Natural Disasters and Climate Change

How to manage an efficient action plan to prevent economic and social damage

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INTRODUCTION

The security and existence of many people are at risk due to the change of climate which has increased income disparities and deepened inequalities: During the last two decades, the recorded number of natural disasters worldwide has doubled and exceeded 400 per year, 80% of which are of climatic origin. The rise of temperature, followed by a drop of terrestrial, agricultural productivity at the countryside make the urbanization process increase rapidly, leading to competition for scarce subsidy resources and public services. Climate change is also increasing the incidence of diseases transmitted by insects and animals (zoonotic disease). Hence the intensification of social tensions as well as of political conflicts on the national and international level are faced with this problem.

Tunisia, located in North Africa bordered by two western and eastern Mediterranean basins with multiple bioclimatic zones, has known for centuries and especially during the last decades several periods of natural damage. But nowadays, it is very urgent to consider a rigorous plan of action for the management of natural disasters in order to face and limit the socio-economic damage which could hit Tunisia during the next years.

CONCEPTUAL AND HISTORICAL FRAMEWORK

1. Concept of natural disaster

1.1. The concept of disaster risk in Tunisian law

Disaster is the only component of disaster risk reduction that is explicitly included in Law No. 91-39 of 08/06/1991 related to the fight against calamites, their prevention and the organization of rescue services: These risks "are considered calamities, fires, floods, earthquakes, storms and generally any scourge, of terrestrial, maritime or air origin which severity and after-effects exceed the normal means available to face at the regional or national level."

Yet, the law does not address determining the ones responsible and the causes behind the damages from natural disasters, nor does it refer to a threshold of magnitude or specify who is responsible for recognizing a disaster.

Historically, after the floods of 1969 which caused hundreds of deaths and significant economic losses, and further in the 1970s, Tunisian authorities have shown growing interest in natural disaster risk management planning. This evolution had to go through several stages ended up in the creation of a National Risk Management Committee followed by regional sub-committees.

1.2. Types of disasters

Disasters have two origins according to the WHO: natural and anthropogenic ones linked to human activities.[1]

Natural disasters are naturally caused by meteorological, seismic or other causes over which man has no control. They fall into four groups:

- unpredictable or difficult to predict disasters such as earthquakes;
- foreseeable disasters within an early timeframe (from a few hours to a few days) giving room for alert, as in the case which certain floods;
- sudden onset disasters such as floods, storms, earthquakes and landslides, plagues, forest fires;
- progressive disasters such as heat waves, cold wave, drought, desertification, erosion, soil degradation.

One the other hand, disasters of anthropogenic origin, or those resulting from humans' presence or action, can be classified into five groups:

- Industrial or technological disasters attributed to bankruptcies in human / machine relationships (explosions, pollution, fires, etc.);
- accident-related disasters;
- deforestation-related disasters (landslides, mudslides, etc.);
- disasters related to a lack of essential goods and services;
- complex emergencies (wars, uprisings, nomadism).

In addition, certain natural disasters may combine with technological accidents.

1 World Health Organization (2014) Emergencies and disasters, shorturl.at/djnFU.

1.3. Risk and the Tunisian context

1.3.1. The concept of risk

The concept of risk is a multidimensional concept where many factors exist simultaneously, namely the protection and the rescue of an endangered issue which a carrying hazard threatens and which can damage it. This hazard presents factors that can either stimulate its vulnerability or eliminate and mitigate its harmful effects (prevention measures). In 1990, the United Nations pioneered spreading the concept of reducing risk from natural and technological disasters around the world, when declaring the International Decade for Natural Disaster Reduction (IDNDR1990-1999). The evolution, systematization and operationalization of the concept accelerated during the Kobe Conference in 2005 and the Sendai Framework for Action report (2015-2030), addressed at the signatory countries.

1.3.2. Major risks in Tunisia

A major risk is defined by two criteria: its low frequency of occurrence and the austerity of its consequences likely to lead to some or several victims as well as limited or enormous material and environmental damage. Several risks of flooding have been recorded in Tunisia such as those of 1969 in Central Tunisia, of 1973 in the Lower Valley of Medjerda, of 1982 in Sfax, of 2003 in Ariana and also of 2012 in Ain-Drahm / Bousalem. Due to its low frequency of occurrence, the major risk is a surprising reality for humans and society.

