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GIS Technology on Natural Disasters Management in Albania

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Abstract: ***This paper presents situation, problems of Natural Disasters management in Albania, and GIS (Geographical Information Systems) using in this field in Albania. Albania territory is very much exposed to different natural disasters as: earthquakes, landslides, erosion, flooding, etc. Until now, the prevention from natural disasters have been organised in traditional ways. Many natural disasters can not be avoided, but they can be predicted, and theirs economical and social effects can be softening through good management. In this paper evidenced the importance of advanced technology using as GIS, in natural disasters management, also given concrete examples used in Albania associated with recommendations for the future.***

Keywords: Natural disaster, management, GIS, Albania

1. Overall View of Natural Disasters in Albania

Disasters caused both from natural and human factors are common in Albania such as: earthquake, floods, forest fires, droughts and industrial accidents. Recently the most frequent disasters have been floods, especially in North-East and South-East areas of the country. More than 80% of the Albanian territory, where is generated more than 80% of GDP, is exposed to two, or more risks. Consequently an Albania rank among those countries with highest economi-cal loses from disasters. Albania is a developing country which emerged from a centralized system to free market economy, and currently ranks among the poorest countries in the region with poor infrastructure, high level of illegal constructions, overutilization and degradation of natural resources, high erosion level, etc. Therefore the economy and population is highly affected by the natural disasters such as floods, earthquakes, landslides, etc.

Earthquakes: Related to earthquakes, Albania lies in the Alpine-Mediterranean seismic belt, on the contact zone of the African and Eurasian lithospheric plates, which extends from the Azore islands to the eastern border of the Mediterranean basin. Its most active part is Aegean Sea and the surrounding area. Albania is characterised from activity of: intensive micro earthquakes (1.0 < Md”3.0); slight earthquakes (3.0 < Md”5.0); moderate earthquakes (5.0 < Md”7.0); and not often strong earthquakes (M > 7.0). During the twentieth century, about 7% of the superficial earthqua-ke’s energy is generated from autochthon and aloctone seismic sources. The most powerful earthquakes have been activated on 1979 with 6, 9 magnitude, damaging Scutary (Shkodra) and Lezha cities. From third century before Christ up to now, Albania is hit by 55 strong earthquakes with intensity I-VIII of MSK-64 scale. Fifteen of them have been earthquakes with intensity of I-IX, MSK.

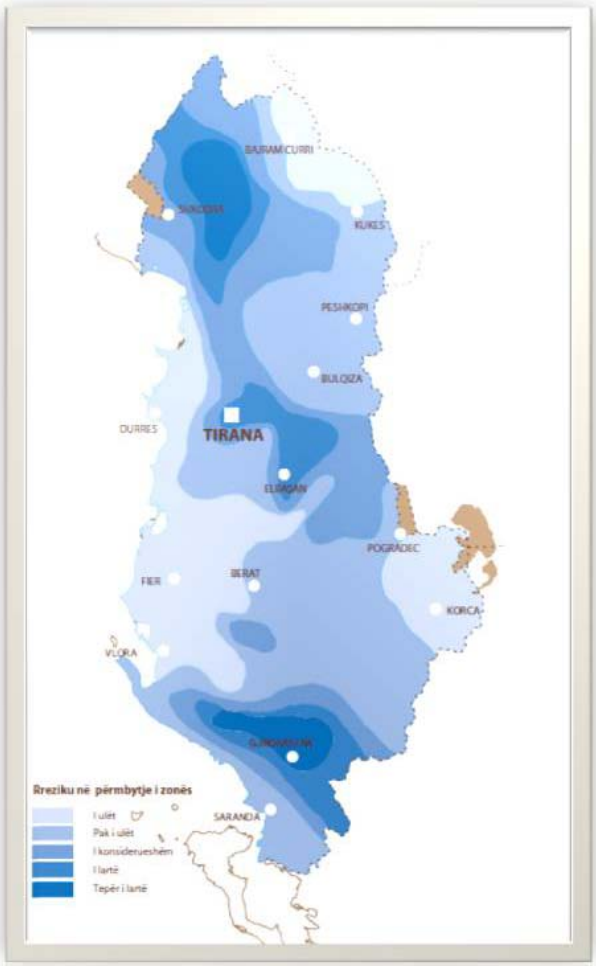

Figure 1: Flooding Map of Albania
[Source: http://www.mbrojtjacivile.al/?page_id=25&rt=1]

