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Risk urbanism, the principle of urban disasters and their prevention with geo-computerized systems, CDMX, Mexico

Urbanismo de riesgo, el principio de los desastres urbanos y su prevención con sistemas geoinformáticos, CDMX, México

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Abstract

The so-called urbanism of risk created the conditions for the inadequate urban planning in Mexico City (CDMX), which affects the populations established there. This term is little known today and should not be confused with urban risk. Nowadays, the incorrect urban configuration creates awareness in the inhabitants about the risks present in their lives, according to the impact of natural phenomena (hazards). It is important to understand that the effects of disasters in urban areas are derived from growth in places with unsuitable characteristics, due to the irregularity of the terrain. Risk is the result between hazard and vulnerability, which becomes urban risk when it affects the established population. The contribution of this article shows that the beginning of the adequate urban configuration based on geoinformatics systems will prevent risk urbanism in areas where there is no city growth yet. As a result, it is shown the crossing of variables provided by governmental institutions and real events occurred, according to floods, landslides, earthquakes and collapse of mined areas, using geoinformatics systems to show the municipalities with greater affectation, according to the existing urban risk, which can be replicated and attended in other parts of the country and the world, based on the management between government, academics and population, with the objective of preventing the creation of risk urbanism.

Keywords: planning; prevention; geoinformatics systems; risk urbanism.

Resumen
Esta investigación de corte cuantitativo tiene como objetivo conocer las dinámicas derivadas de la polarización del movimiento feminista en México desde una perspectiva de la comunicación y cultura digital. A partir del foro Aclaraciones necesarias sobre las categorías sexo y género, organizado por el Centro de Investigaciones Interdisciplinarias en Ciencias y Humanidades de la Universidad Nacional Autónoma de México (UNAM), el 24 de marzo de 2022, se tomó como objeto de estudio la participación en línea de las, los y les audiencias, haciendo un análisis de los comentarios en YouTube y Facebook al respecto, así como de los hashtags #UNAMFeminista y #UNAMSinTransfobia, en Twitter. Para ello, se empleó un repertorio de metodologías digitales para la investigación de contenidos generados en las plataformas de internet, como la minería de datos, el análisis de redes y el análisis de sentimientos de comentarios en las redes sociales digitales. Como parte de los resultados se da cuenta de los principales actores en la esfera pública digital que influyen en la polarización afectiva y en los riesgos de fenómenos comunicativos como los discursos de odio y discriminación. De esta forma, la presente investigación busca contribuir a los movimientos feministas desde la comunicación y cultura digital en México.

Palabras clave:
planificación; prevención; sistemas geoinformáticos; urbanismo del riesgo.

Introduction

The construction of cities and their housing in an appropriate manner, both in Mexico and in the world, requires urban planning, with the implementation of safe projections by specialists and constant supervision so that its development is correct and without risk problems. In several countries, urban planning is interpreted as the duly executed planning with the objective of building new urban centers, which promotes an adequate structuring of housing, buildings, corporations, parks, among others, with the purpose of establishing safety in cities (Real Academia Española, 2023).

It is important to understand that the term risk is manifested as the possible affectation to inhabitants according to the characteristics of the place where they initiate some type of occupation and urban development (Narváez et al., 2020); in addition, it is specified that, in the case of urban areas, the geographical component is of utmost importance. Therefore, it is necessary to consider the parts that make up this risk: hazard and vulnerability. In this sense, hazard is the possible affectation of a certain territory and can foresee serious damage to a certain population based on the existing geographic characteristics (López, 2021). Natural hazards (earthquakes, hurricanes, landslides, extreme rains, among others) are unavoidable factors that are still difficult to contain, since their growth increases risk when vulnerability is not prevented.

Vulnerability should be understood as the exposure to certain events that can be combined in the absence of tools for the protection of the population (Ochoa and Guzmán, 2020), and to specify that it is the only variable that can be reduced according to protection plans in urban areas in the face of possible natural phenomena.

Therefore, it is essential to control any risk variable that may affect certain communities in order to minimize vulnerability based on prompt attention (Navarro et al., 2020). Although it is currently impossible to control the hazard, it is possible to reduce the vulnerability aspect, thus reducing the risk.

By analyzing the above definitions and relating them, the term risk urbanism is unknown in terms of disasters in urban areas (Asociación Mexicana de Urbanistas, 2022) and it is observed that its study is encouraging for the elimination of risk in the future, based on the appropriate initial configuration in areas where there is still no urban growth, with the premise of avoiding disasters in cities and, thus, deaths among the population.

It is transcendental not to establish as synonyms the terms urban risk urbanism and urban risk, the latter only studies current risks in existing urban areas and their possible effects on the population. Urban risk tries to solve problems such as unregulated growth in areas with uninhabitable geographical aspects, environmental overexploitation, alteration of the terrain with construction materials, damage to housing, among others, which is increasingly common in various parts of Latin America and the world (Córdova and Vallejo, 2013).

Urban risk specifically focuses on applying protection measures in established and constantly growing urban areas, while risk urbanism encourages the inadequate beginning of development in urban areas with diverse risk characteristics, the above is encouraged by the lack of previous studies of the general geographic characteristics of the site for the occupation of cities.

Urbanism, examined as a city planning agent, does not establish any risk by building in geographically safe areas; however, the origin of risk urbanism begins to take place by building localities in sites at risk of floods, landslides, volcanic eruptions, mine collapse, among others.

Currently, urban risk in Mexico City (CDMX) , as well as in several state capitals in Mexico and in various parts of the world, is increasing, which complicates the establishment of short-term solutions. Therefore, the growing and ineffective solution so far is the forced relocation with the use of violence against the inhabitants, which only unleashes more problems than solutions, as it forges the reluctance to leave their heritage; therefore, it is necessary to make coordination plans between academics, government and population, always with the premise of raising awareness to avoid any degree of violence.