The review of the management of natural disasters in Tunisia has demonstrated that competent Tunisian organizations manage the action plans for risk management according to an uni-disciplinary approach. This approach, however, is established using the analysis and prediction of natural hazards only, which can lead to ineffectiveness and weakness in the performance of their responses regarding the damage caused by natural disasters.

DIAGNOSTICS AND ANALYSIS

2. Analysis of vulnerabilities and capacity limits

The analysis of vulnerability and capacity limits is based on the conceptualization of a wide range of multidisciplinary factors (ecological, economic, social, cultural, institutional and political) which create this vulnerability.

In order to conduct an effective vulnerability and capacity analysis, establishing the appropriate framework is essential. The framework must include a multi-disciplinary global analysis table that includes the management of several management factors simultaneously. An analysis of natural hazards only to anticipate effective measures, as conducted in the Tunisian case, is unsatisfactory. Rather a global vision which includes social, economic and also strategic factors must be developed. Table 1 gives a classification of these factors and, thus, provides a decomposition of problems, which ensures better visibility and comprehensibility. It may serve as a decision making tool for politicians and members of organizations and committees work on natural disaster risk management.

Discipline	Vulnerability factors	Capacity
Social	• Occupation of densely populated places and buildings in dangerous places • Low mobility • Lack of risk perception • Vulnerable professions • Vulnerable groups and persons • Corruption • Lack of education • Poverty • Poor vulnerability and capacity analysis	• Share capital • Adaptation mechanisms and strategies • Memory of past disasters • Correct exercise of power • Probity • Local authority • Local NGOs • Responsibility • Disaster preparedness
Material	• Vulnerable buildings • Risky infrastructure • Places of high urbanization rate	• Vulnerable buildings • Risky infrastructure • Places of high urbanization rate
Economic	• Monoculture • Undiversified economy • Subsistence economy • Debt • Dependence on emergency aid and / or social assistance	• Economic goods • Livelihood security • Financial reserves • Diversification of agriculture and the economy
Ecological	• Deforestation • Soil, water and air pollution • Disappearance of natural barriers to storms (e.g. mangroves) • Climate change	• Ecological goods • Natural barriers to storms (e.g. coral reefs) • Natural ecological recovery process (e.g. forest regeneration following fires) • Biodiversity • Responsible management of natural resources

Table 1: Vulnerability factors and capacities of various disciplines in relation to natural hazards

So far, several vulnerability factors, which are shown in Table 2, have become manifest (e.g. risks that cause environmental and infrastructure deteriorations in sensitive areas such as flood plains and unstable hillsides). Poverty, movements of people, legal and political problems, discrimination, national and international macro-economic policies and the inability of governments and civil society organizations to protect communities are the least observed underlying factors. Table 2 facilitates the management, the planning and the decision-making by providing all the necessary elements.

Type of hazard	Endangered elements	Insecurity factors	Dynamic pressures	Root causes
• Drought • Deforestation • Phenomena causing secondary disasters such as the epidemic, parasite, fire	• Pre-harvest losses • Loss of livelihoods • Dispersion of goods • Deaths of people who ate toxic foods • Loss of forests due to illegal deforestation and fires • Growing season	• Precarious livelihoods • Weak economy • Lack of irrigation systems • Steep slopes vulnerable to erosion and landslides • Absent basic services • Lack of coordination with state structures • Poor knowledge of how to act to mitigate the risks of occurrence of secondary hazards • Young people's ignorance of ancestral practices to act in the face of disasters	• Forest and mining investigations in hydrographic basins • Lack of land rights for populations in certain regions • Reduced soil fertility • Difficult situation of women, children and the elderly due to the seasonal emigration of men • Sale of essential goods such as food and medicine • Dependence on lenders (very high interest rates)	• Legislation unfavorable to indigenous populations • Unequal distribution of services and resources with a strong prejudice against indigenous populations • Importance accorded to national interests in relation to local rights of populations

Table 2: Chain of pressures cause the vulnerability to disasters

3. Means of developing and implementing the action plan

3.1. General and specific objectives

The set of coordinated actions describing the strategy to develop and implement an action plan to prevent economic and social damage from natural disasters have the following general objectives:

– to restrict and reduce the harmful effects of disasters;

– to develop effective governance within the framework of sustainable development and in accordance with its programs, projects and initiatives, promoting partnership, continuous training and improvement of living standards;

– to develop research and encourage the exploitation of knowledge and carry out ”Kobe” action plans;

– to foster a united and cooperative relationship between developing countries based on the exchange of expertise.