Floods: Flooding phenomenon is widespread in Alba-nia, notably in northern part of the country. The consequen-ces of this phenomenon are landslides, rock fallings, destru-ction of bridges and buildings, etc. The biggest floods in Albania happened in the period 1970-1971 flooding the pumping stations and reservoirs. In Albania, the rivers present the main cause of floods in the conditions of heavy rain falls. Eight main rivers of Albania are grouped in six water

collecting basins, traversing the country from east to west. Their annual discharge is 1,308m^3/sec, which corres-ponds to 30m^3/sec/km^2. The most frequent floods happen during the November-March period, when the 80-85% of the rainfalls of the country occurred. Because of the topographic features, these floods occur very fast (about 8-10 hours). **Fig.1** shows flooded areas in Albania, whereas **Fig.2** shows flooding of Shkodra.

Figure 2: View of flooding in Shkodra region 2010

Erosion: Erosion phenomenon is shown in some forms such as: slides, superficial erosion, collapses, sea erosion, etc. The last one presents an emergency situation threatening hundreds of square kilometres of land and eradicating the beaches. Apart from above, a very spread phenomenon in Albania is the erosion caused by the extraction of inert materials from the rivers. Eliminating the negative conse-quences of this phenomenon, the Ministry of Environment decided to review those licences of entities in charge of extracting inert materials from the riverbeds , which have created a high risk for flooding (**Fig. 2),** and erosion **(Fig. 3)**.

LANDSLIDES: Landslides is also very spread phenomena in Albania. The characteristic of Albania is instability of lands caused by natural factors such as: mechanical action of superficial and underground water, precipitation, seismic activity, etc. Human impact with irrelevant constructions such as the dams or big water reservoirs along the rivers, road constructions, tunnels, and other infrastructure installa-tion, etc, have been the cause of the landslides. The most affected areas in Albania are: Erseka region (Kolonja), Mokra region, Elbasan and Tirana, and the hills close to the sea coast and Tepelena zone. The biggest landslides have happened in January 2009 in Qafë Dardhë (Gur-Shpat village, Polis Commune, Librazhd) where a big landslide was reactivated. The landslide which happened in March 2009 affected a part of Bago village in Synej Commune where many damages where registered. The last ones happe-ned in February 2013 in Qendër Commune in Mallakastër.

2. Problems and Challenges of Albania Concerning the Natural Disasters

Albania is highly exposed to natural disasters and is facing the risk of extreme weather changes caused by climate change. In these circumstances, the main challenge is to guarantee a stable and long-term System for protection from natural disasters. Efficient management of natural disasters is another challenge in order to provide appropriate assis-tance in the proper time and quality to vulnerable areas.

From the management point of view the main problem is natural disasters modelling and precise risk definition, in the condition of absence of a detailed Database of the endangered objects. Of particular importance is the determi-nation of risk scale, or vulnerability of Albania from two main natural disasters in the country: earthquakes and flooding. Currently managing natural disasters in Albania and their modelling is still realised with traditional methods and modelling discipline is under development. Besides this, the public has not the necessary information about the risks that come from natural disasters, and how to be protected from them what brings this as a very important factor to be taken into consideration. From the other side new construc-tions without technical criterion and standards implemen-tation brought increased risk from natural disasters.

Risk modelling from natural disasters is based in four elements: (1) Natural disaster determination; (2) Creation of the inventory of objects or properties in risk; (3) Determi-nation of vulnerability to the natural disasters; (4) Deter-mination of damages in financial terms. In Albania estima-tion of these elements is done only using probability methods, without using the advanced methods and technolo-gies. This is a very important reason to consider new and modern technologies. Likewise indeterminacy of the metho-dologies used for prediction, and assessment of natural disasters is a huge gap which must be filled in the future.

Research and studies in this field are very few. There exist full studies only for the earthquakes risks, but not for the flooding areas. An important element for the manage-ment of natural disasters is the existence of the national database and the map of the risks from natural disasters which unfortunately do not exist. This is an obstacle for the risk prediction, and appropriate protection measures to them as well as the estimation of the expected damages.

