^2, although it clearly does not comply with any pre-established criteria for sustainability (Jeong et al., 2016; Triviño, 2009) due to exposure to risk of loss of human lives. The geomorphic characteristics of the two main water basins in Extremadura, Tajo (Fig. 4) and Guadiana (Fig. 7) mean that flooding will occur in areas with little slope or inclination. This means that the greatest risk is concentrated in the flood plains of the Guadiana River and the Tajo River's main tributaries (Alagón to the west, and Tiétar to the east), which have lessened considerably since the second half of the XX century due to the building of dams (Leal et al., 2018) (scenario observed in SNCZI mapping). However, the level of danger they represent to human life indicates great qualitative importance, because it reveals an inattention to the problem. Assuming occupancy of each residency at 2.1 people/home (homes are occupied by fundamentally adult couples and senior couples), the potential risk of flooding would affect the lives of 3740 people.

Fig. 3. Example of the cadastral cartography omissions.

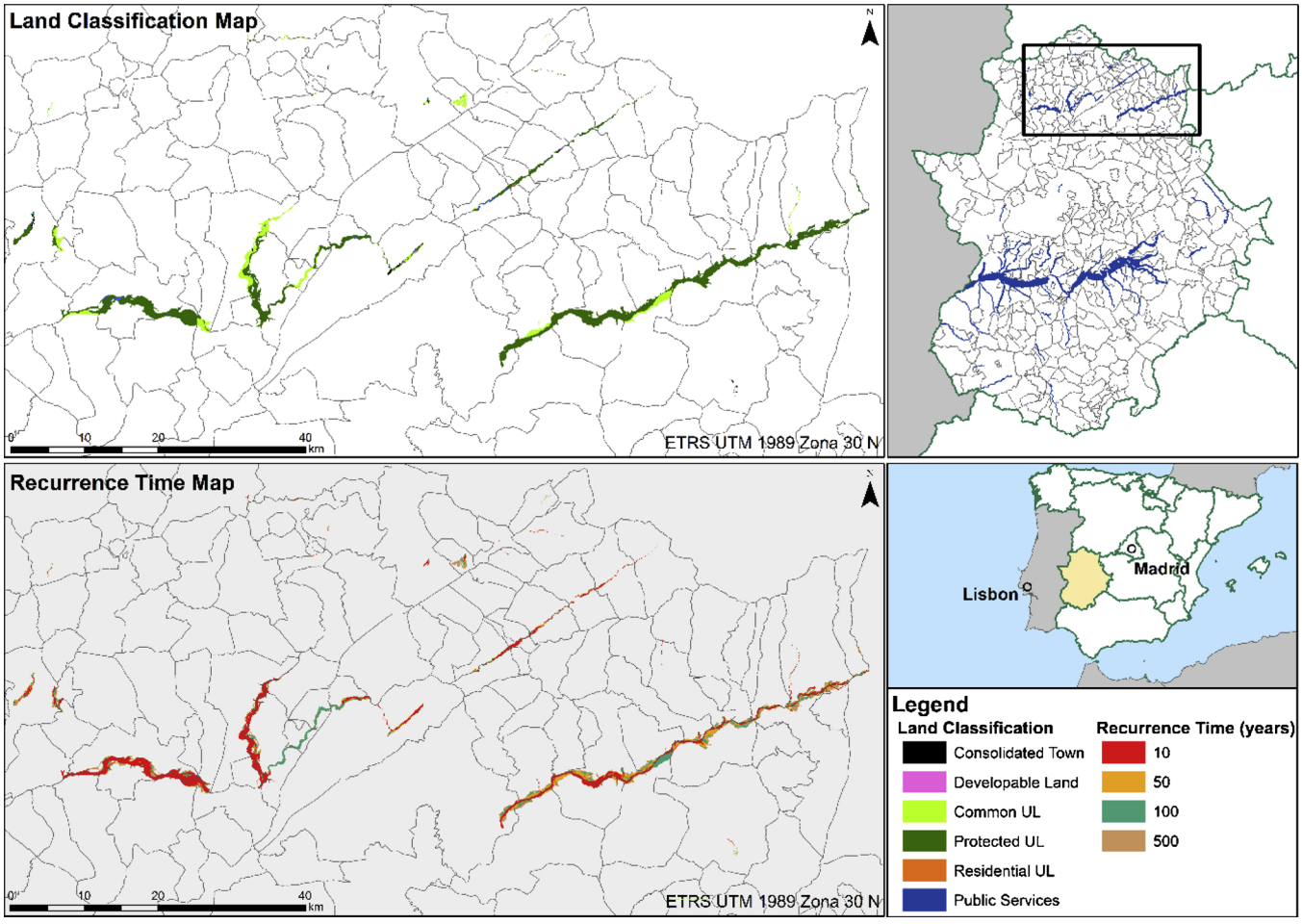

Fig. 4. Urban land use classification in areas at risk of flooding and located in the Tajo river basin, and their classification according to periods for flooding recurrence. Source: Own elaboration and SNCZI.