Background

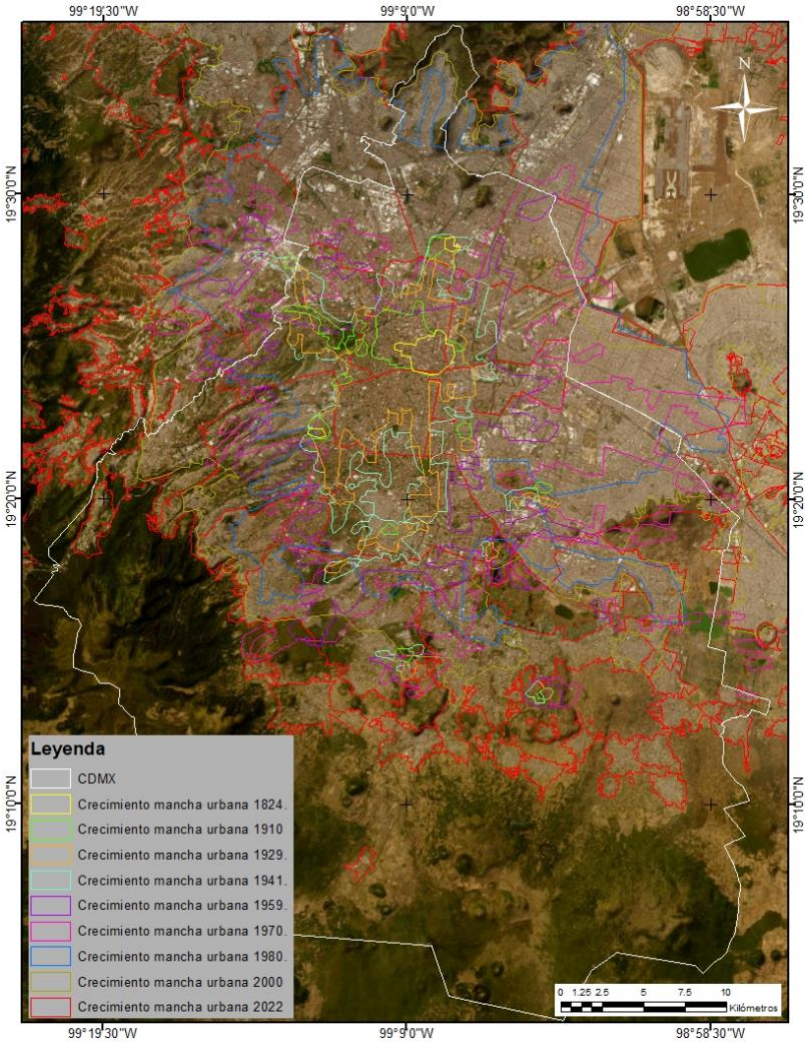
The beginning of urbanism in Mexico City (CDMX) was first implemented in areas with moderately safe characteristics (see map 1), with flat terrain and without slope complications; however, risk urbanism originated around 1959 and continues to grow, becoming over time by affectations derived from natural phenomena in urban risk.

Map 1 shows the construction and conversion of risk urbanism into urban risk in Mexico City (CDMX), due to settlements in places with highly risky characteristics; therefore, it is essential to know the possible effects based on the studies carried out in order to avoid the problems fostered by urban risk.

It is observed that between 1824 and 1959 in Mexico City (CDMX) there was no risk urbanism, construction increased only in the central part of Mexico City (CDMX) due to the low altitude and certain facilities for architectural construction. The urbanism of risk arose with the constructions in zones of medium risk around 1959 and up to the present time, omitting diverse geographic characteristics. Urban planning in Mexico City (CDMX) was limited in the first decades of the last century, which established over time a latent risk in various parts. Currently, it is necessary to organize models based on an integral evaluation considering natural and anthropic factors, with the objective of preventing disastrous events by incorporating urban restructuring plans (Rivera, 2022).

The indifference of the Mexican governmental apparatus in its three scales boosted growth without urban development management in Mexico City (CDMX), which is why there are several urban problems before the possibility of a disaster occurs. In response to these problems, one possibility is the implementation of geo-computerized systems that provide potential solutions in terms of the geographical characteristics of the site. Currently, the use of software makes it possible to have precise quantitative measurements, with which various levels of risk can be established.

Map 1. Urban growth in the CDMX



Source: by the author based on Basemap photointerpretation (ArcGis software).

Likewise, it is essential to establish direct contact with the population in order to implement empirical work with the objective of reinforcing the results obtained from mapping based on geoinformatic systems, with the premise of being more accurate in the results and possible executions of urban planning and reorganization.

The existing theoretical and research component that lies in the urbanism of risk is fundamental, since understanding it and knowing the possible segmented solutions, with the purpose of gathering them, encourages protection in the inhabitants with the establishment at all times of geoinformatic and empirical work, with which reliable results are obtained for its applicability.

Theoretical framework

Disaster risk prevention is vital and should permanently establish a culture of prevention from basic education levels and thereby reduce risks (Vázquez et al., 2017), with the aim that the current student body understands the various effects of natural phenomena in urban or rural areas, establishing a culture of prevention and not just repairing the damage.

In order to educate the population about the real effects of disasters, it should be considered that the information be thoroughly explained to students at basic levels, so that it is replicated among their families and they know the possible effects in the short term; likewise, this child population should be the ones to establish risk management measures in the future. Adequate urban planning must be built with the objective of permanently eliminating the beginning of risk urbanism, as this will allow the path towards the safe construction of cities, which will result in citizens having a true right to a dignified and adequate locality, where safe and resilient spaces are generated and propagated, respecting at all times the geographical characteristics of the place (Rojas et al., 2022).

The elimination of risk urbanism based on the structuring plans in the cities where urban development is being established is the first step towards safety, since year after year there are deaths among the population due to various effects of disasters. This could be eliminated with the construction of buildings and housing in geographically safe places, according to geomorphological, geological, geophysical, hydrographical, edaphological, and other features.

The use of geoinformatics systems and linkage with protection strategies in the inhabitants established in risky urban areas is every day more useful and accurate, their contribution in various social sciences (archeology, sociology, geography, urban planning and economics) constitutes possible solutions establishing multidisciplinarity, interdisciplinarity and transdisciplinarity (Radicelli et al., 2019). The contribution of these systems can occur in the quantitative and qualitative field, since, by establishing a precise mapping of the study area, they can perform a cross-referencing of information generated from the geography of the place with aspects and variables used by areas such as sociology, social work or psychology, in addition to other elements that can be mapped.

The temporal and spatial precision obtained from geoinformatic systems is of great contribution, since, being stored in digital format, its processing is beneficial for its later consultation and permanent improvement (Flores, 2004); therefore, it is important to adequately establish parameters that will be used as information for the object of study, with the premise that the result granted is true and accurate.

For the above, it is important to use information obtained from geo- computer software, whose implementation has grown exponentially in recent years; as an example, these software were used in various scientific articles for territorial information (Juarez, 2018), landslides (Aceves et al., 2016), floodable areas (Esparza, 2019), housing projects (Cuervo, 2015), agriculture and crops (Perez et al., 2019), among others, pointing out that in these investigations different methodologies were used according to the existing problems.

The understanding of the difference between risk urbanism and urban risk is evident, however their connection is also unquestionable, since without the existence of risk urbanism the coexistence of urban risk is not possible; that is why geoinformatics technology, together with various quantitative and qualitative research methods, will establish solutions to various affectations before possible risks in urban areas, with the objective of avoiding urban disasters and, therefore, deaths in the population.

Urban disasters in Mexico

Various affectations in urban areas derived from risks have diminished the tranquility of their inhabitants, events that occur more frequently and with a high degree of devastation, which can generate losses of patrimony and even the lives of the inhabitants. Various urban risk methods are implemented based on geo- computing techniques; however, their use in reality is still complicated, since various natural events continue to occur. The following are some examples of recent news reports that have occurred in various states of Mexico.

> In the capital of Jalisco, a storm can mean a series of tragedies due to the floods that occur in at least 500 points of the urban basins that integrate the municipalities of the metropolitan area of Guadalajara. This was made known by the research professor of the Department of Geography and Territorial Planning of the University Center for Social Sciences and Humanities (CUCSH), Luis Valdivia Ornelas, creator of the Flood Risk Atlas, which in the last four years increased 100 points of risk (Serrano, 2022, p. 1).