Every natural disaster is associated with economic damages, and currently in Albania the relation between natural disaster damages and Insurance Trade is insufficient to cope with consequences of natural disasters. This is not only because of impossibility of insurance companies, but also of non completed legislation. The existing law is appro-ved in 2001 and needs essential update to be adapted with European and international legislation. Albania needs not only a simple review of the law but a complete new law on natural disaster management. The new legislation must predict not only management of emergencies, but also the necessary measures to decrease the risk from the natural disaster. From the organisational and administrative point of view, it is necessary to reorganise the institutions dealing with these issues and increase their independence and the financial support.

National Strategy for natural disasters needs essential improvement including risk estimation and transfer elements. New Strategy should be focused in new approach of public structures moving from decision and action in emergency situation to the prediction, prevention, monitoring and

modern management of difficult situations based on the European model "Response Service"[i].

3. Natural Disasters Management in Albania

Currently the responsible institution for natural disasters in Albania is General Directory of Civil Emergen-cies. This Directory has as its mission to strengthen the ability to prevent, protect, response and rehabilitation from the consequences of natural disasters or those caused by the human activity. The main tasks of civil protection are: Prediction of potentially dangerous phenomena or incidents; Monitoring and implementation of measures to be taken for disasters prevention and emergencies; Preparation, program-ming, planning, estimation, emergency intervention, and organised assistance to cope with different disasters.

Disaster management in Albania is still in its first steps of modernization, and new technologies are not fully implemented. AdriaRADNET is the most important project at the moment (partner countries in this project are Italy, Croatia and Albania), which integrates Radar system based on an information system "NETwork" to support hydro-meteorological monitoring and decision makers for civil protection. This project is financed from European Union through IPA instrument in budget of 3 million Euros.

AdriaRADNET project has as objective to create and integrate an IT infrastructure, which is flexible, interactive and based on low cost radars' network for weather monito-ring. Together with satellite data and GIS models it will be a good support for the decision makers for civil protection for the Adriatic region.

4. Regional Cooperation for Natural Disaster Management

Natural disasters are national and regional concerns therefore regional cooperation is very important for the natural disasters management. After the fall of communism, almost all countries in the region embarked on a rapid transition from centralized systems to democracy. Immediate development of a free market economy gave rise to uncon-trolled population movements, hasty construction of housing and facilities and disproportionate concentration of people in and around big cities. These developments combined with the natural factors impact caused several disasters and much more are expected to happen in the future. For all these reasons regional cooperation for natural disaster management is of special importance.

Balkan Peninsula has the most complicated tectonic in Europe and seismic activity has given a series of devastating earthquakes in the region, destroying entire villages and taking many lives. So far each country has managed these risks almost individually, through various institutions, organizations and agencies, often using different methods. But natural disasters have no national boundaries and problems such as overpopulation, construction without planning, etc., are found in many neighbor countries therefore regional cooperation for natural disasters manage-ment is much needed.

So far there is little collaborative effort in the region such as the mapping of geological risks in the Balkans using GIS technology. Through the integration of many different data layers is intended to give a broad view of how geologi-cal risks can affect a community, a country or a region. This cooperation is very important but yet insufficient. Currently regional cooperation is considered as an exchange of experiences, but still not at the level of organized actions and common management systems.

In general, the main objective of Regional cooperation is the provision of a sustainable and long term system to the citizens, businesses and countries of the region (including Albania) against natural disasters. The main goal is to assist citizens, businesses and every country to their long term financial stability and property security as well as to protect the future of the businesses to real challenges caused by natural disasters, which can occur anywhere, anytime and can affect any segment of the society.

"New Europe" is another project, which operates in the region in order to offer a unique and functional model of cooperation between public and private sector, between the governments of the Member States, recognized global institutions and the private sector, etc. The goal of this project is to provide regional cooperation and to develop mechanisms for disaster risk mitigation.

5. Use of GIS Technology for Natural Disasters Management in Albania

Natural disasters management in Albania is still in the early stages of modernization. Advanced technology is not yet fully involved in this process. However in academic level has begun the study of new technological application such as the examples of GIS application for disaster management. Examples below outline briefly some cases (for university purposes) of GIS application for analyses of soil erosion by rivers and the sea.

