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Integration of a Geodecisional Information System in the CATNAT Insurance Sector to Improve Urban Resilience to Flood Risk in the City of Batna (North East – Algeria)

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Abstract

The concept of urban resilience is linked to the paradigm of sustainable urban development. Resilience is a way of thinking about the continuation or adaptation of urban territory during the occurrence of a major risk or associated disaster. The CatNat insurance sector plays an important role in improving urban resilience to flood risk by informing citizens about the level of risk, the development of the risk culture among insured persons and the contribution to the return to normal situation by compensation.

In this context, the city of Batna located in the Algerian northeast has known significant socio-economic development leading to vulnerability to flood risk, its prevention of which shows the fundamental role of urban resilience in the sustainable management of risk situations and urban disasters.

This research work is part of a geodecisional information system approach in the natural disaster insurance sector to meet the coordination needs between the various interdependent actors and promote the development of solutions contributing to the city's resilience

Key words: Batna, Risk, CatNat insurance, urban resilience, SIGéodécisional.

INTRODUCTION

Algeria, like other countries of the world, has known several earthquakes and a series of floods over the past two decades that have caused loss of life and significant damage (UNISDR 2013).One of the most recent and deadly is that of Algiers in Bab El-Oued, November 2001 which caused 733 deaths and very heavy material damage.

This last tragic event produced an insurance obligation called "CAT-NAT insurance", that is to say insurance against the effects of natural disasters was enacted. The obligation was introduced in September 2003, with the promulgation of Order 03-12 of 26/08/2003 on the obligation to natural disasters insurance and the compensation of victims (JORA 2003).This obligation applies to all owners of built property located in Algeria and persons engaged in a commercial or industrial activity. For this last category, the coverage is extended to the content, its application is ensured by all public or private insurance companies operating in Algeria.

Major natural events have always been viewed by insurers as risks beyond their saturation limits, the extent of property and environmental damage, and the number of casualties, making it difficult, if not impossible, to do so. Implementation of the principle of risk sharing, which is the basis of the insurance process, in that it allows a small number of unfortunate victims of an insured event to be compensated by all contributions paid by the insured

The idea of resilience exists in a number of disciplines. Structural and engineering science is a field to employ the idea of resilience, for example the concept of seismic resilience of buildings understands it to be the property of a system which has: '1. Reduced failure probabilities; 2. Reduced consequences from failures, in terms of lives lost, damage, and negative economic and social consequences; 3. Reduced time to recovery' (Bruneau and Reinhorn 2006). The term

urban resilience is increasingly used in policies, programs and thinking about climate change adaptation and disaster risk reduction (Aditya V.2010).

This work was carried on the city of Batna as it known rainy episodes in 1983, 1987, 2004 and 2007 that generated significant floods whose effects remained alive in the minds because of the vulnerability of this city.Ceci est principalement dû à sa situation géographique (cuvette), mais aussi au développement et à l'extension spatiale des enjeux humains ; En conséquence directe de la croissance démographique, avec sa part d'agglomérations urbaines et d'installations industrielles qui dans de nombreux cas, se trouvent dans des zones à risque potentiel.

Today, decision-makers and land-use planning professionals facing flood risk management problems need decision-support tools to better manage catastrophic scenarios.Indeed, the complexity of the interactions between the city, its urban services and the risk of flooding finds an interesting answer in the concept of urban resilience. This concept makes it possible to meet the challenges of business continuity of the city, which must maintain its operations and recover quickly after a disruption.

DESCRIPTION OF THE STUDY SITE

the city of Batna is located in the North-East of Algeria between latitude 35°34'23" and 35°31'26" North and longitude 6°7'59" and 6°13'31" East.Positioned at the crossroads of cities such as Constantine, Biskra and Khenchela, Batna has acquired a polarising role. It was founded in 1844 in the middle of a natural bowl surrounded by jagged mountains from the Aures range, on a slightly sloping site, crossed by three major rivers and surrounded by rugged terrain; hence the label of "dish town"..(Habibi Y. 2018)

This situation plays a major role in the urban sprawl of the city whose extension is confronted by natural obstacles, which accelerates anarchic urbanization on sites at risk of flooding