Fig. 5. Urbanization of Land not Apt for Urban Planning in Extremadura within the ERA. Source: Own elaboration and SNCZI.

If we base our results on the Basic Planning Guidelines for Civil Protection against Flood Risks the results are of concern. The homes at extreme risk number 380, the majority of them situated in entirely urbanized areas (Fig. 5), although some are isolated. Given this predominance, vulnerability can only be reduced through mitigation actions (Perles et al., 2017; Pérez, 2011).

Thus, although the larger part of the homes in question is in an area of moderate risk (420 in the SRA and 683 in the LRA), a significant proportion of them (38.07%) are in areas of recurrence probabilities of 50 years or less.

In general terms, although some of the homes congregate to form housing groups, the vast majority are considered isolated homes (even those mentioned earlier), meaning almost none of them form part of what one in the strictest sense could consider an urban setting (no asphalt and no sewer systems).

4.2. Regulatory inconsistencies and risk management in land not apt for urban development

There are serious inconsistencies in the limits and borders of risk areas and the classification and urban planning of those areas. As shown

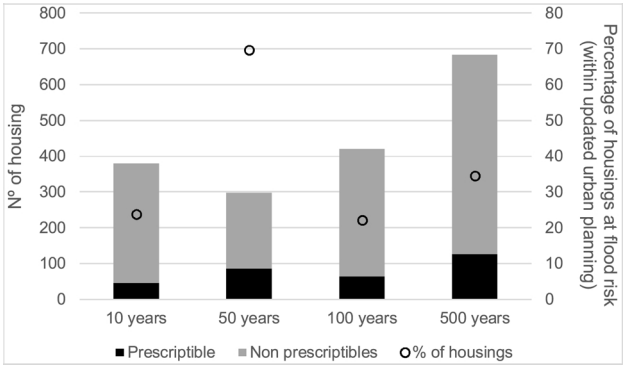

Fig. 6. Number of homes in flooding areas (according to imprescriptibility and time of recurrence) and percentage of homesteads in flood risk areas within townships with updated urban planning protocols. Source: Own elaboration.

in other recent papers, the role of Administration and territorial and urban planning in Spain is counterproductive in mitigating risks (López-Martínez et al., 2017; Sudmeier-Rieux et al., 2015).

In this fashion, even in townships where planning is adapted to urban legislation (and should be adapted to risk maps), the presence of homesteads in flood areas is still significant. The database reveals 23.91% of homes built in the ERA are in townships adapted to current urban legislation (Fig. 6). The percentage increases worryingly up to 69.77% in the case of the HRA, to decrease once more down to 22.22% in the SRA and 34.65% in the LRA. In absolute terms, this means 129 homes are at risk of flooding and are situated in townships with planning instruments that have been adapted and adjusted to current law.

The cross sectional analysis of the database listing land use classifications reveals that 4 out of 5 homes are in the protected LNAUP. If at an environmental level this data point were considered negative, it isn't from a legal standpoint. This means that buildings in this group classification do not adhere to law, the main consequence of which is that these homes are feasibly subject to legal persecution. On the other hand, a fair proportion of the homes in the common LNAUD have adhered to legal stipulations, making their demolition more difficult.

While on this point one must remember that within land not apt for urban planning, the main problem lies in designating a given area in a category that offers no protection when risks exist. In fact, there are 27 townships that due to the characteristics of the planning instruments (Urban Land Border Projects) cannot assign any protection measures from the instrument they employ. In those cases, they will out of necessity have to update their respective planning instruments (with the added difficulty of time and money this implies). As things stand, there are 148.44 km^2 classified as common LNAUD in all of Extremadura (distributed over 87 townships, 14.94% of which have a planning instrument adapted to current legislation), when in truth these areas should be classified as protected LNAUD.

And lastly, the logically unauthorized construction of housing in flood areas is subject to two exceptions in Extremadura (authorization in recurrence areas of 500 and 100 year periods respectively). This particular data point reinforces the fact that what is most important isn't so much the classification of land use, but the allowance of certain uses in determined areas.