The above news reveals the serious problem of flooding in urban areas in Jalisco, which is a matter of concern for the metropolitan area of Guadalajara. It is observed that the establishment and growth of risk urbanism is behind and procedures and urban risk analysis are now established, so it is convenient to implement preventive and not only corrective work, based on models generated through geo-computer systems.

> Pachuca's Local Ordinance Program establishes that on average 17 neighborhoods and colonies maintain medium-high susceptibility and 12 are considered at high risk of facing landslides due to landslides of loose, stony and/or earthy material, because they are located near areas with steep slopes and with that problem, so they should be monitored (Garmez, 2021, p. 1).

Therefore, it is important to avoid the construction of risk urbanism. As an example, it happens the inadequate implementation in the state of Hidalgo, resulting in possible landslides that grow due to the current construction of homes in areas with pronounced orographic characteristics.

"Guerrero has reported abandoned communities and more than three thousand homes affected after the 7.1 earthquake that occurred on September 7. Several municipalities in the state were damaged and the number is expected to increase as the days go by" (Trujillo and Esteban, 2021, p. 1). Every year, the events in Guerrero have repercussions on the well-being of the population. These telluric events are mainly due to the seismic location of the coconut plate under the state, encouraging urban planning to be urgently reconfigured and should have been managed from the beginning to eliminate the establishment of urbanism of risk.

> Researchers from the Geophysics Institute of the National Autonomous University of Mexico (UNAM) designed a risk map that documents the areas affected by lava, pyroclastic flows, ash and mudflows. The entities most affected by incandescent material and even landslides are: Puebla, Morelos, State of Mexico, which are located in the vicinity of Popocatepetl. Ash fall is also expected in Mexico City and Tlaxcala (Infobae, 2019, p. 1).

The risk of a possible eruption experienced by the inhabitants of the State of Mexico, Puebla and Morelos in the areas near the Popocatepetl volcano is shared, since the volcano is located on the perimeter of their states. The construction of risk urbanism with the arrival of the construction of monasteries in 1525 (Villanueva, 2016) potentiated the urban growth of the area, hence the current growing and uncontrolled risk on the slopes of the Popocatépetl volcano.

With the previous sample of affectations by various natural events in some states of the Mexican Republic in recent years, it is observed that the risk is evident and growing in different urban regions, with which it is understood that the urbanism of risk was not managed from the beginning, and that has caused to the populations affectations that are currently minimally resolved.

Urban disasters in Mexico City (CDMX)

Mexico City (CDMX) is one of the places in the world with urban elements that grow day by day and affect the distribution and security of the city. As a result of the above, the problems are so evident

that numerous events directly affect the population, which are suffered and noticed in a normal way, becoming accustomed to the permanent risk, which leads to affectations in certain urban areas in the capital of the country.

As a result, the expansion of the city was so immense that the population built their property in ravines susceptible to landslides, flooding areas, mined areas, among others, in order to build their property, even if the characteristics of the site were unsafe. The following is journalistic data showing various problems related to urban disasters in some municipalities of Mexico City (CDMX).

On September 15, 2020, a heavy rain occurred in the municipality of Iztapalapa, which affected some homes and damaged approximately 457 properties, in addition to the death of two people (Capital 21, 2020). It can be observed that floods due to rainfall affect the whole of Mexico City (CDMX), without forgetting that the same metropolis was established in an ancient endorheic basin, thus omitting its geographical characteristics (General Directorate for the Dissemination of Science, 2016); therefore, the risk urbanism established in this municipality generated the damages that have occurred and that are still being reported today (see photograph 1).

Photograph 1. Houses damaged by the rains in Mexico City (CDMX)

Source: Capital 2021 (2020).

Likewise, in the municipality of Gustavo A. Madero, on September 10, 2021, there was a landslide that left the death of one person and several houses established in unsafe areas (García, 2021). This problem was replicated in other parts of the municipality and even in other parts of Mexico City (CDMX), due to the geomorphological composition and edaphology combined with the slope, which creates a latent urban risk for the inhabitants (see photograph 2).

Another urban disaster affectation occurred in Mexico City (CDMX) happened on September 19, 2017, an earthquake of magnitude 7.1 caused more than 300 deaths in the southern states including Mexico City (CDMX), establishing economic losses estimated at 40 billion pesos (Ledezma, 2021).

Photograph 2. Landslide in Cerro del Chiquihuite, Gustavo A. Madero municipality.

Source: García (2021).

The catastrophe that occurred during and after the earthquake was enhanced by the inadequate urban structuring and omission of the growth of risk urbanism, which affected the Benito Juarez district to a greater extent. It was specified that there were also serious affectations in other neighborhoods according to the geographical characteristics of the territory, such as constructions in places with high slopes and highly unsafe geological and edaphological characteristics (Escolero et al., 2015), which are not suitable for construction (see photograph 3).

Photograph 3. Consequences of the earthquake of September 19, 2017.

Source: Ledezma (2021).

Finally, the problem of mine roof collapse in Mexico City (CDMX) is a latent and growing urban risk, remembering that several areas of Mexico City (CDMX) were excavated, and the extracted material was used for the construction of buildings in the downtown area of the city (López, 2022).

The total number of existing mines in various municipalities of Mexico City (CDMX) is still unknown; however, some studies on geotechnical risks in current housing establish that not all currently urbanized areas are safe due to various geological risks (AN Ingenieros y Consultores, 2020) (see photograph 4).

Based on the analysis of the above information (see map 2), the following shows the main impacts that have occurred in different areas of Mexico City, with the objective of observing the heterogeneity of the urban risk problem as a result of the opening generated by the urbanism of risk, a problem that is multiplying in different places in Mexico and the world.

Methodology

The work carried out with geo-computerized systems helped to establish and understand various problems related to urban risk in Mexico City (CDMX), and also helped to compare information from various public institutions in Mexico responsible for compiling data on prevention and protection in the event of disasters in urban areas.

The information used by the National Center for Disaster Prevention (Cenapred) and the National Commission for the Knowledge and Use of Biodiversity (Conabio) was a great contribution to the visualization of each of the existing variables in Mexico City mentioned throughout the manuscript, so it was important to work with these data in order to observe the current existing urban risk, data stored by the federal government apparatus, which are visible on the Internet for public and free consultation. First, information was downloaded in kml format (Cenapred, 2023), then it was

converted into shape format in the ArcMap geoinformatics system, in order to visualize and map it. Likewise, information in shape format was downloaded from Conabio, with the objective of showing that the information from these two governmental institutions is beneficial for the display of possible solutions to urban risk. It is important to point out that the conversion from kml to shape format was performed in the ArcMap system toolbox, withinthe Conversion tools option (from kml, kml to layer).

Photograph 4. Mines at risk of collapse in the Álvaro Obregón and Miguel Hidalgo municipalities.

Source: Ledezma (2021).

In summary, the methodology implemented gathered several important geographical characteristics at the time of determining certain existing and growing urban risks due to the omission of the beginning of risk urbanism, which are presented in the results section of this manuscript, with the objective of establishing safe cities in the future based on the characteristics of the terrain and showing the habitable and non-habitable zones, depending on the existing risk level.