The strategy must also seek to achieve specific objectives such as:

– to improve the different levels of capacity and promote information tools and techniques in order to establish a fluid dialogue between the different partners;

– to establish a database and knowledge as part of the exchange of expertise to promote common tools and applications;

– to support decentralization in order to foster support between local actors;

– to stimulate cooperation with information and communication technology research institutions and centers in order to ensure good disaster risk management;

– to foster a culture of prevention and preparation and adaptation to the strategy for managing disaster risks and their effects.

3.2. The art of two cultures: Prevention and preparation / alert

Societies that are confronted with the damaging effects of climate change must develop two sorts of culture: the culture of prevention on the one, and the culture of preparation and alert on the other hand.

The introduction of the prevention culture which targets awareness and risk reduction is based on the following elements:

- promote knowledge of prevention and its uses;
- map the different risks;
- improve and develop early warning systems;
- integrate and improve information thanks to developed geographic information systems;
- develop a predictive decision-making aid model and systems;
- establish preventive measures (e.g. laws applied to earthquake-resistant constructions) to receive an early warning of floods, afforestation, etc.

The preparedness and alert culture, on the other hand, is a natural disaster risk reduction tool which covers the following elements:

- management and exchange of information and risks-warnings and protection of citizens;
- regular and general exchange between all partners;
- non-formal and continuous training as part of the ”Kobe” action plan;
- multidisciplinary and voluntary professional training;
- public awareness actions within the framework of the “Kobe” program and by other suitable means.

THE ACTION PLAN AND ITS REQUIREMENTS

4. The disaster risk management action plan

The disaster risk management action plan as conceived in this expert policy paper is designed as a cycle model. The state authorities are not only responsible for the process and the efficiency of this cycle, but they must also ensure that all of the directives and actions can resolve the causes of disasters or mitigate their harmful effects on the population, goods and infrastructure.

The action plan is based on the Disaster Risk Management Cycle (DRMC)[2], a cyclical process that consists of eight phases, describing the steps that start with the risk analysis and end when the population and the distressed areas went back to their normal activities. This cycle has the advantage of tracking the visibility and evaluation, and is designed for the national level; local contexts must be approached with an adapted format related to local particularities.

4.1. Risk analysis

The in-depth analysis of risk factors such as hazard, vulnerability, exposed values and resilience helps the concerned authorities (the ministries of local affairs and of the environment, interior, defense, health, the National Guard and local executive authorities) to better understand the harmful results of these phenomena and to put in place suitable measures according to the needs of the populations and regions in question.

4.2. Prevention and mitigation

The second phase consists of establishing measures on risk realization. The objective of this phase is to eliminate or reduce the damage caused by natural disasters by mitigating the intensity of some hazards (cold waves, extreme heat waves, etc.), or reducing vulnerability (improving life conditions, spatial planning, basic infrastructure, telecommunications-electricity-water networks, etc.). The effectiveness of prevention and mitigation is based on the potential of multiple capabilities with multidisciplinary skills, namely architects, engineers, cartographers, modelers, planners, and entrepreneurs.[3]

2 United Nations Office for Disaster Risk Reduction UNISDR) (2017) Annual Report.
3 World Bank (2013) Tunisia in a Changing Climate Assessment and Actions for Increased Resilience and Development, p. 12.