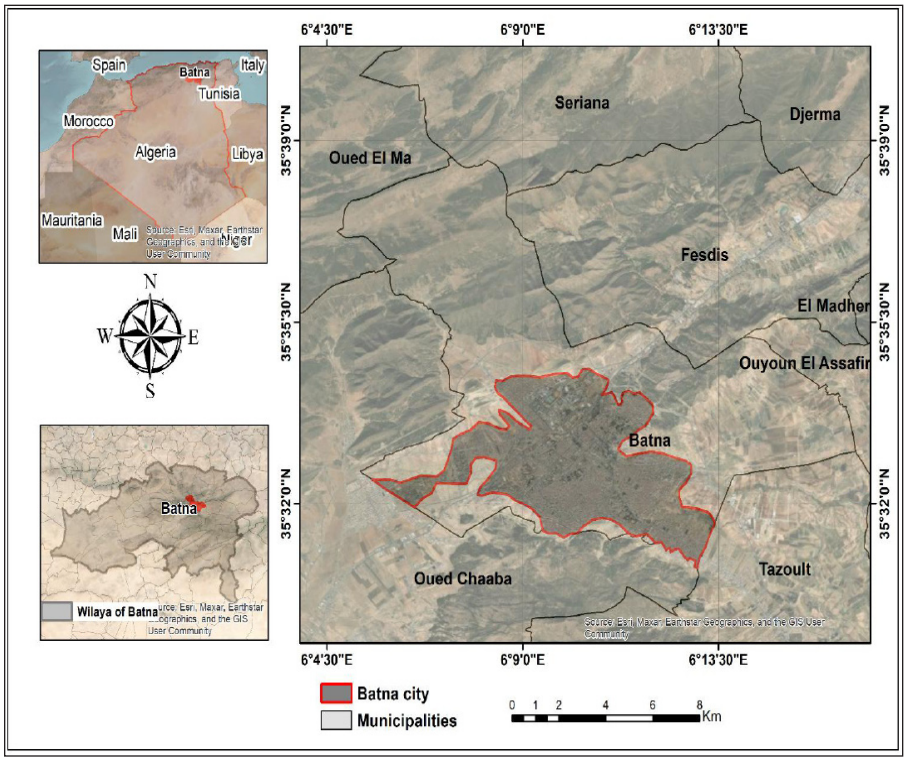

Figure1. Location of the study area

METHOD AND MATERIALS

Geodecisional information systems were born from a need of companies to provide decision-makers with the means to access data from their own systems in order to control their activities (Kheops, (2008). These means are not satisfied by traditional database management systems. Indeed, they operate according to a so-called transactional mode, that is, modify, delete data specific to a business activity.

The Geodecisional information systemshas emerged as a necessity in order to cope with increasing data volumes and the difficulty of decision-makers in obtaining tangible results on the various branches of activity. Tools have been specifically configured to extract data from heterogeneous sources, store them in a homogeneous set and then render the results in analysis and reporting interfaces.

In the insurance sector as in other sectors, TheGeodecisional information systems are useful for reporting functions to technical departments and management teams in order to follow the evolution of their business lines (monitoring of purchases, sales, production, etc.)(Julien Iris. 2009).The values followed are often quantitative and financial: sales figures, turnover by branch, profitability levels of sales outlets, etc.

The Conceptual Model of the Geographical Database

Whatever the modelling technique chosen, the design of a database requires a lot of experience and expertise, without forgetting the knowledge of the different details and the good understanding of the context of the environment envisaged.

The conceptual model aims to give a better representation of the studied context, it allows, among other things, to provide visual and intuitive notation. To design our database, we have identified the following:

- The different functional entities involved.
- The spatial and non-space relationships between the entities and the associated cardinalities.
- Possible aggregation, inheritance operations and entities involved.

The attributes of each entity that are necessary to satisfy the queries we need to answer.