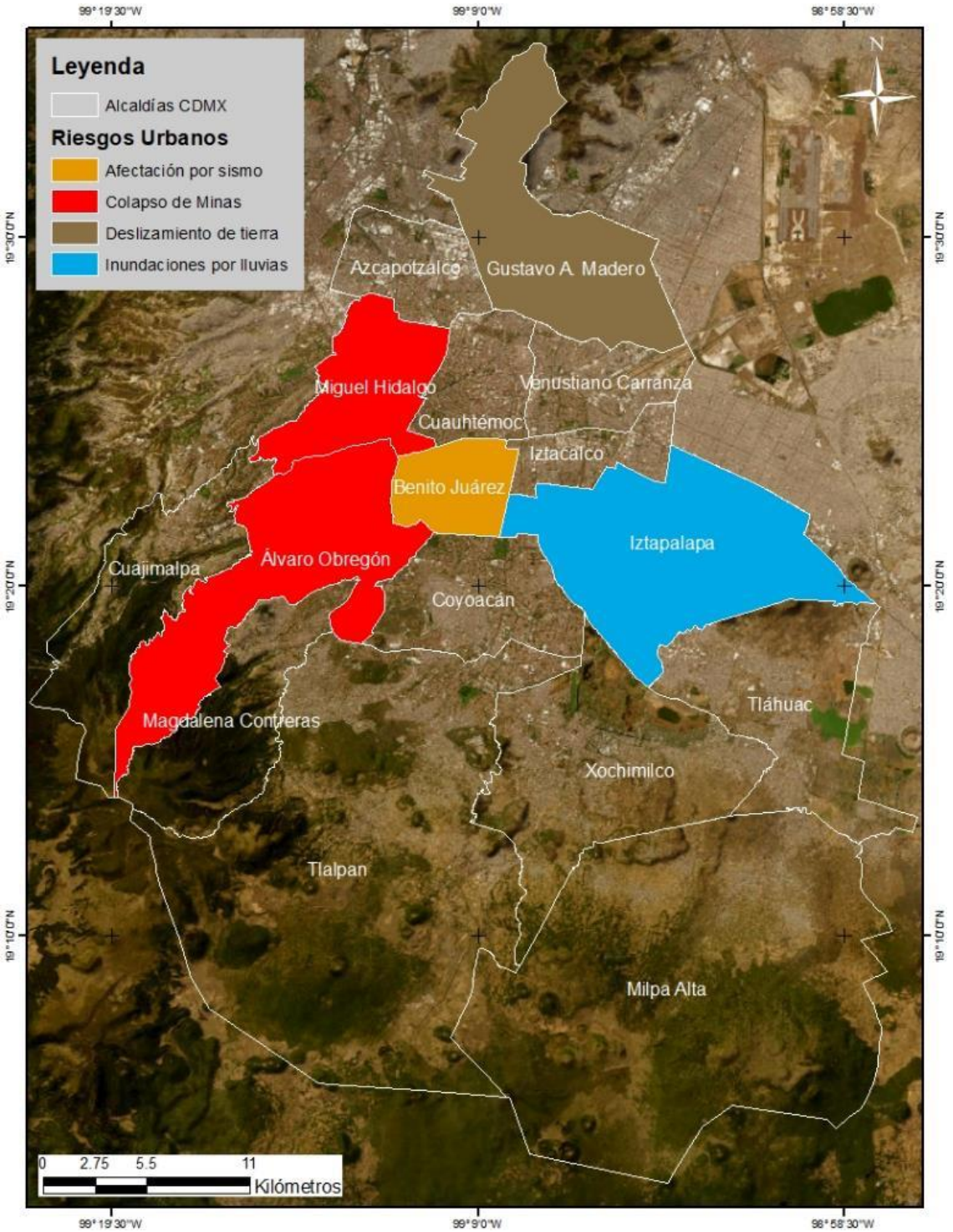
Results

First off, the map on the flood vulnerability index at the mayoral level (Cenapred, 2023) was obtained, where the main affected areas were shown based on the cases of flooding. This information was then crossed with urban risk data (see map 3), in order to understand the risk level of the analyzed areas and the possible damage according to its consequences.

It is important to point out that the soil degradation variable was used in map 4, since landslides potentiate this parameter. For a better understanding, an explanation of soil erosion and damage to urban infrastructure is shared below:

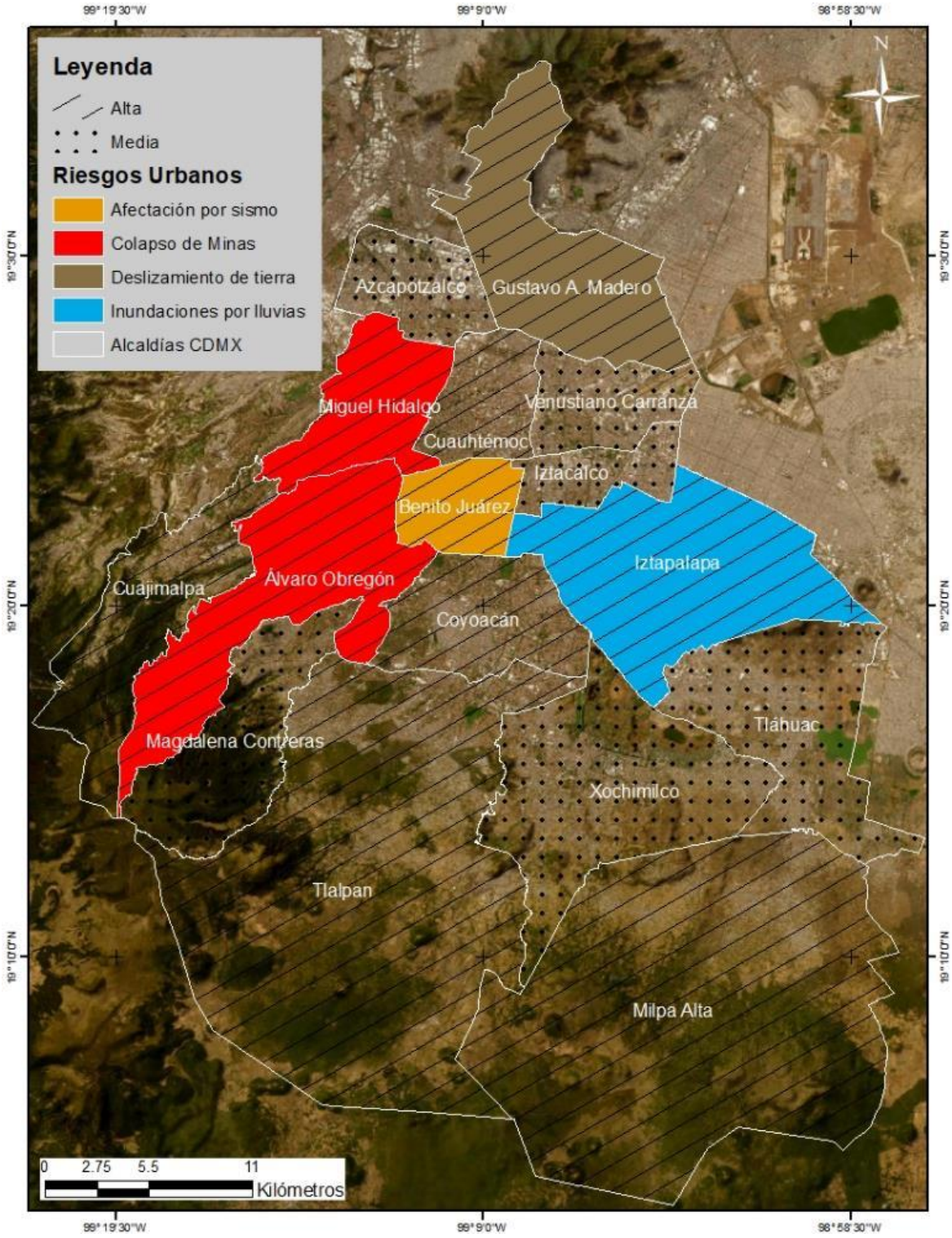
> When soil is not held in place by plant roots, it can be easily washed away by wind or water. As a result, loose and eroded soil can make floods, landslides and hurricane-force winds more intense. These natural disasters not only destroy farms but can also damage urban infrastructure that provides vital services to city dwellers (Food and Agriculture Organization of the United Nations, 2019, p. 1).