4.3. Preventive information and risk education

Populations at risk of disasters must be informed in advance to better manage and understand the risk and know-how to react to an emergency. It is risk education that must be passed on to citizens at an early stage. Several European and Asian countries formally include risk awareness modules in their education systems. These modules relate to primary and secondary school programs and are subject to validation. In Tunisia, the education system should begin with lessons relating to trauma, natural disasters and emergency case management.[4]

In Tunisia, prevention information is optional and is given to the appreciation of operators of Disaster Risk Prevention (DRP). So far, the only action decreed by the UN in 2000 and organized by the Tunisian Health Ministry and the Red Crescent is the International Day for Disaster Reduction established within the framework of the International Strategy for the Reduction of Natural Disasters (SIPC-ISDR). It takes place on the 2nd Wednesday of October at Tunisian universities with the presence of organizations, scientists and politicians.

4.4. Early warning

Early Warning Systems (EWS) represent the means that opt to limit the loss of life and subsistence power caused by hazards and disasters. Structural Adjustment Programs (SAPs) are made up of a series of surveillance techniques and actions that collect information about hazards in a given place in order to intervene in a timely manner. Several sectors, namely health, food security, agriculture, adaptive architecture, use Early Warning Systems to mitigate disaster risks and provide citizens, governments, NGOs and humanitarian actors with the necessary information to be able to intervene effectively.

4.5. Response to alert situations relating to natural disasters

To reduce the risks linked to natural disasters, and to respond to emergency situations, a response system consisting of four phases is put in place:

– *the organizational phase* promotes the effective intervention as well as the use of effective protective measures to deal with a hazard which is likely to be triggered and which presents a danger to the local population and their properties. It is also responsible for restoring the early warning process.

– *the measures of emergency rescue* represent a crucial and necessary step in order to effectively save the distressed populations by a hazard.[5]

– the smooth functioning of the various stages of the organization and the intervention requires the presence of *experienced operators* as well as the development of *capacities* which ensure effective disaster management.[6] In addition, the dialogue around disaster management between experts and members of the community is essential.

– *the response planning phase* includes the stages of the preparation of human and financial resources management, the composition of emergency stocks and the establishment of communication procedures.

During a disaster, the time is sacrificed for planning the intervention. Reasonable and effective planning results in successful and rigorous rescue operations.

4.6. Recovery

Recovery is a post-disaster management phase. It can persist from a few days to several weeks or even years. It begins when the rescue services are completed and the populations resume their usual habits. This phase is divided into two periods:

a) Post-crisis: This phase identifies emerging problems. It is characterized by the restoration of normal activities and the reconstitution of essential establishments and services.

b) Reconstruction: This phase must meet the basic needs, namely rehousing, care, preventive treatment to deal with possible losses, supply of blankets, distribution of food to the communities affected by the disaster and the restoration of essential services such as the administrative services, water, electricity and telecommunications networks.

4 PreventionWeb.net (2018) Communiqué of the Chair on Africa-Arab cooperation on disaster risk reduction, Tunis, Tunisia, shorturl.at/rDJS5.

5 PreventionWeb.net (2018) Communiqué of the Chair on Africa-Arab cooperation on disaster risk reduction, Tunis, Tunisia, shorturl.at/rDJS5.

6 Galali, T. (2008) Gestion des risques naturels, shorturl.at/blCEF.

The recovery phase is the one that triggers the desire to participate in the assistance at the national level: Civil society, NGOs, private companies.

4.7. Feedback

Feedback is the experience gained after each natural or technological disaster, making it possible to look back at the gaps and mistakes committed and to find out alternatives to reduce future risks. This phase is a strong component of DRP which is part of a process of capitalization and knowledge management. It also allows to take precautions and to follow useful procedures and desirable developments useful in the future.[7]

At the national level, large-scale disasters go through the feedback phase and can sometimes lead to an analysis at the inter-ministerial level or at the level of the Presidency of the Government. Although this plan already exists, there are several shortcomings in its practice due to missing elements that influence the effectiveness of the measures.

Since 2000, the Tunisian State has given more importance to monitoring and issuing publications related to the subject. The most resounding events are the subject of an annual international publication.[8]

4.8. Reconstruction

According to the Ministry of Local Affairs and the Environment, Tunisia suffered losses of 150 million Euros in 2018 or 3% of annual deterioration in its GDP caused by natural disasters. Because of the significant losses, the reconstruction is a phase which can last several years. It includes the re-establishment of economic and social cycles and regional redevelopment. It also helps consolidate sustainability and gives hope to the affected populations to live a normal life.