5.1. Soil Erosion by Rivers

One of the examples chosen to illustrate the erosion of rivers is the case of Shkumbin River. This river (181 km long) which originates from Valamara Mountain (Albania) is one of the rivers with highest erosion level of agricultural land. Besides other factors, a very important factor that affects the continuous movement of water flow is the extraction of the inert materials (gravel) in the riverbed by some private companies (Figure 3). The riverbed deepening is 2-3 meters in a length of more than 2km. Soil loss is estimated at up to 50,000 tons per year, or 0.5 ha per year[ii].

The purpose of using GIS technology in the case of Shkumbin River has to do with the study of erosion factors and their cartographic presentation. The program that is used for this purpose is ArcGIS 3.2. The data were provided by various international projects such as CORINE (land cover), Watershade (hydrographic network), etc.

Figure 3: Inerts (gravel) extraction in Shkumbin river
[**Source**: ttp://ekolevizja.wordpress.com/2014/04/25/librazhd]

Based on GIS analyses it is concluded that: (1) Shkumbin River is extremely vulnerable to water erosion; (2) Protective measures against the erosion are not sufficient; (3) Legislation to protect the environment from water erosion does not implement enough; (4) There is no monitoring of damages. **Fig.4** shows GIS based map for Shkumbin River.

5.2. Soil Erosion from the Sea Activity

Another case of GIS technology use, for modeling and management, of natural disasters in Albania is the case of soil erosion from the sea activity. An example of this is the use of GIS to determine the coastline change. The case study is Lezha coast, which represents one of the most popular areas of the Albanian coast, with some protected areas in terms of biodiversity. Coastal erosion in this area has caused the introduction of salt water inland and introduction of invasive species, as well as the damage of the natural ecosystem and vegetation.

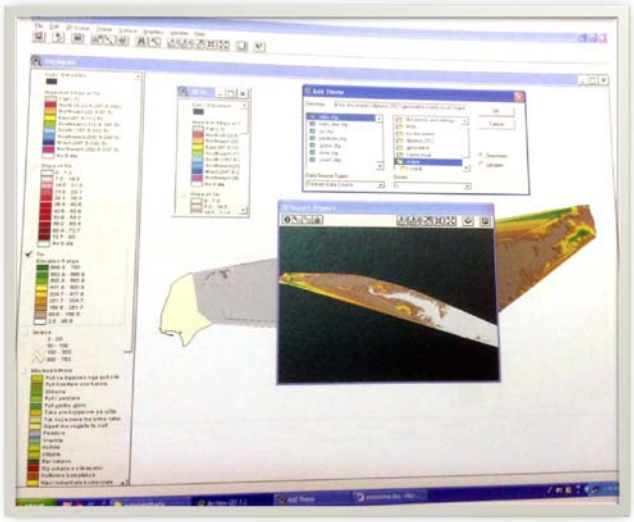

Figure 4: Using GIS for Shkumbin River
[**Source**: Resulaj K, 2013]

The purpose of using GIS technology in this case has been the determination of the Coastline change in Lezha bay. The data are taken from different projects and are analyzed in ArcGIS 3.2 program. Steps taken have been: (1) Collection of information and data from various sources; (2) Digitalization of coastline over the years using topographic maps compiled in 1986 and satellite images for subsequent years; (3) Georeference of the topographic maps in AutoCAD program and determination of the coastline change; (4) Cartographic presentation of the coastline change in different periods.

The final product is the creation of the Map showing the coastline evolution in different periods. Red color line indicates the coastline in 1986 and yellow one the current coastline. It is obvious the sea advancement inland. GIS analyses showed that the coastline of Lezha has been moved 8m inland[iii], (**Fig.5**). The beaches of Tale, Kuna, Vaini and Shëngjin (Lezha bay) are subject to erosion. After 1980, these beaches are facing continuous erosion of 3-13 m/year[iv]. At Tale beach the coastline withdraws some 2-3 m/year over a length of 2 km[v].