Map 2. Affectations in the CDMX due to various urban risks.



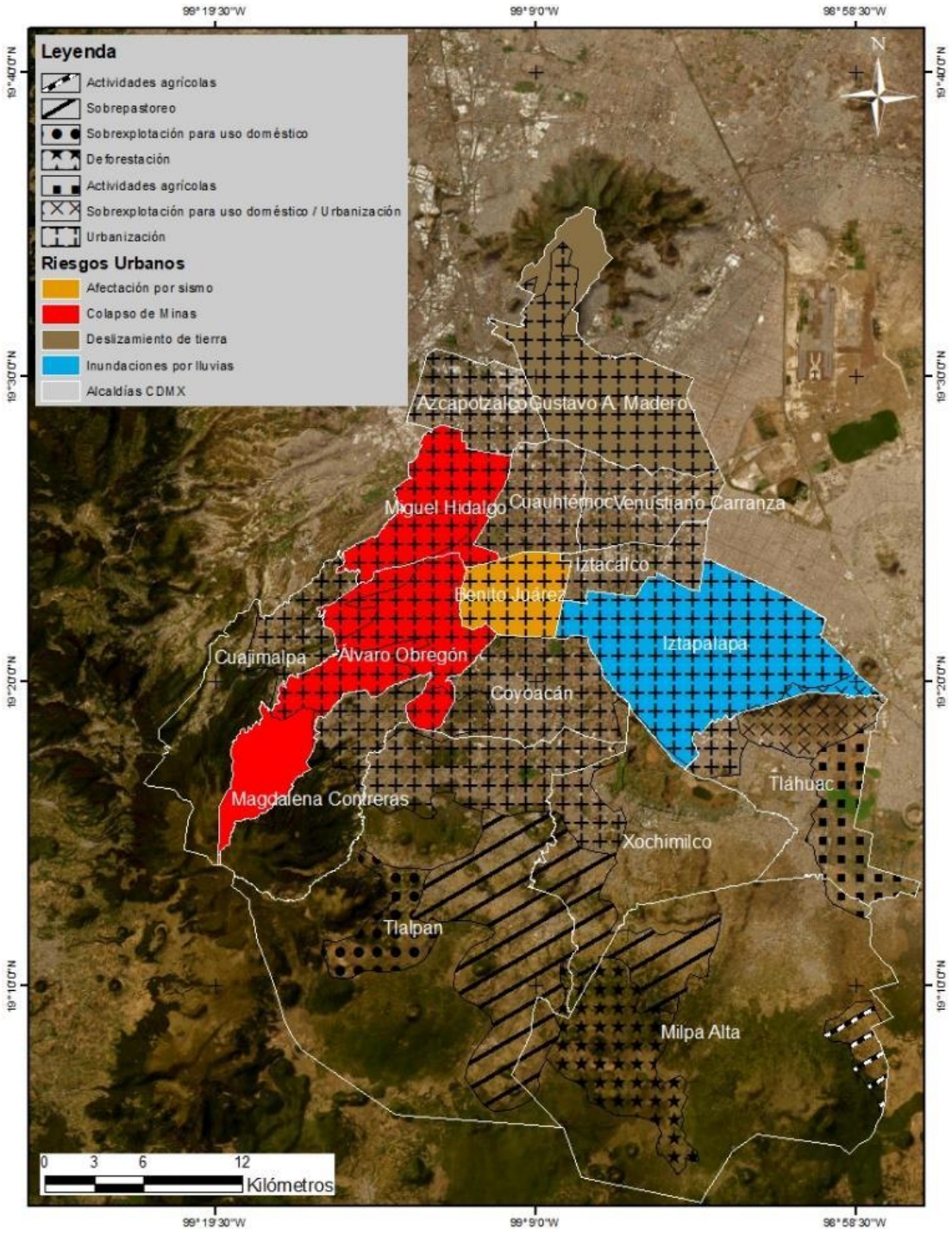
Source: own elaboration based on journalistic reports.