5. Requirements for a good risk management

5.1. Consolidation of good governance and integration of related programs

In order to ensure the security of citizens and their properties, the Tunisian government must have a full commitment regarding the development of permanent prevention and mitigation programs (Vulnerability assessment techniques and applications, VATA) and a clear determination of the responsibilities of all the sectors concerned by prevention from the basis of the risk management strategy.

5.2. Development of a regulatory and legal framework

The coordination, restructuring and promulgation of adequate legislative texts are necessary tasks in order to ensure the implementation of the adopted strategy and ensure its execution.

5.3. Initial and continuous training

Training in different techniques in order to contribute to the development and strengthening of human resource capacities must be initiated and continuously applied. It consists of the development of regional programs favoring the support of national programs for the transfer of knowledge and expertise.

5.4. Means and requirements of risk management

Good risk management requires the use of a series of prevention and intervention techniques:[9]

- management and exchange of information and warnings relating to the protection of citizens;
- constant and global exchange between all partners and stakeholders working on natural disasters;
- facilitate decision-making for the intervener during critical moments and the integration of all available information and data in order to coordinate well between the different operators and skilled professionals by targeting the most appropriate scenario;

7 UNISDR (2013), UNISDR Terminologie pour la Prévention des risques de catastrophe, shorturl.at/bvM04, p. 39.
8 UNISDR (2017) Annual Report.
9 Alwang, J., P.B. Siegal and S.L. Jorgensen (2010) Vulnerability: A view from different disciplines, Social Protection. World Bank Working Paper 0115, shorturl.at/lzCH3.

– intervening and mobilizing communities to help manage the crisis;

– strengthen technical information and preventive awareness of risks and means in schools and through the media.

5.5. The practical implementation of the risk management strategy

Implementing the action plan to manage risks and limit damages consists of:

– the establishment of a geographic information system that provides information on the different scenarios and their results;

– the compilation of information, scenarios and databases in an IT system that helps in the decision-making;

– the development of environmental management based on an analysis of the foreseeable effects of hazards which will allow good decision-making relating to major national projects and programs.

5.6. The role of scientific research and development

Research and development help to mitigate forecast uncertainty and information gaps about an extreme natural event or ecological hazard, and also to improve national, integrated and multidisciplinary scientific capacities to ameliorate the knowledge about the causes and the effects of disasters through the development of a geo-biophysical monitoring system.

5.7. The role of political decision makers

Political decision makers are, first and foremost, determined to correctly interpret the information and results obtained through the scientific research, to properly undertake precautions and prevention measures, and to put in place prevention and sustainable development strategies.

Therefore, developing a public risk policy remains a priority for political decision-makers. This work is carried out in particular at the executive level, which is supposed to take into account the different components of the disaster management cycle (prevention, mitigation, emergency, rehabilitation, reconstruction, allocation of a fixed budget in annual budget planning, etc.) in order to apply strategies, distribute responsibilities and coordinate funding.

Political decision-makers must encourage government institutions to exercise their functions by following the principles of openness and transparency in decision-making. In order to strengthen governance, it is essential that there is transparency and access to information related to the decision-making process for disaster risk reduction and fund management measures aiming at strengthening disaster reduction mechanisms.

5.8. Requirements for specific risk management

Any prevention of risks as far as water is concerned requires a specific approach, namely:

– analysis, monitoring and inventory of extreme cases of floods and heavy rains;

– evaluation and examination of certain parameters such as frequency, violence, possible formulas, etc;

– anticipation of natural disasters;

– early warning for decision support;

– reducing the magnitude of the risks and the losses caused by the hazard allowing an effective intervention;

– facilitating access to water and basic needs and providing specific guarantees, for example employment (preservation of the economic capacity of population).

Disaster management of this kind has been successful in some countries thanks to the efficiency and speed of an established alert system, and to the early measures in planning.

RECOMMENDATIONS

6. Propositions and advice

In Tunisia, effective technocratic measures ensure the proper risk management. But generally they do not necessarily meet the real needs of the natural disasters' victims. Until today, risk management has been rather based on the specific nature of natural hazards and not on the daily lives of people, on poverty reduction and on capacity building. Despite the initiatives taken, the means and progress remain weak to deal with disasters. Hence is the need for further reforms to mitigate the risks of natural disasters.