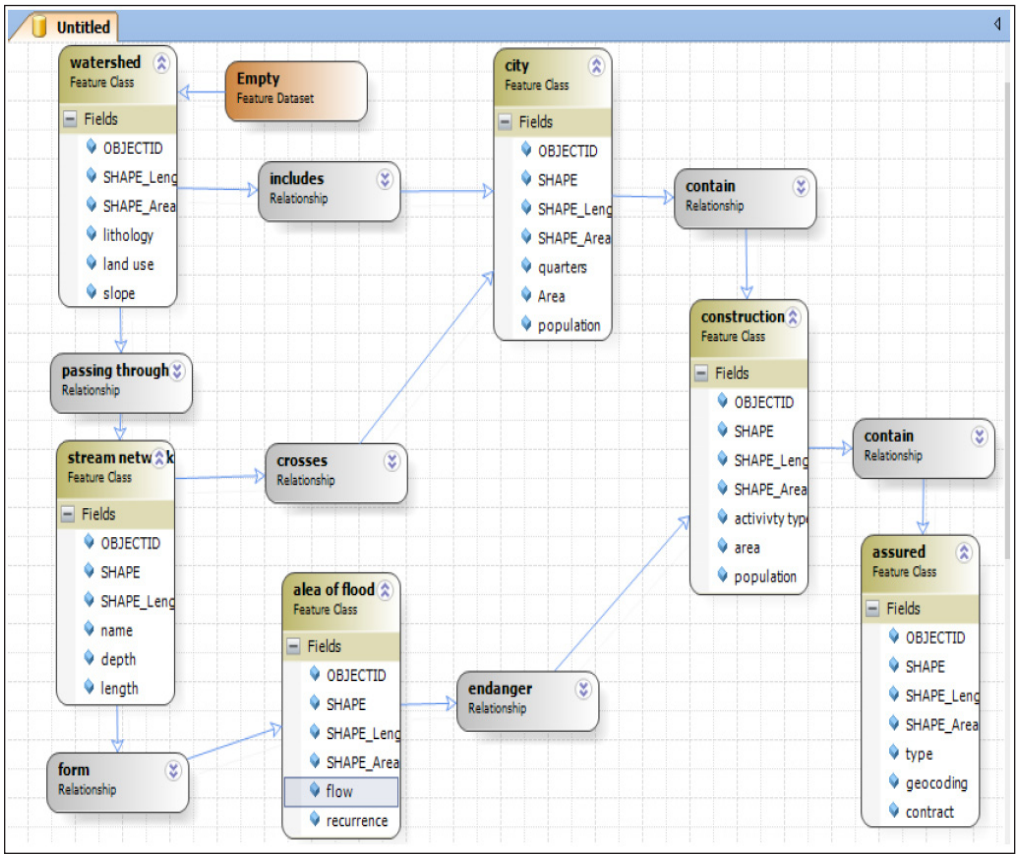

Figure 2. Conceptual data model

Flood Risk Modelling

The optimal management of floods requires a good knowledge of the causes of the phenomenon and a good mapping of its extension (Wade et al, 2008).

Research on spatial modelling of floods has been largely conducted (Guellouh S., 2017) (Yared Abayneh Abebe, et al 2019) (U. C. Nkwunonwo et al 2020) (Ashraf Abd Elkarim, and al 2020). Spatial modelling of flood risks will provide optimal results if supported by good data **(**Feri F. and Al2022). A multi-criteria analysis is carried out under a geographical information system (GIS) integrating several factors concerning precipitation, hydrographic network, slope, land cover and permeability, as well as the HAZUS programme, whose goal is to better know, evaluate and spatialize the hazard in this zone.

Table 1. Parameters involved in the flood hazard

Paramètres Intervenants	Méthode d'acquisition	Sources de données utilisées
Pluviometry and Flow	Calculation and Interpolation	National Water Resources Agency (NWRA)
Slope	Extraction	Digital elevation model (DEM)
Land use	Diriged classification	Sentinel satellite image 30 m
Lithology and permeability	Digitization	Geological map
hydrographic network	Extraction	Digital elevation model (DEM)