Map 3. Flood Vulnerability Index in CDMX



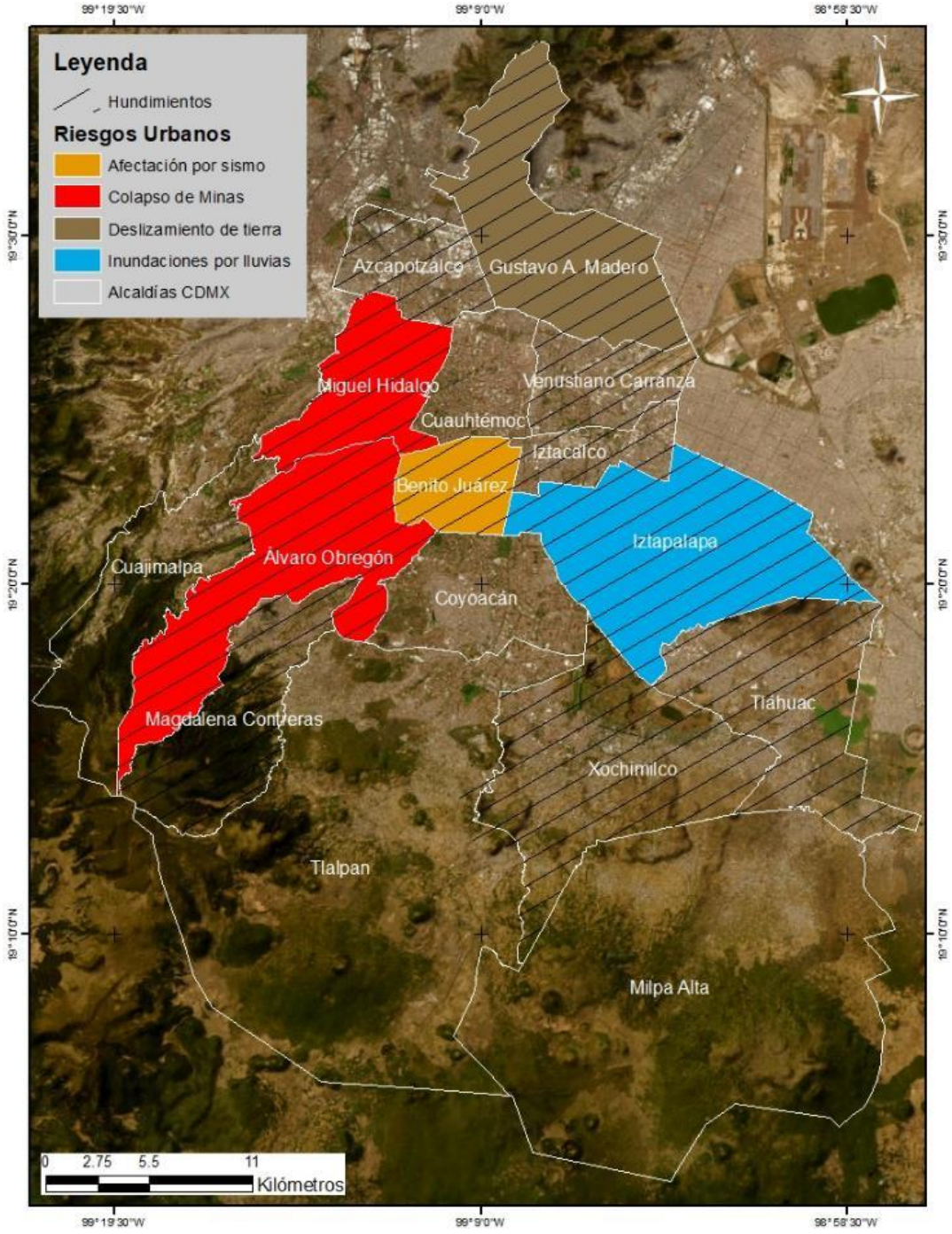
Source: by the authors based on data from Cenapred, 2023.

Map 4. Soil degradation in the CDMX



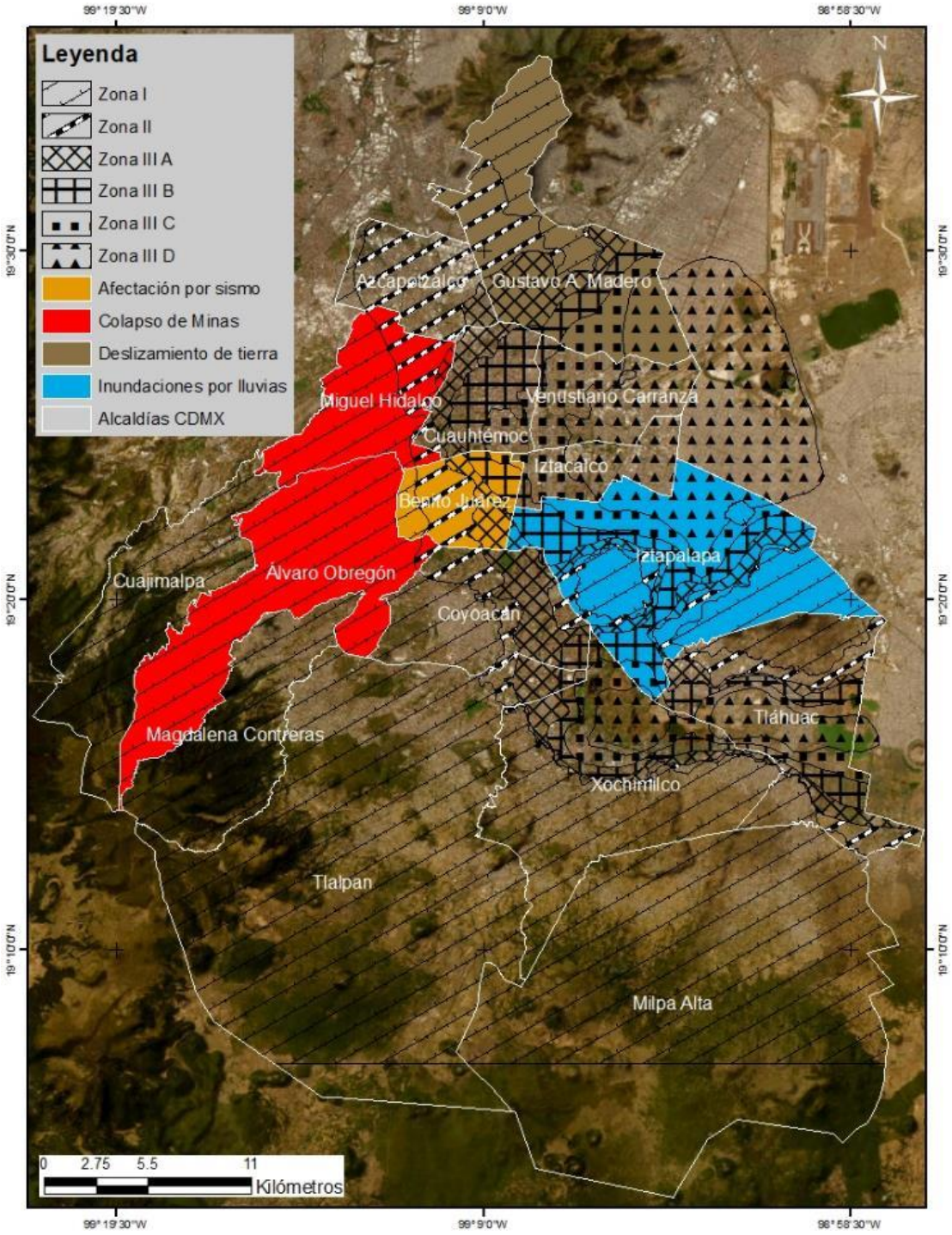
Source: by the authors based on data from Conabio, 2022.

Map 5. Seismic zones in the CDMX



Source: by the authors based on data from Cenapred, 2023.

Map 6. Sinkholes in the CDMX



Source: by the authors based on data from Cenapred, 2023.

To complement the above quote, the degradation index was used to interpret the final data with the purpose of being mostly accurate in implementing them in possible urban reconfigurations according to the level of urban risk identified.

Subsequently, the third map on the main seismic zones of Mexico City (CDMX) (Cenapred, 2023) was obtained, in which the main affected areas are observed based on the previous earthquakes, inserting the urban risk data with the objective of visualizing the serious danger existing in these zones (see map 5). Finally, the subsidence map was obtained (Cenapred, 2023), whose elements were used to observe the level of possible affectation based on the crossing of information with the urban risk aspect (see map 6).

The result and intersection of the data obtained in each of the previous maps reveals the immense current problem of existing urban risk according to the affectations in these municipalities, which were omitted since the beginning of the implementation of risk urbanism in Mexico City (CDMX).