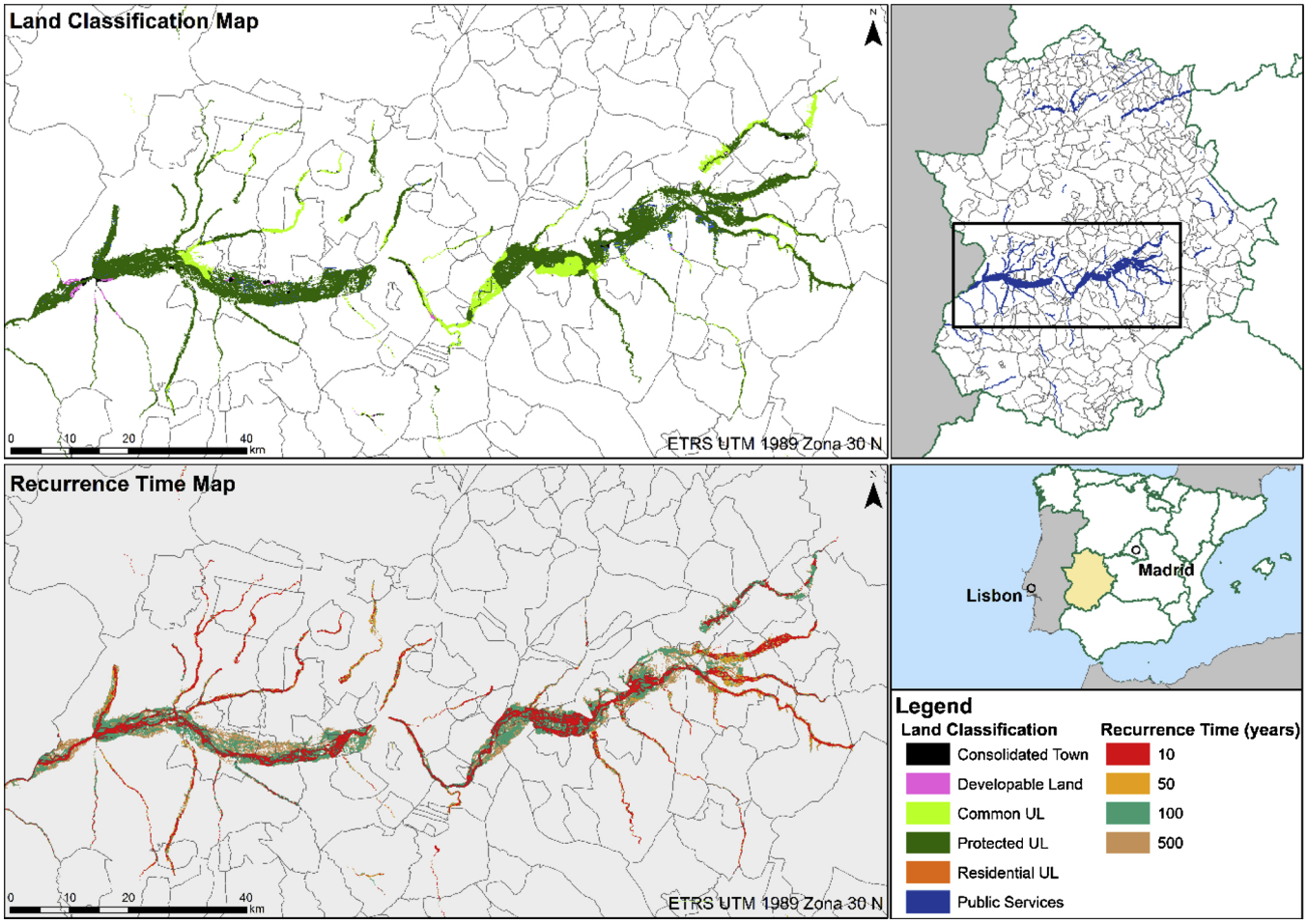

Fig. 7. Urban land classification in flood risk areas in the Guadiana river basin, and the classification of these areas according to flood recurrence. Source: Own elaboration and SNCZI.

4.3. Permissive present and future adoption of flood risks in urban nuclei

The data presented here only considers non-compact and irregular urban development in the LNAUD when in fact the risk of flooding also affects urban land in 65 townships. Areas of urban expansion in 19 townships (all of the part of the previous 65 townships) are affected equally. These last townships are little transformed with risks as yet quantitatively of no real consequence (scarce isolated homesteads), but potentially expandable. This is especially true of the Guadiana water basin (Fig. 7) with more a more dynamic urbanization such as the towns of Badajoz or Mérida, where urbanization and construction works are finished, but with no housing.

Superficial analysis focuses spatially on objectives of a risk prevention policy. Land with greater inconsistencies (in which ERA coincides with urban areas and urban development areas) occupying a total surface area of 2.63 km^2 distributed between 50 townships in Extremadura.