This section provides some key recommendations for their demonstrated effectiveness and ease of implementation or for their relatively low costs.

6.1. Optimizing disaster risk prevention projects

The prevention of natural risks is still far from being a priority in public and development policies, while post-disaster relief, rehabilitation and reconstruction constitute the first forms of risk management and attract the attention of the media and public. Optimizing investments efficiently and usefully in disaster risk reduction radically mitigates their consequences on different levels: human, economic and environmental. This opens the way to a multidisciplinary approach that brings together several stakeholders. More specifically, "one dollar invested in risk prevention saves four to eight dollars in losses."[10] This strategy seems the most appropriate to follow to reduce vulnerability and avoid future losses.

6.2. Improve and implement poverty reduction and environmental protection programs.

The vulnerability of populations means that natural hazards cause them much damage. Therefore, it is important to invest more in the fight against daily poverty and to put in place environmental protection initiatives. Poverty does not represent vulnerability, but without sufficient income, it is difficult for people to eat and drink, to study, work or heal. It is even more difficult to resume normal life after a disaster has occurred, or to become resilient against risks and their consequences.

The deterioration of the environment by deforestation in the north of Tunisia or the depletion of groundwater in and on the Tunisian coasts, which causes the entry of marine salt water during high tides, leads to increased vulnerability of populations in the event of a possible natural disaster. Hence the need to set up monitoring and continuous improvement systems and to develop environmental protection programs in order to mitigate vulnerability and to ensure a sustainable development. Environmental protection certainly plays a major role in development planning and risk prevention.

6.3. Support local communities and promote citizen participation

In order to reduce the vulnerability of populations exposed to natural disasters, it is important to fight against social insecurity, promote local initiatives and encourage the participation of civil society, as is the case for indigenous peoples of the Chebika Oasis located in the south of Tunisia.[11] Hence the importance of developing a program that reaches all age groups and intellectual levels to help them become more aware and prepared to respond to natural disasters. This recommendation, in the same way as the previous ones, aims to improve the capacities of local communities. They must be equipped with the necessary tools to better protect themselves.

6.4. Educate and raise awareness among population

Despite the numerous educational and awareness-raising initiatives adopted, such as the projects carried out by Tunisian civil society to raise awareness among the target communities, these actions remain insufficient unless more efforts are not made. In fact, the education of local communities must be encouraged because only a certain amount of information can be assimilated when it comes to risk culture.[12] It is also encouraged to adopt more interactive, understandable and adapted communication media.

10 Lightbody, L. and Fuchs, M. (2018) Every $1 Invested in Disaster Mitigation Saves $6. shorturl.at/bszL7.

11 An initiative was taken in order to insure the appropriate management of natural resources and the good governance of irrigation waters.

12 UNISDR (2013) UNDRR Terminology for Disaster Risk Prevention, p. 39.

6.5. Meeting the requirements of construction standards

This fifth recommendation consists of complying with the construction standards in order to protect infrastructures and promote their security measures, and of taking into account technologies and standards for respecting architecture and bioclimatic infrastructure. When a natural disaster occurs, the non-compliance with the construction codes and the buildings at risk increase the number of human and material damage.[13] Despite the high rate of its cost and its technical complexity, this recommendation is important to increase the resilience of local communities in the face of disasters.

CONCLUSION

Extreme natural phenomena are inevitable, unlike natural disasters. It is therefore important to implement an effective disaster risk management action plan not only in the local urban, rural and coastal areas of Tunisia, but also in a more general way on a global level. In addition, concrete actions taken at the root cause of natural hazards can effectively mitigate the risks of disasters such as reducing the poverty rate, access to resources, social and societal protection of the community, the development of environmental protection programs, the involvement of local communities, awareness raising and education, through effective regulations for construction standards and by more effective collaboration between the different actors involved. It is the responsibility of state authorities, all legislators, political parties, and stakeholding non-governmental organizations to review not just their risk management policies, but also their development and land use planning policies.

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13 Bankhoff, G., G. Frerks and D. Hilhorst (2004) Mapping Vulnerability: Disasters, Development and People.