Discusion

In summary, after gathering the above cartographic information, it can be seen that in the flood vulnerability index map according to Cenapred (see map 3), in addition to the floods that have recently occurred (see photograph 1), Iztapalapa is the municipality with the highest urban risk to flooding.

However, the municipalities of Benito Juárez, Álvaro Obregón, Miguel Hidalgo, Milpa Alta, Tlalpan, Coyoacán, Cuajimalpa, Cuauhtémoc and Gustavo A. Madero have a medium-high risk, without forgetting that floods in Mexico City (CDMX) are due to various factors, currently potentiated by climate change, coupled with minimal maintenance to the hydraulic infrastructure, in addition to the collapse of the deep and semi-deep drainage network due to high volumes of garbage (González, 2017).

In the case of the map of soil degradation in Mexico City (CDMX) according to Conabio (see map 4) and recent landslides (see photograph 2), it can be seen that the municipality of Gustavo A. Madero is the one with the greatest urban risk in terms of possible landslides. The municipalities of Azcapotzalco, Miguel Hidalgo, Álvaro Obregón, Benito Juárez, Cuauhtémoc, Venustiano Carranza, Iztacalco, Coyoacán and Iztapalapa also have levels of risk for possible future geomorphological effects, elements that serve to establish possible consensual relocations with the objective of protecting the population.

On the other hand, the variable of seismic zones granted by Cenapred (see map 5) specifies that, of the three areas, the third one is the most affected by a possible seismic movement, reinforcing the previous information with the following textual quotation from the Mexican Geological Service:

- Firm or hilly zone I: located in the highest parts of the valley basin, it is formed by highly resistant and not very compressible soils.
- Zone II or transition zone: has intermediate characteristics between zones I and III.
- Zone III or Lake Zone: located in the regions where lakes were formerly found (Lake Texcoco, Lake Xochimilco). The soil type consists of very soft and compressible lake deposits with high water contents, which favors the amplification of seismic waves (Servicio Geológico Mexicano, 2017, p. 1).

In addition to the above, it is important to mention that from the earthquakes that have occurred in recent years (see photograph 3), the municipality of Benito Juarez has a latent and permanent urban risk to various earthquakes of different magnitudes according to the seismic zone where it is located; it is worth mentioning that the municipality of Iztapalapa suffers from the same problem to a lesser extent, although on a constant basis.

Finally, in the case of subsidence mapped by Cenapred (see map 6) and those that occurred recently due to the collapse of mine roofs (see photograph 4), Iztapalapa is the municipality with the highest urban risk of all the municipalities examined; Similarly, Benito Juárez, Álvaro Obregón, Miguel Hidalgo, Xochimilco, Tláhuac, Iztacalco, Venustiano Carranza, Gustavo A. Madero, Magdalena Contreras, Magdalena Contreras and Tláhuac have some degree of urban risk. Madero, Magdalena Contreras and Azcapotzalco, although to a lesser extent.

Conclusions

When performing an in-depth analysis, the incorporation of geo-computing systems in possible solutions to urban disasters is fundamental; however, the cancellation of risk urbanism with the incorporation of geo-computing software with the objective of prevention is a determining factor in order to avoid damages in various cities around the world.

The demand for anthropogenic services is increasingly constant; therefore, urban planning must be properly implemented in order to avoid establishing risk urbanism, since the coordination between academics, private initiative, government and population seeks to populate urban areas that have safe characteristics for the growth of cities.

The omission and indifference of the governmental apparatus in the face of the reluctant establishment of risk urbanism by the inhabitants must be eradicated, since several people settle in areas without taking into account the geographic characteristics of the place according to their needs, without glimpsing a possible latent urban risk. In spite of the fact that people observe evident risks, they generate the same omission of geographic characteristics of the site for the need to establish their patrimony.

The contribution of the use of geo-computing systems aims to avoid the beginning of risk urbanism in the construction of new cities, knowing to a greater extent the geographical characteristics of the terrain, taking as an example what happens in Mexico City (CDMX) and in various parts of the world, where risk urbanism became urban risk, which, being physically established, permanently conceives floods, collapse of mine roofs, earthquakes, landslides, among others, and which can cause deaths, loss of property or even psychological effects, This risk, being physically established, permanently conceives floods, collapse of mine roofs, earthquakes, landslides, among others, which can cause deaths, loss of property or even psychological effects due to the devastation that could have been avoided by eliminating risk urbanism in areas with unsafe and risky geographic characteristics.

REFERENCES

Aceves, J.; Legorreta, G.; Lugo, J.; Umaña, J. & Legorreta, H. (2016). Sistemas de información geográfica y cartografía geomorfológica aplicados al inventario de deslizamientos y cartografía de susceptibilidad en la cuenca del río El Estado, Pico de Orizaba, México. *Investigaciones geográficas*, (91), 43-55. https://doi.org/10.14350/rig.46503

AN Ingenieros & Consultores. (2020). *Los riesgos geotécnicos para las edificaciones en la Ciudad de México*. AN Ingenieros y Consultores. https://www.anic.com.mx/post/los-riesgos-geot%C3%A9cnicos-para-las-edificaciones-en-la-ciudad-de-m%C3%A9xico

Asociación Mexicana de Urbanistas. (26 de diciembre de 2022). Urbanismo de riesgo, el comienzo de desastres urbanos en la CDMX. *El Universal*. https://www.eluniversal.com.mx/opinion/asociacion-mexicana-de-urbanistas-ac/urbanismo-de-riesgo-el-comienzo-de-desastres-urbanos-en-la-cdmx

Centro Nacional de Prevención de Desastres (Cenapred). (2023). *Portal Atlas nacional de riesgos fenómenos*. http://www.atlasnacionalderiesgos.gob.mx/portal/fenomenos/

Capital 21. (2020). Dejan lluvias en CDMX 466 casas con daños; mueren dos. *Capital 21*. https://www.capital21.cdmx.gob.mx/noticias/?p=2381

Comisión Nacional para el Conocimiento y Uso de la Biodiversidad (Conabio). (2022). *Portal de geoinformación 2022*, Sistema Nacional de Información sobre Biodiversidad.

http://www.conabio.gob.mx/informacion/gis/?vns=gis_root/edafo/dsuelo/degra250kgw

Córdova, M. & Vallejo, A. (2013). Riesgos urbanos en América Latina. Letras Verdes. *Revista Latinoamericana de Estudios Socioambientales*, (11), 1-3. https://doi.org/10.17141/letrasverdes.11.2012.912

Cuervo, I. (2015). Metodología de la información georreferenciada en vivienda informal: proyecto habitacional Nuevo Sol de Oriente Medellín. *Repositorio institucional Universidad Nacional de Colombia*. https://repositorio.unal.edu.co/handle/unal/55624

Dirección General de Divulgación de la Ciencia (DGDC). (2016). *La UNAM te explica: la historia hidrológica de la cuenca de México*. https://www.fundacionunam.org.mx/ecopuma/la-unam-te-explica-la-historia-hidrologica-de-la-cuenca-de-mexico/