If we take into consideration all flood areas, consolidated urban areas exposed to the risk of flooding represent 9.41 km^2. These areas must undergo fundamental reorganization in so far as usage (Travassos, 2012), which implies their transmutation where homes are affected. With this assumption there are 35 townships where flooding can reach, at a minimum, 10 homesteads. In the remaining townships urban areas consist of green spaces and riverbanks, where there are hardly any buildings or construction.

In regards to the inconsistencies between future urban development and flood areas, the study revealed the existence of 7.04 km^2 of space at risk. Of the 19 townships with cases like this, 11 have not started urbanization or construction activities. Of the remaining 8 only the largest and most dynamic townships (Badajoz, provincial capital and Merida, autonomous capital) urban expansion areas are effectively urbanized (roadways and facilities) but there are no buildings. Construction in these areas is rara avis mainly due to the economic crisis that followed the real estate boom in Spain. In smaller townships this is added to the lack of demand due to a decrease in the population and emigration away from rural settings. Reclassification of these lands to protected LNAUD could be the most feasible solution, but it's a measure that should be made quickly to prevent urban transformation from consolidating and gaining living rights that complicate the situation.

5. Conclusions

Countryside urbanization official data does not clarify in the proper way the exposure to flood risk, nor the vulnerability to these events in Spain. The figures of the Administration are not exact in terms of the number of houses and their location. The results achieved in this work help to clear the risk equation in Extremadura. For the first time, thanks to this methodology, there is an exact figure that shows us the location and number of homes exposed. Also, this information coincides and matches with the literature by demonstrably proving that in this very same region bodies of water and their currents are an attractive element for building rural homesteads (Jeong et al., 2017), which could increase these problems, especially considering the climate variability present in Extremadura (Acero et al., 2017).

In any case, the importance of this phenomenon in the region is

more qualitative than quantitative. Yet, this does not mean "risk 0", since there are still several thousand people exposed to the risk. The cartography shows that the low significance of the numbers is due to the high building dispersion and its low density. This is a characteristic feature of the edification in land not apt for urban development in Extremadura. In addition, the incidence of phenomena will always be lower in environments such as this, where seasonal use and discontinuous use of homesteads predominates (Camarasa-Belmonte et al., 2011).

This work does not question the validity of SNZCI cartography but criticizes its lack of application. This is important, especially if we take into account that flood risks can not be monitored over time as in other risks associated with water (Rak and Pietrucha-Urbanik, 2019), since the consequences of the events are almost immediate. Despite the facilities (free accessible formats) readily available to apply the zoning criteria of SNCZI in urban and territorial planning, it has not happened. Their use has been denigrated and ignored as a key instrument in territorial and urban planning, aiding in determining the use of the land in question, and the corresponding activities (Bosque et al., 2005). Combating floods from planning, and not from mitigating policies, is a priority in Spain (Perles et al., 2018), which in Extremadura is not met. The results clearly show priority areas of action (coincidence between areas with flood risk and areas not protected by planning), whose legal situation must first be resolved in the planning instruments. In a special way, with greater strength and speed, the situation of ERA must be addressed, where 380 homes are seriously threatened. From the planning forecast must also come solutions for urbanized areas and urban expansion areas. Mainly in the latter, reclassifying these areas as land not apt for urban development is the most optimal solution, based in safety and low-cost reasons (Garrido et al., 2015).

In short, the regional government must apply the available tools (current legislation, SCNZI cartography and scientific results) and act against the expansion of risk and its consequences (with punitive measures and mitigation actions), taking on the more pressing stance of peer entities in Spain such as La Rioja, País Vasco or Cataluña (Godé, 2009).

Ultimately, to assume the risk implies a certain awareness of the nature and scale of the danger, while the normalization of such recklessness will sooner or later lead to failure. The novelty of this particular study is that, by building an accurate and complete cadastre of the construction present in flood areas injects value into the Ministerial maps on the probability of recurring floods. The study also sheds light on the dangers to human lives in Extremadura and insists on the value of manual and traditional techniques over automated technology. Although automation does generate savings in time, they also lose in reliability. The combination of a cadastre of housing construction and ministerial mapping begets precise information that locates and enumerates the risks. The following works should take advantage of the reliability of the data to request the application of urgent measures (especially risk mitigation policies) at specific points. This singular fact discloses the deficiencies in sectorial and urban planning, as well as push the pertinent authorities (regional government and the Ministry) to combat the risks.

Notes

1 According to INUNCAEX Extremadura recorded throughout the entire XX century 136 floods, which it examined for location, and concluded in a general manner that the Tajo water basin presents a slight risk of flooding (moderate in some of its tributaries such as the Jerte and Alagon rivers), a moderate risk in high plains and meadows of the Guadiana river, and high risk in the low plains and meadows of the Guadiana River.

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