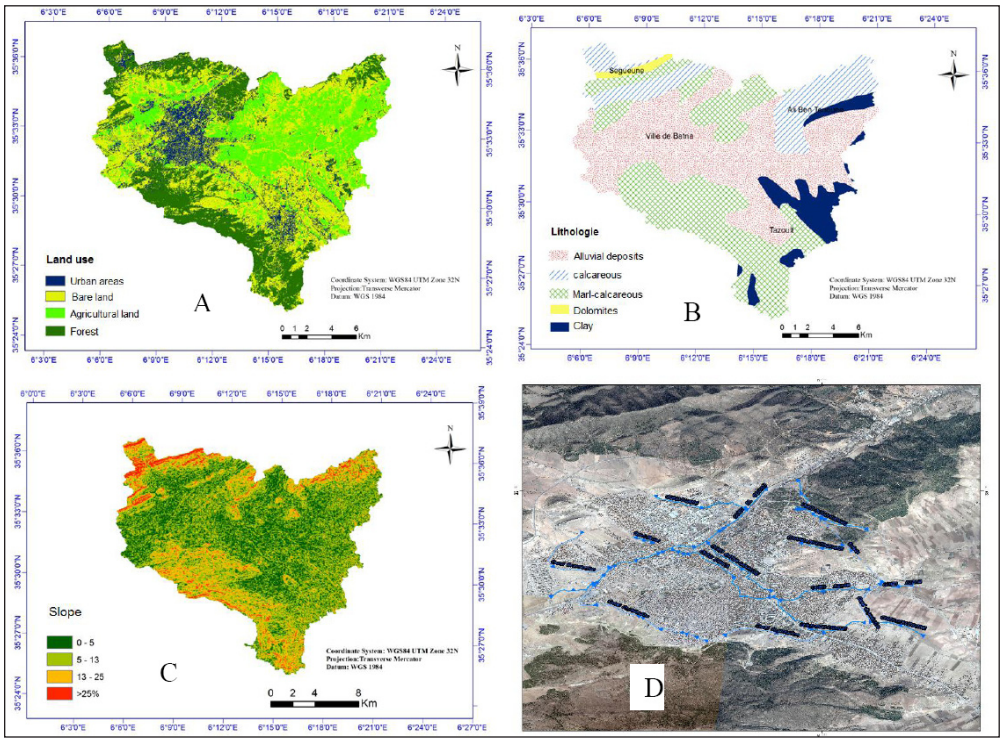

Figure 3. Flood Hazard Factor Maps

A : Land use, B : Lithology, C : Slope, D : Hydrogrphic network

RESULTS AND DISCUSSION

The CatNat insurance sector plays an important role in improving urban resilience, by raising savings and financing the economy, which can make a significant contribution in times of crisis to restoring normality. With the savings and income it accumulated before the crisis, it is a pillar to restore the city's stability in a short time.

In the light of the different parameters involved, we tried to reuse the HAZUS model adjusted to the impluvium of the city of Batna to predict its response to a scenario taking the current land use reality and a 100-year return precipitation rate.

The result allows us to spatialize the flood hazard and especially the result that interests us concerning the level of hazard in urban environment.

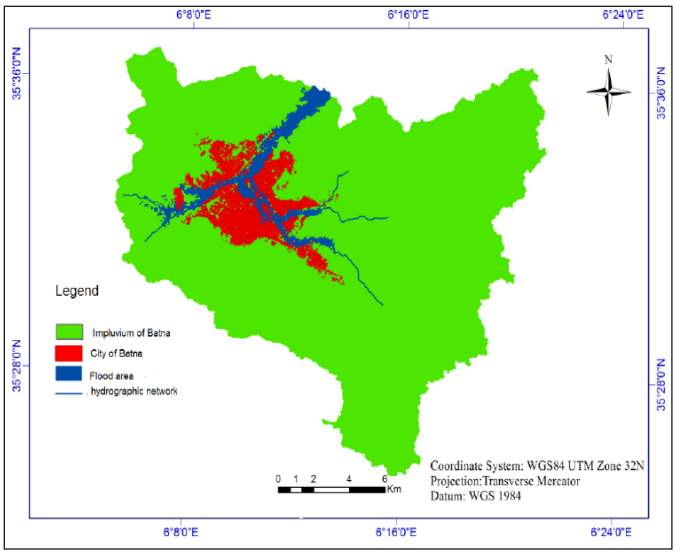

Figure 4. Flood map

Development of Risk Culture and Risk Acceptance

In Algeria, the religious aspect and the excessive negligence of citizens are considered as one of the reasons for their not insured against natural risks (CatNat insurance) which is mandatory insurance since 2003.

The awareness of the population exposed to the risks to accept it, plays a very important role in the increase of the numbers of subscriptions to the insurance CatNat, which thus introduces to the improvement of resilience of the city, from the creation of a financial base to cope with the risk and the rapid reconstruction of the cit.

Moreover, a certain class of population has always considered that any natural disaster that occurs, such as floods, is due to moral reasons in their behavior or to the anger of nature. Previous incidents were not considered natural scientific phenomena in this class. This has led the community not to accept natural hazards and not to coexist with them by means of protection and prevention. Like the Japanese who frequently live with the phenomenon of earthquakes, which has led to a society that accepts the risk and absorbs its effects and returns after it to normal life. This is what we miss a lot and what makes CATNAT underwriting low like, which will lead to an excuse to achieve the urban resilience required in the city.

And for that, awareness campaigns should be intensified on the known natural risks in Algeria and in each region in particular. Thus, illuminate on the importance of insurance against natural and disaster risks, and by highlighting its advantages over man and country, guarantees and sanctions that will be imposed on each one of them who neglects.

The Contribution Premium

The premium paid by insured persons in Algeria depends on two main parameters: The basic rate, which identifies the degree of exposure and the maximum declared value, which is the sum of insured capital. In the case of flooding, the rate is set in (0.2 ‰).