Escolero, O.; Morales, E. & Arce, J. (2015). Geología del Valle de México. Boletín de la Sociedad *Geológica Mexicana*, *67*(2), 1-2. http://www.scielo.org.mx/scielo.php?script=sci_arttext&pid=S1405-33222015000200001&lng=es&tlng=es

Esparza, J. (2019). Identificación y análisis de áreas inundables a partir de una metodología de integración de escalas espaciales. Caso de estudio: La Plata, Buenos Aires, Argentina. *Cuaderno Urbano*, 27. https://revistas.unne.edu.ar/index.php/crn/article/view/4122/3757

Flores, E. (2004). Geoinformática e investigación geográfica situación actual y perspectiva. *Revista Forestal Latinoamericana*, *19*(2), 59-81. http://www.saber.ula.ve/handle/123456789/24105

García, U. (11 de septiembre de 2021). Se registra un deslizamiento de tierra en Cerro del Chiquihuite. *Meteored*. https://www.meteored.mx/noticias/actualidad/deslizamiento-de-tierra-del-cerro-del-chiquihuite-un-riesgo-latente-derrumbes-geologia-valle-de-mexico.html

Garmez, A. (21 de diciembre de 2021). En Pachuca, 29 colonias tienen riesgo de deslave. *Criterio*. https://criteriohidalgo.com/noticias/pachuca-29-colonias-riesgo-deslave

González, J. (6 de junio de 2017). ¿Por qué siempre se inunda la Ciudad de México? *Nación321*. https://www.nacion321.com/ciudadanos/por-que-siempre-se-inunda-la-ciudad-de-mexico

Infobae. (2019). Volcán Popocatépetl: el mapa de zonas de riesgo en caso de erupción. *Infobae*. https://www.infobae.com/america/mexico/2019/03/29/volcan-popocatepetl-el-mapa-de-riesgos-en-caso-de-erupcion/

Juárez, A. (2018). Metodología para la elaboración digital de mapas: caso Volcán Nevado de Toluca. Quivera. *Revista de Estudios Territoriales*, *20*(2), 103-115. https://www.redalyc.org/articulo.oa?id=40158030010

Ledezma, H. (2021). Consecuencias del sismo del 19 de septiembre de 2017. ¿Cuáles fueron? *Unión CDMX*. https://www.unioncdmx.mx/2021/09/18/consecuencias-del-sismo-del-19-de-septiembre-de-2017-cuales-fueron/

López, I. (2021). *Amenaza, vulnerabilidad, riesgo y estrategias*. Universidad Nacional de La Plata. http://sedici.unlp.edu.ar/handle/10915/122245

López, J. (10 de julio de 2022). Minas, en riesgo de colapso súbito en las alcaldías Álvaro Obregón y Miguel Hidalgo. *Excelsior*. https://www.excelsior.com.mx/comunidad/minas-en-riesgo-de-colapso-subito-en-las-alcaldias-alvaro-obregon-y-miguel-hidalgo/1525814

Narváez, I.; Durán, G.; Menoscal, J. & Bayón, M. (2020). Espacio urbano periférico y la construcción social del riesgo en ciudades intermedias. *Cuadernos de Vivienda y Urbanismo*, 13. https://doi.org/10.11144/Javeriana.cvu13.eupc

Navarro, D.; Vallejo, I. & Navarro, M. (2020). Análisis de la vulnerabilidad social a los riesgos naturales mediante técnicas estadísticas multivariantes. *Investigaciones Geográficas*, (74), 29-49. https://doi.org/10.14198/INGEO2020.NVN

Ochoa, J. & Guzmán, A. (2020). La vulnerabilidad urbana y su caracterización socio-espacial. *Revista Legado de Arquitectura y Diseño*, 15(27). https://www.redalyc.org/articulo.oa?id=477963263004

Organización de las Naciones Unidas para la Alimentación y Agricultura (ONUAA). (2019). *Detengamos la erosión del suelo para garantizar la seguridad alimentaria en el futuro*. https://www.fao.org/fao-stories/article/es/c/1193735/#:~:text=La%20erosi%C3%B3n%20del%20suelo%20da%C3%B1a%20las%20infraestructuras%20urbanas&text=Como%20resultado%2C%20el%20suelo%20suelto,vientos%20huracanados%20sean%20m%C3%A1s%20intensos

Pérez, C.; Pérez, J., Hernández, L.; Gustabello, R. & Becerra, E. (2019). Sistema de Información Geográfica para la agricultura cañera en la provincia de Villa Clara. *Revista Cubana de Ciencias Informáticas*, *13*(2), 30-46. http://scielo.sld.cu/scielo.php?script=sci_arttext&pid=S2227-18992019000200030&lng=es&tlng=es

Radicelli, C.; Pomboza, M.; Villacrés, C. & Bodero, E. (2019). Sistemas de información geográfica y su aplicación en las ciencias sociales: Una revisión bibliográfica. *Chakiñan, Revista de Ciencias Sociales y Humanidades*, (8), 93-104. https://doi.org/10.37135/chk.002.08.02

Real Academia Española. (2023). Diccionario de la lengua española, 23.ª ed., [versión 23.6 en línea]. https://dle.rae.es

Rivera, O. (2022). Transformación urbana-ambiental y riesgo de deslizamientos de tierra en el patrimonio arquitectónico no permitido, Área Natural Protegida La Loma, Álvaro Obregón, México. *Revista Geográfica Digital*, *19*(37), 102-112. https://revistas.unne.edu.ar/index.php/geo/article/view/5865/5665

Rojas, A.; Chung, P. & Correa, D. (2022). Servicios urbanos para la construcción de resiliencia en los espacios públicos de tipo abierto en México. *Vivienda y Comunidades Sustentables,* (11), 23-49. https://doi.org/10.32870/rvcs.v0i11.178

Serrano, I. (2022). Crece a 500 los puntos de inundación en Área Metropolitana de Guadalajara. Portal UDG. https://www.udg.mx/es/noticia/crece-500-los-puntos-de-inundacion-en-area-metropolitana-de-guadalajara

Servicio Geológico Mexicano. (2017). Sismología de México. https://www.sgm.gob.mx/Web/MuseoVirtual/Riesgos-geologicos/Sismologia-de-Mexico.html

Trujillo, J. & Esteban, R. (10 de septiembre de 2021). Casas y comunidades abandonadas: los daños que dejó el sismo en Guerrero. Milenio. https://www.milenio.com/estados/guerrero-asi-fueron-los-danos-por-el-sismo-en-casas-y-comunidades

Vázquez, M.; Rodríguez, D.; Ortiz, N.; Olivera, L.; Grillo, J. & Bécquer, T. (2017). La prevención del riesgo de desastres en la comunidad. *Revista Médica Electrónica, 39*(5), 1022-1032. http://scielo.sld.cu/scielo.php?script=sci_arttext&pid=S1684-18242017000500002&lng=es&tlng=es

Villanueva, A. (2016). Primeros monasterios del siglo XVI en las laderas del Popocatépetl Morelos y Puebla (México). *Viaje al patrimonio.*

https://viajealpatrimonio.com/listing/primeros-monasterios-del-siglo-xvi-en-las-laderas-del-popocatepetl/

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