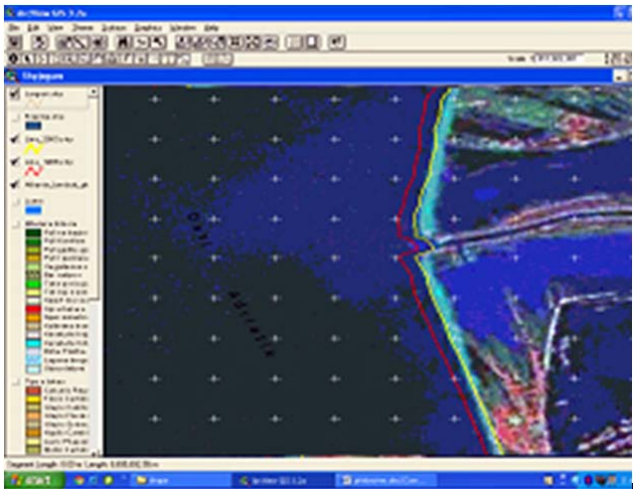

Figure 5: Coastline change of Lezha bay
[**Source**: Nazarko Xh. 2013]

6. Conclusions

1. Albania presents a high risk to natural disasters. High risk comes as a combination of natural and human factors.
2. Main natural hazards in Albania are earthquakes, floods and erosion.
3. Management of natural disasters in Albania, and their modeling methods, is still traditional. Disaster Risk Modeling is an emerging discipline still in development.
4. The public does not have the necessary information about the risks from natural disasters, and how to be protected from them.
5. The risk from disasters is increased due to non-compliance with technical requirements in constru-ction.
6. The approach used to estimate risks in Albania is that of probability.
7. The main problems of risk modeling in Albania are: determination of the exact natural risk, the absence of a precise Database of the endangered objects, and especially the assessment of the vulnerability to natural main risks that threaten the country: earthquakes and floods.

8. There is not a Database, or accurate Inventory, and an updated Map of objects and areas at risk from natural disasters.
9. There is no well defined methodology to study the risk of earthquakes and floods. There are some partial studies and partial data derived by indirect methods and through simulations.
10. The insurance market in Albania is currently insufficient and does not compensate the consequ-ences of natural disasters. These disasters are not covered by the insurance market to date.
11. The use of GIS technology is an important tool to support the decision makers involved in disaster management but currently its use is limited.

7. Recommendations

1. Considering the potential risk posed by natural disasters, and their quick and unexpected develop-ment, it is strongly recommended to change their management from the traditional methods to contemporary management methods including the use of GIS for decision support systems.
2. It is very important to inform, and increase the public awareness, about natural disasters risks and protective measures to them. Organizing awareness campaigns are an effective tool used successfully in other countries.
3. In the case of extraction the inert materials from the rivers it is recommended the review of licenses of entities and environmental impact assessment of inert extracting activities.
4. Due to numerous problems, it is recommended the implementation of projects aimed at solving the problems of river sediments. On the other hand measures of engineering, hydro technical and biological character should be applied in relation to the geological structure of the riverbank.
5. Sea erosion protection measures should consider the natural heritage conservation and the prevention of damages of public infrastructure works.
6. Prohibition of utilization of inert materials, sand and dunes from the beaches to stop the progression of the sea towards the land. Coastal forestation and maintenance of the sewerage network is also reco-mmended.
7. In the context of integration of Albania in the European Union and regional cooperation it is needed the revision of the legal framework and adoption of a law for disasters in view of the National Strategy of Disaster Risk Management and European Strategies.
8. Reorganize and increase the independence of insti-tutions that deal with natural disasters and support them financially.
9. Creation of the National Database for natural disaster risks.
10. Improvement of the National Strategy and transition from Treatment of emergencies caused by natural disasters to Risks modelling and forecasting using GIS technology.
11. Creation of National Risk Map presenting areas with high risk from natural disasters and those ones that have high vulnerability to the risk of natural events.
12. Creation of National Database of endangered objects by determining the degree of risk from natural events to each of them.
13. Use of GIS in all institutions that deal with natural disasters, mainly for the identification of vulnerable areas, risk monitoring and forecasting, and finding optimal solutions to eliminate human losses and property damages.
14. Strengthening regional cooperation for disaster management with other neighbour countries.

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Dr.Edmond Hoxha received the PhD degree on Geosciences and Environment on Polytechnic Unive-rsity of Tirana, Faculty of Geology and Mine. He studied also on leader-ship on Harvard University. He has huge experience working with Gov-ernment of Albania and Internati-onal institutions like World Bank, European Union etc. He was Deputy Minister of European Integration of Albania. He is founder of Albanian Centre of Excellence and publisher of Scientific Journal "Albanian Excellence". He is member of Eurosciences, International Association of Scien-ces, techno-logy and Development. He speaks English and German language. Actually he is a professor in Faculty of Geology and Mine teaching GIS technology and Mine Modelling.

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