But, if we want to contribute more to the progress of resilience to the risk of flooding in the city of Batna, we must change the base rate of this risk from fixed to variable and controlled by the zoning to flood risk in the city (Flood map). So, the closer the construction is in the risk area the higher the rate rises.

The Resistance

The resistance of the urban system is a parameter directly linked to the acceptance of risk by the population. As cultural and perceptual awareness of risk and its consequences increases, we can attract people to this stage.In this way, the resistance problem can be solved, because the growing awareness of citizens by accepting risk and understanding its system will make them work to resist it and build real estate and/or facilities based on strict standards and resistance to it.

Whenever the citizen is well informed about the risk, the CATNAT insurance and especially the premium on which basis they, the more it will build in non-flood zones or take measures that will reduce its material losses and at the same time

help to return to normal in small period. Therefore, we need to communicate more about flood risk with the public in order to encourage appropriate behaviour and to provide the information and equipment needed to deal with this risk. We can also give preventive information in the face of major risks that will evolve the responsibility of populations from an individual scale to a citizen involvement.

Compensation for Citizens

An insurer shall not assume responsibility for the settlement of a loss due to a natural disaster unless both parties are effectively insured against this type of loss and the state of natural disaster is confirmed by an interdepartmental order. This constitutes a moral and political constraint for the authorities concerned. According to the law, compensation is possibly due only if usual and/or prescribed preventive measures have been taken and have proved insufficient.

The victims shall be compensated on the basis of the natural disaster guarantee obligatorily included in their property damage insurance contracts; compensation shall not be due in the absence of such contracts and if there is one, its amount may not exceed that of the principal guarantee; these provisions are difficult to understand and accept by well, ill or uninsured victims who think that the compensation should cover their entire damage, not only material in the strict sense of buildings and objects, but also immaterial and physical harm to persons.

Financial Security of Insurance Companies and Reinsurance

To use the insurance industry in the positive path for resilience, we need to guarantee the financial security of companies, one of the tools that can be used to protect bankruptcy insurers is the geodecisional information system

The geodecisional system allows to detect the maximum number of insured persons for the company, this number being calculated from several indicators such as, the capital of the company, the capacity available to the company and the risk zones. These indicators make it possible to avoid the bankruptcy of the insurers from the creation of a whole database of the data of the insured and uninsured and the establishment of the properties (real estate, commercial and industrial) by contribution to the zone of risk in the city. This database can also help to alert in the case of insuring a building built in high-risk area like the beds of oueds, this type is not entitled to insurance. This calls for reducing reliance on the paper questionnaire, which could put the company in the case of bankruptcy and take more modern methods such as geocoding.

Reinsurance is the operation by which an insurance undertaking is in turn insured for all or part of the risks which it guarantees in respect of insured persons.For this purpose, the Central Reinsurance Fund seems to be the only one able to provide insurance companies with unlimited coverage thanks to the State guarantee which it enjoys for certain risk guarantees, including natural disasters.Reinsurance is therefore an indispensable technique of dilution of risks over time and in the space that makes use of national solidarity.

The transfer of risks to reinsurers allows insurers to improve their solvency ratio. And through the information systems that support exchanges between the transferring company and the reinsurance company can generate new sources of savings. Reinsurance thus guarantees financial security also to insurers, reinsurance contracts covering risks are very important. Reinsurers are obliged to atomize their risks even more than insurers.

CONCLUSION

The insurance system in Algeria relies heavily on the solidarity policy, which has led to limited and insufficient information from residents on insurance against the effects of natural disasters, which has made participation in underwriting low. This is due to lack of advertising for the product and lack of awareness campaigns.

The evaluation of these devices requires an analysis of public perception of risks to understand their effect on behaviour. Beyond the elements of the assessment and the ratings that are made on the impact of the measures on the population. Therefore, the tyres concerned must take charge of this issue in the near future in order to contribute more actively in improving resilience, through the intensification of awareness campaigns on the importance of insurance against natural risks, training for insurers on CATNAT insurance, to provide insured persons with sufficient and satisfactory data.

Geodecisional modeling under GIS is a tool for improving urban resilience through its adequate tools for querying, analyzing and displaying data. Indeed, this tool allows us to share a real vision of the territory with all actors of risk

management and intervention by a common representation of urban space that requires moving towards sustainable urban development in the context of a project territorial. In addition, the need to mobilize all actors of prevention, relief and disaster management requires the integration of time as an important parameter to maintain spatial dynamics before, during and after urban disturbance, and this is the key to getting back to normal.

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